TABLE OF CONTENTS

OVERVIEW

National Science Foundation FY 2004 Budget Request Overview

By any measure, National Science Foundation investments in basic research and education have returned rich dividends to the nation. Recent advances at the frontiers of science and engineering have significantly increased the nation's capability to transform knowledge into economic value, meet enduring social needs, and respond to the new challenge of enhancing homeland security.

To continue these accomplishments, the National Science Foundation requests $5.48 billion for FY 2004, $453 million or 9 percent over the FY 2003 Request of $5.03 billion. These investments will sustain and build U.S. global leadership in science, engineering and technology, and assist the U.S. in addressing priorities of immediate national importance.

NSF Funding by Appropriation
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Research and Related Activities	3,615.97	3,783.21	4,106.36	323.15	8.5%
Education and Human Resources [1]	866.11	908.08	938.04	29.96	3.3%
Major Research Equipment & Facilities Construction	115.35	126.28	202.33	76.05	60.2%
Salaries and Expenses	169.93	202.95	225.70	22.75	11.2%
Office of Inspector General	6.70	7.70	8.77	1.07	13.9%
Total, NSF	$4,774.06	$5,028.22	$5,481.20	$452.98	9.0%

Totals may not add due to rounding.

[1] Does not include $57.31 million in FY 2002 and an estimate of $65.68 million in FY 2003 from H-1B Nonimmigrant Petitioner Fees. Legislation for the activity expires in FY 2003.

Nothing is more important to our nation's prospects than the ability to create and make use of knowledge. We face significant national and international challenges in the areas of security, the economy, health and the environment. Exceptional opportunities for rapid progress in meeting these challenges are emerging at the leading edge of research – in such areas as information technology, nanotechnology, climate change research, and fundamental research related to homeland security.

Our ability to move rapidly across new frontiers of knowledge not only depends critically on discovery and innovation, but also on addressing the National Science Foundation's continuing challenge: building a globally competitive, diverse workforce with mathematical, scientific, engineering, and technological skills that are the best in the world.

Although U.S. workers are the most productive by any measure, demand is rapidly increasing for more sophisticated science and math skills in the workplace. A Commerce Department study concludes that in less than two decades 60 percent of the nation's jobs will require technical skills possessed by only 22 percent of today's workers. New technologies and the rapid pace of change are fundamentally altering how we learn and work.

To meet this challenge, all children must receive an education in math and science that will allow them to participate fully in society and contribute to its continuing progress. The President's Math and Science Partnership Program highlights the need for a focused effort to accomplish this task.

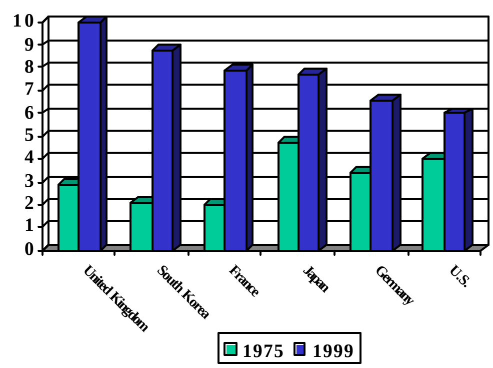
The number of students earning degrees in science and engineering has been declining in recent years in all fields except the life and social sciences. Raising graduate fellowship stipends signals that the nation values those who choose careers in science, technology, engineering and mathematics, and rewards them for it. And the response of students to these fellowship opportunities has demonstrated their value as an incentive.

The nation is facing a watershed moment as our demographics change swiftly. Women and minorities are underrepresented in the science and engineering professions. While women comprise half of the college-educated workforce, they fill only 10 percent of the country's engineering jobs. Ethnic minorities hold only 7 percent of all science and engineering jobs. Yet these two groups are the fastest growing segments of the U.S. workforce.

More must be done immediately to broaden participation. Success in capitalizing on the nation's great diversity can expand our prosperity and help to fulfill the promise of equity. We know that diversity gives strength to the fabric of our society. It will be our strongest suit for enabling the future.

The changes sweeping our economy and society are at work globally, increasing competition for knowledge, and putting a premium on highly skilled knowledge workers. Today, only 6 percent of U.S. 24-year-olds have earned degrees in the natural sciences or engineering, trailing students in other major nations, many of which have doubled and tripled their science and engineering degree output over the past decade. Nations worldwide are taking steps to lift the quality of education and keep their students at home; they are increasing investments in science and technology research and education to unprecedented levels.

Percent of 24-year-old population with Natural Science/Engineering Baccalaureate Degrees



Our nation's best prospects for maintaining our leadership rest on a similar strategy. Developing native talent and seizing current opportunities to expand the frontiers of knowledge to spur innovation will keep the U.S. at the forefront of science and technology. It will also produce the range of sophisticated options we need to solve the complex challenges facing the nation. Achieving these goals requires a level of public investment that reflects the increased importance of science and engineering to economic and social prosperity and national security.

NSF's role in the nation's research and education enterprise is critical. Although NSF accounts for less than 4 percent of federal research and development spending, it supports nearly 50 percent of non-medical basic research at our colleges and universities. The investments proposed in NSF's FY 2004 Request aim to meet these challenges and propel us to global leadership in the knowledge economy of the twenty-first century.

People, Ideas, and Tools: NSF Strategic Goals

National Science Foundation investments produce outcomes at the core of the research and education enterprise: a world-class science and engineering workforce; new knowledge across the frontiers of science and engineering; and the tools to get the job done efficiently and effectively. Expressed simply, but effectively, as *People, Ideas,* and *Tools*, these long-term strategic goals reflect the changing role and increased significance of science and engineering in the 21st Century.

NSF Budget by Strategic Goal
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	Change Amount	Change Percent
People [1]	994.79	1,086.70	1,152.87	66.17	6.1%
Ideas	2,436.28	2,559.45	2,696.04	136.59	5.3%
Tools	1,112.41	1,121.50	1,340.93	219.43	19.6%
Administration and Management	230.58	260.57	291.36	30.79	11.8%
Total, NSF	$4,774.06	$5,028.22	$5,481.20	$452.98	9.0%

Totals may not add due to rounding.
[1] Does not include $57.31 million in FY 2002 and an estimate of $65.68 million in FY 2003 from H-1B Nonimmigrant Petitioner Fees. Legislation for the activity expires in FY 2003.

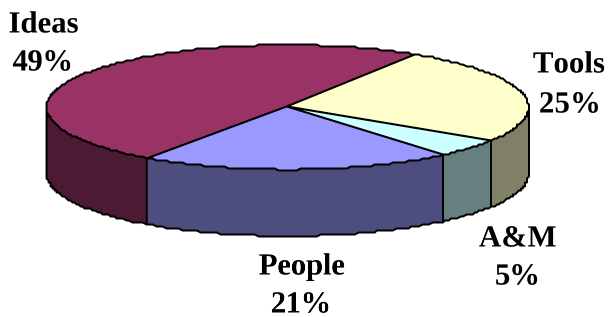
Investments in *People* are key to developing the nation's full talent and increasing the productivity of our workforce. Each year, NSF supports more than 200,000 people – teachers, students, and researchers at every educational level and across all disciplines in science and engineering. NSF's FY 2004 priorities aim to attract more students to graduate study in science and engineering, improve the quality of preK-12 math and science education, and advance research on learning to improve classroom practices and workforce preparation strategies.

Investments in *Ideas* build the intellectual capital that drives technological innovation and spurs economic growth. The nation can draw on this stock of knowledge – as it did in response to the tragic events of 9/11 – in times of changing national circumstances, or to pursue path-breaking opportunities and develop a portfolio of options for the future. State-of-the-art *Tools* and facilities boost the overall productivity of the research and education enterprise. NSF's strategy is to invest in instruments that add unique value to research and are accessible and widely shared among researchers across the nation.

To get the most leverage from its investments in *People, Ideas* and *Tools*, NSF integrates research and education activities, promotes effective collaborations and partnerships, and invests in intellectual capital for the long-term.

In FY 2004, the Request includes $1.2 billion in program investments to meet the strategic goal of People, $2.7 billion for Ideas, $1.3 billion for Tools, and $291 million for Administration and Management.

FY 2004 Budget Request of $5.48 Billion



<u>People</u>: Investing in the Nation's Talent

Leadership in today's knowledge economy requires world-class scientists and engineers and a national workforce that is strong scientifically, technologically and mathematically. NSF programs aim to improve the quality and reach of science, engineering, and mathematics education and enhance student achievement. Embedded in all NSF programs are efforts to build a more inclusive and globally engaged workforce that fully reflects the strength of our diverse population. Therefore, the NSF FY 2004 investment priorities target educational challenges of major national importance.

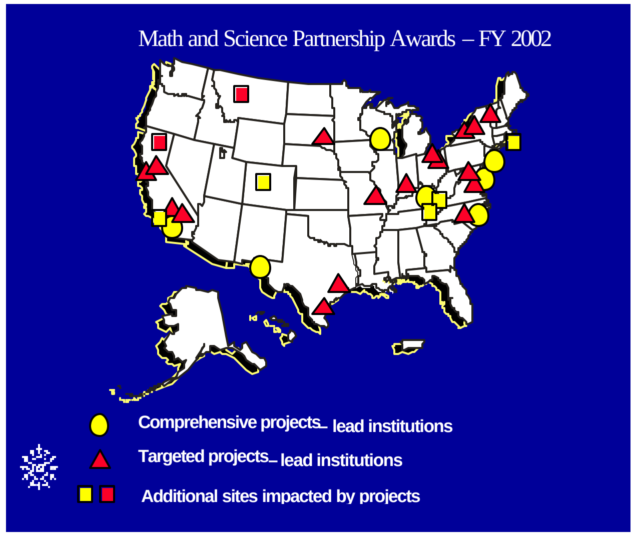
Attracting Talent to Science and Engineering Careers. Recruiting and retaining more U.S. graduate students in science and engineering remains a challenge and a high priority for NSF. In recent years, the number of engineers graduating from our universities has decreased by 20 percent. Doctorates in science and engineering have dropped by 7 percent since 1998.

Low levels of stipends and an increasing burden of debt are among the principal factors that discourage students from continuing science and engineering studies. These financial pressures are particularly severe among minority students, who are more likely to borrow for undergraduate study. Stipend levels for the nation's outstanding graduate students must be increased in order to be competitive with opportunities in the general workforce.

NSF has steadily increased stipend support for graduate fellowship programs from $15,000 in FY 1999 to $30,000 proposed in FY 2004. This strategy has already produced results. Applications for NSF graduate fellowships increased from 6,900 in 2001 to 8,200 in 2002.

In FY 2004 NSF will continue and expand this multi-year effort to attract the most promising students into graduate level science and engineering by raising stipends for graduate fellowship programs and increasing the number of students receiving fellowships.

Math and Science Partnership. High levels of achievement in mathematics, science and engineering are increasingly necessary for success in the complex, high technology workplace of the 21st Century. Children need high-quality learning environments to develop these complex skills, beginning early and continuing throughout their education.



The FY 2004 budget proposes $200.0 million to continue and strengthen NSF's leadership role in the President's Math and Science Partnership, a centerpiece of the *No Child Left Behind* initiative. This represents the third year of a $1.0 billion, five-year investment to enhance the performance of all U.S. students in mathematics and science and improve the quality of preK-12 math and science education.

The program links states and local school districts with science, mathematics, engineering and educational faculty in colleges and universities to improve preK-12 math and science educational practices, train teachers, and create innovative ways to reach out to underserved students and schools. The Math and Science Partnership program supports the development and application of evidence-based approaches to math and science education. The goal is to improve teacher performance and professional development, and to provide a challenging and engaging curriculum for every student.

Workforce for the 21st Century. The nation's economic vitality, national security, and social well being depend fundamentally on world-class scientists and engineers and a national workforce that is scientifically, technically and mathematically strong. NSF will capitalize on its experience with investments in science and engineering education to design a program that joins elements from the most successful activities, and approaches curriculum development innovatively. Drawing elements from existing NSF programs – e.g., LSAMP, GK-12, IGERT, and CREST – collaborators at an institution will design a suite of complementary, integrated activities that reaches from preK-12 through postdoctoral levels. The goal is to develop an innovative and seamless route of advancement for students. The FY 2004 investment totals $8.5 million.

The Science, Technology, Engineering and Mathematics Talent Expansion Program (STEP). Established in FY 2002, STEP provides grants to colleges and universities to establish programs to increase the number of undergraduate math and science majors. The FY 2004 Request is $7.0 million, an increase of $5.0 million or 250 percent over the FY 2003 Request.

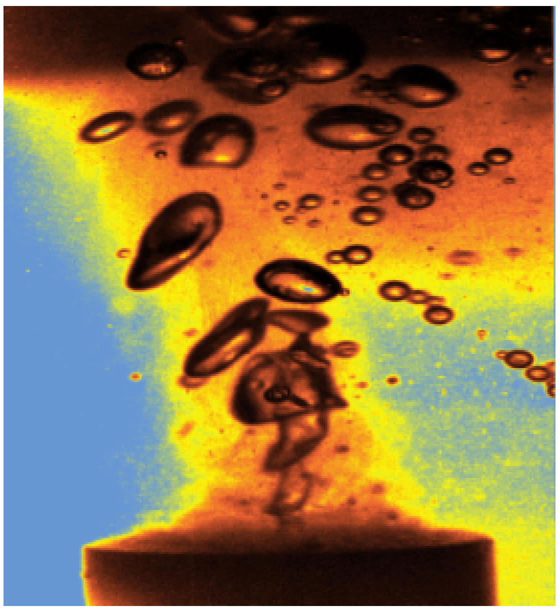
Noyce Scholarships. The Noyce Scholarships address the shortage of highly trained K-12 teachers by providing scholarships to talented mathematics, science and engineering students who wish to pursue teaching careers in elementary or secondary schools. FY 2004 funding for the program is $4.0 million, equal to the FY 2003 Request.

<u>Ideas</u>: Opening New Frontiers for Discovery, Learning and Innovation

One of NSF's hallmarks is supporting the most promising ideas in research and education. These investments produce the fundamental knowledge base that enhances progress in all of science and engineering and also fosters partnerships that connect discovery and learning to innovation and service to society.

Investments in Core Disciplines. NSF investments are aimed at the frontiers of science and engineering, where advances in fundamental knowledge drive innovation and progress. To address the nation's economic, security, and social needs, NSF provides balanced support across the full range of science and engineering disciplines.

The FY 2004 Request places special emphasis on investments in the physical sciences. The physical sciences produce advances and associated analytical tools that bring progress to a host of areas – from medical imaging to environmental restoration to high-speed computing and communications. With renewed support for research and equipment for fields such as physics, chemistry, mathematics, and materials research, the nation will be able to take full advantage of the recent major investments in the health sciences and will also reap benefits in numerous other areas, such as energy, agriculture, and the environment. Support for NSF's mathematical and physical sciences activity increases by 12.7 percent in the FY 2004 Request to a level of $1,061 million, a $120 million increase over the FY 2003 Request of $942 million.



Sonoluminescence – the transformation of sound energy into light – has been observed for decades. Now, Chemists supported by the NSF have for the first time measured the chemical reactions and light emission from a single bubble excited by sound waves, an advance with potential industrial and medical applications.

NSF relies on a competitive, merit-based process to identify the most promising research directions in established fields, and increasingly, to open new frontiers across a broad front of disciplines through multidisciplinary investigations. The continuing vitality of core disciplines is the lifeblood of the research and education enterprise.

It is particularly important in today's research climate, where advances in one field can rapidly lead to new insights in others. The accelerating pace of discovery, combined with new information and communication tools, has produced unprecedented opportunities for these synergies. Information research and technology, for example, have enabled rapid progress in virtually every discipline from molecular biology to astronomy, and from particle physics to the social and behavioral sciences.

NSF's long-term goal is to increase the size and duration of research grants to ensure high productivity among researchers and improve opportunities for training students. This investment strategy is consistent with the findings of a recent survey of NSF-supported principal investigators and institutions. The FY 2004 Request continues to work toward the goal of increasing the average size and duration of awards to $250,000 per year for 5 years.

Priority Areas

NSF Funding by Priority Area
(Dollars in Millions)

Priority Area	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Biocomplexity in the Environment	58.96	79.20	99.83	20.63	26.0%
Information Technology Research	277.22	285.83	302.61	16.78	5.9%
Nanoscale Science and Engineering	204.48	221.25	248.99	27.74	12.5%
Mathematical Sciences	30.00	60.09	89.09	29.00	48.3%
Human and Social Dynamics	N/A	10.00	24.25	14.25	142.5%
Workforce for the 21st Century	N/A	N/A	8.50	8.50	N/A
Total, Priority Areas	$570.66	$656.37	$773.27	$116.90	17.8%

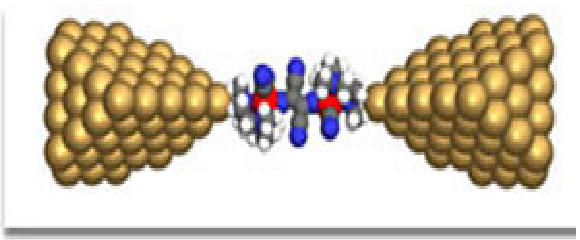
In addition to a balanced portfolio of investments in core disciplines, NSF identifies and supports emerging opportunities that hold exceptional promise to advance knowledge in areas of critical importance for addressing national interests. Investments in these priority areas move novel research rapidly forward, and provide a cadre of scientists and engineers with new skills and new perspectives to exploit new knowledge for transfer of the results to industry.

In close collaboration with the science and engineering community, NSF has identified six priority areas in which to make a sustained level of investment. In FY 2004, NSF will build on our previous pilot effort in the social, behavioral and economic sciences to initiate a *Human and Social Dynamics* priority area. In addition, NSF will continue to fund four established priority areas: Biocomplexity in the Environment, Information Technology Research, Nanoscale Science and Engineering, and Mathematical Sciences. The new Workforce for the 21st Century priority area was discussed above in the People section.

Biocomplexity in the Environment ($99.83 million). Biocomplexity describes the dynamic web of interrelationships that arise when living things at all levels – from molecular structures to genes to organisms to ecosystems to urban centers – interact with the environment. Investigations in this priority area will improve environmental forecasting capabilities, enhance decision-making tools, and integrate human, social and ecological factors into investigations of the physical environment and environmental engineering. The FY 2004 program will support a wide range of education and research activities, including sequencing the genomes of microorganisms of importance to agriculture, food, forestry, and water quality, or as potential bioterrorism threats.

Information Technology Research ($302.61 million). Today, information technology is woven into every aspect of the economy and society. It has opened new frontiers for exploration in every field of research, in engineering design and manufacturing, and in education. The Information Technology Research priority area will deepen fundamental research on large-scale networks, and the creation of new integrative software and advanced architectures for high-end computing. To address critical economic and homeland security issues, NSF will support research to address the pressing need for safe, secure, and dependable information infrastructures for national security and consumer protection, and the education of a new class of information security and assurance professionals.

Nanoscale Science and Engineering ($248.99 million). Nanoscale science and engineering encompasses the systematic organization, manipulation and control of matter at atomic, molecular and supramolecular levels. Novel materials, devices and systems – with their building blocks on the scale of nanometers – expand possibilities in science, engineering and technology. In FY 2004, investments will be expanded to develop and strengthen promising fields, (including nanobiotechnology, manufacturing at the nanoscale, and education) to establish the science and engineering infrastructure and workforce needed to exploit the opportunities of these new capabilities. NSF activities are part of the larger National Nanotechnology Initiative, a crosscutting program involving close collaboration and coordination among federal research agencies.



One of the most promising areas of nanoscale research is the development of single molecule transistors. This transistor consists of an individual molecule bridging two gold electrodes.

Mathematical Sciences ($89.09 million). The mathematical sciences provide powerful tools for insight and a common language for science and engineering. FY 2004 investments in Mathematical Sciences will deepen support for fundamental research in the mathematical sciences and statistics, and the integration of mathematical and statistical research and education across the full range of science and engineering disciplines. Additional work will focus on the challenge of handling large data sets such as those generated by today's sophisticated sensors and observation systems, and on improving methods for assessing uncertainty and forecasting singular events, research that may improve the reliability of power grids, air traffic control, and the Internet. To strengthen mathematical skills, NSF will support innovative educational activities that foster closer connections between research and education in the mathematical sciences.

Human and Social Dynamics ($24.25 million). Building on previous support for enhanced programs in the social, behavioral and economic sciences, NSF will develop a priority area focused on Human and Social Dynamics. Uncertainty and rapid change are inescapable features of life in the 21st Century. This priority area draws on recent convergence of research in biology, engineering, information technology, and cognitive science to investigate the causes and ramifications of change and its complex consequences – cultural, economic, individual, political and social. Funding in FY 2004 will support a wide range of activities, including creating large-scale data resources and advancing methodological frontiers to enable research. Studies will advance our understanding of decision-making, risk and uncertainty, and explore how to translate this knowledge into improved decision-making. Other investigations will explore agents of change, such as globalization and democratization, the evolution of society and its interaction with climate, geography and environment, and the implications of cultural and spatial variation for conflict and assimilation.

Fundamental Research to Enhance Homeland Security. The FY 2004 Request includes investments in fundamental research that will help address new homeland security challenges facing the nation. The Ecology of Infectious Diseases program, jointly sponsored by NSF and the National Institutes of Health, and NSF's Microbial Genome Sequencing program will contribute to a better understanding of potential bioterrorism threats and how to combat them. The Scholarship for Service program, which trains students in information security and assurance in exchange for service in federal government agencies, will increase the nation's capacity to protect vital information infrastructure. Investments in Critical Infrastructure Protection address the need to identify vulnerabilities and strengthen protection for the nation's critical infrastructure – for example, power grids, transportation networks, and water supply systems. National Security-Related Information Technology research supports a portfolio of promising research with potential homeland security applications. The budget request also includes funds to upgrade security at the U.S. Antarctic Program facilities.

Climate Change Research Initiative (CCRI). As part of the Administration's multi-agency Climate Change Research Initiative, NSF will support research to reduce uncertainty in critical areas of climate change knowledge and provide timely information to facilitate policy decisions. NSF will establish three to five interdisciplinary centers to improve understanding of risk management, risk communication, and decision making in relation to climate change. The FY 2004 investment in these centers is $4.5 million. Additional research will advance understanding of abrupt and rapid climate change. Interdisciplinary studies of ocean circulation, combined with studies of paleoclimate records, will document the frequency, temporal resolution, and spatial extent of past rapid climate change. These investigations will complement NSF's ongoing programs in climate change science. The total FY 2004 investment for CCRI increases by $10.0 million to a total of $25.0 million.

Science of Learning Centers. Recent advances in cognitive and behavioral sciences, linguistics, neuroscience, engineering, computer science, psychology, and mathematics have converged to create important research opportunities in the science of learning. The FY 2004 budget provides $20.0 million, equal to the FY 2003 Request, to fund 3-5 new multi-disciplinary, multi-institutional Science of Learning Centers to enhance understanding of how people learn, how the brain stores information, and how to best use new information technology to promote learning.

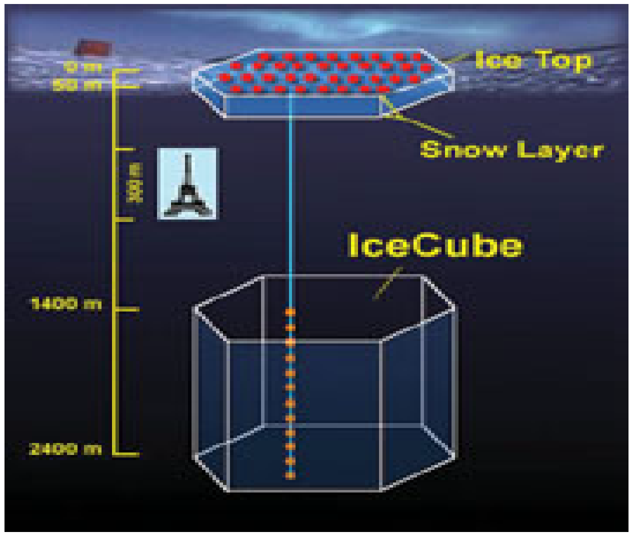
Tools: Getting the Job Done

Funding for U.S. academic research infrastructure has not kept pace with rapidly changing technology, expanding research opportunities, and increasing numbers of users, as has been recognized by the ongoing National Science Board task force on *Science and Engineering Infrastructure for the 21st Century*. To address this challenge, the NSF FY 2004 Request includes increases for a wide range of infrastructure investments.

CyberInfrastructure. NSF's proposed investment of $20.0 million for Cyberinfrastructure will bring next-generation computer and networking capabilities to researchers and educators nationwide. Building on past NSF investments in high-performance computing and networks, Cyberinfrastructure will integrate high-performance computers and high-bandwidth networks with sensors, large data repositories, and new computational, analytical and visualization tools.

Major Research Equipment and Facilities Construction. The Major Research Equipment and Facilities Construction (MREFC) Account totals $202.3 million, an increase of $76.1 million, and will fund seven continuing projects in FY 2004:

- Atacama Large Millimeter Array (ALMA) Construction ($50.84 million)
- EarthScope ($45.0 million)
- High-performance, Instrumented, Airborne Platform for Environmental Research (HIAPER) ($25.53 million)
- IceCube ($60.0 million)
- National Ecological Observatory Network (NEON) ($12.0 million)
- Network for Earthquake Engineering Simulation ($8.0 million)
- South Pole Station Modernization ($960,000)



The FY 2004 Request provides $60 million in funding for the IceCube project.

Major Research Instrumentation. NSF investments in Major Research Instrumentation support a wide variety of mid-sized state-of-the-art research equipment, and reach a broad range of institutions, including non-Ph.D-granting colleges and universities, and community colleges. Such investments play a critical role in training students and developing a skilled workforce. The FY 2004 Request for MRI totals $90.0 million, a $36.0 million increase (67 percent) over the FY 2003 Request of $54.0 million, with special emphasis on support for minority-serving institutions.

Other Small and Mid-Sized Infrastructure. The budget request also includes an increase of $22.5 million for Research Resources, funded through NSF's Directorates and programs. Total funding provided is $128.9 million.

Other FY 2004 Highlights

Broadening Participation. The FY 2004 Request places special emphasis on investments aimed at broadening participation in science and engineering.

- NSF's **Historically Black Colleges and Universities Undergraduate Program (HBCU-UP)** increases by 43 percent, from just under $14 million in the FY 2003 Request to nearly $20 million in the FY 2004 Request, an increase of $6 million.

- The **Louis Stokes Alliances for Minority Participation Program (LSAMP)**, which has helped to generate a significant increase in the number of minority students earning baccalaureate degrees in science and engineering, receives a 23 percent increase in funding. The FY 2004 Request rises to $32.7 million from the FY 2003 Request of $26.5 million, an increase of $6.2 million.

- The **ADVANCE** program, another key component of NSF's multifaceted strategy to realize a diverse scientific and engineering workforce, also sees a 23 percent increase, rising to $21.2 million in the FY 2004 Request from the FY 2003 Request of $17.1 million, an increase of $4.0 million.

- The **Partnerships for Innovation** program doubles in funding, receiving $10.0 million in the FY 2004 Request, an increase of $5.0 million over FY 2003. The program aims to stimulate the transformation of knowledge created by the national research and education enterprise into innovations that create new wealth, build strong local, regional and national economies and improve the national well-being.

- The **Experimental Program to Stimulate Competitive Research (EPSCoR)** builds the capacity of educational institutions to participate more fully in NSF research activities. Funding in FY 2004 totals about $105.0 million, including $75.0 million provided through the Education and Human Resources Appropriation, and approximately $30.0 million provided through cofunding from the Research and Related Activities Account.

Plant Genome Research Program. The FY 2004 budget provides $75.0 million to support ongoing research on the genomics of plants of major economic importance. Multi-investigator teams will investigate the functional genomics of plants, conduct large-scale genome sequencing and develop tools for plant genomics studies. Funding is provided for a program of Young Investigator Awards in Plant Genome Research proposed in FY 2003.

Administration and Management. The FY 2004 Request includes a $291.4 million investment in administration and management, an increase of $30.8 million (12 percent) over the FY 2003 Request of $260.6 million. Excellence in the management of NSF's portfolio is essential to the achievement of the agency's mission and goals. NSF's investments in administration and management respond both to the growing complexity of its work and to new requirements for accountability and transparency in its processes. In FY 2004, NSF will continue its leadership in eGovernment and financial management, and pursue further improvements in large facility management and human resource management. NSF will also continue to support new requirements for both IT and physical security.

Sources/Photo Credits:
Page 2: National Science Board, *Science and Engineering Indicators – 2002*. Arlington, VA: National Science Foundation, 2002 (NSB-02-1), Figure 2-27.
Page 5: National Science Foundation, Directorate for Education and Human Resources.
Page 6: K. S. Suslick and K. J. Kolbeck, University of Illinois
Page 8: Hongkun Park, Harvard University/Jeffrey Long, University of California, Berkeley
Page10: Darwin Rianto, University of Wisconsin

NSF INVESTMENTS AND STRATEGIC GOALS

NSF Investments and Strategic Goals

The National Science Foundation's FY 2004 funding request supports the agency's investment in *People*, *Ideas*, and *Tools* – the Foundation's three strategic outcome goals. These goals flow from NSF's statutory mission, "to promote the progress of science.…" and they form the basis for the many activities of the Foundation. NSF's investments in *People*, *Ideas*, and *Tools* work in concert to promote progress in all aspects of science and engineering research and education, and are underpinned by investments in administration and management.

- *People* - Developing "a diverse, internationally competitive and globally engaged workforce of scientists, engineers and well-prepared citizens."
- *Ideas* - Enabling "discovery across the frontier of science and engineering, connected to learning, innovation, and service to society."
- *Tools* - Providing "broadly accessible, state-of-the-art and shared research and education tools."

NSF Budget by Strategic Goal
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	Change Amount	Change Percent
People	995	1,087	1,153	66	6.1%
Ideas	2,436	2,559	2,696	137	5.3%
Tools	1,112	1,122	1,341	219	19.6%
Administration and Management	231	261	291	31	11.8%
Total, NSF[1]	$4,774	$5,028	$5,481	$453	9.0%

Totals may not add due to rounding.
[1]Total does not include $57.31 million in FY 2002, an estimate of $65.68 million in FY 2003 from H-1B Nonimmigrant Petitioner Fees. Legislation for this activity expires in FY 2003.

The NSF Strategic Plan identifies management of the investment process as a critical factor in achieving the agency's goals. NSF strategies for meeting new challenges and carrying out agency goals and mission include:

- Continued funding to sustain an efficient and enabled research and education community;
- Investments in Priority Areas;
- Adequate funding of the Major Research Equipment and Facilities Construction Account;
- Sustaining a capable and well-trained science and engineering workforce by attracting top U.S. students and broadening participation across science and engineering; and
- Expanded collaborations with international partners.

Additionally, in FY 2004, NSF resources will support the Administration's six interagency research and development (R&D) investment priorities: Networking and Information Technology Research and Development; National Nanotechnology Initiative; Molecular-level Understanding of Life Processes;

Climate Change and Science and Technology; Education Research; and Homeland Security and Antiterrorism. NSF will support development of these important priorities.

Detailed discussions of NSF's investment in *People*, *Ideas*, *Tools*, and Administration and Management follow this section on core and priority area research.

Core Research and Education Activities

NSF investments in core research and education activities are targeted to disciplinary and multidisciplinary programs that support the best ideas generated by the academic community. These funds support single investigator and small group awards and also provide primary support for junior faculty and students. They are extremely important in invigorating the research and education community since they promote emergence of new ideas and fields, especially where the defining borders of disciplines are blurring and new technologies are emerging. Investments in the core activities ensure the vitality of scientific and engineering fields in interdisciplinary research and discovery. If the nation is to maintain the health, security, and vitality of its citizens, it must continue to have access to the best science and engineering talent. The National Science Foundation has a vital role in providing this balance for U.S. science and engineering. This budget request also boosts NSF's investment in the physical sciences.

Investments in Selected Priority Areas

In addition to investments in core research and education, NSF funding for selected priority areas provides key, agency-wide opportunities for pursuing the strategic outcome goals. Through these priority areas, NSF identifies and accelerates progress in areas of emerging opportunity that hold exceptional promise for advancing knowledge and addressing national interests. Each requires appropriate attention to developing people with new skills and new perspectives; seeking new approaches to knowledge generation across the frontiers of science and engineering; and creating the tools that enable rapid advances.

The FY 2004 Request emphasizes investments in six interdependent priority areas – Biocomplexity in the Environment; Information Technology Research; Nanoscale Science and Engineering; Mathematical Sciences; Human and Social Dynamics; and Workforce for the 21st Century. In addition, NSF continues to give highest priority to the Math and Science Partnership begun in FY 2002 as part of the President's education plan *No Child Left Behind*. Within the priority areas, there is a rich mix of activity that integrates areas of fundamental research with elements of practice in related fields. This synergy characterizes the interdependence of the priority areas as, for example, concepts and techniques from the mathematical sciences influence the development of our understanding of biocomplexity or nanoscale science and engineering and vice versa.

NSF Priority Area Investments
(Dollars in Millions)

Priority Area	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Biocomplexity in the Environment	58.96	79.20	99.83	20.63	26.0%
Information Technology Research	277.22	285.83	302.61	16.78	5.9%
Nanoscale Science and Engineering	204.48	221.25	248.99	27.74	12.5%
Mathematical Sciences	30.00	60.09	89.09	29.00	48.3%
Human and Social Dynamics	N/A	10.00	24.25	14.25	142.5%
Workforce for the 21st Century	N/A	N/A	8.50	8.50	N/A
Total, Priority Areas	$570.66	$656.37	$773.27	$116.90	17.8%

Totals may not add due to rounding.

Biocomplexity in the Environment

The world is facing significant scientific and societal challenges, including the prospect of rapid environmental and climate change, the threat of biological warfare, and the complicated question of long-term environmental security. The integrity of local, regional and global ecosystems is inextricably linked to human well-being, and environmental and human health often intertwine. Fundamental study of complex environmental systems is therefore a key element of local, national, and global security and critical to the development of new scientific and technological capabilities that will significantly advance our ability to anticipate environmental conditions and thus improve environmental decision-making.

The *Biocomplexity in the Environment* (BE) priority area is designed to give NSF the capability to respond to the demand for new approaches to investigating the interactivity of biota and the environment. Investigations must be highly interdisciplinary, consider non-human biota and/or humans explicitly, and examine challenging systems that have high potential for exhibiting nonlinear or highly coupled behavior. Advanced computational strategies and technologies must be developed and utilized. The term "biocomplexity" is used to stress the requirement that research questions must explicitly address the dynamic web of interrelationships that arise when living things at all levels – from molecular structures to genes to organisms to urban centers to ecosystems – interact with their environment. This priority area will result in more complete and synthetic understanding of natural processes, of human behaviors and decisions in the natural world, and ways to use new technology effectively to sustain life on earth.

Biocomplexity in the Environment Funding
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Biological Sciences	16.90	35.86	39.86	4.00	11.2%
Computer and Information Science and Engineering	6.10	7.36	8.00	0.64	8.7%
Engineering	3.60	6.00	6.00	0.00	0.0%
Geosciences	23.00	22.22	37.22	15.00	67.5%
Mathematical and Physical Sciences	4.95	4.70	4.70	0.00	0.0%
Social, Behavioral and Economic Sciences	3.00	1.65	2.50	0.85	51.5%
Office of Polar Programs	1.41	1.41	1.55	0.14	9.9%
Total, Biocomplexity in the Environment	$58.96	$79.20	$99.83	$20.63	26.0%

Totals may not add due to rounding.

Long-term Goals: For the next two years, NSF will emphasize research and education on the role of Biocomplexity in the Environment. This priority area is part of investments and accomplishments within NSF's FY 2004 environmental investment portfolio of approximately $960 million. The intellectual goals of the effort are to:

- Synthesize environmental knowledge across disciplines, subsystems, time and space;
- Discover new methods, theories, and conceptual and computational strategies for understanding complex environmental systems;
- Develop new tools and innovative applications of new and existing technologies for cross-disciplinary environmental research;
- Integrate human and societal and ecological factors into investigations of the physical environment and environmental engineering;
- Improve science-based forecasting capabilities and enhance research on decision-making and other human behaviors that affect the environment; and
- Advance a broad range of infrastructure to support interdisciplinary environmental activities: collaboratory networks, information systems, research platforms, international partnerships, and education activities that enhance and diversify the future environmental workforce.

Long-term Funding for Biocomplexity in the Environment

(Dollars in Millions)

FY 2000 Actual	FY 2001 Actual	FY 2002 Actual	FY 2003 Request	FY 2004 Request	FY 2005
$50.00	$54.88	$58.96	$79.20	$99.83	$101.83

FY 2004 Areas of Emphasis: In FY 2004, NSF plans to invest $99.83 million in the interdisciplinary Biocomplexity in the Environment activities described below. The first two areas listed are relevant to enhanced fundamental understanding of microorganisms important in nature and to humans, including some microbes that are potentially harmful.

- **Microbial Genome Sequencing** – a systematic effort to use high throughput sequencing to determine the genetic composition and gene function of microorganisms of fundamental biological interest; importance to agriculture, forestry, food and water quality; or value in understanding potential agents of bioterrorism. Genome sequence information will provide the basis for understanding the physiology, pathology, and ecology of these organisms. This knowledge can be applied to detection and economic uses of organisms and to forecasting their response to environmental changes.

- **Ecology of Infectious Disease** – development of predictive models and discovery of principles for relationships between environmental factors and transmission of infectious agents. Research focuses on ecological determinants of disease transmission, unintended health effects of environmental change, and improved prediction of disease outbreaks, emergence, and reemergence. Examples of environmental factors include habitat transformation, invasive species, biodiversity loss, climate change, toxic pollution, and bioterrorism.

- **Dynamics of Coupled Natural and Human Systems** – quantitative, interdisciplinary analyses of relevant human and natural system processes and the complex interactions among human and natural systems at diverse scales, with special emphasis given to studies of natural capital; landscapes and land use; and uncertainty, resilience, and vulnerability.

- **Coupled Biogeochemical Cycles** – the interrelation of biological, geochemical, geological, and physical processes at all temporal and spatial scales, with particular emphasis on understanding linkages between chemical and physical cycles (for example, the carbon, oxygen, nitrogen, phosphorus and sulfur cycles) and the influence of human and other biotic factors on those cycles.

- **Genome-Enabled Environmental Sciences and Engineering** – the integrated use of genomic and information technology approaches to gain novel insights into environmental questions and problems.

- **Instrumentation Development for Environmental Activities** – the development of instrumentation and software that takes advantage of microelectronics, photonics, telemetry, robotics, sensing systems, modeling, data mining, and analysis techniques to bring recent laboratory instrumentation advances to bear on the full spectrum of environmental biocomplexity questions.

- **Materials Use: Science, Engineering and Society** – studies directed toward reducing adverse human impact on the total, interactive system of resource use, the design and synthesis of new materials with environmentally benign impacts on biocomplex systems, as well as maximizing the efficient use of individual materials throughout their life cycles.

In addition to these primary areas, other multidisciplinary research and education activities will be supported:

- Molecular scale studies of environmental processes and technologies – interdisciplinary teams to investigate biogeochemical processes, benign materials development, and alternative manufacturing processes at the level of molecular reactions and interfaces.
- Water cycle and freshwater resources – fundamental research across the full dimension of the water cycle, with emphasis on understanding fluxes of water among hydrologic reservoirs, causes and prediction of water cycle variability, and linkages between the water cycle and geochemical constituents.
- Carbon cycle and geomicrobiology – research on the chemical, biological, ecological, and physical processes driving carbon distribution, transformation and transport within and between terrestrial, atmospheric, and oceanic environments.
- Social and behavioral processes – emphasis on predictive capabilities and response to extreme and unpredictable events, including the study of adaptation to environmental change in the Arctic.
- "Tree of Life" – a cross-disciplinary exploration of genealogical relationships of the 1.7 million named extant species using new algorithmic methods and genomic technologies, with the goal of constructing a universal genealogy for a wide range of uses in medicine, technology, agriculture and industry.
- Educational activities – a range of projects associated with biocomplexity studies that include informal science activities, professional growth of science teachers, development of instructional material, and efforts in scientific literacy and communication.
- International partnerships – collaborations that include research partners in other countries in order to broaden the experience of U.S. students and expand the scope of biocomplexity research activities.

Information Technology Research

Information Technology (IT) today has created unprecedented new possibilities for advancing knowledge across the spectrum of human endeavors, including fundamental scientific research, education, engineering design and manufacturing, environmental systems, health care, business, entertainment, and government operations. IT is essential in the growth of our economy and in solving critical problems facing our nation. NSF supports research that extends the frontiers of IT, improves our understanding of IT and its impacts on society, and helps prepare Americans for the Information Age. In FY 2000, the NSF Information Technology Research (ITR) program stressed fundamental research and education; in FY 2001, applications in science were added; in FY 2002, the program supported research to create and utilize cutting edge cyberinfrastructure, enabling research and education in multidisciplinary areas and focusing on emerging opportunities at the interfaces between information technologies and other disciplines. In FY 2003, the ITR program continues its emphasis on interdisciplinary research opportunities, with the intent to stimulate broad research on the fundamental challenges facing the expansion and utilization of IT across science and engineering. In FY 2004, ITR will continue to exploit and deepen the ongoing research and will continue to expand research in multidisciplinary areas, focusing on fundamental research that will lead to novel and profound insights about our physical, biological, and social world. The program will continue to support research to enable the wide and secure deployment of pervasive IT through new classes of ubiquitous applications, the creation of new paradigms to achieve high-levels of trust in cyberspace and the development of new tools and methods to enhance our national security and critical infrastructure protection.

Information Technology Research Funding
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Percent
Biological Sciences	6.08	6.80	7.50	0.70	10.3%
Computer and Information Science and Engineering	173.51	190.67	218.11	27.44	14.4%
Engineering	10.23	11.17	11.17	0.00	0.0%
Geosciences	12.16	13.21	14.56	1.35	10.2%
Mathematical and Physical Sciences	32.66	35.52	35.04	-0.48	-1.4%
Social, Behavioral and Economic Sciences	4.36	4.65	5.15	0.50	10.8%
Office of Polar Programs	1.22	1.33	1.55	0.22	16.5%
Subtotal, Research and Related Activities	240.22	263.35	293.08	29.73	11.3%
Education and Human Resources	2.00	2.48	9.53	7.05	284.3%
Subtotal, R&RA and Education and Human Resources	242.22	265.83	302.61	36.78	13.8%
Major Research Equipment and Facilities Construction	35.00	20.00	0.00	-20.00	-100.0%
Total, Information Technology Research	$277.22	$285.83	$302.61	$16.78	5.9%

Totals may not add due to rounding.

Long-term Goals: By expanding basic research in interdisciplinary areas, with a strong emphasis on interdisciplinary opportunities, NSF will amplify the benefits of IT in all areas of science and engineering, stimulate broad research on the fundamental challenges facing the expansion of IT and spur progress across the national economy and society. The Information Technology Research program will involve seven comprehensive and complementary areas of emphasis described below.

Long-term Funding for Information Technology Research
(Dollars in Millions)

FY 2000 Actual	FY 2001 Actual	FY 2002 Actual	FY 2003 Request	FY 2004 Request
$126.00	$261.17	$277.22	$285.83	$302.61

FY 2004 Areas of Emphasis: Investments will emphasize the following research:

- **Large-Scale Networking**. Research in large-scale networking will focus on fundamental research in optical networking, simulation of network dynamics, fault tolerance and autonomous management of network resources, wireless networks, and scalability to improve performance and handling of transient interactions among billions of networked devices and controlling sensors. Additional research in large-scale networking will focus on new and revolutionary paradigms to ensure user privacy, increase security of sensitive information, and enhance the protection of our critical infrastructures. Research will lead to ultra-large scale networks that are secure, stable, reliable, resistant to failures and resilient to extreme events. These higher levels of reliability and stability will contribute, for example, to next-generation air traffic control systems or to telemedicine's potential for remote monitoring, diagnosis, and care for homebound and isolated citizens.

- **High-Confidence Software and Systems**. Research in this area will support a new generation of highly reliable and trustworthy IT systems, including safe, secure, and dependable information infrastructures and consumer products for an information society. It will provide a sound theoretical, scientific, and technological basis for assured construction and certification of safe, trusted computing systems in interconnected environments. The priority area will support research that will advance our understanding of how to build system engineering tools that incorporate risk-based assurance appropriate to specific domains, and research that will lead to scientific principles for the construction of high-confidence systems that are predictable and robust, including adaptive, self-healing systems that are able to function after attack or system failure. Additionally, research will support new paradigms, tools and methods for modeling and enforcing stability of software systems and the actual systems they control from safety-critical automotive and avionics systems, to implantable devices and advanced prosthetics.

- **Human-Computer Interaction and Information Management**. Research will focus on advanced understanding of the needs of end users in work and learning environments, and tools and technologies for organizing, annotating, searching, mining, visualizing, preserving, and utilizing distributed, heterogeneous, multimedia archives and large database systems. The program will also support research that seeks to enhance, through IT, human abilities, investigate language technologies, augment our understanding of how to integrate perception, cognition, and computation, and develop innovative cognitive interfaces and multi-modal technologies, tools and devices. The research investments will lead to improved real-time access to databases, which in turn will accelerate progress and aid in policy-making. Interactions between medicine, robotics, and networking offer the hope of designing robotic assistants for the elderly and disabled.

- **Software Design and Productivity**. Research will focus on developing theory and technology for large embedded software applications subject to temporal, noise, synchronization and dependability constraints. The key technology components to be developed are integrated modeling techniques, integrated modeling environments and model-based generators. Research investments in this priority area will support the development of mathematical, computer science, and engineering models to test new directions for cost-effective development of very high-quality software in the emerging world of interconnectivity among heterogeneous devices, from embedded processors to mobile devices to massive systems of systems. The program will invest in research that seeks to enhance our understanding of scalability and the inherent heterogeneity of components, achieve improvements by evaluating and testing the practical applicability of new methods and techniques on realistic large-scale application platforms, and address the theoretical foundations of software design while including substantial experimental evaluations.

- **Social, Economic and Workforce Implications of IT and IT Workforce Development**. Research investments in this category will support issues about the manner in which social, behavioral, economic, and political process shape the use of IT by people, organizations, and cultural groups, as well as the ways IT affects economic growth, democracy and political processes. Innovative information technology applications will be developed for work-related learning, including improved uses of existing and emerging information technologies to transform the way our workforce learns, increase the universal participation in a digital society by women, minorities and underrepresented groups and promote the use and development of new learning methods and interactive learning environments of an effective integration of IT with education and training.

- **High-end Computing**. Research in High-end Computing will continue to focus on advanced computing concepts targeted at scientific and engineering applications, including innovative and non-conventional architectures, software technologies, and algorithms. Advances in photonics, nanodevices, sensors, actuators, opto-electronics, and smart fabrics make it possible to provide extremely fast and high-density processing power. The program will seek to explore new computational substrates, such as quantum or DNA computing, and investigate new materials and methods to create wholly new designs for processors in computing devices. Additionally, investments in this priority area will support research on the design of new, modular hybrid architectures that will enable high-degrees of fault-tolerance, programmability and security features needed in embedded systems. All of these hardware technologies and software components must be integrated seamlessly and reliably in large-scale, parallel and distributed systems.

- **High-end Computation and Infrastructure**. Research in this priority area will continue to provide support for terascale computing and computational facilities needed for high-end computational capabilities and promote collaborative research and information sharing across the sciences. The research will build on current scientific knowledge of human perception, cognition, communication and physical response to enable unprecedented opportunities for new information technologies which will amplify human physical, mental and sensory abilities, and enhance the performance and experiences of human beings in a variety of activities, occupations, and social contexts. Investments in this category will also support research in protein folding, neural modeling, and gene expression. This category will also focus on research which seeks to gain new insights into the interactions between biological and physical components of ecosystems and pollutants, atmosphere, oceans and soil, and which can lead to the development of new models and new methods of data management. Additionally, the priority area will support research on meteorological forecasting, modeling of earthquakes, oceanographic computations linked to biological studies of ocean productivity and biodiversity, and high-end computing tools to accelerate the design and implementation of next generation manufacturing techniques such as photonic crystals, optical and electronic switching devices, sensors and detectors.

Nanoscale Science and Engineering

Nanoscale science and engineering encompasses the systematic organization, manipulation and control of matter at atomic, molecular and supramolecular levels. Novel materials, devices, and systems – with their building blocks on the scale of nanometers – shift and expand possibilities in science, engineering, and technology. A nanometer (one-billionth of a meter) is to an inch what an inch is to 400 miles. With the capacity to manipulate matter at this scale, science, engineering, and technology are realizing revolutionary advances, in areas such as individualized pharmaceuticals, new drug delivery systems, more resilient materials and fabrics, catalysts for oil industry, and order of magnitude faster computer chips.

Nanoscale science and engineering promises a better understanding of nature, a new world of products beyond what it is now possible, high efficiency in manufacturing, sustainable development, better healthcare and improved human performance.

Nanoscale Science and Engineering Funding
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Biological Sciences	2.50	2.98	4.98	2.00	67.1%
Computer and Information Science and Engineering	10.20	11.14	15.14	4.00	35.9%
Engineering	86.30	94.35	106.85	12.50	13.2%
Geosciences	6.80	7.53	7.88	0.35	4.6%
Mathematical and Physical Sciences	98.68	103.92	110.42	6.50	6.3%
Social, Behavioral and Economic Sciences	0.00	1.11	1.50	0.39	35.1%
Subtotal, Research and Related Activities	204.48	221.03	246.77	25.74	11.6%
Education and Human Resources	0.00	0.22	2.22	2.00	909.1%
Total, Nanoscale Science and Engineering	$204.48	$221.25	$248.99	$27.74	12.5%

Totals may not add due to rounding.

The National Nanotechnology Initiative (NNI) began in FY 2001 (http://www.nano.gov). NSF's role in NNI emphasizes long-term, fundamental research aimed at discovering novel phenomena, processes, and tools; addressing NNI Grand Challenges; supporting new interdisciplinary centers and networks of excellence, including shared user facilities; supporting research infrastructure; and addressing research and educational activities on the societal implications of advances in nanoscience and nanotechnology.

NSF has been a pioneer among federal agencies in fostering the development of nanoscale science, engineering and technology. In FY 2003, NSF requested $221.25 million for research in a wide range of research and education activities in this priority area, including approximately 15 nanotechnology research and education centers, which focus on electronics, biology, optoelectronics, advanced materials and engineering.

This investment will be expanded in FY 2004 to develop and strengthen critical fields (including nanobiotechnology, manufacturing at the nanoscale, instrumentation, and education) to establish the science and engineering infrastructure and workforce needed to exploit the opportunities presented by these new capabilities. In addition to single investigator research, support will be focused on interdisciplinary research and education teams, national science and engineering centers, exploratory research and education projects, and education and training,

Long-term objectives include building a foundation of fundamental research for understanding and applying novel principles and phenomena for nanoscale manufacturing and other NNI Grand Challenges; ensuring that U.S. institutions will have access to a full range of nano-facilities; enabling access to nanotechnology education for students in U.S. colleges and universities; and catalyzing the creation of new commercial markets that depend on three-dimensional nanostructures. These goals will enable development of revolutionary technologies that contribute to improvements in health, advance agriculture, conserve materials and energy, and sustain the environment.

Long-term Funding for Nanoscale Science and Engineering
(Dollars in Millions)

FY 2001 Actual	FY 2002 Actual	FY 2003 Request	FY 2004 Request	FY 2005
$149.68	$192.28	$221.25	$248.99	$253.97

These increases are needed to bring funding up to the levels suggested by National Science Technology Council/Office of Science Technology Policy (NSTC/OSTP) or recommended by the National Research Council report on NNI.

FY 2004 Areas of Emphasis: NSF's planned investment for Nanoscale Science and Engineering in FY 2004 is $248.99 million. NSF five programmatic focus areas are:

- **Fundamental Research and Education.** The FY 2004 request includes $152 million for fundamental research and education, with special emphasis on:
  - *Biosystems at the Nanoscale* – Approximately $21 million to support study of biologically-based or inspired systems that exhibit novel properties and potential applications. Potential applications include improved drug delivery, biocompatible nanostructured materials for implantation, exploiting of functions of cellular organelles, devices for research in genomics, proteomics and cell biology, and nanoscale sensory systems, such as miniature sensors for early detection of cancer.
  - *Nanoscale Structures, Novel Phenomena and Quantum Control* – Approximately $57 million to discover and understand phenomena specific at the nanoscale, create new materials and functional nanoscale structures and to exploit their novel properties. Potential applications include quantum computing and new devices and processes for advanced communications and information technologies.
  - *Device and System Architecture* – Approximately $28 million to develop new concepts to understand interactions among nanoscale devices in complex systems, including the physical, chemical, and biological interactions between nanostructures and device components. Interdisciplinary teams will investigate methods for design of systems composed of nanodevices.
  - *Nanoscale Processes in the Environment* – Approximately $10 million to support studies on nanoscale physical and chemical processes related to the trapping and release of nutrients and contaminants in the natural environment. Potential benefits include artificial photosynthesis for clean energy and pollution control, and nanoscale environmental sensors and other instrumentation.
  - *Multi-scale, Multi-phenomena Theory, Modeling and Simulation at the Nanoscale* – Approximately $22 million to support theory, modeling, large-scale computer simulation and new design tools and infrastructure in order to understand, control and accelerate development in new nanoscale regimes and systems.
  - *Manufacturing processes at the nanoscale* - Approximately $11 million to support new concepts for high rate synthesis and processing of nanostructures, fabrication methods for devices, and assembling them into nanosystems and then into larger scale structures of relevance in industry and in the medical field.
  - *Converging technologies from the nanoscale* – Approximately $3 million. The convergence of nanotechnology with information technology, modern biology and social sciences will reinvigorate discoveries and innovation in almost all areas of the economy. This new theme includes investments in:

· Nano-biology interface and improving human performance; and
· Nano-information interface research.

- **Grand Challenges.** Approximately $10 million will fund interdisciplinary activities to focus on major long-term challenges: nanostructured materials 'by design,' nanoscale electronics, optoelectronics and magnetics, nanoscale-based manufacturing, catalysts, chemical manufacturing, biological-chemical detection and protection, environment and healthcare.

- **Centers and Networks of Excellence.** Approximately $46 million will support four new research and education centers initiated in FY 2002, and a multidisciplinary, multi-sectoral network for modeling and simulation at the nanoscale.

- **Research Infrastructure.** Approximately $28 million will support instrumentation and facilities for improved measurements, processing and manipulation at nanoscale, and equipment and software for modeling and simulation. University-industry-national laboratory and international collaborations will be encouraged, particularly for expensive instrumentation and facilities. A National Nanofabrication Infrastructure Network (NNIN) will be established.

- **Societal and Educational Implications of Science and Technology Advances.** Approximately $13 million will support student assistantships, fellowships and traineeships, curriculum development on nanoscience and engineering and development of new teaching tools. The implications of nanotechnology on society will be analyzed from social, behavioral, legal, ethical, and economic perspectives. Factors that stimulate scientific discovery at the nanoscale ensure the responsible development of nanotechnology, and converging technologies to improve human performance will be investigated. The development and use of nanoscale technologies is likely to change the design, production and use of many goods and services, ranging from vaccines to computers to automobile tires.

In 2004, the Nanoscale Science and Engineering priority area will continue its focus on fundamental research through investments in investigator-led activities, centers and networks of excellence, and infrastructure. Transition from scientific discoveries to technological innovation is likely to increase due to the increased rate of discoveries in the last couple of years. Priority in funding will be given to: (1) research to enable the nanoscale as the most efficient manufacturing domain, (2) nanobiotechnology, and nanobiology for improving human performance, (3) innovative nanotechnology solutions to biological-chemical-radiological-explosive detection and protection, (4) the discovery, understanding and potential application of phenomena specific to the nanoscale, (5) development of new instrumentation and standards, (6) the education and training of the new generation of workers for future industries, and (7) establishing of the National Nanotechnology Infrastructure Network (NNIN) for user facilities, development of new instrumentation, and training.

Mathematical Sciences

Today's discoveries in science, engineering and technology are intertwined with advances across the mathematical sciences. New mathematical tools disentangle the complex processes that drive the climate system; mathematics illuminates the interaction of magnetic fields and fluid flows in the hot plasmas within stars; and mathematical modeling plays a key role in research on micro-, nano-, and optical devices. Innovative optimization methods form the core of computational algorithms that provide decision-making tools for Internet-based business information systems.

The fundamental mathematical sciences – embracing mathematics and statistics – are essential not only for the progress of research across disciplines, they are also critical to training a mathematically literate workforce for the future. Technology-based industries which help fuel the growth of the U.S. economy and increasing dependence on computer control systems, electronic data management, and business forecasting models, demand a workforce with effective mathematical and statistical skills, well-versed in science and engineering.

It is vital for mathematicians and statisticians to collaborate with engineers and scientists to extend the frontiers of discovery where science and mathematics meet, both in research and in educating a new generation for careers in academia, industry, and government. For the United States to remain competitive among other nations with strong traditions in mathematical sciences education, we must attract more young Americans to careers in the mathematical sciences. These efforts are essential for the continued health of the nation's science and engineering enterprise.

The role of mathematics has expanded in science and society, but the resources devoted to three key areas – fundamental mathematical and statistical research, interdisciplinary collaboration between the mathematical sciences and other disciplines, and mathematics education – have not kept pace with the needs, thus limiting the nation's scientific, technical, and commercial enterprises. To strengthen the mathematical foundations of science and society, the NSF will expand the priority area, focused in the mathematical sciences, encompassing interdisciplinary efforts in all areas of science, engineering and education supported by the Foundation.

Mathematical Sciences Funding
(Dollars in Millions)

	FY 2002	FY 2003	FY 2004	Change	
	Actual	Request	Request	Amount	Percent
Biological Sciences		0.91	2.21	1.30	142.9%
Computer and Information Science and Engineering		2.29	2.29	0.00	0.0%
Engineering		0.91	2.91	2.00	219.8%
Geosciences		4.57	7.07	2.50	54.7%
Mathematical and Physical Sciences	30.00	47.39	70.19	22.80	48.1%
Social, Behavioral and Economic Sciences		1.10	1.50	0.40	36.4%
Office of Polar Programs		0.18	0.18	0.00	0.0%
Subtotal, Research and Related Activities	$30.00	$57.35	$86.35	29.00	50.6%
Education and Human Resources	$0.00	$2.74	$2.74	0.00	0.0%
Total, Mathematical Sciences	$30.00	$60.09	$89.09	29.00	48.3%

Totals may not add due to rounding.

Long-term Goals: From FY 2003 through FY 2007, NSF will emphasize research and education in the mathematical sciences. The goal of this priority area is to advance frontiers in three interlinked areas: (1) fundamental mathematical and statistical sciences, (2) interdisciplinary research involving the mathematical sciences with science and engineering, and focused on selected themes, and (3) critical investments in mathematical sciences education. The five-year investment plan will allow efforts in research and education to take root and begin a transformation in the way mathematics, science, and education interact. The long-term goals of the investments in the priority area are to:

- Foster significant advances in fundamental mathematics and statistics with important benefits for the mathematical and other sciences and engineering;
- Bring support for researchers in the mathematical sciences to a level competitive with other sciences and recognize mathematicians and statisticians as full partners in research, by increasing award size and duration;
- Integrate the most appropriate, state-of-the-art, statistical principles and mathematical tools and concepts into all NSF sponsored research;

- Foster interdisciplinary research partnerships that integrate the mathematical sciences with other science and engineering disciplines;
- Train a new generation of researchers in interdisciplinary approaches to future science and engineering challenges;
- Increase the numbers and diversity of U.S. students trained in the mathematical and statistical sciences to meet the increasing demands of scientific research, engineering, and technology in academic institutions, industry and government laboratories; and
- Develop a framework to significantly advance the image and understanding of mathematics in the general population.

Long-term Funding for Mathematical Sciences

(Dollars in Millions)

FY 2002 Actual	FY 2003 Request	FY 2004 Request	FY 2005	FY 2006	FY 2007	FY 2008
$30.00	$60.09	$89.09	$90.87	$92.69	$94.54	$96.43

FY 2004 Areas of Emphasis: NSF plans to invest $89.09 million in the Mathematical Sciences activities described below. These investments fall into three primary areas: (1) fundamental mathematical and statistical sciences, (2) interdisciplinary research connecting the mathematical sciences with science and engineering, and (3) mathematical sciences education.

- **Fundamental Mathematical and Statistical Sciences.** Fundamental research areas include themes such as dynamical systems and partial differential equations, geometry and topology, stochasticity, number theory, algebraic and quantum structures, the mathematics of computation, Bayesian estimation, and multi-scale and multi-resolution analysis. To enhance research in these areas, NSF will provide improved support for mathematical sciences through focused research groups and individual investigator grants, as well as through institutional and postdoctoral training activities.

- **Advancing Interdisciplinary Science and Engineering.** The concepts and structures developed by fundamental mathematics often provide just the right framework for the formulation and study of applications in other disciplines. Mathematics and statistics have yielded new analytical, statistical, computational and experimental tools to tackle a broad range of scientific and technological challenges long considered intractable. This success has fueled a demand both for further development of new mathematical and statistical techniques and for research teams capable of applying these sophisticated techniques to the problems of science and engineering. A new breed of researchers, broadly trained in both mathematics and science or engineering disciplines, is needed to tackle the increasingly complex multidisciplinary research topics that confront society. Three broad, research themes have been identified for initial emphasis in the mathematical sciences priority area:

  Mathematical and statistical challenges posed by large data sets – Much of modern science and engineering involves working with enormous data sets. Major challenges include: the identification and recovery of meaningful relationships between data; the identification and validation of the structure of large data sets, which require novel mathematical and statistical methods; and improvement of theories of control and decision-making based on large data streams, with new statistical techniques to assess complicated data sets. These challenges arise in such diverse arenas as: large genetic databases; the explosion of data gathered from satellite observation systems, seismic networks, and global oceanic and atmospheric observational networks; situations in which privacy and missing data are major concerns; the massive data streams generated by automated physical science instruments which must be compressed, stored and accessed for analysis; and data produced by modern engineering systems that place networked sensors and actuators on scalable networks to support dynamic interactions.

Managing and modeling uncertainty – Predictions and forecasts of phenomena – bracketed by measures of uncertainty – are critical for making better decisions, whether in public policy or in research. Improved methods for assessing uncertainty will increase the utility of models across the sciences and engineering and result in better predictions of phenomena. Improving the ability to forecast extreme or singular events will improve safety and reliability in such systems as power grids, the Internet, and air traffic control. Advancing techniques to assess uncertainty has applications ranging from helping to forecast the spread of an invasive species, to predicting genetic change and evaluating the likelihood of complex climate change scenarios. In the social sciences, methods for assessing uncertainty will improve the utility of forecasts of market behavior.

Modeling complex nonlinear systems – Advances in mathematics are necessary for a fundamental understanding of the mechanisms underlying interacting complex systems and will be essential to the further development of modern physical theories of the structure of the universe at the smallest and largest scales. Across the sciences and engineering, there is a great need to analyze and predict emergent complex properties and understand multi-scale phenomena, from social behaviors to brain function, and from communication networks to multi-scale business information systems to complex engineering systems.

To enhance research in these areas of science and engineering which depend on cross-cutting themes in the mathematical sciences, NSF support will build on existing efforts and create new opportunities to encompass interdisciplinary focused research groups, interdisciplinary centers, interdisciplinary cross-training programs, and partnership activities with other federal agencies. Training activities will cover interdisciplinary professional development at many levels and those that link highly innovative training activities with research.

- **Advancing Mathematical Sciences Education.** This effort will support innovative educational activities, centered on the research priorities highlighted above. Activities which foster closer connections between research and education will include: teacher preparation and professional development; curriculum development both in the mathematical sciences and in incorporating sophisticated mathematics into other disciplines; introducing new technologies and materials across the K-16 spectrum; and research on how mathematics is learned, particularly in light of new learning technologies and emerging mathematical fields. Investments include support for undergraduate and graduate education and postdoctoral training coupled with curriculum reform.

Human and Social Dynamics

The arrival of the twenty-first century has brought with it new hopes and possibilities for better living but also change, uncertainty, and disruption. The tragedy of September 11, 2001 shattered our nation's sense of security. Economic fluctuations have shaken faith in the new economy. Advances in biotechnology have brought with them the promise of postponing aging and conquering disease, but they have also forced us to reconsider basic questions about the nature of life and the ethical parameters for research. Computing and communications technologies have created a wealth of new employment opportunities and transformed many jobs so as to increase productivity, but they have also rendered large numbers of once vibrant jobs obsolete. Workplace rewards for education have increased dramatically, yet the country's educational system is not producing a workforce with the science, mathematics and technology skills needed to retain its leadership in the global marketplace.

Social and knowledge systems do not develop independently. Humans develop new knowledge that leads to new technologies. Social institutions shape what is produced and determine how these new products become part of everyday life. People and institutions respond to and are influenced by new knowledge and technologies. Understanding the human and social dynamics underlying these complex interdependencies is essential for our nation's continued progress. Multi-scaled, multidisciplinary approaches, many of which have been made possible by recently acquired knowledge and new technologies, can yield this understanding. A new NSF priority area, *Human and Social Dynamics*, will develop and apply these approaches.

This priority area seeks to better understand the causes and ramifications of change, to increase our collective ability to anticipate the complex consequences of change (cultural, science and technology, economic, individual, political, and social), to better understand the dynamics of the human mind, to better understand the cognitive and social structures that create and define change, and to help people and organizations better manage profound or rapid change.

Understanding human and social dynamics in a changing world requires us to examine past and ongoing large-scale social changes from a variety of perspectives, paying special attention to the reciprocal relationship between individual and social action, on the one hand, and knowledge production and technological change, on the other. We must also investigate how human cognition and social forces work together to shape attitudes toward change. Understanding the role of human cognition involves exploring the relationship between genetic and social factors in cognition, considering human emotions as forces that both shape and respond to change, and unraveling the long-term evolution of the cognitive strengths and limitations that shape human existence. Understanding the influence of social and economic forces requires attention to gender, race and culture as well as to social institutions like markets, government and the media. This priority area also requires research into smaller scale institutions such as firms, voluntary associations, and police forces. We must also pay attention to the implications of social dynamics for diversity and equality.

Human and Social Dynamics Funding
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Biological Sciences			0.50	0.50	N/A
Computer and Information Science and Engineering			3.00	3.00	N/A
Engineering			2.00	2.00	N/A
Geosciences			1.35	1.35	N/A
Mathematical and Physical Sciences			0.50	0.50	N/A
Social, Behavioral and Economic Sciences		10.00	15.90	5.90	59.0%
Office of Polar Programs			0.00	0.00	N/A
Subtotal, Research and Related Activities	N/A	$10.00	$23.25	13.25	132.5%
Education and Human Resources	N/A		$1.00	1.00	N/A
Total, Human and Social Dynamics	N/A	$10.00	$24.25	14.25	142.5%

Totals may not add due to rounding.

Long-term Goals: For the next five years, NSF will emphasize research and education related to *Human and Social Dynamics*. The intellectual goals of the effort are to:

- Develop a comprehensive, multidisciplinary approach to understanding human and social dynamics;
- Exploit the convergence in biology, engineering, information technology, and cognition to advance our understanding of human behavior and performance at both the individual and social levels;
- Refine our knowledge of decision-making, risk, and uncertainty, and to learn how to translate this knowledge into improved decision-making;
- Develop the broad range of infrastructure needed to support transformative interdisciplinary research. Examples include collaboratory research networks, large-scale experimental laboratories, cognitive neuroimaging centers, national and international topic-focused research sites, and innovative research platforms such as real and modeled virtual communities;
- Create accessible large-scale data resources and advance methodological frontiers, including agent-based modeling, complex network analysis, non-linear dynamics, computer-assisted qualitative analysis, multi-level, multi-scalar analysis and measurement research and technologies. These will provide the foundation for social and behavioral investigations for the next decade.

Long-term Funding for Human and Social Dynamics
(Dollars in Millions)

FY 2002 Actual	FY 2003 Request	FY 2004 Request	FY 2005	FY 2006	FY 2007	FY 2008
N/A	$10.00	$24.25	$35.00	$55.00	$70.00	$80.00

FY 2004 Areas of Emphasis: In FY 2004, NSF plans to invest $24.25 million in interdisciplinary research on *Human and Social Dynamics* with special attention to the priorities described below.

- **Enhancing human performance** – Research on behavior, cognition, development, emotion, language, neuroscience and social interaction, in conjunction with advances in biology, engineering, robotics and information technology, will aid the development of approaches for enhancing human performance. Research on organizations, markets and informal groups will advance our understanding of how social structure interacts with human capacities to encourage or impede optimum performance.

- **Decision-making under uncertainty** – Research will focus on decision-making in normal and crisis circumstances, the implications of distributed versus centralized decision-making systems; and risk assessment and management; and the development of databases, decision-support, and other tools and approaches to facilitate effective decision-making and risk communication. Especially important will be research on behavior in response to extreme events such as natural disasters and terrorist attacks. Approximately $5.0 million within the SBE Directorate supports a portion of NSF's $25.0 million investment in the Administration's Climate Change Research Initiative.

- **Agents of change** – Research will focus on better understanding of large-scale transformations, such as globalization and democratization; the reciprocal relationship between individual and social action; the evolution of society and its interaction with climate, geography and environment; the implications of cultural variation for conflict and assimilation; the implication of such transformations for diversity and equality; and adaptation and resistance to technological change and new science-based knowledge.

- **Modeling human and social dynamics** – Many aspects of human and social dynamics may be seen as complex networks: examples include social groups, large organizations, communication grids and economic systems. It is also possible to study group and societal behavior that results from numerous individual or small group actions and decisions. Advances in statistics and modeling theory are making the analysis of these and other complex realities of social interaction possible. This area of emphasis includes the development and application of stochastic agent-based modeling, complex social network analysis, and techniques for modeling of human behavior and interaction using innovative information and engineering technologies.

- **Spatial social science** – Recent technological advances have the potential for qualitatively changing the nature of social science by providing tools and techniques for acquiring information about location that can be combined with demographic, political, health-related and other social data. Examples of such advances include the use of the global positioning system (GPS) for highly precise locational specification; the development of geographic information systems (GISs) for gathering, analyzing, and presenting spatial data; and ever-expanding communications capabilities associated with the Internet and related media. The potential for using mobile devices and integrated sensors/transmitters for information gathering as well as for communications has only begun to be exploited. This area of emphasis will sponsor research using these technologies to explore human and social dynamics as well as research aimed at improving existing tools and making them more accessible.

- **Instrumentation and data resource development** – The development of instrumentation and software that takes advantage of information technology, microelectronics, nanotechnology, photonics, robotics, sensing systems, modeling, data mining, and meta-analysis techniques promises to bring recent laboratory instrumentation advances to bear on the full spectrum of social and behavioral questions. New instruments include tools and techniques for genetic analysis and cognitive neuroimaging. Data resource needs include new and extended longitudinal databases such as those that capture organizational variables and changes in them over time. Tools are also needed for data-rich linguistic analysis and corpus linguistics, and databases, with fail-safe privacy protections, that couple genetic information with behavioral and social information. Database related tools include systems and devices for more rigorously collecting and analyzing qualitative data; the integration of diverse data resources across multiple scales; advanced techniques for the analysis of information from diverse sources, and technologies for anonymizing sensitive data and efficiently analyzing these data.

Workforce for the 21st Century

The nation's economic vitality, capacity for security, and overall quality of life depend on a general workforce that is scientifically and technologically literate and a science and engineering professional workforce that is world class at all levels. Our educational system has been and continues to be effective at the collegiate level and attracts students globally. At the same time, many K-12 graduates are ill-prepared to respond to the demands of today's world, fewer citizens choose to pursue science and engineering careers, and fewer than half of those who do choose these career paths graduate, putting the nation's economy and security at peril.

This softening of the nation's capacity to perform is exacerbated by the slow progress in attracting, supporting, developing, and advancing underrepresented minorities, women and persons with disabilities to careers in science and engineering. These issues must be addressed with both passion and strategic investment. It is unrealistic to imagine that the United States can persist in sustaining its freedom without long-term dedication to resolving this workforce conundrum. In the words of James Madison, "What spectacle can be more edifying or more seasonable than that of liberty and learning, each leaning on the other for their mutual and surest support?"

NSF's *Workforce for the 21st Century* priority investment is designed to capitalize on its experience with a variety of programmatic investments over the years by integrating the most effective of them, premising program designs on research findings bearing on science, mathematics, engineering, and technology learning, and broadening participation throughout. The focus is a highly synergistic and interconnected enterprise that will require the active involvement of researchers and educators at all levels and from every science and engineering discipline.

NSF has a long tradition of innovation in mathematics, science, engineering, and technology education. From its initial 1952 investment in Graduate Research Fellowships (a story on the Class of '52 is posted at http://www.nsf.gov/od/lpa/nsf50/classof52.htm) to K-12 curriculum and faculty development to television programming for the public, NSF has promoted the preparation of high quality scientists, engineers, and scientifically literate citizens. Now, in the *Workforce for the 21st Century (Workforce 21)* priority area, these efforts will be brought together in distinct activities that build on what has been learned over half a century.

Long-term goal: For the next five years, all NSF directorates will partner in an integrated research and education effort to address science and engineering workforce needs. The elements of this goal are to:

- Prepare scientists, mathematicians, engineers, technologists and educators capable of meeting the challenges of the 21st Century;
- Attract more U.S. students to science and engineering fields; and
- Broaden participation in science and engineering fields.

To ensure quality of the process and achieve this goal, the following strategies will be pursued:

- Prepare and support K-12 teachers and higher education faculty who inspire and challenge students and provide this instructional workforce with effective materials, training, and methods to promote and assess learners;
- Integrate the connections across elementary, middle and high school for a seamless K-12 experience for all learners;
- Improve coordination and vertical integration of NSF programs along career paths to ensure a holistic education for all students;
- Focus on models for attracting and retaining U.S. students in science and engineering through the junctures along their career paths, from high school to college, from 2-year to 4-year institutions, from baccalaureate to graduate programs, and from graduate study to careers;
- Promote both institutional and multi-institutional networking, partnerships, alliances and collaborations, to achieve results of mutual benefit; and
- Pursue research on factors that influence career choices and evaluate the productivity of strategies for increasing and broadening participation in K-12 science and mathematics and careers in science and engineering.

To achieve the goal of this priority area, three integrative investments that build on successful activities will be pursued over the next five years:

- **Integrative Institutional Collaborations:** Currently, NSF supports a number of effective programs for encouraging U.S. students to participate in science and engineering fields. The successful Research Experiences for Undergraduates (REU) investment broadly impacts students across all sectors. REU awards support individual investigators and site directors in offering hands-on research experiences for undergraduates. In these activities, students benefit from personal mentoring in career skills and opportunities and elect, in significant numbers, to continue in science or engineering as a result. Institutions involved in the Louis Stokes Alliances for Minority Participation (LSAMP) investment produce 70 percent of the underrepresented minority science and engineering baccalaureate degree recipients. The Alliances for Graduate Education and the Professoriate (AGEP) program has encouraged a substantial increase in graduate degrees in just a few years. Centers of Excellence in Science and Technology (CREST) support research capacity in minority-serving institutions. Together, these programs advance undergraduates, graduate students, and build research capacity. When coupled with support for Historically Black Colleges and Universities (HBCUs) and Graduate Teaching Fellowships in K-12 Education (GK-12), the Math and Science Partnership (MSP), Major Research Instrumentation (MRI), and other projects, integrated sets of these programs can have substantial impact on a campus and on advancement of U.S. students, over and above what is envisioned by any one of them. Additionally, NSF's outstanding research and education centers, such as the Science and Technology Centers, the Engineering Research Centers, the Centers for Learning and Teaching, and the Long-Term Ecological Research Program, can also be important contributors to integrative campus programs. Integrative Institutional Collaborations will enable institutions to craft complementary activities that weave together, vertically integrate, and augment support from existing programs, creating a seamless route of advancement for students from the K-12 through post-doctoral levels – a result that is much greater than the sum of its parts.

- **Faculty for the Future.** This program will enhance both preparation and professional development for K-12 teachers and the professoriate. Importantly, it is aimed at offering K-12 and higher education faculty the opportunity to hone the skills necessary to meet the challenges of today's fast-paced growth in knowledge and tools of knowledge transfer. One component supports development of innovative approaches to the education of new K-12 and higher education faculty, particularly those aimed at attracting and retaining members of underrepresented groups. These efforts may include development of new cost-effective tools that will enhance learning and allow students and faculty to participate in research, including use of simulation and Internet access to specialized research environments, and adaptation of research equipment to educational uses. A second component provides early and mid-career Minority Serving Institution (MSI) faculty with research-based faculty development opportunities in laboratories at research-intensive universities. The intent is to promote mutual partnerships and mentorships between host and visiting faculty members and to establish long-term relationships between individual faculty members, departments, and institutions that will strengthen the learning-through-research environment of the MSI.

- **Workforce Research**. As the educational environment increases in complexity, young people and adults have many options for pursuing a degree or for enhancing their employability and opportunity for advancement. While many programs and activities are known to elicit interest in science and engineering and to reinforce decisions to pursue careers in those fields, the decisive factors in career choices remain elusive. Additional research is needed to determine what experiences or strategies are most effective in attracting and retaining students in careers that require fluency in mathematics, science, engineering, or technology. This program will complement the Centers for Learning and Teaching in promoting study of the factors that influence career choices; analyzing the quality and productivity of the pathways that students use to prepare for science and engineering careers or advance in their careers; and evaluating programs designed to increase and broaden participation in science, mathematics, and engineering areas at all levels. The long-term outcome is to develop effective ways to meet the changing needs of the 21st Century workforce for knowledge and skills in science, technology, and engineering.

Long-term Funding for Workforce for the 21st Century
(Dollars in Millions)

FY 2002 Actual	FY 2003 Request	FY 2004 Request	FY 2005	FY 2006	FY 2007	FY 2008
N/A	N/A	$8.50	$30.00	$50.00	$65.00	$75.00

FY 2004 Investment: In FY 2004, NSF will initiate this priority area by investing $6.5 million in Integrative Institutional Collaborations and $2.0 million in Workforce Research. The FY 2004 investment is intended to prepare the community for a robust focus on this priority investment over the subsequent five years.

Math and Science Partnership

NSF's FY 2004 budget provides $200.0 million for the President's Math and Science Partnership (MSP) program, the same as requested in FY 2003. The MSP program responds to a growing national concern – the lackluster performance of U.S. children in mathematics and science. *No Child Left Behind*, which enunciates the President's vision for K-12 education, articulates this concern and identifies the main underlying factors for the poor performance of U.S. students: too many teachers teaching out of field, too few students taking advanced coursework, and too few schools offering challenging curricula and textbooks.

MSP builds on the nation's dedication to improve mathematics and science education through support of partnerships that unite the efforts of local school districts with faculties of colleges and universities – especially disciplinary faculties in mathematics, science, and engineering – and with other stakeholders. MSP seeks to improve student outcomes in mathematics and science for all students, at all K-12 levels. As the achievement of students rises, MSP expects to significantly reduce achievement gaps in mathematics and science education among diverse student populations.

To achieve these long-term outcomes, the MSP program supports the development, implementation and sustainability of promising partnerships among: mathematics, science, engineering and education faculty and their institutions of higher education; administrators, teachers and guidance counselors in K-12 schools and school systems; and other important stakeholders to:

- Ensure that all K-12 students have access to, are prepared for, and are encouraged to participate and succeed in challenging curricula and advanced mathematics and science courses;
- Enhance the quality, quantity and diversity of the K-12 mathematics and science teacher workforce; and
- Develop evidence-based outcomes that contribute to our understanding of how students effectively learn mathematics and science.

The first competitions for (a) MSP *Comprehensive* and *Targeted* projects and (b) MSP *Research, Evaluation and Technical Assistance* (RETA) projects were held in FY 2002 and resulted in seven *Comprehensive* awards, seventeen *Targeted* awards and twelve RETA awards. Collectively, the funded *Comprehensive* and *Targeted* projects and RETA projects constitute the *MSP Learning Network*, a network of researchers and practitioners studying and evaluating promising strategies to improve K-12 student achievement and other student outcomes in mathematics and science. The *MSP Learning Network* activities are expected to deepen our understanding of how students effectively learn mathematics and science such that successful approaches can be broadly disseminated and emulated in educational practice.

MSP *Comprehensive* projects implement change in mathematics and science educational practices in both higher education institutions and in schools and school districts to result in improved student achievement across the K-12 continuum. Projects are distinguished by the range and variety of lead institutions and partners involved. The Washington University MSP, for example, partners the university with five school districts, the St. Louis Science Center, and the St. Louis Zoo. The El Paso MSP involves not only the University of Texas at El Paso and twelve independent school districts, but also the Office of the Mayor of El Paso and the Hispanic and Black Chambers of Commerce.

Targeted projects focus on improved K-12 student achievement in a narrower grade range or disciplinary focus in mathematics and/or science. The partnership housed at the University System of Maryland, for example, targets science in grades 9 through 12, while the California State University-Fullerton partnership targets mathematics in grades 6 through 12.

- SUNY-Brockport teams with the Rochester City School District and the Brighton Central School District, with the Shodor Foundation and the Krell Institute as additional partners. A Computational Mathematics, Science and Technology (CMST) approach to learning science will be employed in which students and teachers engage in fieldwork, laboratory experiments, mathematical modeling, computer simulation and visualization. CMST employs mathematical models to describe physical phenomena, therefore bringing a new perspective to the usefulness of mathematics as a tool in real life. A challenge program incorporating CMST will provide tools and motivation for 200 7^{th} through 12^{th} grade students under the supervision of participating teachers. In addition to the collaboration and new strategies for problem solving, an important component of the professional development program for mathematics and science teachers is a four-week summer institute each year, serving a total of 240 teachers. In addition, there is a master's degree program for 30 teachers. Preservice education programs at SUNY - Brockport are being revised and new courses are to be introduced with a focus towards improving the quality, quantity and diversity of the new teacher workforce.

Research, Evaluation and Technical Assistance (RETA) projects provide large-scale research and evaluation capacity for the *MSP Learning Network*, and provide *Comprehensive* and *Targeted* awardees with assistance in the implementation and evaluation of their work.

- The Council of Chief State School Officers has established a collaborative research team involving the Wisconsin Center for Education Research and the American Institutes for Research to address the following research questions: (1) To what extent is the quality of the professional development supported by MSP consistent with a research-based definition of quality? (2) What effects do teachers' professional development experiences have on instructional practices and content taught in math and science classes? Are high-quality professional development activities more likely than lower-quality activities to increase the alignment of content with state standards and assessments? (3) How can MSP projects use study findings to improve professional development and the content and instruction of mathematics and science classes?

In FY 2003, MSP continues support for new *Comprehensive* and *Targeted* awards and a combination of research, evaluation and technical assistance grants and contracts, informed by assessments of lessons learned from the FY 2002 efforts. In FY 2004, MSP adds a new activity for *Teacher Institutes for the 21st Century*, with a focus on developing master teachers who have deep content expertise in mathematics, science, and related technologies, who are excited about newer developments in these fields, and who have the disciplinary depth and stature to motivate students towards continued study of mathematics and science in advanced courses.

The U.S. Department of Education sponsors numerous programs that support the President's education initiative, and NSF and the Education Department will continue to collaborate on appropriate program linkages to manage the federal investment in science and mathematics education for the greatest effectiveness. In FY 2002, NSF and ED co-funded one MSP *Comprehensive* award and one *Targeted* award.

Federal Crosscuts

NSF will continue its active participation in federal crosscut areas in FY 2004, supporting research and education in the U.S. Global Change Research Program at $188.30 million, the Networking and Information Technology Research and Development program at $723.60 million, and the National Nanotechnology Initiative at $248.99 million. In addition, in FY 2004, the Administration's Climate Change Research Initiative (CCRI), first proposed in FY 2003, will be funded at $25.0 million. The CCRI is a multiagency effort with a strong focus toward short-term outcomes and deliverables. NSF will participate in four specific areas: understanding the North American carbon cycle, research on climate change risk management, developing sensors to measure carbon dioxide and methane, and measuring and understanding the impact of black carbon.

People

Developing "a diverse, internationally competitive and globally engaged workforce of scientists, engineers and well-prepared citizens."

The linkage of research and learning is a defining characteristic of all NSF investments. NSF activities directly involve over 200,000 people including researchers, graduate students and post-doctorates engaged in cutting-edge research and teachers and students at all grade levels. Support for programs specifically addressing NSF's Strategic Goal of People totals $1.15 billion in FY 2004, an increase of 6.1 percent over the FY 2003 Request. This increase is driven by funding for graduate fellowship and traineeship programs and focused efforts to broaden participation in the science and engineering enterprise. FY 2004 also marks the third year of the President's Math and Science Partnership (MSP), which promotes partnerships among states, local school districts and universities to strengthen K-12 mathematics and science education. The FY 2004 Request provides $200.0 million for MSP in keeping with the original five-year plan for this program.

Support by Level of Education
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	Change Amount	Change Percent
PreK-12	317	373	363	-10	-2.8%
Undergraduate	253	243	267	24	9.9%
Graduate and Professional	329	376	430	53	14.2%
Other Support	96	94	93	-1	-1.1%
Total, People[1]	$995	$1,087	$1,153	$66	6.1%

Totals may not add due to rounding.
[1]Total does not include $57.31 million in FY 2002, and an estimate of $65.68 million in FY 2003 from H-1B Nonimmigrant Petitioner Fees. Legislation for this activity expires in FY 2003.

The funds associated with the Foundation's People goal primarily address education and training opportunities for the current and future scientists and engineers and the instructional workforce in science, technology, engineering, and mathematics (STEM). NSF's other strategic goals, Ideas and Tools, also advance the People goal. Education is an integral component of all research projects, as the skills and training needed for the next generation of scientists, engineers, and technologists are provided within the context of the research experience and the state-of-the-art tools used in these efforts.

The Foundation places a high priority on formal and informal STEM education at all levels -- preK-12, undergraduate, graduate, professional, and public science literacy that engages people of all ages in lifelong learning. NSF programs are intended to increase opportunities for all students to learn mathematics and science, prepare for and complete higher education, join the workforce as competent and contributing members, and become well-informed, science-literate citizens.

PreK-12 Education

The FY 2004 NSF Request for preK-12 programs is $362.87 million, a decrease of $10.39 million or nearly 3 percent from the FY 2003 Request of $373.26 million. The decrease reflects the consolidation of the Foundation's Rural Systemic Initiatives program and the Urban Systemic Program into NSF's teacher enhancement activities.

- The Math and Science Partnership (MSP) builds on the nation's dedication to improve K-12 mathematics and science education, through support of partnerships that unite the efforts of local school districts with faculties of colleges and universities -- especially disciplinary faculties in mathematics, science and engineering -- and with other stakeholders. MSP seeks to improve student outcomes in mathematics and science for all students, at all K-12 levels. NSF is requesting $200.0 million for MSP for FY 2004. The success of the partnerships will be measured through performance indicators such as increasing student participation in advanced courses in mathematics/science and student success in passing advanced placement exams, and increasing the numbers of prospective teachers who major in mathematics or science. Comprehensive projects designed to continuously improve student achievement in math and science from the earliest grades through grade 12 will reach over a million students in 11 states as part of the first round of this program. An additional 600,000 students will be reached through more targeted projects focusing on either science or mathematics at particular grade bands. The Comprehensive and Targeted projects constitute one component of the MSP program. A second component focuses on research, evaluation and technical assistance (RETA) in support of the Comprehensive and Targeted projects. A third component is expected to focus on teachers who will provide intellectual leadership in their schools and districts through the *Teacher Institutes for the 21st Century*. All MSP-funded projects contribute to the *MSP Learning Network*, a network of researchers and practitioners studying and evaluating promising strategies to improve K-12 student achievement and other student outcomes in mathematics and science. *MSP Learning Network* activities will deepen our understanding of how students effectively learn mathematics and science such that successful approaches can be broadly disseminated and emulated in educational practice. Additional information regarding MSP can be found in the Education and Human Resources section.

Undergraduate Education

The FY 2004 Request for programs to improve undergraduate education is $267.33 million, an increase of $24.12 million, or 9.9 percent, over the FY 2003 Request of $243.21 million. Highlights in FY 2004 include:

- NSF's Historically Black Colleges and Universities Undergraduate Program (HBCU-UP) totals $19.97 million, an increase of $6.0 million, or 43 percent, over the FY 2003 Request level of $13.97 million. HBCU-UP provides awards to enhance the quality of undergraduate STEM programs through curricular reform and enhancement, faculty development, research experiences for undergraduates, upgrading of scientific instrumentation, and improvement of research infrastructure.

- Funding for the Louis Stokes Alliances for Minority Participation (LSAMP) program totals $32.73 million, an increase of 23 percent, or $6.20 million, over the FY 2003 Request of $26.53 million. The program strengthens and encourages STEM baccalaureate degree production of students from underrepresented populations by utilizing the knowledge, resources, and capabilities of a broad range of organizations from the academic, federal, and commercial sectors. The effectiveness of LSAMP is demonstrated by significant increases in the number of minority students in STEM fields earning baccalaureate degrees.

- The Science, Technology, Engineering and Mathematics Talent Expansion Program (STEP), established in FY 2002, is funded at $7.0 million in FY 2004, an increase of $5.0 million or 250 percent over the FY 2003 Request of $2.0 million. Under STEP, grants to colleges and universities are provided to establish programs to increase the number of undergraduate math and science majors. In addition to STEP, NSF will continue to support the Noyce Scholarship program at the FY 2003 Request level of $4.0 million.

- The FY 2004 Request includes $16.18 million for the Federal Cyber Service: Scholarship for Service (SfS) program, an increase from the FY 2003 Request of $5.0 million, or about 45 percent. SfS provides scholarships to students in the fields of information assurance and computer security in return for a commitment following graduation to work for a federal agency. The program's goal is to increase the capacity of the U.S. higher education enterprise to produce professionals in these fields. Supplemental funding of $19.30 million was provided in FY 2002, recognizing the program's role in the homeland security effort.

- NSF's Foundation-wide Research Experiences for Undergraduates (REU) program requests funding of $45.58 million for FY 2004, an increase of $750,000 over the FY 2003 Request of $44.83 million. REU supports active research participation by undergraduate students and seeks to expand student participation in science and engineering research areas supported by NSF, whether disciplinary, interdisciplinary, or educational in focus.

- For FY 2004, NSF's Workforce for the 21st Century priority area will focus on attracting students, especially those students who have traditionally been underrepresented, to science, technology, engineering and mathematics (STEM) disciplines. Examples of possible activities include integrating research and education through hands-on research experiences for high school students and/or undergraduates across disciplines, providing for partnerships with non-academic S&E employers to offer internships and in-service learning, and conducting research on factors determining students' career choices. The Foundation is requesting $8.50 million to launch the initial phase of this priority area.

Graduate and Professional Education

The FY 2004 Request for graduate and professional programs totals $429.89 million, an increase of $53.50 million or 14.2 percent over the FY 2003 Request of $376.40 million.

- Increasing the stipend level and the number of students in the three NSF-supported graduate education programs are high priorities of the Foundation in FY 2004. In FY 2003, NSF requested a stipend level of $25,000 for Fellows and Trainees in the Graduate Research Fellowships (GRF) program, the Integrative Graduate Education and Research Traineeships (IGERT) program, and the Graduate Teaching Fellowships in K-12 Education (GK-12) program. For FY 2004, NSF is proposing to raise stipends to an annual amount of $30,000, starting in academic year 2004-2005, and to increase the number of students in these programs to nearly 5,000.

  - NSF's GRF program will increase by $17.24 million overall to $97.80 million in FY 2004. This flagship program selects and supports the most promising science and engineering students in the U.S. and provides support for stipends and cost of education allowances for their graduate education. Approximately 2,550 students will be supported in FY 2004.

  - The GK-12 program supports graduate and advanced undergraduate students in science and engineering as content resources for K-12 teachers while providing students the opportunity to develop teaching skills. Funding will increase by $8.65 million to a total of

$50.10 million. A new competition is supported with this increase, which will bring the program to about 900 graduate students.

- Support for the IGERT program will increase by $13.31 million to $67.10 million in FY 2004. In addition to raising stipends, approximately 1,500 IGERT students will be supported through the program. IGERT is distinguished from other training programs in that it has a strong emphasis on interdisciplinary training, innovation in graduate education, and broadening participation of underrepresented groups.

- Support for the Faculty Early Career Development (CAREER) program will total $128.33 million, an increase of $5.65 million from the FY 2003 Request of $122.68 million. This NSF-wide activity emphasizes the early development of academic careers by presenting this award to new faculty who are poised to become academic leaders of the future.

- Funding for ADVANCE, to increase the participation and advancement of women in all fields of science and engineering, will increase by $4.02 million, or 23 percent, to $21.16 million in FY 2004. ADVANCE is an integral part of the Foundation's multifaceted strategy to help realize a diverse science and engineering workforce.

- Postdoctoral Faculty Fellowships, a new program funded at $3.0 million in the Engineering Activity, will provide 15 promising postdocs with opportunities to enhance interdisciplinary research expertise and learning pedagogy needed to become outstanding new research faculty. The Office of Polar Programs is also initiating a new postdoc program, proposed in FY 2004 at $1.20 million, which is targeted to encouraging underrepresented groups to study emerging scientific frontiers in polar areas. In addition, the Advanced Studies Institutes program within SBE's Office of International Science and Engineering will provide funding to bring together graduate students and postdoctoral fellows from the United States and selected developing countries to explore cutting-edge areas of research.

Other Support

The FY 2004 Request for other People-related activities is $92.78 million, a decrease of $1.05 million.

- The Partnerships for Innovation (PFI) program will be funded at $10.0 million in FY 2004, an increase of $5.0 million over the FY 2003 Request. The PFI program builds innovation capacity by linking new knowledge and knowledge-rich workforce to economic growth and other societal benefits through the partnership endeavors of a diverse range of colleges and universities, private sector firms, local, state, and federal government entities and other organizations.

- Informal Science Education activities will be supported at $50.0 million in FY 2004, a decrease of $5.0 million. Projects included in this activity promote the general public's understanding of science, technology, engineering, and mathematics through media (e.g., print, film, television) and informal science organizations (e.g., museums, parks, zoos, libraries, community groups). Priorities include outreach to smaller communities and underrepresented groups.

- Evaluation efforts will be funded at $11.64 million, a $1.0 million decrease from the FY 2003 Request. NSF's evaluation program is designed to support evaluative studies that build the knowledge base about effective STEM education policy and practice, and to increase the size and capacity of the evaluation community. The modest reduction for evaluation is due to the increased presence of a significant research, evaluation and technical assistance component in MSP.

- The Program for Gender Equity in Science, Mathematics, Engineering, and Technology (PGE) will be funded at $9.96 million, a decrease of $550,000 from the FY 2003 Request. This decrease is offset by a $4.02 million increase in the Request for the ADVANCE program described above. The generally low participation of women in science, technology, engineering, and mathematics is a national concern. PGE is committed to overcoming barriers that have discouraged the early and continuing interest in STEM, and to developing interest, knowledge, and involvement of girls and young women in these fields.

- The Research in Disabilities Education (RiDE) program, formerly the Program for Persons with Disabilities (PPD), will be funded at $5.28 million, the same as the FY 2003 Request. RiDE supports efforts to increase the participation and achievement of individuals with disabilities in STEM education and careers. Methods and products of focused research awards are incorporated in program-sponsored regional alliances. The alliances serve to inform educators, government and industry about proven-good practices in the classroom, promote broader awareness and inclusion of disabilities issues, and define specific areas of human learning in need of further attention by the research community.

FY 2004 PERFORMANCE GOAL FOR PEOPLE

The following table summarizes NSF's FY 2004 Performance Goal for PEOPLE. For additional information, see the FY 2004 Performance Plan.

STRATEGIC OUTCOME GOAL	NO.	*ANNUAL PERFORMANCE GOAL*[A]	FY 2004 AREAS OF EMPHASIS: PROSPECTIVE REPORTING: INVESTMENTS IN EMERGING OPPORTUNITIES	FY 2004 AREAS OF EMPHASIS: RETROSPECTIVE REPORTING, AS RELEVANT
PEOPLE **Developing "a diverse, internationally competitive and globally engaged workforce of scientists, engineers, and well-prepared citizens."**	**III-1**	***NSF's performance for the PEOPLE Strategic Outcome is successful when, in the aggregate, results reported in the period demonstrate significant achievement in the majority of the following indicators:*** • Development of well-prepared researchers, educators or students whose participation in NSF activities provides experiences that enable them to explore frontiers or challenges of the future; • Contributions to development of a diverse workforce through participation of underrepresented groups[B] in NSF activities; • Development or implementation of other notable approaches or new paradigms[C] that promote progress toward the PEOPLE outcome goal.	❑ Math and Science Partnership ❑ Priority Area: - Workforce for the 21st Century ❑ Graduate Student Support	❑ PreK-12 Education, e.g., - Systemic Reform ❑ Undergraduate Education, e.g., - REU ❑ Graduate and Professional Development, e.g., - IGERT - GK-12 - CAREER ❑ Centers for Learning and Teaching (CLT) ❑ Broadening Participation, e.g., - Partnerships for Innovation - Historically Black Colleges and Universities – Undergraduate Program - Louis Stokes Alliances for Minority Participation

A This performance goal is stated in the alternate form provided for in GPRA legislation.
B For example, women, underrepresented minorities, persons with disabilities or underserved institutions.
C For example, broad-based, program-wide results that demonstrate success related to improved math and science performance for preK-12 students, or professional development of the STEM instructional workforce, or enhancement of undergraduate curricular/laboratory/instructional infrastructure, or highly synergistic education and research activities, or international collaborations, or communication with the public regarding science and engineering.

Highlights of Recent Accomplishments (People)

Examples of accomplishments of NSF-supported education and training programs are described below.

Fostering Broader Participation in STEM. NSF has actively promoted coordination between the Louis Stokes Alliances for Minority Participation (LSAMP) program and the Alliances for Graduate Education and the Professoriate (AGEP) program. The level of achievement in LSAMP alliances formed around the nation during the past ten years provides an excellent avenue to expand the number of underrepresented minority candidates joining the professoriate, and an important opportunity for maximizing graduate education is the tracking and routing of LSAMP students into AGEP. The *Minority Graduate Education at Mountain States Alliance* (MGE@MSA), funded by AGEP has enrolled 329 African American, American Indian, and Hispanic students in science, mathematics and engineering doctoral programs. After the first year of MGE@MSA, 43 doctoral degrees in these disciplines were awarded to program participants, up 87 percent from the 23 produced in the baseline year. The overall five-year goal of the project is to triple the number of underrepresented minority doctorates to achieve an annual rate of 69 by the year 2004. This goal was set following nine years of successful experience in mentoring minority students through Arizona State University's LSAMP project. For 2001-2002, *ASU's Mountain States Alliance* increased the number of MGE@MSA faculty mentoring participants from 51 to 179, and student participants from 129 to 238.

Multimedia science experience for children, educators, and families reaches more than one million households. In January 2002, *DragonflyTV*, a new weekly science magazine television show, was launched and is now seen by over 1,000,000 households nationwide. *DragonflyTV* is a multimedia science experience for kids, educators, and families. The show involves real kids doing real science and gives children and scientists a national forum where they share the excitement of scientific discovery. More than 90 percent of 5th graders and 87 percent of 6th graders said they understood the *DragonflyTV* investigations. In small group discussions, these children were able to describe investigations in detail, and offer ideas for new investigations of their own. The project includes an interactive website, http://pbskids.org/dragonflytv/index.html; Teacher's Guides that reach over 40,000 classrooms; and community outreach efforts to schools, Boys and Girls Clubs of America, and other youth organizations.

Participation of K-12 teachers in summer research projects results in significant improvement in students' scores on standard exam. K-12 teachers participate in summer research projects at MIT's radio Haystack Observatory, and then develop lesson plans for their classrooms based on their experiences. The final report on this grant contains the following paragraph: "Mindy Lekberg began testing her RET unit on molecular structure using radio astronomy, and reported that her students' scores on a standard American Chemical Society Test Bank Exam increased 13 mean points from 1997-1999. In addition, the head of the Science Department at Chelmsford High School informed us that one of Lekberg's REU lesson plans will be adopted by all of the physical sciences teachers once it is tested and finalized. Finally, Lekberg organized a 90-minute program for 275 ninth-grade physical sciences students in which the centerpieces was the use of the Haystack 37-meter telescope via the Internet from Chelmsford High School to image Cygnus A, observe the nature and properties of electromagnetic radiation, and discuss molecular emission from our galaxy using the water, ammonia and methanol lines."

Integration of engineering concepts and language in social science and humanities courses. Faculty in the Materials Science Department at MIT host a series of summer workshops for professors at liberal arts colleges. The Summer Institute (SI) assists faculty at liberal arts colleges in introducing materials science and engineering to their undergraduate curricula. It brings together MIT faculty, faculty from undergraduate liberal arts institutions, and MIT graduate students in a modular, case study format that combines materials science and engineering with social science and humanities fields. A pivotal aspect of this project is the leverage gained in teaching educators who will bring the perspectives and methodologies of materials science and engineering to a much broader and diverse public audience than is usually present at engineering institutions.

ATE Regional Center Created in California. An Advanced Technological Education project that has grown to incorporate a new ATE Regional Center is the *California Regional Consortium for Engineering Advances in Technological Education (CREATE)*, based at the College of the Canyons in Los Angeles County, California. CREATE was formed as a joint effort of seven community colleges and over 70 high tech engineering technology employers to develop a regional approach to the preparation and training of engineering technicians. In 1997, all of the seven colleges in CREATE were challenged by a dichotomy between low enrollment in their credit electronics programs and a high demand from employers for highly skilled engineering technicians. Partnership with industry to develop programs tied to industry standards and certifications has resulted in an unprecedented level of success for the CREATE colleges, their students, and the industry partners. Over 10,000 students have been trained in CREATE engineering technology courses. New instructors have been hired and 115 new courses and 30 new credit certificate and degree programs have been State-approved and implemented. New equipment has been donated by industry and government partners (Strasbaugh, Procter and Gamble, NAVSEA) so that they can now outsource their training to the community colleges, college laboratories have been renovated by industry personnel (PG&E), and college instructors have been trained on industry sites at industry cost (Boeing) to make the curricula meet state-of-the-art industry requirements. Economic development impact has included the high rate of student placement in paid internships and jobs, and employers who report that the CREATE program has allowed them to compete favorably on large contracts (Aerospace Dynamics, Inc.) and remain in California (Xircom) because of the trained technicians made available by the project. http://www.create-california.org/

Internship program in marine sciences for African-American teachers. The Dauphin Island Sea Laboratory (DISL) is operated by the Alabama Marine Environmental Sciences Consortium. The faculty studies a variety of problems in oceanography and marine biology, and they provide advice to industry, government, and the public. DISL serves Alabama's research and instructional needs in the marine sciences. Students at all educational levels, including K-12 pupils, undergraduate and graduate students, teachers-in-training, elder hostel participants, and the general public, benefit from the programs offered at DISL. DISL is an NSF-REU site, and the laboratory is developing a minority internship program in marine science, the first of its kind in Alabama. In addition, this year the lab has developed a program to bring in African American teachers as interns for the summer to learn the material presented in the Discovery Hall displays, assist in teaching at each grade level, assist in the field-based programs and be mentors for the young students. These opportunities go beyond traditional methods of teaching and curriculum enhancement and will blaze a trail for minority teachers in marine science.

K-12 Education: GLACIER. This project focused on the development of a website designed for the general public (http://www.glacier.rice.edu/) and on development of an inquiry-based, thematic curriculum that integrates into the traditional middle school earth, ocean and space science curriculum. GLACIER uses ongoing research in the Antarctica to deliver science content in the areas of geologic principles, glacial geology, geomorphology, geography, meteorology, oceanography and environmental science. Requisite mathematics and hands-on explorations are included. Students are assigned the role of scientist and connect to on-line databases and with Antarctic researchers to conduct their investigations. GLACIER integrates with, and replaces portions of, the traditional middle-school sciences curriculum. Collaborators include educators from Texas, Colorado, Massachusetts, and Maine, participants in Teachers Experiencing Antarctica (TEA), and researchers involved in the West Antarctic Ice Sheet Initiative and funded through OPP.

An Integrated Curriculum for Intelligent Microprocessor-Based Mechanical Systems. The University of Notre Dame is developing a new curriculum that combines traditional discipline elements and embedded computing in all forms of mechanical systems. These experiences will better prepare students to use the sensing, actuation and control technologies resulting in the explosive growth of intelligent mechanical systems. During the past year every freshman, sophomore and senior (about 200 students in the Aerospace and Mechanical engineering degree programs) have been involved with hands-on projects associated with intelligent, autonomous engineering systems. The project engages faculty from various mechanical engineering disciplines who have limited experience with these new technologies, develops infrastructure and facilities to support student learning activities, and collaborates with industry to integrate elements of intelligent, embedded computing systems across the curriculum. A new Intelligent Systems and Automation Learning Laboratory has been developed and 12 courses will be modified to demonstrate applications or develop techniques for smart mechanical systems. Applications include control of medical equipment, specialized intelligent toys, rocket telemetry, sampling the thermal distribution in a lake using a GPS guided autonomous boat and the design and fabrication of an automated floor cleaning apparatus.

Software Training for IT Instructors. In April 2002, the American Association of Community Colleges and the *National Workforce Center for Emerging Technologies*, an Advanced Technological Education (ATE) center of excellence at Bellevue Community College, launched a new effort to provide software training for information technology instructors at community and technical colleges across the country. During the summer of 2002, intensive week-long workshops were held in Washington and Texas, and sessions in ten more states will be added in 2003. The sponsors hope to bring similar training programs to all 50 states within the next five years. Instructors will be able to develop skills using Java, Linux, and network security software. The Microsoft Corporation has pledged $1.3 million, as well as software, to the project over the next two years. http://www.nwcet.org/

Number of People Involved in NSF Activities

Over 200,000 people are directly involved in NSF programs and activities, receiving salaries, stipends, or participant support. In addition, NSF programs indirectly impact many millions of people. These programs reach preK-12 students, preK-12 teachers, the general public and researchers through activities including workshops; informal science activities such as museums, television, videos, and journals; outreach efforts; and dissemination of improved curriculum and teaching methods.

Number of People Involved in NSF Activities.

	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate
Senior Researchers	28,960	29,820	30,590
Other Professionals	12,060	12,180	12,640
Postdoctoral Associates	5,740	6,060	6,170
Graduate Students	26,170	27,440	28,690
Undergraduate Students	34,250	32,710	36,350
K-12 Students	11,460	13,640	14,640
K-12 Teachers	84,710	85,460	86,830
Total Number of People [1]	203,350	207,310	215,910

[1] Does not include individuals to be funded through H-1B Nonimmigrant Petitioner Receipts.

Senior Researchers include scientists, mathematicians, engineers, and educators receiving funding through NSF awards. These include both researchers who are principal or co-principal investigators on research and education projects, and researchers working at NSF-supported centers and facilities.

Other Professionals are individuals who may or may not hold doctoral degrees or its equivalent, who are considered professionals, but are not reported as senior researchers, postdoctoral associates, or students. Examples are technicians, systems experts, etc.

Postdoctoral Associates are individuals who have received Ph.D., M.D., D.Sc., or equivalent degrees and who are not members of the faculty of the performing institution. Most of these postdoctoral associates are supported through funds included in research projects, centers or facilities awards. The balances are recipients of postdoctoral fellowships.

Graduate Students include students compensated from NSF grant funds. Some of these students receive support through programs such as the NSF Graduate Research Fellowships, Integrative Graduate Education and Research Traineeship Program (IGERT), and NSF Graduate Teaching Fellowships in K-12 Education. The balance assists senior researchers or postdoctoral associates in performing research, and are supported through funds included in research projects, centers, or facilities awards. NSF provides support for approximately five percent of the science and engineering graduate students in the U.S.

Undergraduate Students include students enrolled in technical colleges or baccalaureate programs compensated from NSF grant funds. They may either be assisting senior researchers or postdoctoral associates in performing research, or participating in NSF programs specifically aimed at undergraduate students, such as Research Experiences for Undergraduates and the Louis Stokes Alliances for Minority Participation.

K-12 Students are those attending elementary, middle, and secondary schools. They are supported through program components that directly engage students in science and mathematics experiences such as teacher and student development projects.

K-12 Teachers include teachers at elementary, middle, and secondary schools. These individuals actively participate in intensive professional development experiences in sciences and mathematics.

Ideas

Enabling "discovery across the frontier of science and engineering, connected to learning, innovation, and service to society."

In order to achieve NSF's mission, one of the agency's key strategies is to support the most promising ideas in research and education. The expected outcomes of these investments are a fundamental knowledge base that enhances progress in all areas of science and engineering and partnerships that connect discovery and learning to innovation and service to society.

NSF Funding for Ideas
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	Change Amount	Percent
Centers	356	372	411	39	10.6%
Other Ideas	2,081	2,187	2,285	97	4.4%
Ideas, Total	$2,436	$2,559	$2,696	$137	5.3%

FY 2004 support for Ideas totals $2.70 billion, an increase of $136.59 million, or 5.3 percent, above the FY 2003 estimate of $2.56 billion. This provides funding for research projects that support researchers and postdoctoral associates as well as undergraduate and graduate assistants. Funds are also provided for items necessary for performing research, such as instrumentation and supplies, and for related costs such as travel and conference support. Research in core disciplinary areas as well as studies within NSF's priority areas is included within funding for Ideas. Through outreach activities, NSF seeks out and supports excellent proposals from groups and regions that traditionally have not fully participated in science, mathematics, and engineering.

Support provided primarily to further NSF's other strategic outcomes, People and Tools, is essential for facilitating Ideas – *discovery across the frontier of science and engineering, connected to learning, innovation, and service to society*. NSF's investment in People promotes the integration of research and education and ensures that the U.S. has world-class scientists and engineers, a workforce that is scientifically and mathematically strong, and a public that understands and can take full advantage of basic concepts of science, mathematics, engineering and technology. Support for Tools provides access to state-of-the art facilities and platforms, which are essential for world-class research.

In FY 2004, NSF will continue its efforts to increase the average size of awards. This effort will contribute to increasing the efficiency of the Foundation's merit review process and achieve greater cost-effectiveness for both NSF and the university community, consistent with the findings of the recent survey of NSF-supported principal investigators and institutions. The average grant size and duration will increase to $128,000 per year for 3 years.

The FY 2004 Request focuses on areas that build strength in the science and engineering disciplines, enable the development of new and emerging fields, and provide leadership to improve the health and continued vitality of the nation's science, technology, engineering, and mathematics (STEM) research and education enterprise.

The following are areas of emphasis within NSF's core research programs that will be supported in FY 2004.

- The physical sciences produce advances and associated analytical tools that bring progress to a host of areas - from the magnetic resonance imaging techniques that are now central to medical imaging to the fiber optic networks that enable today's high-speed communications. With renewed support for research and infrastructure for fields such as physics, chemistry, mathematics, and materials research, the nation will be able to take full advantage of recent investments in the health sciences and will also reap benefits in areas such as energy, agriculture, and the environment.

- 21st Century Biology capitalizes on recent advances in genomics, proteomics, informatics, computer science, mathematics, physics, chemistry, engineering and the earth and social sciences. Its fundamental characteristics are that it is multidimensional, multidisciplinary, information-driven, education-oriented and internationally engaged. The emphasis in FY 2004 will be Living Networks. This activity focuses on integrating knowledge, especially that generated through genomics projects, to achieve an understanding of life from the level of atoms to entire ecosystems.

- CyberTrust Security focuses on research to understand and build systems that can be "trusted." Elements of "trust" include privacy (keeping unauthorized people out of systems), integrity (assuring that messages received or files read are not corrupted), authentication (techniques to know with whom you are communicating), and availability (making sure that systems are available to do the intended jobs and preventing denial of service attacks).

- Measurements of cosmic microwave background radiation will continue, including its polarization at South Pole Station, permitting unprecedented observations of the early structure/development of the universe and setting new parameters for cosmological theory.

- An increase in core funding for sensors will enhance health and environmental monitoring and the efficiency of industrial processes. It will also augment homeland security capabilities while creating a workforce knowledgeable in the operation and deployment of sensor technologies. Areas of emphasis include sensor technologies research related to nano/micro-scale sensors, wireless communications, functional materials with selective adsorption capabilities, nondestructive evaluation, and remote sensing.

- Enhanced core funding on environmental issues will lead to an increased knowledge base for protecting and restoring the environment and for reducing energy consumption. Areas of emphasis include fundamental research on environmental issues including environmentally benign manufacturing and production processes; waste reduction and recycling; increasingly efficient combustion processes; innovative approaches to controlling greenhouse gases; industrial ecology; and the integration of life-cycle product design methodologies with manufacturing enterprise systems and tools to assess, manage, and restore stressed environmental systems.

- Research on cognitive science, computational linguistics, and human origins, and on the science and technology of risk analysis and decision-making under uncertainty will be continued with a special focus on the problematics of climate change and extreme events and on the integration of economic, sociological, psychological and technical data.

- Increased attention for studies of abrupt and rapid climate change is anticipated through interdisciplinary studies of ocean circulation combined with those of paleoclimate records to document the frequency, temporal resolution, and spatial extent of past rapid climate change.

- Multidisciplinary studies of the processes that govern water quality and quantity, the character and dynamics of the Earth's surface, and the interactive processes at the intersection of the geosphere and biosphere will continue.

- The field of Quantum Science and Technology (QST) is emerging from discoveries at the interface between classical and quantum phenomena in physics, chemistry, materials research, engineering and computation. Quantum phenomena are key to understanding the origins of the universe, the nature of chemical bonding, phenomena in nanoscale materials, and relationships between physical forces. QST has the potential to shape all areas of science from the geophysical and biological sciences, to information technology and nanoscale science and engineering, which in turn will drive the future of computing and communications. The next five to ten years is likely to see the emergence of QST as a key to 21st century technology.

- Core research in the mathematical sciences involves the transfer of results and applications between mathematics, statistics, and the science and engineering disciplines; challenges the limits of current mathematical theories; and develops a new cadre of researchers who are trained in mathematics, as well as science and engineering.

- The Experimental Program to Stimulate Competitive Research (EPSCoR), a State-NSF partnership, will continue to support improvements in academic research competitiveness. In FY 2004, funding for EPSCoR through the Education and Human Resources Appropriation totals $75.0 million, equal to the level provided in the FY 2003 Request. Linkages between EPSCoR and other NSF-supported research activities are expected to invest an additional $30 million for projects in EPSCoR states.

- The Small Business Innovation Research (SBIR) program and the Small Business Technology Transfer (STTR) program are supported at mandated levels of at least 2.5 percent and 0.30 percent, respectively, of the agency's extramural research. SBIR will total $90.93 million, an increase of $11.95 million over the FY 2003 Request of $78.98 million, and STTR will total $10.22 million, an increase of $5.55 million over the FY 2003 Request of $4.67 million. Recent congressional action increased the mandated agency spending target for STTR from 0.15 percent to 0.30 percent of the agency's extramural research budget in FY 2004.

Also included within support for Ideas are funds for fundamental research within five of the Foundation's priority areas: Biocomplexity in the Environment, Information Technology Research, Nanoscale Science and Engineering, Mathematical Sciences, and Human and Social Dynamics.

Centers

NSF supports a variety of individual centers and centers programs that contribute to NSF's investment in Ideas. The centers play a key role in advancing science and engineering in the U.S., particularly through their encouragement of interdisciplinary research and the integration of research and education. While the programs are diverse, the centers generally share common commitments:

- To address scientific and engineering questions with a long-term, coordinated research effort by involving a number of scientists and engineers working together on fundamental research addressing the many facets of long-term complex problems;

- To include a strong educational component that fosters public understanding of science and provides research experiences for teachers as well as establishes a team-based cross-disciplinary research and education culture to educate the nation's next generation of scientists and engineers to be leaders in academe, industry and government; and

- To develop partnerships with industry that bring fundamental advances to bear on national priorities and directly connects academic research and advanced education with the industrial innovation process.

The center programs, which contribute to the Ideas goal, are listed below.

NSF Centers Programs
(Dollars in Millions)

	Program Initiation (year)	FY 2002 # of Centers	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate
Center for Ecological Analysis and Synthesis	1995	1	$3	$3	$3
Centers of Research Excellence in Science and Technology	1987	11	$9	$9	$11
Chemistry Centers	1998	21	$14	$10	$20
Earthquake Engineering Research Centers	1988	3	$6	$6	$6
Engineering Research Centers and Groups[1]	1985	32	$61	$56	$60
Industry/University Cooperative Research Centers	1973	46	$5	$5	$5
State/Industry/University Cooperative Research Centers	1991	3	$0	$1	N/A
Information Technology Centers	2000	66	$73	$70	$74
Long-Term Ecological Research Program	1980	24	$19	$19	$19
Materials Centers	1994	29	$53	$53	$57
Mathematical Sciences Research Institutes	1982	6	$10	$14	$15
Nanoscale Science and Engineering Centers	2001	6	$11	$12	$19
Physics Frontiers Centers	2003	5	$10	$13	$13
Plant Genome Virtual Centers	1998	23	$32	$31	$32
Science and Technology Centers	1987	11	$44	$45	$45
Science of Learning Centers	2003	N/A	N/A	$20	$20
SBE Centers[2]	N/A	7	$6	$5	$13
TOTAL		294	$356	$372	$411

Totals may not add due to rounding.
[1] Funding for Nanoscale Science and Engineering Centers was previously reported in Engineering Research Centers & Groups.
[2] SBE Centers include the National Consortium on Violence Research, the Children's Research Initiative Centers, the Environmental Social and Behavioral Science Centers, the Climate Change Research Initiative Centers, and the Research Centers on the Human Dimensions of Global Change.

Additional information for selected centers supported by NSF is provided below:

FY 2002 Estimates for Selected Centers
(Dollars in Millions)

	Number of Participating Institutions	Number of Partners	Total NSF Support	Total Leveraged Support	Number of Participants
Centers of Research Excellence in Science and Technology	62	44	$9	$9	2,900
Chemistry Centers	45	29	$14	$1	610
Earthquake Engineering Research Centers	71	55	$6	$14	648
Engineering Research Centers	383	522	$61	$86	3,622
Industry/University Cooperative Research Centers and State/Industry/University Cooperative Research Centers	85	603	$6	$62	1,374
Long Term Ecological Research Program	178	117	$19	$45	2,578
Materials Centers	79	315	$53	$71	4,931
Plant Genome Virtual Centers	62	9	$32	$6	2,160
Physics Frontiers Centers	8	7	$10	$2	244
Science and Technology Centers	100	211	$44	$23	2,140

Number of Participating Institutions: all academic institutions which participate in activities at the centers.
Number of Partners: the total number of non-academic participants, including industry, states, and other federal agencies at the centers.
Total Leveraged Support: funding for centers from sources other than NSF.
Number of Participants: the total number of people who utilize center facilities, not just persons directly supported by NSF.

Description of NSF Centers

Center For Ecological Analysis and Synthesis

The Center for Ecological Analysis and Synthesis (CEAS) at the University of California at Santa Barbara promotes integrative studies of complex ecological questions and serves as a locus for the synthesis of large data sets. The goals of the center are to advance the state of ecological knowledge through the search for universal patterns and principles and to organize and synthesize ecological information so that it will be useful to researchers, policy makers and resource managers addressing important environmental issues. The center was considered for renewal in FY 2000 and received an award for 6 years of additional funding. NSF's FY 2004 support for the CEAS program is $3.15 million.

Centers of Research Excellence in Science and Technology

The Centers of Research Excellence in Science and Technology (CREST) program upgrades the research capabilities of the most productive minority institutions. Through strong alliances with other universities and laboratories, the centers produce new knowledge and provide students with direct experience in science, technology, engineering, and mathematics. NSF will provide $10.88 million for CREST in FY 2004, an increase of $2.0 million (22.5 percent) over the FY 2003 Request of $8.88 million. This funding level will support 11 Centers in FY 2004.

Chemistry Centers

Chemistry Centers include the Environmental Molecular Science Institutes (EMSIs), the Collaborative Research Activities in Environmental Molecular Science (CRAEMS), Collaborative Research in Chemistry (CRC), and the Laboratory for Molecular Sciences (LMS). In addition, new centers, Chemical Bonding Centers (CBCs), will be launched to attack grand challenges in our understanding of the nature of the chemical bond. Chemistry Centers support a wide range of activities, from developing a molecular understanding of the environment to investigation of fundamental steps in chemical reactions. In FY 2004, NSF will provide $19.70 million, an increase of $9.31 million (89.6 percent) over the FY 2003 Request of $10.39 million, to support 12 new centers, bringing the total to 32 centers.

Children's Research Initiative Centers

The Children's Research Initiative (CRI) supports a variety of research activities, including small research centers, individual investigator awards, collaborative proposals, and workshops. Together, the research centers represent a new thrust in the field of integrative developmental science; individually, they support leading-edge research about children and media, developmental science, and the integration and dissemination of developmental science to inform both research and policy. Centers are located at the University of North Carolina, Cornell University, and New York University. A fourth center is a collaboration among four universities: Georgetown University, Northwestern University, University of Texas-Austin, and University of California-Los Angeles. In FY 2004, additional centers will be established, and support for the CRI centers will amount to $4.0 million of the $5.0 million total requested for the Children's Research Initiative.

Climate Change Research Initiative Centers

Three to five centers will be supported focusing on Risk Analysis and Decision Making in relation to global climate change as part of the government-wide Climate Change Research Initiative. The FY 2004 investment in these centers is estimated to total $4.50 million, with the expectation that continuing support at this level will be provided annually for three additional years. The centers will involve interdisciplinary teams that will push the frontiers of research on risk analysis and decision making to enhance our nation's capacity to evaluate the risks associated with climate change and to develop policies and decisions based on realistic appraisals of risks.

Earthquake Engineering Research Centers

The three Earthquake Engineering Research Centers (EERCs) focus on reducing earthquake losses, integrating research and education, and developing partnerships with industry and the public agencies responsible for earthquake hazard mitigation at the local, state and federal levels.

The EERCs link geological information about the nature of earthquake hazards in different regions of the country with geotechnical and structural engineering knowledge to provide state-of-the-art structural design methodologies. They provide the knowledge and technology base for industry and public agencies to build and retrofit buildings, bridges, and other infrastructure to better withstand the impacts of earthquakes. Because these centers involve partnerships among social scientists and engineers, they are developing a new generation of decision tools to improve public service agencies' planning for earthquake hazard mitigation and their responses during earthquake emergencies.

EERCs are rapidly becoming major contributors in the field both in the U.S. and internationally. In FY 2002, NSF provided nearly $6.0 million to three EERCs, which leveraged this support with $14 million from universities, three states, and industry. FY 2004 support is maintained at the FY 2003 Request level of $5.99 million.

Engineering Research Centers

The Engineering Research Centers (ERC) program stands as a landmark in federal support for university research and education in partnership with industry. These centers provide an environment where academe and industry can focus together on advances in the complex engineered systems that transform industrial processing systems and product lines most important for the Nation's future. ERCs bring diverse engineering and scientific disciplines together to address fundamental research issues at the interface between the discovery-driven culture of science and the innovation-driven culture of engineering. They provide the intellectual foundation for industry collaboration with faculty and students to resolve generic, long-range challenges, producing the knowledge needed to ensure steady advances in technology, speed their transition to the marketplace, and train graduates who are effective in applying them in industry.

ERCs are also devoted to the integration of research and education by creating team environments for learning and research and producing curricula and course materials for bioengineering, multimedia information systems, manufacturing, electronic packaging, and particle science and technology, among others. In addition, all ERCs have active programs to stimulate interest in engineering with pre-college students and their teachers and several have sites at local museums to educate the general public about engineering and technology.

An additional $86 million in support from industry, other federal agencies, universities, and ten states leveraged NSF support of $60.71 million in FY 2002. There were 383 non-industry organizations from the U.S. and abroad and 522 firms involved in partnerships and collaborations in research and education in these centers. In FY 2004, NSF will provide a total of $60.22 million, an increase of $4.0 million (7.1%) over the FY 2003 Request. This funding supports 16 ongoing ERCs across a broad range of technologies.

Environmental Social and Behavioral Science Centers

From FY 1995 though FY 2003, NSF supported a consortium of Research Centers on the Human Dimensions of Global Change. Following a new competition, NSF intends to continue providing support for centers that advance fundamental knowledge about environmental social and behavioral science, promote education and training at levels ranging from undergraduate to postdoctoral; and foster interdisciplinary and multidisciplinary research collaborations. NSF's FY 2004 support for two or three new Environmental Social and Behavioral Science Centers is expected to total $3.50 million, a $1.20 million increase (52.2 percent) from the level of $2.30 million that supported the HDGC Centers in FY 2003 during their final year of funding.

Industry/University Cooperative Research Centers and State/Industry/University Cooperative Research Centers

Industry depends on the Industry/University Cooperative Research Centers (I/UCRCs) and State I/UCRCs to provide a steady stream of enabling technologies critical to advancing their manufacturing processes, information technology support systems, and new product lines. In FY 2002, there were 49 of these highly leveraged centers, representing a total NSF investment of about $5.83 million. NSF's investment generated $62 million in leveraged support and substantial "in-kind" contributions for the centers. Another indication of high payoff from the supporters of the I/UCRCs is that they have invested over $160 million per year to fund follow-up internal research and implementation activities in their organizations as a result of the centers' research results.

In FY 2004, NSF will provide $5.18 million for I/UCRCs, a decrease of $110,000 from the FY 2003 Request of $5.29 million. The Industry/University Cooperative Research Centers program will support 46 I/UCRCs.

Information Technology Centers

As part of the Information Technology Research (ITR) program begun in FY 2000, NSF began support for 33 new center projects. These focus on major challenges for information technology research and often address interdisciplinary themes. In FY 2001, the number of center projects doubled. In support of their long-term mission, some centers will develop testbeds and include education and outreach components. Other centers are virtual centers that link, by high-performance networks, geographically separate investigators with individualized expertise or instrumentation. Some of these virtual centers will foster research on distributed computing and applications. In FY 2004, NSF will fund approximately 73 Information Technology Research Centers at the level of $74.0 million, an increase of $4.0 million (5.7 percent) over the FY 2003 Request of $70.0 million for enhancements to existing centers.

Long Term Ecological Research Program

The Long Term Ecological Research (LTER) program supports long-term analysis of ecological phenomena, both natural and human influenced; comparisons of observations across diverse ecosystems; integration of information from multiple sites and multidisciplinary projects through cross-site syntheses; and provision of large, secure, ecologically diverse sites with well-developed support capabilities. Extensive computer networking allows regional, national and international synthesis efforts.

In FY 2003 NSF is supporting 24 LTER sites that are representative of major ecosystems, including two sites in Antarctica and two in Alaska, one in Arctic Alaska. The LTER program has taken the lead in establishing a worldwide ecological research network by electronically linking the U.S. LTER network with research sites in Europe, Latin America, and the Asia/Pacific region.

NSF's FY 2004 support for the LTER program is $19.02 million, an increase of $350,000 (1.9 percent) over the FY 2003 Request of $18.67 million.

Materials Centers

Materials Centers support interdisciplinary materials research addressing fundamental problems of intellectual and strategic importance. They include Materials Research Science and Engineering Centers (MRSECs) and beginning in FY 2003 will also include International Materials Institutes (IMIs) and Partnerships for Research and Education in Materials (PREMs). The MRSECs have strong links to industry and other sectors; MRSECs, IMIs and PREMs all support research and educational partnerships with other institutions.

MRSECs include broad-based centers with diverse research agendas as well as more focused centers. The MRSECs feature cutting-edge materials research in areas such as polymers, biomimetic and biomolecular materials, nanoscale materials, electronic and photonic materials, and superconducting and superhard materials. Annual NSF support for individual centers ranges from less than $1.0 million to more than $4.0 million. Additional support from non-NSF sources for these centers totaled $71 million in FY 2002. Approximately 27 MRSECs will be supported in FY 2004 at a total of $48.96 million.

IMIs focus specifically on stimulating and supporting cooperative activities in various areas of materials research and education between U.S. investigators and their colleagues worldwide. Three new IMIs are proposed in FY 2003, increasing to five or six in FY 2004 for a total of $3.60 million.

In FY 2004, up to eight Partnerships for Research and Education in Materials (formerly Collaboratives for Materials Research and Education in the FY 2003 Request) will be supported at $4.0 million. PREMs will link minority-serving institutions with focused research groups, centers, and user facilities in materials research and support collaborations between them.

NSF's FY 2004 support for the Materials Centers is $56.56 million, an increase of $3.80 million (7.2 percent) over the FY 2003 Request level of $52.76 million.

Mathematical Sciences Research Institutes

The institutes provide a national resource for in-depth research in the mathematical sciences and for multidisciplinary research between mathematical scientists and other scientists and engineers from academia, industry, and government laboratories. Significant postdoctoral experiences are nurtured through mentoring with world-class mathematical scientists and through opportunities with partner universities, industries, and government laboratories. In FY 2004, NSF will provide $15.0 million, an increase of $1.0 million (7.1 percent) over the FY 2003 Request of $14.0 million.

Nanoscale Science and Engineering Centers

As part of the multiagency National Nanotechnology Initiative, NSF funded six centers in FY 2001 and two new centers focused on manufacturing at the nanoscale are proposed in FY 2003. Research at the nanoscale aims to advance the development of the ultra-small technology that will transform electronics, materials, medicine, environmental science and many other fields. Each center has a long-term vision for research, and together they will provide coherence and a long-term outlook to U.S. nanotechnology research and education. Support will be provided for education and outreach programs from the graduate to the K-12 level designed to develop a highly skilled workforce, advance pre-college training, and advance the public understanding of nanoscale science and engineering. The centers have strong partnerships with industry, national laboratories and international centers of excellence. In FY 2004, NSF will provide continuing support to the eight centers at $18.91 million, an increase of $6.50 million (52.4 percent) over the FY 2003 Request of $12.41 million.

National Consortium on Violence Research

NSF supports the National Consortium on Violence Research (NCOVR), which is engaged in a program of capacity building in the violence research community. The Consortium's activities focus on training the next generation of researchers in interdisciplinary approaches to understanding interpersonal violence and to increase the participation of underrepresented groups in research on violence. NCOVR also seeks to facilitate collaborative methodological research and the promotion of intellectual exchange that cuts across disciplines. Support for FY 2004 will be maintained at the FY 2003 Request of $1.0 million.

Physics Frontiers Centers

The Physics Frontiers Centers program was initiated in FY 2001. These centers provide critical resources and needed infrastructure to exceptionally promising new areas of physics. They serve as focal points to help catalyze new fields, with the resources and infrastructure to enable development of the new tools and techniques needed, and facilitate exploration of new directions in a way that is not practical in individual investigator awards. Areas such as atom lasers, quantum information science, computational physics, biological physics, and astrophysics are particularly promising for such an investment. Interdisciplinary research will be a key element of this program, and each center will have a significant outreach and infrastructure component. In FY 2004, NSF will provide a total of $13.0 million, equal to the FY 2003 Request, for support of five centers.

Plant Genome Virtual Centers

The Plant Genome Research subactivity supported twenty-three Plant Genome Collaboratories or Plant Genome Virtual Centers in FY 2003. These are multi-institutional networks where coordinated, multi-disciplinary teams pursue comprehensive, interdisciplinary research on the structure, organization and function of plant genomes relevant to economically important plants or plant processes. NSF support for Plant Genome Virtual Centers in FY 2004 will total $31.70 million, an increase of $700,000 (2.3 percent) over the FY 2003 Request of $31.0 million.

Of 23 centers supported in FY 2002, 21 are continuations or renewals of virtual centers created in previous years; 2 are newly established centers. The 23 centers involve 191 scientists as key personnel with a large number of postdoctoral fellows, graduate students, undergraduate students, technical personnel, and others involved. Key participants are located at 62 institutions in 29 States. International collaborators are involved in a number of areas of center research including the potato, wheat, and model legume projects.

Research Centers on the Human Dimensions of Global Change

NSF has supported a consortium of Research Centers on the Human Dimensions of Global Change since FY 1995. The goals of these centers are to facilitate the progress of Human Dimensions of Global Change (HDGC) research; promote the education and training of researchers ranging from undergraduate to postdoctoral levels; and foster interdisciplinary and multidisciplinary research collaborations on HDGC issues. FY 2003 is the final year of support for the two HDGC centers.

Science and Technology Centers

The Science and Technology Centers (STC) Integrative Partnerships Program supports innovation in the integrated conduct of research, education, and knowledge transfer in fields of basic science, mathematics, and engineering. STCs foster partnerships that build a new collaborative culture among researchers and educators at all levels in academia, industry, government laboratories, and other public and private organizations. The Centers provide opportunities to explore challenging and complex research problems that often require interdisciplinary expertise and high-risk approaches, access to state-of-the-art instrumentation and facilities, and a commitment of high levels of support for sustained periods of time. It is estimated that STC funding from other sources totaled approximately $23 million in FY 2002.

STCs have an impressive record of research accomplishments, research training, contributions to K-12 education, and timely transfer of knowledge and technology from the laboratory to industry and other sectors. Traditional barriers among disciplines and among university, governmental, and industrial laboratories have been reduced, creating a new mode of leadership and management in research and education. STCs have engaged the nation's intellectual talent, robustly drawn from its full human diversity, in the conduct of research and education activities; enabled the training of undergraduate students, graduate students, and postdoctoral fellows; involved scores of industrial researchers in basic research; and spawned new companies, products, and jobs.

STCs also create partnerships and programs that transfer knowledge in service to society with respect to new research areas, promising new instrumentation, and potential new technologies. NSF's FY 2004 support for the STC program is $44.91 million, a decrease of $190,000, from the FY 2003 Request of $45.10 million.

Science of Learning Centers

NSF's investment in Science of Learning Centers (SLC), proposed to begin in FY 2003, will build on the Foundation's support for learning research in multiple disciplines including biology, psychology, education, neuroscience, cognitive science, linguistics, computer and information science, robotics, mathematics and statistics, engineering, the physical sciences, and the social and behavioral sciences. SLCs will be organized around an integrated, unifying, multidisciplinary research focus or one that significantly advances disciplinary frontiers and be connected to educational, scientific, technological, and/or workforce challenges; consist of diverse teams at all organizational levels of the center; and establish partnerships with schools, industry, international collaborators, professional societies and/or other appropriate partners.

SLCs must demonstrate an effective implementation strategy that will achieve all three of the SLC principal goals: (1) advancing the understanding of learning, through research on the learning process, the context of learning, and/or learning technologies; (2) strengthening the connections between science of learning research and educational and workforce development, in a manner that mutually advances both; and (3) building effective collaborative research communities with sufficient resources and organizational capacity to respond to new educational and workforce challenges, and capitalize on new research opportunities and discoveries. FY 2004 support for the SLCs totals $20.0 million, equal to the FY 2003 Request.

FY 2004 GPRA PERFORMANCE GOAL FOR IDEAS

The following table summarizes NSF's FY 2004 Performance Goal for IDEAS. For additional information, see the FY 2004 Performance Plan.

STRATEGIC OUTCOME GOAL	NO. ANNUAL PERFORMANCE GOAL[A]	FY 2004 AREAS OF EMPHASIS PROSPECTIVE REPORTING: INVESTMENTS IN EMERGING OPPORTUNITIES	RETROSPECTIVE REPORTING, AS RELEVANT:
IDEAS **Enabling "discovery across the frontier of science and engineering, connected to learning, innovation, and service to society."**	**III-2** ***NSF's performance for the Ideas Strategic Outcome is successful when, in the aggregate, results reported in the period demonstrate significant achievement in the majority of the following indicators:*** • Discoveries that expand the frontiers of science, engineering, or technology; • Connections between discoveries and their use in service to society; • Partnerships that enable the flow of ideas among the academic, public or private sectors; and • Leadership in fostering newly developing or emerging areas.	❑ Priority areas: - Biocomplexity in the Environment - Information Technology Research - Nanoscale Science and Engineering - Mathematical Sciences - Human and Social Dynamics ❑ Core research and education activities ❑ Science of Learning Centers	❑ Balance of portfolio, including projects that are innovative, high-risk, or multidisciplinary ❑ Priority Areas: e.g., <u>Current</u> - Biocomplexity in the Environment - Information Technology Research - Nanoscale Science and Engineering <u>Former</u> - Life and Earth's Environment - Information Technology for the 21st Century - Knowledge and Distributed Intelligence ❑ Core research and education activities ❑ Centers, e.g., - STCs, ERCs, MRSECs. ❑ EPSCoR

[A] This performance goal is stated in the alternate form provided for in GPRA legislation.

Highlights of Recent Accomplishments (Ideas)

NSF investments in fundamental research provide support for cutting-edge research and education in many fields and help to maintain the nation's capacity to conduct research in science and engineering. Selected examples of accomplishments of NSF-supported investments are described below.

Uranium-eating bacterium's surprising survival tactics. Genomic information enabled the discovery of how *Geobacter metallireducens*, a common soil bacteria that consumes metals - specifically, iron and manganese oxides and which was previously believed to be incapable of movement, is able to locate and home in on metals if a source of iron or manganese is not nearby. As *Geobacter's* genome was sequenced, it revealed evidence of genes for flagella, the whip-like structures that enable bacteria to move, and genes for sensing chemicals in the environment. Experiments confirmed that *Geobacter* could sense chemicals and produce flagella. The results are significant since motile *Geobacter* can be used to clean up petroleum spills, and may offer a more efficient and economic method for removing uranium from contaminated groundwater than the current practice of pumping water out of an area and removing the soil. *Geobacter* transforms uranium from a soluble form to an insoluble form, which doesn't readily leach into the groundwater and contaminate rivers.

Self-tightening bolts. At a laboratory at the Virginia Polytechnic Institute and State University, when bolts and screws are used, NSF-supported researchers also use sensors and washers made of the "smart" materials known as piezoelectric, or PZT, patches and shape memory alloys (SMAs) respectively. The former provide an electrical signal used for continuous monitoring of the mechanical load or torque on the bolt or screw, and when something changes, for example in response to vibrations, extreme loads, or perhaps something as simple as temperature induced changes that allow the nut to loosen, the SMA washer changes it shape to "take up the slack" and restore the tightness of the bolt to its design load.

Superconductivity. Conventional superconductivity in materials like lead and tin results from interaction of electrons with lattice vibrations (phonons). NSF-supported researchers have now used the facilities of the National High Magnetic Field Laboratory to show that superconductivity can also result from the existence of charge density waves in an organic material at low temperatures. This kind of superconductivity was first predicted to be possible in 1954. Such superconductivity had never been seen before. The sample had to be cooled to within one degree of absolute zero in a magnetic field five hundred thousand times as strong as the Earth's field.

Composite bone materials. An NSF project has developed a nanoscale self-assembly technique to create composite materials very similar to bone tissue. Specifically, new polymeric molecules that self-assembled on their own to form cylindrical nano-sized fibers. These fibers direct the growth of reinforcing minerals such as hydroxyapatite into an alignment that is very similar to that in natural bone. This new technique holds promise not only for development of artificial bone, but also for repairing nerve fibers, creating nano-electronic wires, or preparing high-strength polymeric composites. This result was published in *Science* and elicited major coverage in *Chemical and Engineering News* and other publications.

Discovery of largest asteroid in solar system. The largest asteroid in the solar system, orbiting far from the sun (a Kuiper Belt Object), even larger than Pluto's moon, Charon, was discovered with the Cerro Tololo Inter-American Observatory 4-meter telescope in Chile. This discovery, by astronomers visiting from Lowell Observatory, arose from collaboration with NASA to characterize these outermost objects with the objective of gaining fundamental information on the formation of the solar system.

Early history of whales. Three articles published in *Science* and *Nature* this year by two groups of scientists point out great advances being made in understanding the early history of cetaceans (whales).

Both groups arrive independently at the same startling conclusions about the early evolution of whales based on new fossil finds in Pakistan. Whales evolved approximately 50 million years ago from land-based even-toed ungulates (hoofed animals) rather than mesonychians (an extinct group of carnivorous ungulates) as has been traditionally believed. These fox- and wolf-sized four-footed ungulates were surface paddlers in the shallow seas of Eocene time and evolved into modern whales.

Opening of the Bering Strait. A U.S.-Russia collaborative research project determined the date of the Bering Strait's opening by studying *Astarte* clams found in southern Alaska. The results indicate that the Strait opened about 2 million years earlier than previously thought. The revised opening date will allow researchers to more accurately document ancient climates.

Molecular electronics. Molecular electronics is based on the notion that the molecular organization of matter can result in very different electronic properties than are seen in more traditional semiconductor structures. The critical issue has to do with how charge is shared between molecules (discrete nano-scale structures) and electrodes (continuous metals). The most general picture for how these things work focuses on the interface, and on transport at that interface. In this area, an NSF-supported group at Northwestern University has developed robust general theoretical methodologies for *designing* interfaces that would be most effective in producing charge flow in molecular nanostructures.

Adaptive optics. NSF began support of adaptive optics over 15 years ago. Today, adaptive optics is maturing into a very powerful tool for high spatial resolution imaging. A few years ago, astronomical adaptive optics were limited to correcting for atmospheric turbulence over a small area of about 6 arc-seconds and required that a bright star be in the field. Today astronomers have learned how to create an artificial star in the sky using lasers, and have learned enough about the dynamics of the turbulent atmosphere to measure and forecast correction over arc-minutes field of view for telescopes in the 10 to 20 meter size category.

Effects of increased atmospheric carbon dioxide. An NSF-supported project has discovered that rising levels of atmospheric carbon dioxide associated with global warming can interfere with plants' ability to incorporate certain forms of nitrogen. Nitrogen is an element that is key to producing proteins and nucleic acids such as DNA in plants. The researchers found that nitrate fertilizer is not nearly as efficient as ammonium fertilizer when atmospheric carbon dioxide levels are unusually high. This study suggests that a shift to increase ammonium availability might be needed in the coming years as atmospheric CO_2 levels increase.

Hidden damage to buildings from earthquakes. Earthquakes cause buildings and bridges to collapse and highways to crack, but much of their most severe damage does not meet the eye. University of Southern California researchers at the Multidisciplinary Center for Earthquake Engineering Research (headquartered at The University at Buffalo) have been seeking ways to make public utility systems more resilient in the face of earthquakes. The researchers, including geotechnical, structural, risk and electrical engineers and economists from multiple institutions and municipalities, identify elements that are at risk, evaluate the geotechnical causes of damage, and estimate potential losses due to continuing service outages. The system allows municipalities to anticipate areas of greatest damage, strengthen those vulnerable areas with preemptive repairs, develop better emergency plans, and respond faster in the event of an earthquake.

Detection of polarization in the cosmic microwave background. Scientists at the South Pole using the Degree Angular Scale Interferometer measured a minute polarization of the cosmic microwave background (CMB), the sky-pervading afterglow of the Big Bang. The polarization of the CMB was produced by the scattering of cosmic light when it last interacted with matter, nearly 14 billion years ago. The discovery verifies the framework that supports modern cosmological theory and indicates that ordinary matter – humans, stars and galaxies – accounts for less than 5 percent of the universe's total mass and energy. The vast majority of the universe is made of a mysterious force that astronomers call "dark energy" which is as-yet undiscovered forms and objects.

Thin-film material may have important applications in drug synthesis. An NSF-supported team has developed a thin-film material with nanometer-sized cavities that serves as a molecular gatekeeper. The material can be manipulated to allow the passage of certain molecules but not others depending on size, shape and other properties. The scientists have also found a means of chemically transforming molecules within these cavities. The tiny cavities of the array serve as a filter, but in solution the cavities can also be used to encapsulate catalysts that chemically transform molecules. The next step is to combine the filtration and catalytic steps. This would allow conversion of plentiful low-cost hydrocarbon molecules into valuable complex molecules with potential applications such as selective drug delivery, synthesis of specialty chemicals or new types of semiconductors.

A new route for polymer synthesis. Kris Matyjaszewski received this year's American Chemical Society (ACS) Polymer Chemistry Award for his innovations through development of the new technique of Atom Transfer Radical Polymerization (ATRP). This new synthetic tool has found very widespread application all over the world and is considered the most robust method for creating many polymeric materials. This work has created a market in polymer synthesis that is expected to exceed $20 billion per year. His technique is now used by dozens of laboratories around the world.

Underwater gliders for 4-D measurement of bio-optical and chemical parameters. Scientists from the University of Maine and the University of Washington, in partnership with industry, have been developing new and advanced autonomous underwater vehicles (gliders) and biological sensors. Recent advances in sensor development will provide unprecedented views of the biology of the ocean, specifically phytoplankton, both in time and in space. NSF and the National Oceanographic Partnership Program currently support these efforts. The work with gliders is revolutionizing the way that measurements are being made in the coastal and open ocean waters and provide oceanographers with a 4-dimensional view of the ocean,

Advanced numerical hurricane model. An NSF-supported scientist, in collaboration with the National Oceanic and Atmospheric Administration, has developed an advanced numerical hurricane model. In addition to providing better understanding of ocean/atmosphere interactions, the numerical model developed has demonstrated significant improvement in storm intensity prediction compared to the previous operational (uncoupled) numerical model. The new system has been run in parallel with the prior model and the ocean coupling has improved hurricane intensity forecasts by about 25 percent. The National Weather Service has adopted the model developed under this award as their new operational model.

Supercritical carbon dioxide process – partnership with DuPont Teflon. DuPont Fluoroproducts has introduced the first commercial DuPont Teflon® fluoropolymer resins made using proprietary and fundamentally new manufacturing technology that replaces traditional water-based polymerization with a process based on supercritical carbon dioxide. According to DuPont, the new technology produces Teflon® with enhanced performance and processing capabilities, while generating less waste. The new products are being manufactured at the company's Fayetteville, N.C., plant in a new $40 million facility that started up in late 2000. The new technology was developed jointly by DuPont and scientists at the University of North Carolina, Chapel Hill. The fundamental chemical processes in supercritical carbon dioxide that form the basis of this new technology were developed with NSF support.

International long-term ecological research. South Africa has recently joined the ILTER Network by establishing a site in Kruger National Park. ILTER sites enable researchers to study an area's unique attributes and to use long-term data to address new ecological challenges. The severe southern African floods in early 2000 caused widespread changes in the riverine forest vegetation and soils in Kruger Park. U.S. scientists are working with South Africans to study how the long-term recovery of these systems is influenced by large browsing animals such as elephants and by exotic invasive plants. Such long-term data may shape conservation policies for the growing elephant populations in southern Africa and provide insights to researchers and land managers who must deal with increasing numbers of invasive species.

Experimental Program to Stimulate Competitive Research (*EPSCoR*) program. Researchers in Kansas are considering critical questions in Homeland Security and attempting to mitigate future bioterrorism and biological hazards through the *Kansas Program for Complex Fluid Flow*. A dozen scientists at Kansas State University, the University of Kansas, and Wichita State University are gaining a better understanding of how air moves through a confined space occupied by people, such as a room or an aircraft cabin, and how particles or contaminants may be transported through the area and around objects.

Tools

Providing "broadly accessible, state-of-the-art and shared research and education tools."

In pursuit of its mission to provide a widely accessible, state-of-the-art science and engineering infrastructure, NSF invests in Tools. NSF provides support for large, multi-user facilities, which allow researchers access to essential facilities. Support for these unique national facilities is necessary to advance U.S. capabilities required for world-class research. NSF investments in Tools also include support for Internet-based and distributed user facilities, advanced computer resources, research networks, major research instrumentation, research resources, digital libraries, and large databases, all of which contribute to a state-of-the-art science and engineering infrastructure resource. Facilities and other tools supported are shown below:

Tools Funding
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	Change Amount	Change Percent
Facilities					
Academic Research Fleet	61.90	62.00	65.00	3.00	4.8%
Antarctic Facilities and Operations	123.38	128.70	144.29	15.59	12.1%
Cornell Electron Storage Ring	19.49	19.49	21.00	1.51	7.7%
Gemini	12.50	12.60	14.20	1.60	12.7%
Incorporated Research Institutions for Seismology	12.93	13.10	14.10	1.00	7.6%
Laser Interferometer Gravitational Wave Observatory	24.00	29.50	29.00	-0.50	-1.7%
Major Research Equipment & Facilities Construction[1]	122.41	136.28	226.33	90.05	66.1%
National Astronomy Facilities	88.36	84.33	93.43	9.10	10.8%
National Center for Atmospheric Research	77.59	74.87	80.09	5.22	7.0%
National High Magnetic Field Laboratory	24.97	24.00	24.50	0.50	2.1%
National Superconducting Cyclotron Laboratory	14.81	14.70	15.20	0.50	3.4%
Ocean Drilling Program/Integrated Ocean Drilling Program	31.50	30.00	15.40	-14.60	-48.7%
Partnerships for Advanced Computational Infrastructure	75.27	71.49	76.49	5.00	7.0%
Other Facilities[2]	42.43	63.54	87.29	23.75	37.4%
Other Tools					
Advanced Networking Infrastructure	47.60	46.62	46.42	-0.20	-0.4%
Cyberinfrastructure	0.00	0.00	20.00	20.00	N/A
Major Research Instrumentation	75.89	54.00	90.00	36.00	66.7%
National High Field Mass Spectrometry Facility[3]	1.06	0.99	0.00	-0.99	-100.0%
National STEM Digital Library	27.07	27.50	23.80	-3.70	-13.5%
Polar Logistics	97.85	94.07	97.07	3.00	3.2%
Research Resources	111.23	106.36	128.85	22.49	21.1%
Science Resource Statistics	16.18	23.36	24.47	1.11	4.8%
Science and Technology Policy Institute	3.99	4.00	4.00	0.00	0.0%
Total, Tools Support	**$1,112.41**	**$1,121.50**	**$1,340.93**	**$219.43**	**19.6%**

[1]Funding levels for MREFC projects in this table include initial support for operations and maintenance funded through R&RA as well as construction, acquisition and commissioning costs funded through MREFC.
[2]Other Facilities includes support for the National Nanofabrication Users Network through FY 2003, the National Nanotechnology Infrastructure Network in FY 2004, and other physics, materials research, ocean sciences, atmospheric sciences, and earth sciences facilities.
[3]Support for the National High Field Mass Spectrometry Facility will be integrated into the National High Magnetic Field Laboratory in FY 2004.

The FY 2004 Request for Tools totals $1,340.93 million, a $219.43 million increase from the FY 2003 Request of $1,121.50 million. Operations and maintenance of multi-user facilities and research resources are funded through the Research and Related Activities (R&RA) and the Education and Human Resources (EHR) Accounts; major construction projects are funded through the Major Research Equipment and Facilities Construction (MREFC) Account.

To describe the life-cycle of a facility, the Foundation has adopted a set of distinct stages in its recently completed Facilities Management and Oversight Guide, found at http://www.nsf.gov/bfa/lfp/start.htm. These stages are: 1) Concept/Development – The phase during which the idea of a facility is articulated and project planning and design begins and is completed; 2) Implementation – This stage includes construction and/or acquisition, system integration, commissioning, testing, acceptance, transition to operations, and management of these efforts; 3) Operations and Maintenance – This stage includes the day-to-day work required to support and conduct research and education activities, to ensure that the facility is operating efficiently and cost-effectively, and to provide small- and intermediate-scale technical enhancements when needed to maintain state-of-the-art research capabilities; and 4) Renewal or Termination – Decisions regarding continued support of a facility are made. During this stage the information learned during the Operations and Maintenance stage and through various reviews of the results of research and education activities and facility management is used to determine whether the facility will be renewed, upgraded, re-competed or terminated.

MAJOR MULTI-USER RESEARCH FACILITIES

Academic Research Fleet

Project Description: The Academic Research Fleet consists of 27 vessels in the University-National Oceanographic Laboratory System (UNOLS). These vessels range in size, endurance, and capabilities, providing NSF and other federally-funded scientists with a diverse fleet capable of operating in coastal and open ocean waters to conduct ocean science research. This project includes funding for ship operations, shipboard scientific support equipment, oceanographic instrumentation and technical services, ship acquisition and upgrade, and submersible support.

Principal Scientific Goals: The Academic Research Fleet serves as the main platform for the collection of data and testing of hypotheses in oceanography. Through use of these facilities, scientists contribute to advances made in such areas as climate, fisheries, and marine research.

Principal Education Goals: Vessels in the Academic Research Fleet permit shipboard training of future oceanographers. Through cruise participation, graduate and undergraduate students interact with scientists, and marine technicians, enabling them to gain first-hand exposure to ocean science field research. Through recent technological innovations, research conducted at sea can be transmitted remotely back to the classroom, broadening the educational impact of the vessels to a wider audience, including K-12 students.

Partnerships and Connections to Industry: The Academic Research Fleet is supported through an interagency partnership, principally with the National Oceanic and Atmospheric Administration (NOAA) and the Office of Naval Research (ONR) via a Memorandum of Understanding (MOU). NSF provides approximately 65 percent of the operating funds for the Fleet, while the remaining operating costs are divided proportionally among the other vessel users. NSF also coordinates with ship-operating and non-operating academic institutions through its connection with UNOLS.

Management and Oversight: NSF provides oversight to the Academic Research Fleet through cooperative agreements with each ship-operating institution and the UNOLS Office, and through standard grants. In addition, NSF oversees the fleet through external review of proposals, site visits, ship inspections, and participation at UNOLS Council and sub-committee meetings by program managers. Several program managers within the Division of Ocean Sciences (GEO) are involved in the activities and overall oversight of the academic research fleet.

Management of an individual institution's ship-operating facilities varies with the size of the operation, but the core responsibility typically resides with the Director of the Institution, the Marine Superintendent (for all aspects of the facility), the Port Captain (for shore-side facilities) and the Ship's Captain (for at-sea operations). For larger multi-ship-operating facilities, a chief of marine technicians, schedulers and finance administrators may also be involved in facility management.

Current Project Status: NSF has supported this project for many years. Based on projected science requirements identified in recent reports and workshops, a fleet of vessels to support ocean science research will be needed far into the future. In coordination with the ocean science community, the Federal Oceanographic Facilities Committee (FOFC, of which NSF is Chair) recently developed and published a report on the long-range plan for renewal of the academic fleet. The FY 2004 Request for the Academic Research Fleet totals $65.0 million, an increase of $3.0 million over the FY 2003 Request of $62.0 million. This increase will support the continued operation of the U.S. Academic Research Fleet.

Funding Profile: All funding for the Academic Research Fleet to date has been provided through the R&RA Account.

Academic Research Fleet Funding Profile
(Dollars in Millions)

	Implementation	Operations & Maintenance	Total, NSF
FY 1994	$2.1	$44.8	$47.0
FY 1995	$0.6	$45.7	$46.3
FY 1996	$1.5	$41.5	$43.0
FY 1997	$0.0	$40.9	$40.9
FY 1998	$0.4	$40.2	$40.6
FY 1999	$0.0	$43.3	$43.3
FY 2000	$0.3	$45.1	$45.4
FY 2001	$2.3	$56.6	$58.9
FY 2002	$2.3	$59.6	$61.9
FY 2003 Req	$1.0	$61.0	$62.0
FY 2004 Req	$2.2	$62.8	$65.0
FY 2005 Est	$32.0	$70.6	$102.6
FY 2006 Est	$2.3	$72.7	$75.0
FY 2007 Est	$30.0	$72.8	$102.8
FY 2008 Est	$0.0	$74.0	$74.0

NOTE: Estimates for FY 2005 and beyond are placeholders only, and are not intended to reflect actual budget requirements.

Information pertaining to the data in the table is included below.

- Implementation: From time to time, vessels require conversions or upgrades that go beyond the normal maintenance supported by operating costs. Funding decisions for conversions and upgrades are based on strong evidence of a scientific need. In recent years, the funding has provided for the conversion or upgrade of ships already in service whose age, configuration, or operating costs have impaired their usefulness. Planning for future years includes the replacement of ships that have reached the end of their useful life and replacing the capability for studies in the deep ocean as the aging ALVIN submersible reaches the end of its useful life. In December 2001, the FOFC of the National Oceanographic Partnership Program (NOPP) prepared a report titled *Charting the Future for the National Academic Research Fleet*, which defines a federal interagency renewal strategy for the national academic research fleet. Major upgrade expenditures indicated in FY 2005 and FY 2007 implementation estimates are for development of a new deep submergence vehicle and replacement of regional ships consistent with the FOFC plan.

- Operations and Maintenance: This includes funds for operating and maintaining the fleet, shipboard scientific support equipment, oceanographic instrumentation and technical services, and submersible support.

Renewal or Termination: Participation of each ship in the research fleet through a cooperative agreement is governed by the existence of an efficient schedule of scientific research cruises for that ship, assessments of the continued fitness of the ship to conduct research at sea, and the ability of the operating institution to maintain cost effective operations.

Associated Research and Education Activities: Research utilizing the fleet is supported by NSF's research programs, and is subjected to NSF's standard merit review process utilizing review by peers. The fleet supports approximately 2,500 users per year, which is based on the total number of individual researchers, postdoctoral candidates, graduate and undergraduate students, teachers, K-12 students and observers who have participated in cruises.

Year	K12	Undergrad	Graduate	Teachers[b]
FY 1994	12	194	503	12
FY 1995	0	228	596	5
FY 1996	1	179	454	6
FY 1997	0	177	453	0
FY 1998	1	193	550	29
FY 1999	0	331	476	7
FY 2000	0	251	389	8
FY 2001[a]	2	222	489	10

[a] Estimated number based on recent year average.
[b] Teachers include those participating in Teacher-At-Sea programs.

Science Support: NSF-supported researchers with grants totaling approximately $55 million in FY 2002 used the academic research fleet. Because of its collaborative nature and the interagency cooperation, which enables the operation of the academic fleet, NSF only pays for ship time used by NSF researchers.

Antarctic Facilities and Operations

Project Description: Antarctic Facilities and Operations provide the basic infrastructure and transportation support for all U.S. research conducted in Antarctica, including that funded by U.S.

mission agencies, for year-round work at three U.S. stations, two research ships, and a variety of remote field camps. All life support is provided by NSF, including facilities infrastructure, communications, and utilities (water and power), and health and safety infrastructure.

Principal Scientific Goals: Antarctic Facilities and Operations provides science support in Antarctica, ranging from astrophysics to microbiology and climatology; provides environmental stewardship, and maintains U.S. presence in Antarctica in accord with U.S. policy.

Principal Education Goals: Antarctic Facilities and Operations integrate education and outreach activity with the research projects in Antarctica.

Partnerships and Connections to Industry: Raytheon Polar Services Company is the primary support contractor, which oversees approximately 385 separate subcontractors for supplies and technical services.

Management and Oversight: The Office of Polar Programs (OPP) has the overall management responsibility for Antarctic Facilities and Operations. The performance of the support contractor is evaluated every year by an Award Fee Board, with representatives from OPP and the Division of Acquisition and Cost Support. In addition, performance is reviewed by Committees of Visitors and the OPP Advisory Committee.

Antarctic Facilities and Operations also includes management of South Pole Station Modernization, an activity funded out of the Major Research Equipment and Facilities Construction (MREFC) Account from FY 1998 through FY 2004. The new station will provide the infrastructure required for imaginative new science on the drawing board.

Current Project Status: All three Antarctic stations are currently operating as normal.

Funding Profile: All funding for Antarctic Facilities and Operations has been provided through the R&RA Account. Support for South Pole Station Modernization, the South Pole Safety and Environment, and the Polar Aircraft Upgrades projects are found in the MREFC Section.

Antarctic Facilities and Operations Funding Profile
(Dollars in Millions)

	Implementation	Operations & Maintenance	Total, NSF
FY 1994	0.00	104.54	104.54
FY 1995	0.00	104.67	104.67
FY 1996	0.00	107.35	107.35
FY 1997	0.00	100.29	100.29
FY 1998	0.00	97.02	97.02
FY 1999	0.00	95.90	95.90
FY 2000	0.00	106.50	106.50
FY 2001	0.00	116.45	116.45
FY 2002	0.00	123.38	123.38
FY 2003 Req	0.00	128.70	128.70
FY 2004 Req	0.00	144.29	144.29
FY 2005 Est	0.00	148.04	148.04
FY 2006 Est	0.00	152.04	152.04
FY 2007 Est	0.00	156.30	156.30
FY 2008 Est	0.00	160.83	160.83

NOTE: Estimates for FY 2005 and beyond are placeholders only, and are not intended to reflect actual budget requirements.

Information pertaining to the data in the table is included below.

- Operations and Maintenance: The Office of Polar Programs (OPP) contracts with a prime support contractor for operations and maintenance of the Antarctic stations and related infrastructure in New Zealand and Chile, as well as leasing of research vessels and fixed-wing aircraft used in support of research.

Renewal or Termination: N/A

Associated Research and Education Activities: The Antarctic infrastructure makes science possible - ranging from astrophysics to microbiology and climatology - in Antarctica and maintains U.S. presence in Antarctica in accord with U.S. policy. Research is funded through the Antarctic Research Grants Program at NSF and through other federal agencies funding research in Antarctica.

Science Support: N/A

Cornell Electron Storage Ring (CESR)

Project Description: The Cornell Electron Storage Ring (CESR) is a facility that supports research in elementary particle and accelerator physics. CESR is an electron-positron storage ring that has provided important knowledge of the properties of the b quark. Funding for CESR also supports the associated detector (CLEO) for use in elementary particle physics research in the b-quark sector, as well as research in accelerator physics and superconducting radio frequency (RF) applications. Cornell University will modify the CESR colliding beam accelerator and upgrade the CLEO particle detector for operation over the energy range 1.5 GeV to 5.6 GeV per beam in order to address high-priority physics questions that can not be addressed elsewhere. The transformed collider and detector are named CESRc and CLEOc respectively.

Principal Scientific Goals: CESRc and CLEOc will explore a large set of critical weak and strong interaction phenomena, knowledge of which is either lacking or fragmentary. These in turn will drive theoretical advances that will both extend and enable the full program of physics targeted by many new-generation detectors, such as those at SLAC, Fermilab, and the Large Hadron Collider (LHC), and will lay the foundation for strong interaction theory to meet the requirements of future physics beyond the Standard Model.

Principal Education Goals: To support and enhance Ph.D. level graduate education, postdoctoral research experience, research experiences for undergraduates, and research experiences for K-12 science teachers. Engendering excitement in science among young children will be a focus for strengthening K-12 engagements. An important component of that effort will be the participation of CLEO and CESR graduate students in school science classrooms.

Partnerships and Connections to Industry: CESR staff is transferring CESR Superconducting RF (SRF) technology to industry. Two new industrially fabricated SRF cavity systems have been acquired in order to shorten CESR bunch length with higher voltage. Through a license arrangement with Cornell, the Accel Corporation manufactures a superconducting RF source to power synchrotron light sources. Also some of the Cornell High Energy Synchrotron Source (CHESS) users are from industry, including: pharmaceutical corporations (Rib-x Pharmaceuticals) and the research arms of chemical corporations (Eastman Kodak, Xerox) and automotive corporations (General Motors). Some medical institutions also make use of CHESS (Dana Farber Cancer Institute, Boston Biomedical Research Institute, and Memorial Sloan-Kettering Institute).

Management and Oversight: CESRc is managed by the Laboratory Director, with help from an Assistant Director and an Associate Director for Accelerator Physics. The CLEOc experiment is the sole CESRc experiment in particle physics, and this collaboration consists of users from about 20 U.S. institutions. The CESRc management interacts with the CLEOc collaboration through the collaboration spokesperson and executive board as needed, and there are monthly meetings of the collaboration that include CESRc management.

NSF oversight (PHY/MPS) is provided through annual site visits by NSF staff. Technical review of the award involves panel evaluation of the CESRc proposal, and by a site visit by NSF staff and external reviewers. The oversight process includes monthly and quarterly financial reports and program reports to the NSF; annual review by a Program Advisory Committee of outside physicists reporting to the Laboratory Director and NSF; and annual oral reports to the High Energy Physics Advisory Panel (advisory to NSF and the Department of Energy).

Current Project Status: Cornell University will modify the CESR colliding beam accelerator and upgrade the CLEO particle detector as mentioned above. In addition to the particle physics program, a vigorous program of accelerator science and technology development for accelerator concepts for the future will continue. CESRc will also provide intense x-ray beams for the program in x-ray science at the Cornell High Energy Synchrotron Source (CHESS). The particle physics program and x-ray science program will now begin to use different accelerator energies, requiring the two programs to operate in different time periods. CHESS is supported through the Materials Research Subactivity of the Mathematics and Physical Sciences Activity, the Biological Sciences Activity, and by the National Institutes of Health. The FY 2004 Request for CESR totals $21.0 million, an increase of $1.51 million over the FY 2003 Request of $19.49 million.

Funding Profile: The FY 2003 - FY 2008 estimated funding for CESRc and CLEOc will ensure completion of the elementary particle physics program and provide sufficient time for the particle physics group and the CHESS facility to plan their future activities. All funding for CESR to date has been provided through the R&RA Account.

CESR Funding Profile
(Dollars in Millions)

	Implementation	Operations & Maintenance	Total, NSF
FY 1994		17.40	$17.40
FY 1995	10.90	12.50	$23.40
FY 1996	8.70	14.90	$23.60
FY 1997	6.50	14.00	$20.50
FY 1998	6.20	12.40	$18.60
FY 1999	3.20	16.30	$19.50
FY 2000		19.49	$19.49
FY 2001		19.49	$19.49
FY 2002		19.49	$19.49
FY 2003 Req		19.49	$19.49
FY 2004 Req		21.00	$21.00
FY 2005 Est		21.00	$21.00
FY 2006 Est		20.00	$20.00
FY 2007 Est		18.00	$18.00
FY 2008 Est		8.50	$8.50

NOTE: Estimates for FY 2005 and beyond are placeholders only, and are not intended to reflect actual budget requirements.

Information pertaining to the data in the table is included below.

- Implementation: These figures reflect an upgrade to CESR to allow the accelerator to produce higher luminosity beams and to CLEO to allow the detector to operate and take data under the higher luminosity conditions.

- Management and Operations: The facility operates about 5500 hours per year for CLEO research and for accelerator physics and development. Maintenance is provided through a weekly 8-hour shift and through two or three, 3-week shut-downs for maintenance of the accelerator, superconducting RF, helium refrigerator, vacuum system, beam lines for CHESS, power systems, and other ancillary systems. Approximately 30 percent of the CESR funding is directed toward in-house research (both experimental elementary particle physics and accelerator physics) with the remainder used to operate and maintain the facility. The funding profile above includes minor detector and accelerator changes that are essential to completion of the scientific program before FY 2009.

Renewal or Termination: The current cooperative agreement expires in FY 2003. At this time, and subject to approval by the National Science Board, NSF expects to renew the program through a cooperative agreement that will expire in FY 2008. NSF does not expect to renew the program of CESR operations for elementary particle physics when the new agreement expires in FY 2008.

Associated Research and Education Activities: Cornell has held three staff workshops in Diversity Awareness in 2002. They have conducted "Expand Your Horizons" workshops for ~100 middle school girls over the last three years, involving 7 female graduate students and 1 female faculty member. They participate in "Saturday Academy," a group of ~25 minority grade and high school students meeting monthly. The Cornell Laboratory for Nuclear Science (LNS) sponsors a monthly Visiting Scientist series at a rural elementary school where 36 percent of the children are eligible for free school lunches. And they conduct an "Atoms for Kids" program at two rural elementary schools where ~30 percent of the students are similarly eligible for free school lunches. The laboratory trains graduate students in accelerator physics and has supported the development of superconducting radio frequency accelerating cavities.

Science Support: Approximately $3 million is provided annually by NSF in support of separate awards to external users of the CESR/CLEO facility. DOE provides a similar amount in support of awards to individual investigators and groups. In addition, $600,000 is provided in a separate award to Cornell in support of theoretical elementary particle physics research.

About 200 physicists from 22 universities have built and are operating the CLEO detector to study the products of the electron-positron collisions. CESR is a national user facility and the collaboration includes researchers from 25 U.S. and foreign institutions. The CESR facility is also used by the materials research community (500-600 users per year, typically) for synchrotron radiation studies.

Gemini Observatories

Project Description: The Gemini Observatory consists of two 8-meter telescopes, one in the northern hemisphere, in Hawaii, and one in the southern hemisphere, in Chile. The Hawaiian telescope is optimized for infrared observations and is located on Mauna Kea at an altitude of 4200 meters. The telescope in Chile is located on Cerro Pachon, an outstanding photometric site, at an altitude of 2700 meters. This siting of the two telescopes assures complete coverage of the sky to complement the observations from space-based observatories, and provides access to the center of our own Galaxy as well as the Magellanic Clouds, our nearest galactic neighbors. Both telescopes are designed to produce superb image quality and both use sophisticated adaptive optics technology to compensate for the blurring effects of the Earth's atmosphere. The Observatory is an international collaboration with the United Kingdom, Canada, Australia, Chile, Argentina and Brazil.

Principal Scientific Goals: Astronomers need to resolve important questions about the age and rate of expansion of the universe, its overall topology, the epoch of galaxy formation, the evolution of galaxies once they are formed, and the formation of stars and planetary systems. The new generation of optical/infrared telescopes with significantly larger aperture (8-meter diameter) than existing instruments will provide better sensitivity and spectral and spatial resolution. Technological advances in a number of key areas of telescope construction and design allow these instruments to take advantage of the best performance the atmosphere will allow.

Principal Education Goals: The Gemini telescopes will play a central role in the education and training of U.S. astronomy and engineering students. An estimated 20 percent of the projected 400 users per year will be students from the partner countries. Gemini is also providing a focus for public outreach and high school student training in all the partner countries, including the development of "sister city" arrangements between Hilo, Hawaii and La Serena, Chile involving students and teachers at high school and elementary school levels.

Partnerships and Connections to Industry: Gemini is an international partnership with the United Kingdom, Canada, Australia, Chile, Argentina, and Brazil. Construction of the telescopes and their instrumentation has involved a large number of industrial concerns in a number of partner and non-partner countries. These have involved firms in large and/or complex optical systems, aerospace industries, electronics and engineering firms, etc. Continued involvement of such industries is part of the instrumentation and facilities renewal activities included in the operating budget of the Gemini Observatory.

Management and Oversight: The project is governed by the Gemini Board established by the International Gemini Agreement signed by the participating nations and agencies. NSF serves as the Executive Agency for the seven-nation partnership, carrying out the project on their behalf. Programmatic management has been the responsibility of the Staff Associate for Gemini in the Division of Astronomical Sciences (MPS), assisted by an internal Project Advisory Team with representation from Office of the General Counsel, Office of Legislative and Public Affairs, Division of Grants and Agreements, Division of Financial Management, and the Office of International Science and Engineering. During construction and oversight, a committee of outside experts regularly reviewed progress and reported to the partnership. With the start of scientific operations, the Gemini Board is establishing an independent Visiting Committee that will advise on the operation of the Observatory. Gemini is managed by Associated Universities for Research in Astronomy (AURA), Inc on behalf of the partnership through a cooperative agreement with NSF. AURA conducts its own management reviews through standing oversight committees. The current cooperative agreement expires in FY 2005. Under the terms of the international agreement, the partnership will determine whether to compete the management of the Observatory at that time.

Current Project Status: Construction of both telescopes is complete and science operations have begun at both sites. Commissioning of telescopes and, particularly, facility instruments, continues at both telescopes. The Chilean partner in Gemini, CONICYT, has had a perennial problem paying operations contributions, though they have completed the construction payments in full. The astronomical community in Chile feels a far greater need to develop astronomy within the country than a need for more observing time. Gemini South is on Chilean soil and the conditions of exemption from taxes and duties under which Gemini operates in Chile are very advantageous.

CONICYT proposed that the Gemini partners effectively return the equivalent of Chile's construction payment to CONICYT to be used as a fund whose proceeds would be used to develop astronomy. In a "cooperative agreement" CONICYT remains a partner and returns to the partnership the 5 percent observing time on both telescopes that they had been entitled to as a result of paying 5 percent of the capital and operating costs. This proposal has been accepted by the Gemini Board and has been discussed with the National Science Board's Committee on Programs and Plans. Within the partnership there is now agreement that the U.S. will assume 52.5 percent of the Chilean share, Australia 30 percent, Canada 15 percent and Brazil the remaining 2.5 percent. A schedule of payments has been constructed that results in the payment of the full capital return by the end of 2005.

The FY 2004 Request totals $14.20 million, an increase of $1.60 million over the FY 2003 Request of $12.60 million. Included in this increase is $1.0 million for partial return of the U.S. share of Chilean capital.

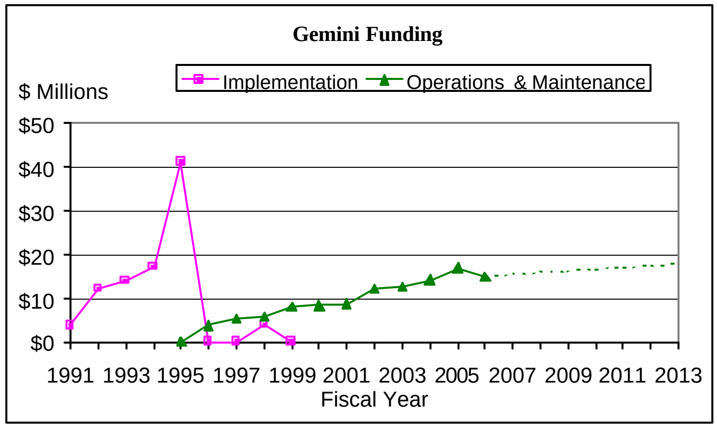
Funding Profile: The total NSF contribution to the construction of the Gemini telescopes is $92.0 million, representing a 50 percent share of the total project cost. Experience gained during the construction and integration of the Hawaii telescope allowed for an accelerated schedule in Chile.

Gemini Funding Profile
(Dollars in Millions)

	Concept/ Development		Implementation[1]		Operations & Maintenance[1]		Grand
	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	Total
FY 1994 & Earlier	12.00		47.00				59.00
FY 1995				41.00			41.00
FY 1996					3.82		3.82
FY 1997					5.32		5.32
FY 1998				4.00	5.72		9.72
FY 1999					8.05		8.05
FY 2000					8.38		8.38
FY 2001					8.66		8.66
FY 2002					12.50		12.50
FY 2003 Req					12.60		12.60
FY 2004 Req[2]					14.20		14.20
FY 2005 Est[2]					16.82		16.82
FY 2006 Est[3]					14.76		14.76
FY 2007 Est[4]					15.49		15.49
Subtotal, R&RA	$12.00		$47.00		$126.32		$185.32
Subtotal, MREFC		$0.00		$45.00		$0.00	$45.00
Total, Each Phase		$12.00		$92.00		$126.32	$230.32

[1]Reporting of costs in these categories is as considered and reported by NSF in its response to OIG report 01-2001.
[2] FY 2004 and FY 2005 funding includes the cost of the Chilean capital return, consistent with the U.S. assumption of a portion of the Chilean share.
[3]The current cooperative agreement ends in FY 2005. Estimates for FY 2006 and beyond reflect the anticipated growth of the operating budget being used by the Observatory and the Gemini Board for planning purposes. The anticipated lifetime of the Observatory is 25 years.
[4]A steady state of about $15 million annually is anticipated for the U.S. share of operations beginning in FY 2007.

Information pertaining to the data in the table is included below.



- Concept/Development: Funds represent estimated U.S. investments in the development of mirror technologies for a new generation of telescopes, as recommended by the National Academy Report "Astronomy and Astrophysics for the 1980's." Three different mirror technologies were explored. These investments in technology development contributed to the plans for Gemini, as well as to other new telescopes that advance research in astronomy.

- Implementation: Gemini construction was initiated in FY 1991, before establishment of the MREFC Account in FY 1995. The $92 million obligated for Gemini construction is the U.S. share of the total cost ($184 million) for the two telescopes, with the balance provided by international partners.

- Management and Operations: Funding ramped up as the telescopes approached initial operations. Beginning in FY 2002 operations include the U.S. assumption of a portion of the Chilean share of operations costs, as agreed by the international partners. The funds provide additional observing time to the U.S. astronomy community while Chile maintains a share of observing time as host country. Under this adjustment, NSF supports just over 50 percent of management, operations and maintenance. In FY 2004-2005, costs reflect Chilean capital return, consistent with U.S. assumption of a portion of Chilean share.

Renewal or Termination: The cooperative agreement for the support of Gemini operations is in its third year and expires in FY 2005. Under the terms of the international agreement, the partnership will determine whether to compete the management of the Observatory at that time.

Associated Research and Educational Activities: The public information and outreach office at Gemini carries out local outreach to schools, teachers, and the general public, as well as coordinates and serves as a liaison for the outreach efforts of partner countries. They also provide media services and web based resources.

Science Support: Along with direct operations and maintenance support for Gemini, NSF will support research performed at the facility, through ongoing research and education programs. The annual support for such activities is estimated to be about $5 million, once the facility reaches full operations.

Incorporated Research Institutions for Seismology (IRIS)

Project Description: IRIS is a consortium of 96 U.S. universities and not-for-profit institutions with research and teaching programs in seismology. IRIS operates a distributed national facility for the development, deployment, and operational support of modern digital seismic instrumentation to serve national goals in basic research in the earth sciences, in earthquake research, and in nuclear test ban monitoring. IRIS is organized in four major program elements: (1) The Global Seismographic Network (GSN) currently consists of a global deployment of 136 permanently installed digital seismic stations; (2)

The Program for Array Seismic Studies of the Continental Lithosphere (PASSCAL) manages a pool of portable seismometers which are made available to the seismology research community for scheduled regional and local scale studies; (3) The IRIS Data Management System (DMS) provides the national and international seismic research community with timely access to data from the GSN and PASSCAL; and (4) The IRIS Education and Outreach (E&O) Program which enables audiences beyond seismologists to access and use seismological data and research for educational purposes, including teacher workshops, student internships, museum exhibits, educational materials, and programs for under-resourced schools.

<u>Principal Scientific Goals</u>: The Earth's interior remains a major scientific frontier holding the key to understanding the origin of the planet. Recent developments in seismic sensor design, and the acquisition, transmission and storage of data have resulted in dramatic improvements in the resolving power of seismic imaging of the interior. Earthquake research, including rapid and accurate location and characterization of the earthquake source, its magnitude and a better understanding of the physical process involved, has also benefited greatly from recent technical advances. The IRIS facility serves the research needs of the national and international seismology community by making available state-of-the-art designs in seismic sensors and data acquisition systems. In addition to its role in providing the observational data essential for basic research in geophysics and earthquake dynamics, IRIS plays a significant role in seismic monitoring of the Comprehensive Test Ban Treaty and in bringing seismology to students and the public through the activities of its Education and Outreach program.

<u>Principal Education Goals</u>: The IRIS Education and Outreach (E&O) Program enables audiences beyond seismologists to access and use seismological data and research for educational purposes. E&O activities include teacher workshops, student field internships, museum exhibits, educational materials, the development of classroom seismic stations, and programs for under-resourced schools. E&O projects serve not only to advance public understanding of geoscience, but also to foster improved understanding of the scientific process and scientific data. The E&O program of IRIS will expand its educational displays, and provide more access to real-time data for educational purposes.

<u>Connections to Industry</u>: The use of IRIS PASSCAL instruments for investigations of the shallow crust provides opportunities for collaboration with the petroleum exploration industry. Many students involved in these experiments receive training in techniques that prepare them for careers in the exploration industry. In a broader sense, IRIS has had and continues to have close collaboration with industry in the area of seismic instrumentation and software development. NSF program staff encourage IRIS to continue its efforts to establish closer ties to industry, and follows these developments on a regular basis.

<u>Partnerships</u>: IRIS is heavily involved in partnership activities, many of them international in nature. Installation and operation of the Global Seismographic Network (GSN) has put IRIS in contact with scientists as well as government and non-government organizations all over the world. IRIS GSN stations in many countries are designated as the official monitoring stations for nuclear test ban monitoring in those countries. International teams of scientists organize most PASSCAL projects overseas. IRIS membership in the FDSN and the designation of the IRIS Data Management System (DMS) as the international archive for broadband digital waveform data are additional examples of IRIS activity on the international scene. NSF envisions that IRIS will enlarge the scope of its international activities in the coming years. The IRIS facilities also are multi-use resources for other government agencies that have responsibilities for development of a nuclear test-ban monitoring capability and for monitoring of global seismicity. For these purposes, agencies in partnership with NSF have provided substantial support to IRIS for accelerated development of the GSN (Department of Defense), shared operation and maintenance of the GSN (U.S. Geological Survey), and accelerated development of the PASSCAL instrument pool (Department of Energy).

Management and Oversight: IRIS is incorporated as a nonprofit consortium representing practically all U.S. university and nonprofit organizations with research and teaching programs in seismology. Each member institution appoints a representative who serves with full voting privileges on the IRIS Board of Directors. However, all IRIS program and budget decisions are made by an eight-member Executive Committee, elected by the Board of Directors to three-year terms. These decisions are made after consultation with the IRIS advisory committees (the four standing committees for each of the four IRIS programs and additional *ad hoc* working groups appointed for special tasks). The Executive Committee appoints a president of IRIS to a two-year term. The president is responsible for IRIS operations, all of which are managed through the IRIS Corporate Office.

The Division of Earth Sciences (EAR/GEO), through its Instrumentation & Facilities Program (IF), has a major responsibility for providing IRIS with general oversight and monitoring to help assure effective performance and administration, as well as facilitating the work done by IRIS. IF/EAR also cooperates in the coordination of IRIS programs and projects with other NSF-supported facilities and projects and with other Federal agencies and evaluates and reviews the scientific and administrative performance of IRIS.

Current Project Status: The IRIS consortium was founded in 1984 by 26 universities in response to recommendations in a report issued in 1983 by the Committee on Science, Engineering, and Public Policy (COSEPUP) of the National Academy of Sciences. This report urged that "NSF act as overall coordinator and lead agency for funding a global digital seismic array and that the operation be planned and overseen by a university consortium." During the last fifteen years, with support from the Foundation and federal partners, the IRIS consortium has grown to 96 full-member (voting) U.S. universities that operate core research facilities consisting of a Global Seismographic Network (GSN), the Program of Array Seismic Studies of the Continental Lithosphere (PASSCAL), and a Data Management System (DMS). During the last cooperative agreement period, IRIS initiated a new Education and Outreach (E&O) program. The FY 2004 Request for IRIS totals $14.10 million, an increase of $1.0 million over the FY 2003 Request of $13.10 million.

Funding Profile: All funding for IRIS to date has been provided through the R&RA Account.

IRIS Funding Profile
(Dollars in Millions)

	Implementation	Operations & Maintenance	Total, NSF
FY 1994	1.67	5.64	7.31
FY 1995	2.03	5.52	7.55
FY 1996	5.61	2.39	8.00
FY 1997	2.32	8.83	11.15
FY 1998	1.27	9.76	11.03
FY 1999	0.69	10.77	11.46
FY 2000	0.46	11.16	11.62
FY 2001	1.90	11.38	13.29
FY 2002	1.93	11.00	12.93
FY 2003 Req	2.00	11.10	13.10
FY 2004 Req	2.20	11.90	14.10
FY 2005 Est	2.21	12.39	14.60
FY 2006 Est	2.30	12.00	14.30
FY 2007 Est	2.40	12.20	14.60
FY 2008 Est	2.50	12.30	14.80

NOTE: Estimates for FY 2005 and beyond are placeholders only, and are not intended to reflect actual budget requirements.

Information pertaining to the data in the table is included below.

- Implementation: Implementation includes funds for major equipment purchases (data recorders and seismometers) for the PASSCAL Instrument Center in Socorro, NM and the Global Seismographic Network (GSN).

- Operations and Maintenance: This category includes funds to support the IRIS corporate office in Washington, DC, including the Education & Outreach Program (E&O); the PASSCAL Instrument Center in Socorro, NM; the Data Management System (DMS) in Seattle, WA; and the Global Seismographic Network (GSN). IRIS conducts no "in-house research."

Renewal or Termination: Two reviews have been stipulated in the new NSF cooperative agreement with IRIS: (1) an in-depth study by IRIS of the operation, personnel, and instrument costs, and support of the Global Seismographic Network (GSN), in collaboration with the USGS, representatives of the Federation of Digital Seismic Networks (FDSN), and GSN network operators by July 1, 2003; and (2) an NSF review of IRIS management in coordination with IRIS and its appropriate governance committees, to be completed by July 1, 2004. This latter review will provide more information for the basis of the decision to either allow the submission of a renewal proposal or to recompete the operation of this facility.

Associated Research and Education Activities: IRIS sponsors an active education and outreach program, which touches a vast number of individuals annually. There are currently 471 schools and individuals on the IRIS mailing list, and 25 K-12 schools with IRIS seismographs. The website visitors data in the table below indicate a yearly sum of unique visitors each month, and the K-12 students number assumes each teacher interacts with 80 students per year. IRIS also holds a number of workshops each year for K-12 and college students; in FY 2002, 5 such workshops were held.

IRIS Participation

Year	K-12	Undergrad	Graduate	Teachers	Faculty	Museum Display Visitors	Posters Distributed	Website Visitors
FY 1998	3400	2	28	43		500,000	2,000	
FY 1999	5300	9	22	23	35	2,000,000	5,000	
FY 2000	6900	2	30	20	20	9,000,000	4,000	280,000
FY 2001	12000	2	33	65	25	9,000,000	3,000	280,000
FY 2002	18000	6	24	86	16	9,000,000	2,000	410,000

Science Support: The EAR/Geophysics and Continental Dynamics Programs and the OCE/Marine Geology & Geophysics Program provide most of the funds for NSF-sponsored research, totaling approximately $15 million per year. Funds permit deployment of PASSCAL instruments and use of GSN data stored at the DMS to solve major earth science problems.

Laser Interferometer Gravitational Wave Observatory (LIGO)

Project Description: Einstein's theory of general relativity predicts that processes involving super-massive objects in the universe will produce gravitational radiation that will travel to Earth. Detection of gravity waves is of great importance both for fundamental physics and for cosmology. LIGO is designed to be the most sensitive gravitational wave detector ever built. LIGO comprises two main facilities, one in Livingston Parish, LA and one in Hanford, WA. At each facility, a large vacuum chamber, with two 4-km arms joined at right angles, houses one or more optical interferometers. The interferometers are used to measure minute changes in the distances between test masses at the ends of the straight sections caused by a passing gravity wave. The distortion in space between the test masses caused by the gravity wave is much less than the size of a hydrogen nucleus, implying a measurement of length change divided by the length of the interferometer arms of h ~ 10^{-21}. The size of the LIGO interferometers is required to meet this extreme requirement. These are by far the largest optical interferometers ever built.

Principal Scientific Goals: Of the four known fundamental forces of nature (electromagnetic, weak, strong, and gravitational), the gravitational force is the most enigmatic. It is by far the weakest, yet it holds the universe together, ignites the fusion reaction in stars, and curves space in black holes so severely that light is trapped. And, although the universe is believed to be filled with gravity waves from a host of cataclysmic cosmic phenomena, we have never detected a gravity wave and measured its waveform.

The principal scientific goals of LIGO are to detect gravity waves on Earth for the first time and to develop this capability into a new window on the universe, a window through which we can observe phenomena such as the inspiral and coalescence of neutron stars in binary orbit, black hole collisions, unstable dynamics of newborn neutron stars, supernovae, stochastic background from the early universe, and a host of more exotic or unanticipated processes.

Principal Education Goals: LIGO is a significant source of highly trained Ph.D. graduates for the country's workforce. With the beginning of LIGO science runs in FY 2002, the number of graduate students is expected to grow. In addition LIGO has a diverse set of educational activities at its different sites, activities that involve a large number of undergraduate (including those from minority serving institutions), hands-on activities for K-12 classes, teachers at all levels, and informal education and outreach activities for the public, including a planned Visitor's Center at the Livingston, Louisiana site.

Connections to Industry: Substantial connections with industry have been required for the state-of-the-art construction and measurements involved in the LIGO projects. Some have led to new products. Areas of involvement include novel vacuum tube fabrication technology, seismic isolation techniques, ultrastable laser development (new product introduced), development of new ultra- fine optics polishing techniques, and optical inspection equipment (new product).

Management and Oversight: LIGO is sponsored by NSF and managed by Caltech and MIT under a cooperative agreement. The management plan specifies significant involvement by the user community, represented by the LIGO Scientific Collaboration (LSC), and collaboration with the other major gravitational wave detector activities in Japan, Europe, and Australia. External peer-review committees organized by the NSF help provide oversight through an annual review. NSF oversight is coordinated internally by the LIGO program director in the Division of Physics (MPS), who has also convened a LIGO Project Advisory Team, comprising staff from the Office of General Counsel, the Office of Legislative and Public Affairs, the Division of Grants and Agreements, and the Budget Division. The Project Advisory Team has been in existence since 1994.

Current Project Status: All three LIGO interferometers have been completed, locked, and operated in coincidence. FY 2002 was devoted to continuous improvement of the sensitivity of the interferometers and the first science run S-1 that accumulated nearly 100 hours of triple coincidence in the period from August 23, 2002 to September 9, 2002 with a strain sensitivity approaching 10^{-20} $(Hz)^{-1/2}$. Work on sensitivity improvements continues in FY 2003 in preparation for a much longer second science run S-2 scheduled to begin in February 2003. Recently strain sensitivities about ten times better than those observed in S-1 have been achieved (December, 2002). The FY 2004 Request for LIGO totals $29.0 million, a decrease of $500,000 over the FY 2003 Request of $29.50 million. This funding level reflects full operations of the Laser Interferometer Gravitational-wave Observatory (LIGO) to run their interferometers at sites at Hanford, WA and Livingston, LA in coincidence with each other and with gravitational wave detectors abroad.

<u>Funding Profile</u>: The history of the LIGO project dates back to early conceptual work in the mid-1970s, moving through pre-construction R&D in the late 1980s to the initiation of LIGO construction in FY 1992. LIGO pre-dates the establishment of the MREFC Account in FY 1995.

LIGO Funding Profile
(Dollars in Millions)

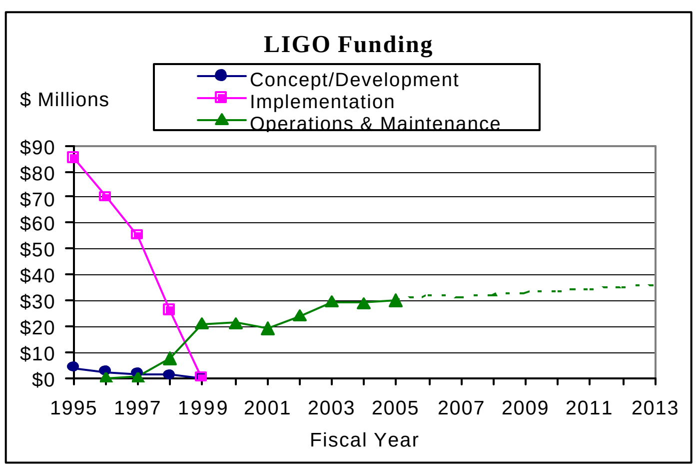
	Concept/ Development		Implementation		Management & Operations		Totals		Grand Total
	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	
FY 1994 & Earlier	38.70		35.90				$74.60		$74.60
FY 1995	4.00			85.00			$4.00	$85.00	$89.00
FY 1996	2.38			70.00			$2.38	$70.00	$72.38
FY 1997	1.62			55.00	0.30		$1.92	$55.00	$56.92
FY 1998	0.86			26.00	7.30		$8.16	$26.00	$34.16
FY 1999					20.80		$20.80		$20.80
FY 2000					21.10		$21.10		$21.10
FY 2001					19.10		$19.10		$19.10
FY 2002					24.00		$24.00		$24.00
FY 2003 Req					29.50		$29.50		$29.50
FY 2004 Req					29.00		$29.00		$29.00
FY 2005 Est					30.00		$30.00		$30.00
Subtotal, R&RA	$47.56		$35.90		$181.10		$264.56		
Subtotal, MREFC				$236.00				$236.00	
Total, each phase		$47.56		$271.90		$181.10			$500.56

NOTE: A steady state of $30 million for operations is anticipated by the end of FY 2005, after the initial years of science operations. The expected operational lifespan of this project is about 20 years.

Information pertaining to the data in the table is included below.

- <u>Concept/Development</u>: Funds supported three phases of planning, design and development for LIGO: early conceptual R&D - $11.6 million (FY 1975-87); pre-construction R&D - $16 million (FY 1988-91); and ongoing R&D throughout construction - $20 million (FY 1992-98).

- <u>Implementation</u>: LIGO construction occurred between FY 1992-98, totaling $271.90 million. Prior to the start of the MREFC Account, construction funding was provided through the R&RA Account.



- <u>Management and Operations</u>: LIGO commissioning and operations costs began phasing-in in FY 1997. Commissioning costs are included in LIGO operations (as reported in NSF budget justifications to Congress) through FY 2001. Operations with the first science run began in FY 2002.

Renewal or Termination: The cooperative agreement for the support of LIGO operations is in its second year and expires in FY 2006. NSF expects to renew the agreement at that time pending a satisfactory performance review.

Associated Research and Education Activities: Active Outreach programs have been developed at both the Livingston and Hanford sites. For example, the Livingston team has provided visual displays, hands-on science exhibits, and fun activities for students visiting the site. In the last three years an average of over 2000 students per year have taken advantage of this opportunity. More formal programs at the site include participation in the Research Experience for Teachers (RET) Program, a set of "scientist-teacher-student" research projects in support of LIGO, and participation in the SURF/REU programs for college students. In addition to a set of similar on-site activities, the Hanford team has developed a Web-based Resource for teachers by teachers (grades 5 through 12) that includes information on research opportunities for schools, internships in public science education, and a set of classroom activities, lessons, and projects related to LIGO science.

Science Support: Along with direct operations and maintenance support for LIGO, NSF will support science and engineering research performed at the facility, through ongoing research and education programs. The annual support for such activities is estimated to be about $8.5 million once the facility reaches full operations.

In 1997 LIGO founded the LIGO Scientific Collaboration (LSC) to organize the major international groups doing research that was supportive of LIGO. The LSC now has 44 collaborating institutions with over 440 participating scientists. The role and membership responsibilities of each participating institution are determined by a MOU between the LIGO Laboratory and the institution. The LSC plays a major role in many aspects of the LIGO effort including: R&D for detector improvements, R&D for Advanced LIGO, data analysis and validation of scientific results, and setting priorities for instrumental improvements at the LIGO facilities.

Major Research Equipment and Facilities Construction Projects

The MREFC Account supports the acquisition, construction and commissioning of major research facilities and equipment that provide unique capabilities at the frontiers of science and engineering. Projects supported by this account are intended to extend the boundaries of technology and open new avenues for discovery for the science and engineering community. Initial planning and design, and follow on operations and maintenance costs of the facilities are provided through the Research and Related Activities (R&RA) Account.

The National Science Board (NSB) reviews and approves potential MREFC projects for inclusion in future budget requests. The NSF Director, after discussion with OMB, then selects from the group of NSB-approved projects those appropriate for inclusion in a budget request to the Congress. Funding is requested in this Budget Request for all projects approved by the NSB to date. In FY 2004, funding is requested for the highest priority items, the ongoing projects identified in the following table. In addition, three new starts are requested in FY 2005 and FY 2006. In priority order, these are:

- Scientific Ocean Drilling ($76.85 million in FY 2005)
- Rare Symmetry Violating Processes ($30.0 million in FY 2006)
- Ocean Observatories ($24.76 million in FY 2006)

A total of $202.33 million is requested in FY 2004, an increase of $76.05 million over FY 2003, to support seven ongoing projects. Additional information on these projects can be found in the MREFC section.

MREFC Funding
(Dollars in Millions)

Projects[1]	FY 2002[2] Actual	FY 2003 Request	FY 2004 Request
Atacama Large Millimeter Array Construction	12.50	30.00	50.84
EarthScope: USArray, SAFOD, PBO	N/A	35.00	45.00
High-Performance Instrumented Airborne Platform for Environmental Research (HIAPER)	35.00	--	25.53
IceCube Neutrino Observatory	10.12	--	60.00
Large Hadron Collider	16.90	9.72	--
National Ecological Observatory Network	N/A	12.00	12.00
Network for Earthquake Engineering Simulation (NEES)	24.40	13.56	8.00
Polar Aircraft Upgrades	0.89	--	--
South Pole Station	15.55	6.00	0.96
Terascale Computing Systems[3]		20.00	--
Total, Major Research Equipment and Facilities (MREFC) Construction Account	$115.35	$126.28	$202.33

Totals may not add due to rounding.
[1]Additional funding for operations and maintenance of MREFC projects is provided through the Research and Related Activities Account.
[2]FY 2002 Actuals include $16.44 million in carryover from prior year appropriations for the South Pole Station Modernization project, the South Pole Station Safety and Environment project and the Polar Aircraft upgrades. $39.88 million appropriated in FY 2002 is carried over into FY 2003. This FY 2002 carryover will be reflected in the Current Plan following an FY 2003 appropriation.
[3]FY 2002 funding for Terascale in the amount of $35.0 million, was carried over into FY 2003 due to the NSB meeting schedule. The award was approved in October, 2002 and the funds have been obligated.

- Atacama Large Millimeter Array (ALMA) Construction (Phase II) is the construction phase of the ALMA project, begun in FY 2002 and supported by international partnership through NSF. ALMA is planned as a millimeter wave interferometer made up of 64 12-meter antennas and will be an aperture-synthesis radio telescope operating in the wavelength range from 3 mm to 0.4 mm.

- EarthScope is planned as a distributed, multi-purpose geophysical instrument array that will make major advances in our knowledge and understanding of the structure and dynamics of the North American continent. The three components of the project are the USArray, the San Andreas Fault Observatory at Depth (SAFOD), and the Plate Boundary Observatory (PBO).

- HIAPER is a multidisciplinary high-altitude research aircraft capable of conducting science at or near the tropopause with an extensive scientific payload and a range in excess of 6,000 nautical miles. HIAPER will be the only extant U.S. civilian research platform for intercontinental and transoceanic research flights above 43,000 feet. It will serve the entire geosciences community: atmosphere, cryosphere, biosphere, and hydrosphere.

- IceCube is planned as an extension of the successful AMANDA project, It will be a neutrino observatory that uses one cubic kilometer of the Antarctic ice sheet as the detector medium. IceCube will open a new astronomical window, giving us hitherto unseen views of the most active and energetic astrophysical objects, and it will complement the existing and planned instruments funded by NSF, NASA and others.

- National Ecological Observatory Network (NEON) will be a continental scale research instrument consisting of 17 geographically distributed observatories, networked via state-of-the-art communications, for integrated studies to obtain a predictive understanding of the nation's environments.

- Network for Earthquake Engineering Simulation (NEES) will upgrade, modernize, expand and network major facilities including shake tables used for earthquake simulations, large reaction walls for pseudo-dynamic testing, centrifuges for testing soils under earthquake loading, and field testing facilities.

- South Pole Station will be expanded to provide support infrastructure and utilities for 150 people, versus the original capacity for 110. This will accommodate increased interest in conducting research at the South Pole.

National Astronomy Centers

National Astronomy and Ionosphere Center (NAIC)

Project Description: The NAIC is a visitor-oriented national research center, supported by NSF and focusing on radio and radar astronomy and atmospheric sciences. Its principal observing facility is the world's largest radio/radar telescope, a 305m-diameter spheroid constructed within a karst depression in western Puerto Rico near the town of Arecibo. The facility itself is called the Arecibo Observatory. The NAIC is a federally funded research and development center (FFRDC) operated by Cornell University for NSF under a cooperative agreement. NAIC provides telescope users with a wide range of research and observing instrumentation. The center has a permanent staff of scientists, engineers, and technicians who are available to help visiting investigators with their observation programs.

Principal Scientific Goals: The NAIC was founded to advance the study of basic research in Radio Astronomy, Solar System Radar Astronomy, and Ionospheric Physics.

Principal Education Goals: NAIC's primary education goal is to support and enhance the education of graduate and undergraduate student researchers. Arecibo was one of NSF's first sites for the Research Experiences for Undergraduates (REU) program. At Arecibo, graduate students receive training through use of the facility for Ph.D. research. NAIC also sponsors a major outreach program in Puerto Rico via a modern Visitor's Center, a new Learning Center, and summer workshops for K-12 teachers. In addition, last year it also held, in collaboration with NRAO, a summer school on single-dish radio astronomy techniques at Arecibo. This will be a continuing bi-yearly school alternating between NRAO sites and Arecibo.

Partnerships and Connections to Industry: NAIC currently has partnerships with NASA, NRAO, Penn State and other Universities, and the Angel Ramos Foundation of Puerto Rico (a private organization).

Management and Oversight: NAIC is one of four National Centers in astronomy supported by the Astronomical Sciences Subactivity in the Mathematics and Physical Sciences (AST/MPS) Activity. Management is via a cooperative agreement with Cornell University. This agreement requires that an annual progress report and program plan be submitted to and approved by NSF. Bi-weekly teleconferences are maintained between the NSF program manager and the NAIC Director. The program manager visits the Observatory several times per year. Arecibo Visiting Committee meetings (commissioned by Cornell) are attended by the NSF program manager, and committee reports are made available to NSF. Yearly status reports and long-range plans are presented by NAIC/Cornell representatives in visits to NSF. Management reviews by external review panels for NSF are held typically three years into a 5-year cooperative agreement.

Current Project Status: The current cooperative agreement with Cornell to manage NAIC expires in 2004; an extensive review of the management of NAIC will occur before the expiration of the current cooperative agreement. Cornell has recently instituted a new oversight committee, at NSF's urging, to monitor the progress and management of NAIC and Arecibo Observatory. A search is currently underway for a new Director of NAIC. The FY 2004 Request for NAIC totals $12.10 million, an increase of $3.10 million over the FY 2003 Request of $9.0 million. This increase will support continued operation and maintenance of the renovated Arecibo telescope and the development of instrumentation to take advantage of its greater sensitivity.

Funding Profile: All funding for NAIC to date has been provided through the R&RA Account.

NAIC Funding Profile
(Dollars in Millions)

	Implementation	Operations & Maintenance	Total, NSF
FY 1994	1.30	7.40	8.70
FY 1995	0.40	7.30	7.70
FY 1996	0.60	7.70	8.30
FY 1997	0.40	8.20	8.60
FY 1998	0.40	7.80	8.20
FY 1999	0.50	8.80	9.30
FY 2000		8.80	8.80
FY 2001	1.10	9.00	10.10
FY 2002		11.11	11.11
FY 2003 Req		12.10	12.10
FY 2004 Req		10.30	10.30
FY 2005 Est		10.30	10.30
FY 2006 Est		10.30	10.30
FY 2007 Est		10.30	10.30
FY 2008 Est		10.30	10.30

NOTE: The current cooperative agreement expires in FY 2004. Estimates for FY 2005 and beyond are placeholders only, and are not intended to reflect actual budget requirements. GEO contributions for science support are included.

Information pertaining to the data in the table is included below.

- Implementation: All construction and commissioning occurred before this reporting period. Construction of the Arecibo Observatory by the Air Force was completed in 1963. NSF took over funding for operations in 1970. The primary NSF-funded upgrade during the period reported was installation of a Gregorian feed system to enhance telescope efficiency and increase useable bandwidth.

- Operations and Maintenance: The current cooperative agreement with Cornell to manage NAIC expires in 2004. In-house research accounts for about 6 percent of the total operations budget of NAIC. Most of this research concerns traditional radio-astronomical observations (interstellar gas, galaxies, pulsars) and radar astronomy of solar system objects (asteroids, planetary surfaces and moons). This research furthers the scientific mission of the facility and maintains a scientifically competent staff. The planetary radar program, which has been funded by NASA since 1974, is in a period of transition. NASA has decided to ramp down and then terminate its support by the end of FY 2005. Under an agreement currently under negotiation between NSF and NASA, NSF will assume primary funding responsibility for the program in FY 2005-2006.

Renewal or Termination: The current cooperative agreement expires in FY 2004; an extensive review of the management of NAIC will occur before the expiration of the current cooperative agreement by which time NSF will decide whether to renew or recompete the program. Funding amounts for FY 2005 and beyond will be determined through negotiation at that time.

Associated Research and Education Activities: Teacher training is conducted in intensive workshops, held in the past at the Visitor's Center, and as of 2002 in the new Learning Center (both built with funding from the Angel Ramos Foundation of Puerto Rico). Arecibo attracts roughly 110,000 visitors per year, with many K-12 school groups visiting from across the island. Many graduate students use NAIC for dissertation research and Research Experiences for Undergraduates (REU) students also use the telescope as part of their summer research experience. Support for REU is at the level of roughly $40,000 per year.

Science Support: In addition to MPS funding, the Atmospheric Sciences Subactivity in the Geoscience Activity provided $1.70 million in FY 2002 and will provide $1.80 million in FY 2004 by for ionospheric staff support and research. NSF does not provide individual investigator awards targeted specifically for use of NAIC. Many users are supported through NSF or NASA grants which pursue scientific programs that require use of NAIC.

National Optical Astronomy Observatory (NOAO)

Project Description: The National Optical Astronomy Observatory was established in 1982 by uniting the operations of the Kitt Peak National Observatory in Arizona and the Cerro Tololo Inter-American Observatory in Chile. NOAO is a federally funded research and development center (FFRDC) for research in ground-based nighttime optical and infrared astronomy. NOAO also represents the U.S. astronomical community in the International Gemini Observatory. The National Solar Observatory (NSO), once administratively part of NOAO but now with an independent management structure, makes available to qualified scientists the world's largest collection of optical and infrared solar telescopes and auxiliary instrumentation for observation of the solar photosphere, chromosphere, and corona. The NSO operates facilities in New Mexico and Arizona. As national facilities, NOAO and NSO telescopes are open to all astronomers regardless of institutional affiliation on the basis of peer-reviewed observing proposals.

Principal Scientific Goals: NOAO supports basic research in astronomy and solar physics by providing the best ground-based astronomical telescopes to the nation's astronomers, promoting public understanding and support of science, and advancing all aspects of U.S. ground-based astronomical research.

Principal Education Goals: NOAO promotes and enhances the education of undergraduate and graduate student researchers and outreach training for K-12 teachers. Some recent examples of outreach activities include: Project ASTRO, which matches astronomers with 4th to 9th grade teachers and community educators in the Tucson area who want to enrich their astronomy and science teaching; and the use of Astronomy in Research Based Science Education (RBSE), a summer workshop for middle and high school teachers.

Partnerships and Connections to Industry: The management organization of NOAO is comprised of 29 U.S. Member Institutions and 6 International Affiliate Members the Member Institutions of AURA,. Other partners include the USAF Office of Scientific Research, NASA, and industrial vendors. Development of new telescopes, instrumentation, and sensor techniques is done in partnership with relevant industry, through subawards to various large and small aerospace, optical fabrication, and IT companies.

Management and Oversight: Management is through a cooperative agreement with the Association of Universities for Research in Astronomy (AURA), Inc. Separate Directors for NOAO and NSO report to the President of AURA. Oversight is through detailed annual program plans and long range plans for NOAO and NSO, plus quarterly and annual reports. NSF has periodic reviews of AURA management by external committees. Ongoing oversight and evaluation is by an assigned NSF program director (AST/MPS) and by a standing external committee for NOAO.

Current Project Status: Cooperative agreements for continuing management and operations are for terms of five years; a new agreement was recently competed and awarded to AURA October 1, 2002. A management review will be carried out three years into the current cooperative agreement. The FY 2004 Request for NOAO totals $38.60 million, an increase of $2.90 million over the FY 2003 Request of $35.70 million. NOAO funding includes $34.80 million for NOAO and NSO telescopes, plus $4.0 million for the Telescope System Instrumentation Program (TSIP), which is administered for the community through NOAO. TSIP is a program to unify the privately-held and the national optical and IR observatory facilities.

Funding Profile: All funding for NOAO to date has been provided through the R&RA Account.

NOAO Funding Profile
(Dollars in Millions)

	Implementation	Operations & Maintenance	Total, NSF
FY 1994		28.60	$28.60
FY 1995		29.00	$29.00
FY 1996		27.10	$27.10
FY 1997		28.00	$28.00
FY 1998	3.00	27.90	$30.90
FY 1999	1.40	28.70	$30.10
FY 2000	1.40	28.70	$30.10
FY 2001		31.20	$31.20
FY 2002		36.82	$36.82
FY 2003 Req		35.70	$35.70
FY 2004 Req		38.60	$38.60
FY 2005 Est		38.60	$38.60
FY 2006 Est		38.60	$38.60
FY 2007 Est		38.60	$38.60
FY 2008 Est		38.60	$38.60

NOTE: The current cooperative agreement expires in FY 2006. Estimates for FY 2007 and beyond are placeholders only, and are not intended to reflect actual budget requirements. TSIP funding is included.

Information pertaining to the data in the table is included below.

- Implementation: All construction and commissioning of major telescopes occurred before this reporting period. Recent upgrades have been made in the National Solar Observatory facilities, with the construction of the Synoptic Optical Long-term Investigations of the Sun (SOLIS) telescope in 1998 – 2000.

- Operations and Maintenance: The management and operations budget primarily maintains and utilizes existing facilities and develops new instrumentation for existing telescopes in support of research by the national astronomical community. Basic research by in-house scientific staff accounts for approximately 5 percent of the total budget. Design and development is underway at the National Solar Observatory for an Advanced Technology Solar Telescope (ATST).

Renewal or Termination: The current cooperative agreement expires in FY 2006. A management review will be carried out three years into the current cooperative agreement on the basis of which NSF will decide whether to renew or recompete the program. Funding amounts for FY 2007 and beyond will be determined through negotiation based on proposals received at this time.

Associated Research and Educational Activities: Teacher training includes participation in Project ASTRO and intensive (multi-week) training of about 25 teachers per year through Teacher Learning through Research Based Science Education; K-12 numbers are not tracked but it is estimated that school groups make up about 10 percent of the roughly 75,000 visitors per year to public visitor centers at NOAO and NSO. Observational facilities are also used by approximately 200 graduate students each year and by undergraduate students participating in the REU program.

Science Support: In addition to the funds listed above, approximately $500,000 per year is provided in total from the NSF Division of Elementary, Secondary and Informal Education (EHR), the NSF Division of Atmospheric Sciences (GEO), the Program for Education and Special Programs in the Astronomy Division (REU and teacher enhancement) (MPS), and the NSF Office of International Science and Engineering (INT). For all NOAO and NSO telescopes, a peer-review telescope allocation committee provides merit-based telescope time but no financial support. NSF does not provide awards targeted specifically for use of NOAO. Most users are supported through NSF or NASA grants to pursue scientific programs that require use of NOAO.

National Radio Astronomy Observatory (NRAO)

Project Description: The National Radio Astronomy Observatory (NRAO) is a federally funded research and development center (FFRDC) that provides state-of-the-art radio telescope facilities for use by the scientific community. NRAO conceives, designs, builds, operates and maintains radio telescopes used by scientists from around the world to study virtually all types of astronomical objects known, from planets and comets in our own Solar System to quasars and galaxies billions of light-years away. NRAO operates major radio telescopes at Green Bank, West Virginia and Socorro, New Mexico, with headquarters in Charlottesville, Virginia. These federally funded, ground-based observing facilities for radio astronomy are available to any qualified astronomer, regardless of affiliation, on the basis of scientific peer-reviewed proposals.

Principal Scientific Goals: NRAO supports and advances basic research in the astronomical sciences, including understanding: the geometry and the matter content of the universe; the formation of galaxies, stars and planets; and the nature of black holes.

Principal Education Goals: NRAO supports and enhances the education of undergraduate and graduate student researchers and outreach training for K-12 teachers. The primary education goal is to support the development of a scientifically and technically literate society through a comprehensive outreach program in which information about radio astronomy is made available to the public through the world-wide web and news media. NRAO sites support visitor/education centers; and educational programs are developed in partnership with other institutions. NRAO also supports undergraduate, graduate and post-doctoral students in radio-astronomy scientific research, the design, construction, test and implementation of innovative scientific instruments and telescopes for radio-astronomy and of software tools for the scientific data analysis and for the interpretation of radio-astronomical data.

Partnerships and Connections to Industry: To make the observations needed to sustain radio astronomy research, 2000 scientists from over 150 institutions around the world partner with NRAO. Numerous other U.S. universities, NASA, foreign scientific and technical institutes and industrial vendors are also partners. The development of new telescopes, instrumentation, and sensor techniques is completed in partnership with relevant industry, through competitive subawards to various large and small aerospace companies, radio antenna manufacturing firms, and specialized electronics and computer software companies.

Management and Oversight: Management is through a cooperative agreement with Associated Universities Incorporated (AUI). The NRAO director reports to the President of AUI. Oversight is through detailed annual program plans and long range plans for NRAO, plus quarterly and annual reports. NSF has periodic reviews of AUI management by external committees. Ongoing oversight and evaluation is by an assigned NSF program director (AST/MPS) and by a standing external committee for NRAO.

Current Project Status: Cooperative agreements for continuing management and operations are for terms of five years. The current agreement has been extended to September 30, 2004. A recent management review led to the recommendation, approved by the National Science Board, that AUI continue as managing organization of NRAO after the expiration of this cooperative agreement. A renewal proposal from AUI for operations of NRAO will form the basis of a new 5-year cooperative agreement. The NRAO is engaged currently in three projects: the Expanded Very Large Array (EVLA); the Green Bank 100 Meter radio telescope; and the ALMA submillimeter radio telescope, which received approval as a Major Research Equipment and Facilities Construction project from the National Science Board, winter 2001. NRAO is the implementing organization of the ALMA project. The FY 2004 Request for NRAO totals $42.73 million, an increase of $3.10 million over the FY 2003 Request of $39.63 million. This increase will support continued improvements and enhancements to the EVLA and optimization of science operations of the Byrd Green Bank Telescope.

Funding Profile: All funding for NRAO to date, excluding construction funding for ALMA, which is managed by NRAO, has been provided through the R&RA Account.

NRAO Funding Profile
(Dollars in Millions)

	Implementation	Operations & Maintenance	Total, NSF
FY 1994		29.00	$29.00
FY 1995		29.40	$29.40
FY 1996		29.60	$29.60
FY 1997		30.70	$30.70
FY 1998		31.50	$31.50
FY 1999		33.00	$33.00
FY 2000		33.10	$33.10
FY 2001	5.00	47.10	$52.10
FY 2002	5.00	35.43	$40.43
FY 2003 Req	5.00	34.63	$39.63
FY 2004 Req	5.00	37.73	$42.73
FY 2005 Est	5.00	37.70	$42.70
FY 2006 Est	5.00	37.70	$42.70
FY 2007 Est	5.00	37.70	$42.70
FY 2008 Est	5.00	37.70	$42.70

NOTE: The current cooperative agreement expires in FY 2004. Estimates for FY 2005 and beyond are placeholders only, and are not intended to reflect actual budget requirements.

Information pertaining to the data in the table is included below.

- Implementation: All construction and commissioning of NRAO telescopes occurred before this reporting period. The Observatory is now engaged in a major upgrade to the 25-year-old Very Large Array (VLA) radio telescope located in Soccoro, NM. The Expanded Very Large Array (EVLA) upgrade is in the second year of the 9-year project.

- Operations and Maintenance: Funding for management, operations and maintenance primarily maintains and utilizes existing facilities and develops new instrumentation for existing telescopes in support of research by the national astronomical community. Basic research by in-house staff is less than 5 percent of the total budget.

Renewal or Termination: The current cooperative agreement expires in FY 2004. A recent management review led to the recommendation, approved by the National Science Board, that AUI continue as the managing organization of NRAO after the expiration of this cooperative agreement. A renewal proposal from AUI for operations of NRAO will form the basis of a new 5-year cooperative agreement and funding amounts for FY 2005 and beyond will be determined through negotiation at that time.

Associated Research and Education Activities: NRAO conducts an active educational and public outreach program. The observatories host approximately 50,000 visitors each year to either the Green Bank or the Very Large Array facilities, including school field trips for K-12 students. Observatory professional scientific and engineering staff also visit classrooms regularly to provide an hour of special instruction in the astronomical and radio sciences. Observational facilities are used by graduate students carrying out dissertation research and those on work experience programs and by undergraduate students participating in the REU program.

Science Support: In addition to the funding listed above, approximately $500,000 per year is provided in total from the NSF Division of Elementary, Secondary and Information Education in EHR and the Program for Education and Special Programs in the Astronomy Division. A peer-review telescope allocation committee provides merit-based telescope time but no financial support. NSF does not provide individual investigator awards targeted specifically for use of NRAO. Many users are supported through NSF or NASA grants to pursue scientific programs that require use of NRAO.

National Center for Atmospheric Research (NCAR)

Project Description: National Center for Atmospheric Research (NCAR) is a federally funded research and development center (FFRDC) serving a broad research community, including atmospheric scientists as well as researchers in complementary areas. Facilities available to university, NCAR, and other researchers include an advanced computational center providing resources and services well suited for the development and execution of large models and for the archiving and manipulation of large data sets. NCAR also provides research aircraft, which can be equipped with sensors to measure dynamic physical and chemical states of the atmosphere. In addition, one airborne and one portable ground-based radar system are available for atmospheric research as well as other surface sensing systems.

Principal Scientific Goals: NCAR research programs focus on the following areas: large-scale atmospheric and ocean dynamics that contribute to an understanding of the past and present climate processes and global change, including interactions with other environmental systems; global and regional atmospheric chemistry including geochemical and biogeochemical cycles; the variable nature of the Sun and the physics of the corona; the physics of clouds, thunderstorms, precipitation formation, and the interactions and effects on larger-scale weather; and the examination of human society's impact on and response to global environmental change. In addition, NCAR provides fellowships for visiting scientists to conduct research and interact with NCAR scientists.

Principal Education Goals: NCAR disseminates information about the geosciences to students in K-12, undergraduate, and graduate schools, to postdoctorates, and to the general public. One way this goal is achieved is via educational tours and exhibits reaching tens of thousands of people every year. Professional training, innovative and award-winning science education websites as well as the recent establishment of the Office of Education and Outreach are further examples of the way NCAR's principal educational goals are attained.

Connections to Industry: NCAR works to develop new collaborations and partnerships with the private sector. To this end, the NCAR director has established a new external advisory council comprising influential leaders from all these sectors and charged them with improving dialog and developing more concrete plans for new alliances.

Partnerships: Research collaborations among NCAR staff and university colleagues are integral to its success as an institution, and the strength, variety, and frequency of its interactions with the university community provide metrics of the health of our programs. NCAR fosters and strongly supports these interactions through many approaches devised over the course of 42 years. Examples: 1) The National Wildland Fire R&D Program, which involves collaboration with the National Aeronautics and Space Administration (NASA), the National Oceanic and Atmospheric Administration (NOAA), the Federal Aviation Administration (FAA) and a number of universities, are attempting to resolve the problem of fuel buildup, due to decades of effective fire suppression and housing growth at the wildland-urban interface, which have led to more frequent, serious confrontations between people and fires; 2) Terrestrial Impacts of Solar Output, which involves collaboration with the University of Colorado, Hampton University, the University of Wuppertal, Germany, the Institute of Volcanic Geology and Geochemistry, Russia, and the University of Munich, Germany, who are all studying the anthropogenic effects in the upper atmosphere (where they are frequently much larger than in the lower atmosphere). Such research can provide important information on the magnitude of anthropogenically induced global change at lower levels in the atmosphere, while studies of the downward transport of solar variability effects through the atmosphere provide a basis for understanding the relative importance of solar and anthropogenic variability effects on biospheric global change.

Management and Oversight: NCAR is managed by the University Corporation for Atmospheric Research (UCAR), a university-governed and university-serving organization, with NCAR as its major engine of basic and applied research. UCAR works in partnership with NSF, the university community, and its other sponsors. NSF's Division of Atmospheric Sciences (GEO) along with the Division of Grants and Agreements, provide oversight of this facility via a cooperative agreement with the managing institution, the University Corporation for Atmospheric Research (UCAR). The cooperative agreement consists of terms and conditions and numerous task orders known as Scientific Program Orders (SPO). These SPOs allow NSF to provide oversight and accountability for the activities taking place under the cooperative agreement.

Current Project Status: NCAR has retired the Electra Aircraft from operation, due to age. The ELDORA Radar formerly attached to the Electra has been removed and installed on the Naval Research Lab P-3 aircraft for use during field campaigns. NCAR, managing the acquisition of the Major Research Equipment and Facilities Construction (MREFC) project High-Performance Instrumented Platform for Environmental Research (HIAPER), has contracted with Gulfstream, Inc. to procure a G-V aircraft that should be ready for operation in FY 2005. For further information on HIAPER, see the MREFC chapter. The NCAR's Scientific Computing Division has entered into a contract with IBM to increase its capacity from one to nine Teraflops over the next two years. The FY 2004 Request for NCAR totals $80.09 million, an increase of $5.22 million over the FY 2003 Request of $74.87 million. This increase will support research on Earth's natural cycles, including climate system modeling and the operation of the computation facilities for the Climate Simulation Laboratory; projects within the U.S. Weather Research Program (USWRP) and the National Space Weather Program (NSWP); and continued development of observational and computational capabilities. Included in these amounts, the Division of Mathematical Sciences of the Directorate for Mathematical and Physical Sciences (MPS) provides $1.27 million annually from FY 2002-04 to support statistics and modeling at NCAR.

Funding Profile: All funds for NCAR during this time frame have been provided through the R&RA Account.

NCAR Funding Profile
(Dollars in Millions)

	Implementation	Operations and Maintenance	Total, NSF
FY 1994	$0.85	$54.90	$55.75
FY 1995	$3.95	$59.60	$63.55
FY 1996	$3.90	$59.50	$63.40
FY 1997	$3.88	$59.30	$63.18
FY 1998	$3.42	$60.30	$63.72
FY 1999	$7.47	$64.10	$71.57
FY 2000	$7.50	$64.70	$72.20
FY 2001	$7.53	$70.50	$78.03
FY 2002	$3.75	$73.84	$77.59
FY 2003 Req	$3.84	$71.03	$74.87
FY 2004 Req	$3.94	$76.15	$80.09
FY 2005 Est	$4.04	$78.70	$82.74
FY 2006 Est	$4.14	$82.80	$86.94
FY 2007 Est	$4.24	$87.00	$91.24
FY 2008 Est	$4.30	$91.50	$95.80

NOTE: Estimates for FY 2005 and beyond are placeholders only, and are not intended to reflect actual budget requirements. MPS contributions for statistics and modeling are included.

Information pertaining to the data in the table is included below.

- Implementation: In FY 1999-2001, a project to refurbish the Mesa Lab building located in Boulder, CO was funded and project tasks undertaken. The refurbishment includes upgrade of various facets of NCAR's facilities such as handicap accessibility, wiring systems, structural upgrades, etc. The project will be completed in FY 2005.

- Operations and Maintenance: This funding supports the operation of the NCAR facilities, including supercomputers, instrumented research aircraft and associated flight costs, and ground-based portable observing systems. Routine maintenance costs of the aircraft and facilities are also covered under this category. In addition, approximately half of the management, operations and maintenance amount is used to support science conducted by NCAR scientists.

Renewal or Termination: The decision to renew, recompete, or terminate NCAR is informed by a mid-award review of both science activities as well as management effectiveness. Based on the outcome of this intermediate review, a competitive proposal may be invited for continued operation of NCAR. This proposal is subject to NSF's standard merit review procedures, and is reviewed by both individual reviewers as well as a focus panel composed of preeminent researchers and managers. The current cooperative agreement expires in FY 2003. A proposal for continuing support of NCAR has been submitted and is currently under review. Future funding levels beyond FY 2004 will be dependent on the outcome of that review.

Associated Research and Education Activities: NCAR employs a large number of scientists who pursue research objectives individually and in groups. In addition, numerous external researchers use NCAR facilities to further their research objectives. NCAR has various hands-on displays for K-12 when school-children or citizens come to visit the Mesa Laboratory. Lectures and demonstrations are also provided for students and teachers. Teachers in the table below are those K-12 instructors coming to attend a workshop or bring students to learn about atmospheric sciences. Undergraduate and graduate students are those who arrive at NCAR for a temporary stay to do specific research that usually lasts three months to a year or two at most.

NCAR Participation

Year	K-12	Undergrad	Graduate	Teachers
FY 1994	3,799	*23*	*66*	108
FY 1995	8,477	*23*	*66*	100
FY 1996	5,926	*25*	*65*	47
FY 1997	7,067	*25*	*67*	32
FY 1998	7,063	*26*	*68*	264
FY 1999	9,569	*24*	*69*	90
FY 2000	9,894	*24*	*69*	92
FY 2001	8,995	23	63	101
FY 2002	9,424	*67*	*57*	865[a]

NOTE*: All numbers in italics are estimates.*
[a] The increased number of teachers in FY 2002 includes participants at a series of workshops.

Science Support: NSF-supported researchers with grants totaling approximately $20 million used the aircraft operated by NCAR in FY 2002. This support comes from programs within the Atmospheric Sciences Subactivity for proposals submitted for use of the NCAR aircraft during field campaigns such as IHOP, ACE-ASIA, etc. NSF-supported researchers with grants totaling approximately $30 million used the computational resources of NCAR. Many principal investigators request computing time at the NCAR facility to accomplish analyses required to evaluate results from their proposed work.

National High Magnetic Field Laboratory (NHMFL)

Project Description: The NHMFL develops and operates high magnetic field facilities that scientists use for research in physics, biology, bioengineering, chemistry, geochemistry, biochemistry, materials science, and engineering. It is the largest and highest powered magnet laboratory, outfitted with the world's most comprehensive assortment of high-performing magnet systems. Many of the unique facilities were designed, developed, and built by the world's premier magnet engineering and design team of the NHMFL in collaboration with industry. The facilities are available to all qualified scientists and engineers through a peer-reviewed proposal process.

Principal Scientific Goals: NHFML scientific goals are to provide the highest magnetic fields, state-of-the-art instrumentation, and support services for scientific research conducted by users from a wide range of disciplines, including physics, chemistry, materials science, engineering, biology, and geology.

Principal Education Goals: NHFML promotes science education and assists in developing the next generation of science, engineering, and science education leaders. A variety of programs, opportunities, and mentorship experiences are available for teachers and students at all academic levels-K-12 through post-graduate. The laboratory, with its distinguished faculty and world-class facilities, provides a truly unique interdisciplinary learning environment and has had a national impact in curriculum development.

Partnerships and Connections to Industry: The Magnet Science and Technology (MS&T) Division of the NHMFL is a national resource with broad responsibility to develop magnet and magnetic materials in response to national needs, such as building advanced magnet systems for the NHMFL site, working with industry to develop the technology to improve and address new opportunities in magnet-related technologies and pushing the state-of-the-art beyond what is currently available in high field magnet systems through materials and magnet research. To this purpose, MS&T has established leading capabilities in many aspects of magnet system engineering and assessment. In addition, MS&T cooperates with industry and other laboratories on a variety of magnet technology projects, including advancement in magnet materials. These projects cover the range of analysis, design, materials, component development and testing, coil fabrication, cryogenics, system integration and testing.

The laboratory engages in numerous collaborations as one of its mission objectives "to engage in the development of future magnet technology." NHMFL researchers and staff work aggressively to engage private partners in diverse magnet technology areas. In 2001 the laboratory collaborated with 40 private sector companies, 22 national laboratories and federal centers, and 23 international institutions. In addition, the NHMFL has established numerous partnerships and programs to enhance science education and public awareness. The annual open house, with many hands-on demonstrations, attracts over 3,000 people.

<u>Management and Oversight</u>: The NHMFL is operated for the NSF by a collaboration of institutions comprising Florida State University (FSU), the University of Florida (UF), and Los Alamos National Laboratory (LANL) under a cooperative agreement that sets forth the goals and objectives of the NHMFL. NSF established the NHMFL in 1990 and new facilities were dedicated and open to users in October 1994. FSU, as the signatory of the cooperative agreement, has the responsibility for establishing and maintaining the appropriate administrative and financial oversight and ensuring that the operations of the laboratory are of high quality and consistent with the broad objectives of the cooperative agreement.

The principal investigator serves as the director of the NHMFL. Four senior faculty members serve as co-principal investigators. The laboratory is organized into three functional activities: User Programs, Magnet Science and Technology Programs, and Research Programs. In addition, the NHMFL has an Office of Government and Public Relations that oversees outreach activities, including education and corporate affiliates. Through the organizational network, the director receives guidance and recommendations from staff, the participating institutions, and user communities. Two external committees meet on a regular basis to provide the laboratory with critical advice on important user, management, and operational issues. The Users' Committee, elected by the user community, reflects the broad range of users of all of the NHMFL facilities and provides guidance on the development and use of NHMFL facilities and services in support of users. The External Advisory committee comprises representatives from academic, government, and industrial organizations and the user community and provides advice and guidance on matters critical to the success of the management of the NHMFL.

From the inception of the NHMFL, NSF administration and oversight has been the responsibility of the Executive Officer, Division of Materials Research (MPS) with guidance from an ad hoc working group with representatives from the Division of Chemistry (MPS) and the Directorate for Engineering and the Directorate for Biological Sciences. Site visit reviews are conducted annually. Representatives from other Federal agencies including DOE and NIH are invited to participate as observers at the site visit reviews. In July 2002 a new position of Program Director for National Facilities was established in the NSF Division of Materials Research with primary responsibility for NSF administration and oversight of the NHMFL.

<u>Current Project Status</u>: The NHMFL was established in FY 1990. It is currently moving its primary emphasis from magnet technology and development to a new phase of service to users. A 5-year renewal proposal was reviewed in FY 2000. More than 300 groups currently use the NHMFL facilities annually, and the Laboratory was described by the NSF external review committee as the leading institution of its kind in the world. The NSB approved NSF support for the requested 5-year period (January 2001 through December 2005), making support for the final three years of the award contingent on satisfactory progress in the R&D program, management, and leadership of the Nuclear Magnetic Resonance program. A comprehensive NSF site visit review was conducted in May 2002; progress was assessed as satisfactory

and the NSB was informed of the outcome of this review in October 2002. A further progress review will be conducted early in 2003. The FY 2004 Request for the NHMFL totals $24.50 million, an increase of $500,000 over the FY 2003 Request of $24.0 million. This increase reflects the phasing in of support of the National High Field Mass Spectrometry Facility supported as a separate facility in FY 2003 by the Chemistry Subactivity of MPS.

Funding Profile: All funding for the NHMFL to date has been provided through the R&RA Account.

NHMFL Funding Profile
(Dollars in Millions)

	Implementation	Operations & Maintenance	Total, NSF
FY 1994 & Earlier	28.00	20.00	48.00
FY 1995	6.30	5.70	12.00
FY 1996	6.00	11.50	17.50
FY 1997	6.80	10.70	17.50
FY 1998	5.30	12.20	17.50
FY 1999	5.50	12.00	17.50
FY 2000	5.20	12.30	17.50
FY 2001	6.20	13.80	20.00
FY 2002	7.97	17.00	24.97
FY 2003 Req	6.50	17.50	24.00
FY 2004 Req	6.50	18.00	24.50
FY 2005 Est	6.00	19.00	25.00

NOTE: Estimates for FY 2005 are placeholders only, and are not intended to reflect actual budget requirements.

Information pertaining to the data in the table is included below.

- Implementation: The NHMFL supports a wide range of state-of-the-art magnets and facilities that are continuously upgraded. Recent examples include the development of an ultrasonic spectrometer for use in pulsed high magnetic fields at the Los Alamos facility of the NHMFL, the design and development of an innovative magnet providing uniform transverse field at over 20 tesla, and a design effort currently underway to upgrade six sites with higher field magnets. In addition, the high temperature superconducting magnets and materials group, in collaboration with Oxford Superconductor Technologies, is designing and building a high-field insert coil for the 20 tesla wide-bore resistive magnet. The pulsed magnet group continues to deliver capacitively driven magnets for the Los Alamos user facility, and improved lifetime of the 60 tesla 15 mm bore magnets has been achieved.

- Operations and Maintenance: These funds support the operation of the NHMFL, including magnet technology and development, support for user programs, in-house research, routine maintenance, instrumentation and technical services, and education and outreach programs. The increase for operations and maintenance from FY 2001 to FY 2002 is a significant part of the ramp-up to the increased level of support required as the NHMFL moves from a primary focus on magnet development to a primary focus on research, outreach, and support for users. Specifically, the increased level of maintenance and operations support from FY 2001 to FY 2002 enabled the NHMFL to strengthen its programs for user support, equipment and facility maintenance, educational outreach and partnerships, and in-house research, and to meet increased costs for internal facilities and administration including electricity demand charges to operate high-field magnets.

Renewal or Termination: A progress review is scheduled for FY 2003. In FY 2005 a proposal for a further five years' support will be considered either by renewal or recompetition.

Associated Research and Education Activities: The NHMFL base award currently includes approximately $500,000 per year in support of Research Experiences for Undergraduates and a wide variety of pre-college educational outreach and partnership activities with additional funding from the State of Florida. Supplementary NSF funding of $106,000 per year supports a Research Experiences for Teachers program. The number of K-12 students and teachers, undergraduates, and graduates students participating in these programs is shown in the following table:

NHMFL People Participation

Year	K-12	Undergrad[1]	Graduate[2]	Teachers[3]
FY 1994	1,200	8	N/A	3
FY 1995	1,515	10	N/A	9
FY 1996	3,990	16	N/A	30
FY 1997	4,075	18	19	255
FY 1998	4,080	18	15	547
FY 1999	7,100[a]	20	16	385
FY 2000	4,266	21	22	1,875 [b]
FY 2001	3,959	17	20	1,117
FY 2002 Est	3,500	15	17	1,319

[1]Undergraduates participating in the Summer Minority Program and/or Research Experiences for Undergraduates (REU)
[2]NHMFL-affiliated graduate students earning Ph.D.'s
[3]Reflects teachers participating in workshops, Ambassador Program, and Research Experiences for Teachers
[a]Statewide implementation of curriculum project in 1999
[b]Teacher workshops extended to Connecticut and Illinois in 2000

The NHMFL serves as a national resource for education not necessarily reflected by these numbers. For example, in FY 2001, 70 undergraduates and 33 post doctoral students were supported at NHMFL by other funding sources outside the base award.

Science Support: Users are supported by NSF, other Federal, state and local agencies, other national agencies, and the private sector. User projects and time are allocated by merit on a competitive basis. NSF does not track the level of user support from external sources. The number of user projects averages around 400 per year. The average number of users (individuals) per user project is 5.

Additional Information: The NHMFL is an ongoing partnership between NSF and the State of Florida. The following table shows matching funds over the past ten years and commitments through the end of the current award, together with contributed funds from industry, the State of Florida and other sources over the same period.

Leveraged Funds

	Matching	Contributed	Total
FY 1994[1]	6.13	23.17	29.30
FY 1995	6.29	5.81	12.10
FY 1996	6.44	4.86	11.30
FY 1997	6.60	5.90	12.50
FY 1998	6.60	5.90	12.50
FY 1999	6.72	5.78	12.50
FY 2000	6.91	5.60	12.50
FY 2001	6.78	2.35	9.14
FY 2002	6.78	2.36	9.14
FY 2003 Est	6.78	3.10	9.88
FY 2004 Est	6.78	2.41	9.19
FY 2005 Est	6.78	2.46	9.24
Total $M	79.61	69.70	149.31

[1] FY 1994 contributed funds include State of Florida funds to complete construction.

The NHMFL currently provides facilities to more than 300 user groups annually. The final table shows the average size of user groups (number of individuals per group) at the various facilities of the NHMFL over the past three years. The DC (Direct Current), EMR (Electromagnetic Resonance) and Geochemistry facilities are at Florida State University. There are NMR (Nuclear Magnetic Resonance) facilities at Florida State University and at the University of Florida. The High B/T (Field/Temperature ratio) facility is at the University of Florida; and the Pulsed Field facility is at Los Alamos National Laboratory.

Average User Group Size by Facility

Facility	Average Group Size
Direct Current	4.4
Pulsed Current	4.7
High B/T (Field/Temperature ratio)	9
Nuclear Magnetic Resonance	3.3
Electromagentic Resonance	3.8
Geochemistry	2

National Superconducting Cyclotron Laboratory (NSCL)

Project Description: This project supports the operation of the NSCL at Michigan State University (MSU) as a national user facility and also supports the MSU research program. The NSCL is the leading rare isotope research facility in the United States. NSCL scientists and researchers employ a wide range of tools for conducting advanced research in fundamental nuclear science, nuclear astrophysics, and accelerator physics. Important applications of the research conducted at the NSCL benefit society in numerous areas, including new tools for radiation treatments of cancer patients and the assessment of health risks to astronauts. The NSCL began operations of the coupled cyclotron radioactive beam facility in FY 2002, providing users with unique access to beams of unstable nuclei. The NSCL is among the world leaders in heavy ion nuclear physics and, now nuclear physics with radioactive beams.

The NSCL operates two superconducting cyclotrons. The K500 was the first cyclotron to use superconducting magnets, and the K1200 is the highest-energy continuous beam accelerator in the world. These and other related devices have enabled researchers to learn more about the origins of the elements in the cosmos.

Principal Scientific Goals: Scientists at the NSCL work at the forefront of rare isotope research. They make and study atomic nuclei that cannot be found on earth and perform experimental research using beams of unstable isotopes to extend our knowledge of new types of nuclei, many of which are important to an understanding of stellar processes. Research activities include a broad program in nuclear astrophysics studies, the studies of nuclei far from stability using radioactive ion beams, and studies of the nuclear equation of state. In addition, research is carried out in accelerator physics.

Principal Education Goals: NSCL supports and enhances Ph.D. level graduate education and post-doctoral research experience. In addition, the site provides research experiences for undergraduate students, as well as training for K-12 teachers.

Partnerships and Connections to Industry: NSCL occasionally enters into license agreements with industry for cyclotron technology or nuclear electronics. Specific license agreement with Accel Corporation for compact cyclotrons based on superconducting technology.

Management and Oversight: The NSCL is managed by the Laboratory Director and two Associate Directors: one for Nuclear Science and one for Accelerator Research. During the NSCL upgrade, NSF convened several technical panels to review cost, schedule, technical progress, and management of the project. The NSCL research program is guided by a Program Advisory Committee consisting of external experts as well as an in-house expert, and includes the chairperson of the full NSCL User Group. The procedure for users includes writing and submitting proposals to the NSCL Director and oral presentations. There are two opportunities for proposal submission each year. Approximately 5,000 beam hours for experiments are provided each year. There is generally at least a one-year backlog for experiments. NSF oversight is provided through annual site visits by the cognizant program officer of the Physics Subactivity (MPS) and other staff, accompanied by external experts.

Current Project Status: An experimental program using the recently completed coupled cyclotron facility is now underway. The FY 2004 Request for the NSCL totals $15.20 million, an increase of $500,000 over the FY 2003 Request of $14.70 million. This increase will support full operations and research at this unique radioactive ion beam facility.

Funding Profile: All funding for NSCL to date has been provided through the R&RA Account.

NSCL Funding Profile
(Dollars in Millions)

	Implementation	Operations & Maintenance	Total, NSF
FY 1994		9.40	9.40
FY 1995		9.40	9.40
FY 1996		9.70	9.70
FY 1997	2.10	9.20	11.30
FY 1998	1.90	9.80	11.70
FY 1999	6.00	9.80	15.80
FY 2000	4.70	9.90	14.60
FY 2001	1.00	11.40	12.40
FY 2002	0.40	14.41	14.81
FY 2003 Req		14.70	14.70
FY 2004 Req		15.20	15.20
FY 2005 Est		15.20	15.20
FY 2006 Est		15.20	15.20

NOTE: Estimates for FY 2005 and beyond are placeholders only, and are not intended to reflect actual budget requirements. Estimates for FY 2007 and beyond will be dependent upon a new cooperative agreement.

Information pertaining to the data in the table is included below.

- Implementation*:* The facility was recently upgraded to couple two superconducting cyclotrons and to upgrade the fragment separator to produce intense beams of unstable isotopes providing a facility unique in the world. This recent upgrade of the NSCL to the coupled cyclotron facility was accomplished using $12.0 million in incremental funding from the NSF and over $6 million from MSU. In addition, $4.0 million was provided to upgrade the cryogenic plant.

- Operations and Maintenance: Funding within this category supports the operation of the facility. Such activities include routine preventative maintenance of the two coupled NSCL cyclotrons, including vacuum systems, RF power systems, beam transport systems, the helium refrigerator used to supply coolant for the superconducting cyclotrons, and miscellaneous subsystems, are carried out each quarter. Approximately 25 percent of the funding is directed toward in-house research (both experimental nuclear science and accelerator research & development) with the remainder used to operate and maintain the facility for all users. The facility currently (FY 2003) serves about 150 users per year. This is expected to grow to about 250 users/year following the upgrade.

Renewal or Termination: The current cooperative agreement expires in FY 2006. NSF expects to consider a proposal to renew the program, and funding amounts for FY 2007 and beyond will be determined through negotiation at that time.

Associated Research and Education Activities: The figures shown in the table below under K-12 and Teachers are participants in the NSCL Physics of Atomic Nuclei (PAN) program. This is a two-week summer program sponsored by MSU with the objective to stimulate an interest in science; particularly in female and minority students. The figures shown in the Undergrad column are the approximate number of undergraduates employed by the NSCL to assist researchers or to work with staff members in operating and maintaining the facility. Figures shown under Graduate are the number of students completing their Ph.D. at MSU in each fiscal year. Additional students from other institutions participated in experiments conducted at the NSCL, but figures are not shown.

Participants in the NSCL Physics of Atomic Nuclei (PAN) Program

Year	K-12	Undergrad	Graduate	Teachers
FY 1994	27	45	4	6
FY 1995	25	50	6	6
FY 1996	29	50	7	6
FY 1997	31	65	9	15
FY 1998	25	65	4	9
FY 1999	25	65	4	13
FY 2000	21	65	2	12
FY 2001	20	55	5	13
FY 2002	21	58	6	12

Science Support: Theoretical nuclear physics research at the NSCL is separately supported by annual grants totaling approximately $500,000. Additionally, in several recent years Major Research Instrumentation grants have been awarded which have permitted construction of detectors and other equipment important to the operation of the laboratory as a user facility.

Ocean Drilling Program/Integrated Ocean Drilling Program

Project Description: The Ocean Drilling Program (ODP) is an international partnership of scientists and research institutions organized to explore the evolution and structure of Earth as recorded in the ocean basins. ODP provides sediment and rock samples (cores), shipboard and shore-based facilities for the study of these samples, downhole geophysical and geochemical measurements (logging), and opportunities for special experiments to determine *in situ* conditions beneath the seafloor. The *JOIDES Resolution* is the drillship used to collect geologic samples from the floor of the deep ocean basins through rotary coring and hydraulic piston coring. The logs and samples of the cores are made available to qualified scientists throughout the world for research projects.

Principal Scientific Goals: ODP activities explore the Earth's crust beneath the ocean revealing the composition, structure, and history of the submerged portion of Earth's surface. Through core samples and downhole logging, the drilling program has advanced our understanding of the Earth by providing insights to the pathways of fluids through the oceanic lithosphere, global climate change from areas as diverse as the equator and the Arctic, past changes in sea-level, tectonic evolution of oceanic crust, and the complex processes related to the evolution of passive margins.

Principal Education Goals: Undergraduate and graduate students participate in drilling expeditions, working with some of the world's leading scientists and becoming part of the intellectual fabric essential for future advances in the earth sciences. To reach students that do not participate directly in ODP, investments are made in curriculum enrichment including interactive CD-ROMs, visiting lecture programs, museum displays, and remote classroom broadcasts from the drillship.

Connections to Industry: The drillship is owned and operated by Transocean Seco-Forex, a leading offshore drilling contractor. Schlumberger International, a leading oilfield service company, provides logging services. In addition, scientists from industrial research laboratories participate in ODP cruises, are members of the program's scientific and technical advisory committees, and have supplied data for planning and interpretation of drilling results.

Partnerships: More than 20 countries participate in ODP. NSF provides 60 percent of the funds for program operations, with the remaining 40 percent provided through contribution of funds from the international members. Due to the expense of the facilities necessary to drill deep in the oceanic crust, as well as the need for global coverage, international cooperation is of mutual advantage to participating countries. The ODP is one of the largest science programs in existence today.

Management and Oversight: NSF and agencies in twenty-one other member nations have signed Memoranda of Understanding with the NSF sponsor, The Ocean Drilling Program. NSF manages the program through a prime contract with Joint Oceanographic Institutions, Inc. (JOI), a consortium of major United States oceanographic institutions. JOI has a subcontract with Texas A&M University, which acts as the ODP Science Operator. JOI also has subcontracts with Lamont-Doherty Earth Observatory, which acts as the ODP Logging Operator and the ODP Site Survey Databank. Scientific advice and guidance for ODP is provided through the JOIDES scientific advisory structure. The JOIDES Science Advisory structure is responsible for providing scientific advice and guidance for ODP, and consists of the JOIDES Executive Committee (EXCOM) and a science advisory structure headed by the JOIDES Science Committee (SCICOM). The JOIDES Office, under the direction of the SCICOM Chair, is responsible for the coordination of the JOIDES committees and panels, and for integrating the advice from the panel structure in a manner suitable for providing drilling and operational guidance to JOI.

The Ocean Sciences Subactivity (GEO) manages ODP for NSF. ODP is a program under the Marine Geosciences Section, with several program officers dedicated to its oversight. One of the program officers serves as the contracting officer's technical representative on the prime contract.

<u>Current Program Status and Future Program Planning</u>: Drilling activity under the Ocean Drilling Program is scheduled to end in September 2003, as reflected in the program funding profile below. Plans for a new program of scientific ocean drilling, the Integrated Ocean Drilling Program (IODP), are under consideration. The FY 2004 Request for ODP totals $8.40 million, a decrease of $21.60 from the FY 2003 Request of $30.0 million, which reflects the phaseout of this program.

Although ODP will terminate as planned, ocean drilling is an essential capability in modern geoscience research and education and is used to examine processes ranging from changes in the Earth's climate to the rifting and drifting of continents. Over 600 ocean and earth scientists have completed an internationally-coordinated planning effort to examine the scientific objectives for IODP. These objectives require a heavy vessel for drilling deep sedimentary and crustal holes, a lighter vessel to provide widely distributed arrays of high-resolution cores to address climate, environmental, and observatory objectives, and occasional use of drilling platforms for the Arctic and nearshore projects, which cannot be undertaken from the two primary IODP vessels. The total capital cost required for the two vessels is approximately $600 million. The Ministry of Education, Culture, Sports, Science and Technology (MEXT) of Japan has secured funding of approximately $500 million and is completing construction of the heavy drillship Chikyu (Earth, in Japanese) to address deep drilling objectives in the new program. Chikyu was launched in January 2002, will undergo outfitting and testing in 2003-2006, and will be available for IODP operations in 2007. NSF's planned contribution to the capital costs necessary to fully equip this program includes the acquisition, conversion and outfitting of a vessel suitable to achieve the goals of the light vessel requirement. Further information on this component of the IODP program can be found under Scientific Ocean Drilling in the MREFC Chapter. Finally, a European consortium of 15 countries is being organized to provide the short-term use of chartered drilling platforms for near-shore and Arctic objectives.

NSF and MEXT plan to contribute equally to IODP operations costs, with up to one-third of total costs contributed by the European consortium. NSF is requesting $7.0 million in FY 2004 for startup operations of the IODP program and for planning, design and development of the Scientific Ocean Drilling project through the R&RA Account. Further information on the future operations of IODP can be found under Scientific Ocean Drilling in the MREFC chapter.

<u>Funding Profile</u>: All funding for the operation of the ODP has been provided through the R&RA Account.

ODP Funding Profile[1]
(Dollars in Millions)

	Implementation	Operations & Maintenance	Total, NSF
FY 1994		$28.43	$28.43
FY 1995		$27.55	$27.55
FY 1996		$27.68	$27.68
FY 1997		$27.09	$27.09
FY 1998	$3.00	$26.95	$29.95
FY 1999	$3.00	$28.13	$31.13
FY 2000		$29.50	$29.50
FY 2001		$30.60	$30.60
FY 2002		$31.50	$31.50
FY 2003 Req		$30.00	$30.00
FY 2004 Req		$8.40	$8.40
FY 2005 Est		$5.90	$5.90
FY 2006 Est		$3.40	$3.40
FY 2007 Est		$3.10	$3.10
FY 2008 Est		$0.00	$0.00

NOTE: Estimates for FY 2005 and beyond are placeholders only, and are not intended to reflect actual budget requirements.
[1]Excludes funding for IODP and the acquisition component of the new program, Scientific Ocean Drilling, to be proposed through the MREFC Account. Please see the MREFC chapter additional information pertaining to IODP.

.

Information pertaining to the data in the table is included below.

- Implementation: An upgrade was performed in September/October 1999, which required that the JOIDES Resolution be dry-docked for 58 days. NSF contributed $6.0 million and the ship's operator contributed $1.30 million for repairs and upgrades of the ship and its equipment necessary for the five-year contract extension through FY 2003.

- Operations and Maintenance: The general contractor for the overall management and operation of the ODP is Joint Oceanographic Institutions, Inc. (JOI), a consortium of major United States oceanographic institutions. Drilling operations and science support services (laboratory equipment, technical support, database maintenance, sample storage and distribution) are managed by Texas A&M University. Lamont-Doherty Earth Observatory of Columbia University manages logging. Support for participation and drilling-related research performed by U.S. scientists is provided by NSF.

Renewal or Termination: At its inception, the Ocean Drilling Program was planned as a fixed duration program. The contract for the ship the program has utilized expires at the end of FY 2003, and at that time, the Ocean Drilling Program will officially end.

Associated Research and Education Activities: A breakdown by year and by categories is reflected in the table below. Much of the support for Education and Outreach activities in ODP is through a cooperative agreement with JOI Inc., which has resulted in various educational products and services described here in brief. Two educational CD-ROMs with teaching activities have been developed and widely distributed. An educational poster titled, "Blast from the Past," describing the meteorite impact that led to the demise of the dinosaurs was printed, and 64,000 copies have been distributed. A brochure of abstracts (text and figures), highlighting 17 of the Ocean Drilling Program's greatest scientific accomplishments, was published and distributed. JOI also publishes a newsletter three times a year with a distribution of about 2,000. In addition, a display of ODP materials was produced and contributed to the Smithsonian Museum, in Washington DC, where it has been on permanent display since 1997. This display is viewed daily by thousands of museum visitors (numbers are not reflected in the table below).

The services of the program are also listed here in brief. A Distinguished Lecturer Series, through which each year, approximately 6 lecturers give a total of about 30 lectures at universities, colleges, and other institutions throughout the country. A new Undergraduate Student Trainee Program enables undergraduates to sail on a research vessel as members of the scientific team. Mentors and scientific projects are an integral part of this program. An internship program at JOI Inc. was initiated two years ago as an attempt to introduce recent graduates to the career opportunities of science program management. A longstanding fellowship program provides graduate student fellowship awards to conduct ODP research. Each year, JOI sponsors educational and promotional booths at national and international meetings where products and services are highlighted. The ODP drillship JOIDES Resolution has visited U.S. ports approximately 8 times since 1994. At each visit, ship tours are given, and promotional and educational activities have been held at four of these port calls. JOI/ODP sponsors scientific research and planning workshops that commonly involve graduate students. And lastly, many graduate students have sailed on the JOIDES Resolution.

ODP Participation

Year	K-12	Undergrad	Graduate	Teachers
FY 1994	620	1,500	1,300	700
FY 1995	620	1,550	1,400	700
FY 1996	620	1,500	1,400	700
FY 1997	2,620	6,210	4,900	1,800
FY 1998	1,300	4,110	3,800	1,300
FY 1999	2,600	5,740	5,900	2,200
FY 2000	17,600	13,680	7,400	4,200
FY 2001	5,600	9,750	9,400	9,700
FY 2002 Est	7,000	8,000	10,000	7,000

Science Support: NSF provides most of the support for the participation of U.S. scientists in the ODP. The majority of the funding comes from the Ocean Sciences Subactivity (GEO), with additional funding from the Office of Polar Programs related to Antarctic drilling research. Total funding for U.S. participation and analysis of samples and data is approximately $15 to $18 million annually.

Over 1,500 scientists from forty nations have participated on ODP cruises since 1985. About 700 of these have been U.S. scientists from 150 universities, government agencies, and industrial research laboratories who have participated in ODP cruises, with about 300 of them participating in more than one ODP cruise. Samples and data have been distributed to an additional 700 to 800 U.S. scientists. These 1,400 to 1,500 direct U.S. users of ODP materials constitute approximately 10 to 15 percent of the U.S. Geoscience community as identified by the American Geological Institute.

Partnerships for Advanced Computational Infrastructure

Project Description: The PACI Program supports two partnerships: the National Computational Science Alliance (Alliance) and the National Partnership for Advanced Computational Infrastructure (NPACI).

Each partnership consists of a leading edge site, the National Center for Supercomputing Applications in Urbana-Champaign (Alliance) and the San Diego Supercomputer Center in San Diego (NPACI), and a significant number of partners. There are more than 60 geographically distributed partner institutions from 27 states and the District of Columbia associated with either Alliance or NPACI or both. The two leading edge sites, together with the partners who support smaller versions of these computers and provide access to experimental systems, constitute a distributed, metacomputing environment connected via high-speed networks. In addition, the partners contribute to the infrastructure by developing, applying and testing the necessary software, tools, and algorithms which contribute to the further growth of this "national grid" of interconnected high-performance computing systems.

Principal Scientific Goals: The PACI Program has four major goals: (1) to provide access to a diverse set of advanced and mid-range computing engines and data storage systems and experimental machine architectures; (2) to promote enabling technologies, by developing both software tools for parallel computation and software to enable use of the partnership's widely distributed architecturally diverse machines and data sources to effectively use the partnership's very large distributed systems; (3) to promote application technologies, by engaging groups in high-end applications to develop and optimize their discipline specific codes and software infrastructures and to make these available to the program as a whole, as well as to researchers in other areas; and (4) to provide education outreach and training, building growing awareness and understanding of how to use high performance computing and communications resources, and broadening the base of participation to help ensure the nation's continued world leadership in computational science and engineering.

Principal Education Goals: The three goals of PACI Education Outreach and Training Activity are: 1) to demonstrate the use of NSF PACI technologies and resources among diverse audiences by leveraging PACI thrust/team efforts; 2) to increase the participation of underrepresented groups, including persons with disabilities, in computer science, engineering, and information technology; and 3) to enable broad national impact in education, government, science, business, and society with systemic, sustainable, scalable programs.

Partnerships and Connections to Industry: The PACI program by definition is a partnership program. Each of the two leading edge sites has a large number of academic partner institutions. Some, but not all of the academic partners contribute computational resources to the PACI Program. Resource Partners include: University of Texas, Caltech, University of Michigan, University of California, Berkeley, University of New Mexico, University of Wisconsin, Boston University, and University of Kentucky. Other partner institutions contribute to the PACI efforts in enabling and applications technologies. In all, the Alliance has 57 partner institutions, and NPACI has 55 partners. There are also international partnerships. Examples of partnerships include joint work with the Advanced Computational Modeling Centre at the University of Queensland in Australia, with the Parallel Computing Center at the Royal Institute of Technology in Stockholm, Sweden and with the Center for Research on Parallel Computation and Supercomputers in Naples, Italy.

The PACI Partnerships have a number of industrial strategic partnerships with Fortune 500 Companies including: Allstate Insurance Company; The Boeing Company; Caterpillar Inc.; Eastman Kodak Company; J. P. Morgan; Kellogg Company; Motorola, Inc.; Sears, Roebuck and Co.; Shell Oil Company; Arena Pharmaceuticals; BAE Systems; Brocade; Ceres, Inc; Computer Science Corp.; Pfizer; JVC; Lockheed Martin; and ESRI. They also have strategic technology partnerships with a number of companies including ANSYS, Inc.; Informix Corp.; Microsoft Corp.; SGI; Sun Microsystems; IBM; Qwest; Oracle; Compaq; Storage Tek; and Intel.

Management and Oversight: The PACI Partnerships are funded through cooperative agreements that define their responsibilities. The Partnerships are expected to manage their own operations and resources with oversight provided by the NSF PACI Program Officer (CISE). Each Partnership is required to have an Executive Committee, an External Visiting Committee, a User Advisory Committee, and a Resource Allocation Committee. A National Resource Allocation Committee meets semi-annually to review and make recommendations on large resource requests. Enabling Technology and Application Technology Teams that receive funding through the Partnerships must submit annual Statements of Work and quarterly progress reports. The Partnerships submit annual reports and program plans that are reviewed by a Program Review Panel comprised of experts external to NSF. Recommendations of the Program Review Panel and recommended actions are acted upon by the NSF program officer and reviewed by the Division Director. The PACI program had a Committee of Visitors review in 2002, which found the program to be very well managed. PACI was also reviewed in 2001-2002 by an external advisory committee which also found it to be successful and made suggestions for changes consistent with a new vision of cyberinfrastructure.

Current Project Status: FY 2002 marked the last year of the 5-year PACI cooperative agreements. An Advisory Committee on Cyberinfrastructure was chartered in April 2001 and charged with: 1) evaluating the performance of the PACI Program in meeting the needs of the scientific research and engineering community; 2) recommending new areas of emphasis for the NSF Computer and Information Science and Engineering Activity that will respond to the future needs of this community; and 3) recommending an implementation plan to enact any changes anticipated in the recommendations for new areas of emphasis. A one-year extension was approved by the National Science Board to allow the NSF to study the recommendations of the Advisory Committee and formulate a follow-up to the current program. Contingent on the recommendation of the Advisory Committee on Cyberinfrastructure, NSF anticipates modifying and extending the cooperative agreement for a period of 1 to 4 years. The FY 2004 Request for PACI totals $76.49 million, an increase of $5.0 over the FY 2003 Request of $71.49 million. This increase will support increased operations costs, small projects that often support outreach and training, and additional costs the PACI sites incur as part of working with the Pittsburgh-based Terascale Computing System.

Funding Profile: All funds for the operations and maintenance of PACI to date have been provided through the R&RA Account.

PACI Funding Profile
(Dollars in Millions)

	Implementation	Operations & Maintenance	Total, NSF
FY 1994 & Earlier			0.00
FY 1995			0.00
FY 1996			0.00
FY 1997			0.00
FY 1998	$21.30	$38.80	60.10
FY 1999	$23.90	$45.60	69.50
FY 2000	$27.20	$42.80	70.00
FY 2001	$21.90	$51.40	73.30
FY 2002	$25.90	$49.37	75.27
FY 2003 Req	$25.00	$46.49	71.49
FY 2004 Req	$25.00	$51.49	76.49

NOTE: The current cooperative agreement expired in FY 2002 and was extended until FY 2003 (see below). Estimates for FY 2005 and beyond will be dependent upon a new cooperative agreement.

Information pertaining to the data in the table is included below.

- Concept/Development: Concept planning for PACI was done in the 1995-1997 time frame. The Advisory Committee for Cyberinfrastructure, whose report is anticipated in FY 2003, is expected to suggest some revisions to the program.

- Implementation: Implementation of the PACI facility included initial development of supercomputing facilities and includes continued upgrades to those facilities to maintain the highest performance computing possible. The Partnerships use approximately one third (actuals range from about 32 to 38 percent) of their annual budget for upgrades to keep their computational, storage and networking resources up to the current state-of-the-art. These funds provide a continual technology refreshment for existing resources which currently have a useful lifetime of approximately three years.

- Operations and Maintenance: The Operations and Maintenance data include funds that support the development of enabling and applications technologies. Approximately half of the funds listed are designated for this purpose. These funds, as defined in the PACI cooperative agreements are to develop technologies that facilitate the efficient use of the computational resources provided by the program. Funding for FY 2004 and beyond is dependent upon the recommendations of the Advisory Committee on Cyberinfrastructure.

Renewal or Termination: The current cooperative agreement expired in FY 2002 and was extended with approval by the National Science Board for one additional year. Contingent on the recommendation of the Advisory Committee on Cyberinfrastructure, NSF anticipates modifying and extending the cooperative agreement for a period of 1 to 4 years, and funding levels for FY 2005 and beyond will be negotiated at that time.

Associated Research and Education Activities: The table below indicates the impact that the PACI Program has had in the area of Education, Outreach and Training (EOT). The base funding for the EOT-PACI component amounts to approximately 5 percent of the fund for the two PACI cooperative agreements. The EOT-PACI leadership team is comprised of members from both the NPACI and the Alliance Partnerships. The funds they receive through the PACI Program are highly leveraged through donations from private foundations and through NSF funding from EHR and other programs within the NSF. They have designed and administered numerous programs for underrepresented groups including Minority Serving Institutions, the Coalition to Diversity Computing, GirlTech, Teacher Education and Training Programs, etc. The numerous activities of the PACI-EOT team may be found at http://www.eot.org.

PACI Participation

Year	K-12	Undergrad	Graduate	Teachers
FY 1998	3,910	370	60	330
FY 1999	6,300	500	150	420
FY 2000	4,000	460	70	350
FY 2001	6,200	4,600	150	1,300
FY 2002	11,300	730	170	550

NOTE: FY 2001 Undergrads include 3,000 BioQuest-related undergrads. The large number in Teachers for that year is also related to BioQuest. In FY 2002, K-12 participants include a Girl Scout outreach program in the San Diego area.

Science Support: The PACI Program provides access to leading-edge computational resources for all areas of scientific and engineering research supported by the NSF. Percent usage of resources by NSF Directorate Activity are shown in the following table:

Resource Usage, by NSF Directorate

NSF Activity	Percentage of Users[1]	Percentage of Usage
BIO	7%	17%
CISE	23%	11%
ENG	10%	7%
GEO	12%	6%
MPS	27%	55%
SBE	10%	4%

[1]Totals do not add to 100%, as the remaining 11% of users are center staff and industrial participants.

It is estimated that the average annual support of the research groups using these facilities is in excess of $200 million. This is an estimate based on the number of users. There are approximately 600 projects, with an average of five to six users. We assume that approximately 200 large projects have an estimated grant support of $500,000 per year; approximately 400 smaller projects have estimated grant support of about $250,000 per year. The net support for these projects is thus estimated to be $200 million per year.

The PACI Partnership Program is a highly leveraged activity with cost sharing contributions from State Government, University, Private Foundations, and Industrial Vendors. From FY 1998-2000 the base support provided through the NSF PACI Program is approximately $200 million and, was matched by a total of $142 million from these other sources.

Other Facilities

Other Facilities support includes continued support for the National Nanofabrication Users Network (NNUN), an integrated network of nanofabrication user facilities at Cornell University, Stanford University, Howard University, Pennsylvania State University, and University of California at Santa Barbara. NNUN itself ends in FY 2003, with the expanded National Nanotechnology Infrastructure Network beginning in FY 2004. Support for NNIN in FY 2004 totals $11.70 million, an increase of $5.50 million over the FY 2003 funding of NNUN of $6.20 million.

Other items within this category include facilities for computational sciences, physics, materials research, ocean sciences, atmospheric sciences, and earth sciences.

OTHER TOOLS

Advanced Networking Infrastructure (ANI)

Advanced Networking Infrastructure (ANI) activities enable and expand scholarly communication and collaboration by providing researchers and educators with network access to high performance, remote scientific facilities including supercomputer facilities and information resources. The very high performance Backbone Network Service (vBNS), now ending its three-year, no-cost extension phase, together with the high performance connections program, have led to the development of a new level of networking for the nation's research universities, including the UCAID/Internet2 operated network Abilene. ANI participates, through focused efforts such as the Network Middleware program, in accelerating the development and deployment of new technologies in the university-led Internet2 effort jointly supported by the participating universities and the private sector. In FY 2003, ANI will begin programs in Experimental Infrastructure Networks and in Network Research Testbeds. NSF's FY 2004 support for ANI facilities is $46.42 million, a decrease of $200,000 from the FY 2003 Request of $46.62 million.

Cyberinfrastructure

A cyberinfrastructure focus will begin in FY 2004 with requested funding of $20.0 million. Cyberinfrastructure will link computational and data resources (building on experience being gained with Terascale computing efforts) with sensors and instruments, advanced software and middleware to enable distributed systems and analysis, and visualization resources and facilities to promote understanding of science and engineering applications. The promise and demand for cyberinfrastructure has been articulated in a draft NSB report on "Science and Engineering Infrastructure for the 21st Century: the Role of the National Science Foundation." (NSB-02-190). An upcoming report from an NSF Advisory Committee will also provide recommendations. The needs and opportunities in cyberinfrastructure are great at this time, due to rapidly increasing volumes of data generated by scientific instruments and sensors, the increasing capability (with decreasing costs) of computing, networking and sensors, and the demonstration in all fields of the potential for revolutionizing science and engineering.

Major Research Instrumentation (MRI)

The Major Research Instrumentation program is designed to improve the condition of scientific and engineering equipment for research and research training in our nation's academic institutions. This program seeks to foster the integration of research and education by providing instrumentation for research-intensive learning environments. In FY 2004, NSF requests $90.0 million, an increase of $36.0 million from the FY 2003 Request of $54.0 million, for continued support of the acquisition and development of research instrumentation for academic institutions. A significant portion of the increase will focus on ensuring the availability of cutting-edge research instrumentation to a broad set of academic institutions, including undergraduate institutions, minority-serving institutions, and community colleges. To facilitate broader participation in the MRI program, NSF will significantly reduce or eliminate the MRI cost-sharing requirement for small and minority institutions.

National High Field Mass Spectrometry Facility

The National High Field Mass Spectrometry (NHFMS) facility is located at the National High Magnetic Field Laboratory (NHMFL) in Tallahassee, Florida. Its purpose is to develop and exploit the unique capabilities of Fourier Transform Ion Cyclotron Resonance (FT-ICR) mass spectrometry. To that end, the NHFMS facility is routinely used to analyze samples that require ultrahigh resolution and high mass accuracy of FT-ICR. Examples of the ultrahigh resolution provided by this technique include the precise identification of thousands of molecular components in complex biological, pharmaceutical, or petroleum samples. In FY 2004, this facility will be integrated into the NHMFL and supported at $500,000. Future funding will be provided through the NHMFL.

National STEM Education Digital Library

A National STEM Education Digital Library (NSDL) responds to needs articulated by the NSF, the academic community, and corporate leaders for accelerating improvements in science, technology, engineering and mathematics (STEM) education. The NSDL, capitalizing on recent developments in digital libraries, will provide: a forum for the merit review and recognition of quality educational resources; a mechanism for electronic dissemination of information about high-quality educational materials, pedagogical practices, and implementation strategies; a centralized registry and archive for educational resources; and a resource for research in teaching and learning. In addition, the NSDL will provide an infrastructure to support and accelerate the impact of NSF programs. For example, developers of curricula and courses will benefit from awareness and knowledge of extant instructional materials, as well as information on their implementation. NSF support for the NSDL in FY 2004 totals $23.80 million, a decrease of $3.70 million from the FY 2003 Request of $27.50 million

Polar Logistics

Arctic research support and logistics is driven by and responsive to the science supported in U.S. Arctic Research programs. Funding for logistics is provided directly to grantees or to key organizations that provide or manage Arctic research support and logistics. Major components include: access to U.S. Coast Guard and other icebreakers, University-National Oceanographic Laboratory vessels and coastal boats, and support on the U.S. Coast Guard Cutter *Healy*; access to fixed and rotary-wing airlift support; upgrades at Toolik Field Station, University of Alaska, Fairbanks' field station for ecological research on Alaska's North Slope; safety training for field researchers and funding for field safety experts, global satellite telephones for emergency response, and improved logistics coordination; development of a network of strategically placed U.S. Long-Term Observatories linked to similar efforts in Europe and Canada; and installation of a modern local area network in Barrow/Naval Arctic Research Laboratory with improved access to the Internet.

U.S. Antarctic Logistical Support is provided by U.S. Department of Defense components. Major elements include: Military personnel of the 109th Airlift Wing (AW) of the New York Air National Guard; 109th AW LC-130 flight activity and aircraft maintenance; transportation and training of personnel in connection with the U.S. Antarctic Program; logistics facilities of the Air Force Detachment 13 in Christchurch, New Zealand and the 109th Airlift Wing in Scotia, New York; air traffic control, weather forecasting, and electronic equipment maintenance; charter of Air Mobility Command Airlift and Military Sealift Command ships for the re-supply of McMurdo Station; fuel purchased from the Defense Logistics Agency; and use of Department of Defense satellites for communications.

NSF is requesting $97.07 million for Polar Logistics, an increase of $3.0 million over the FY 2003 Request of $94.07 million. This increase in Arctic Logistics support will provide for up to 30 additional projects throughout the Arctic including Alaska, Canada, the Arctic Ocean, Greenland, Scandinavia and Russia; modest upgrades at Toolik Field Station, University of Alaska, Fairbanks' field station for ecological research on Alaska's North Slope; begin development of a network of strategically placed U.S. Long-Term Observatories linked to similar efforts in Europe and Canada; and installation of a modern local area network in Barrow/Naval Arctic Research Laboratory with improved access to the Internet. Support provided by DoD for the U.S. Antarctic Logistics program is level in FY 2004, at $68.07 million.

Research Resources

Research Resources supports a range of activities throughout the Research and Related Activities Account including: multi-user instrumentation; mid-scale instrumentation, the development of instruments with new capabilities, improved resolution or sensitivity; upgrades to field stations and marine laboratories; support of living stock collections; facility-related instrument development and operation; and the support and development of databases and informatics tools and techniques. These various resources provide the essential platforms and tools for effective research in all areas of science and engineering. In FY 2004, funding for Research Resources totals $128.85 million, an increase of $22.49 million over the FY 2003 Request of $106.36 million.

Science Resources Statistics

Science Resources Statistics provides researchers and policymakers with data and information that is the basis for making informed decisions and formulating policy about the nation's science, engineering and technology enterprise. The primary statistical series produced by the Science Resources Statistics Subactivity includes the education and employment of scientists and engineers and the performance and financial support of research and development. NSF is requesting an additional $1.11 million over the FY 2003 Request of $23.36 million, to a total of $24.47 million in FY 2004. Funding enables NSF to fulfill its statutory mandate to produce data and analysis on the scientific and engineering enterprise, and provides funds to support survey redesign activities and quality improvement projects.

Science and Technology Policy Institute

The Science and Technology Policy Institute (STPI), a federally funded research and development center (FFRDC), provides analytical support to the Office of Science and Technology Policy (OSTP) to identify near-term and long-term objectives for research and development, and identifies options for achieving those objectives. NSF is requesting $4.0 million in FY 2004, level with support requested in FY 2003.

FY 2004 PERFORMANCE GOAL FOR TOOLS

The following table summarizes NSF's FY 2004 Performance Goal for TOOLS. For additional information, see the FY 2004 Performance Plan.

STRATEGIC OUTCOME GOAL	NO. ANNUAL PERFORMANCE GOAL[A]	FY 2004 AREAS OF EMPHASIS PROSPECTIVE REPORTING: INVESTMENTS IN EMERGING OPPORTUNITIES	RETROSPECTIVE REPORTING, AS RELEVANT
TOOLS **Providing "broadly accessible, state-of-the-art and shared research and education tools."**	**III-2** ***NSF's performance for the TOOLS Strategic Outcome is successful when, in the aggregate, results reported in the period demonstrate significant achievement in the majority of the following indicators:*** • Development or provision of tools[D] that enables discoveries or enhances productivity of NSF research or education communities; • Partnerships with local, state or federal agencies, national laboratories, industry or other nations to support and enable development of large facilities or other infrastructure; • Development or implementation of other notable approaches or new paradigms[E] that promote progress toward the TOOLS outcome goal.	❑ Major Research Equipment and Facilities Construction (MREFC) ❑ Cyberinfrastructure ❑ Science Resources Statistics (SRS) Survey Redesign	❑ Major Research Equipment and Facilities Construction (MREFC) ❑ Major Research Instrumentation (MRI) Program ❑ Science and Engineering policy analyses, information, reports and databases ❑ Scientific databases and tools for using them, including the National STEM Education Digital Library

A This performance goal is stated in the alternate form provided for in GPRA legislation.

D For example, includes research and education infrastructure such as large centralized facilities, or integrated systems of leading-edge instruments, or databases, or widely utilized, innovative computational models or algorithms, or information that provides the basis for a shared-use networked facility.

E For example, broad-based, program-wide results that demonstrate success related to management/utilization of large data sets/information bases, or development of information and policy analyses, or use of the Internet to make STEM information available to NSF research or education communities, or exceptional examples of broadly accessible tools shared by NSF research and education communities.

Highlights of Recent Accomplishments - Tools

Advanced Research Computing System (ARCS). Atmospheric scientists now have access to powerful new computational, storage, and communications technologies provided by the National Center for Atmospheric Research (NCAR) with the purchase of a new IBM SP supercomputer, code-named Blue Sky, to be followed by the latest-generation technologies, in a three-phase acquisition. The new system is expected to accelerate research in global and regional climate change, droughts, short- and long-range weather prediction and warnings, wildland fires, turbulence, atmospheric chemistry, space weather, and other critical areas. The addition of Blue Sky to NCAR's computing center is the single biggest increment in raw computing power in NCAR history. ARCS will provide U.S. scientists with the speed, efficiency, and data storage space they need to stay at the forefront of research in climate, weather, and many other essential areas. The center provides supercomputing power, as well as observing facilities, to atmospheric researchers at universities around the nation.

Robotic undersea exploration. The Autonomous Benthic Explorer (ABE), the first vehicle of its kind, was developed because of scientists' frequent need to monitor an area over long periods of time, which is very expensive using a surface ship with submersibles such as Alvin. ABE is a true robot, able to move on its own with no pilot or tether to a ship, designed to perform a predetermined set of maneuvers to take photographs and collect data and samples within an area about the size of a city block. It will then “go back to sleep,” conserving power to enable months of repeating these tasks. Its developers envision that in the future underwater acoustic transmission systems now being developed will allow scientists anywhere in the world to receive video and data from ABE and to control its movement and measurements from their home laboratories.

Telemedicine technology at the South Pole. A meteorologist wintering over at the South Pole underwent successful knee surgery with the help of a telemedicine link between the South Pole and doctors at Massachusetts General Hospital. The physician at the South Pole, assisted by an orthopedic surgeon and an anesthesiologist in Boston, Massachusetts, carried out the operation. Two-way voice and video links between the U.S. and Antarctica have been used to assist in medical procedures before, but this is the first time that telemedicine has been used for surgery.

Completion of the Pegasus runway. This past season a compacted snow/ice runway was created at McMurdo Station, Antarctica that is capable of supporting all types of wheeled transport aircraft. This development enables large, wheeled aircraft to operate season long between Christchurch, New Zealand, and McMurdo Station, thereby freeing up the ski-equipped LC-130’s to maximize the numbers of intra-continental flights devoted to Antarctic science or construction. The runway also provides the opportunity to extend the science season.

Improved infrastructure for support of Arctic science. NSF continued to improve infrastructure for Arctic science at Toolik Lake field station, including completing improvements to the kitchen, bathroom and sleeping facilities, and improving the internal laboratory layout. Toolik now accommodates up to 100 scientists during the peak summer months, double the capacity of just three years ago.

Continual queries. NSF-supported investigators have introduced the concept of Continual Queries (CQ) and have developed techniques that monitor events and notify the user of changes whenever updates of interest happen. This system has been used by the National Cancer Institute to track cancer clinical trial information over a dozen information sources. It helps cancer researchers, patients, friends, and relatives track new treatments and new cancer trials of interest. This research has led to the current wide interest in data stream research technologies. Application areas include logistics and unified access to about 500 biological databases.

Assessment of children's attention. Accurate assessment of children's attention is essential for continued examination of the role of attention in the development of skills such as literacy and numeracy as well as examination of the neurological substrates of attention. NSF-supported scientists have developed the Attention Network Task (http://www.sacklerinstitute.org/), a database to reliably assess orienting and alerting aspects of attention in children. The Attention Network Task is being used to track an attention-oriented literacy-training program that is showing initial promise in the laboratory and in public school settings. As well, they are also using this task to link genetic, electroencephalograms (EEG), and functional magnetic resonance imaging (fMRI) findings to attentional behavior. Other researchers have begun to use the Attention Network Task to study Attention Deficit Hyperactivity Disorder (ADHD), autism, child abuse, and other conditions that might affect attentional functioning.

National High Magnetic Field Laboratory (NHMFL). The National High Magnetic Field Laboratory provides the highest continuous magnetic fields in the world, including the only magnet system in the world providing a 45 tesla steady field. The 45-T magnet is available as a user facility for basic research. It provides unique opportunities to users from the U.S. and worldwide for groundbreaking research in a variety of disciplines ranging from condensed matter physics to materials science, chemistry, biology and engineering. Many of the technologies used in developing the high field magnet systems at the NHMFL have been developed in collaboration with private industry. The NHMFL is supported in partnership by NSF and the State of Florida, and is operated cooperatively by Florida State University, the University of Florida, and the Department of Energy's Los Alamos National Laboratory.

Dive and Discover. "Dive and Discover" is an interactive distance learning Web site designed to immerse students in the excitement of discovery and exploration of the deep seafloor. Six expeditions to the seafloor have been completed. The most recent expedition was an exploration of the Galápagos Rift hydrothermal vents that commemorated the discovery of the first hydrothermal vent communities 25 years ago. The Dive and Discover web site (http://www.divediscover.whoi.edu) contains information intended for both teachers and students. Daily updates, slide shows, videos, and e-mail correspondence with scientists aboard research vessels allow students to follow the progress of the scientific mission and get a taste of life aboard a research vessel. The Educator's Companion portion of the site gives teachers access to classroom integration tips including background information, interactive learning modules, and assessment tools.

The Panel Study of Income Dynamics (PSID). The PSID meets NSF's strategic performance goal "to provide broadly accessible, state-of-the-art and shared research and education tools." With thirty-plus years of data on the same families, the PSID can be considered a cornerstone of the infrastructure support for empirically-based social science research. The PSID is a longitudinal survey initiated in 1968 of a nationally representative sample for U.S. individuals and the family units in which they reside. The major objective of the panel is to provide shared-use databases, research platforms and educational tools on cyclical, intergenerational and life-course measures of economic and social behavior. PSID has been central to the fundamental understanding of key social science issues with substantial broad impacts on society: income, poverty and wealth; cyclical behavior of wages, labor supply and consumption; savings, wealth accumulation and transfers; demographic events (teen childbearing, marriage, divorce, living arrangements, mortality); labor market behavior; and the effects of neighborhoods. PSID data are being used to assess current government policies such as the impact of welfare reform on low-income, African-American and Hispanic families. A consortium of government agencies supports PSID, including NSF, NIA, HHS, HUD and USDA. http://www.isr.umich.edu/src/psid/

Dissemination of information by Federal agencies while protecting confidentiality. NSF support has enabled development of computer algorithms that use geographical aggregation to disseminate, as nearly as possible at the county level, data that previously were disseminated only at the state level. The algorithms also allow characterization of inferences drawn from the released information. Systems were built to implement geographical aggregation in real time, producing maps and other forms of output that disseminate information safely and in unprecedented detail. The Web-based system for geographical aggregation, with its powerful graphical user interface, is usable by sophisticated researchers and by citizens with less technical training. The project is developing an entirely new paradigm for disseminating information derived from confidential data, balancing the utility of the released information against disclosure risk.

Water resources. The NSF Science and Technology Center for Sustainability of semi-Arid Hydrology and Riparian Areas (SAHRA) provides scientists from many different disciplines an opportunity to engage in field research that addresses fundamental water resource questions. Desert streams provide aesthetic, environmental, and economic resources. Questions being investigated include how changing land uses, droughts, fire management policies, and other factors have affected vegetation in the semi-arid Southwest and how vegetation changes impact surface water runoff and recharge of groundwater aquifers.

Science research assists the Joint Strike Force Fighter program. As an example of basic science research yielding unforeseen benefits, the Joint Strike Force Fighter program is reaping rewards from the NSF investment in the Laser Interferometer Gravitational-wave Observatory (LIGO) facility. Designed to hunt for gravity waves (a fundamental physics concept championed by Albert Einstein), LIGO's lasers need to be extremely precise. NSF-supported Stanford researcher Robert Byer loaned one of the LIGO technologies for refining laser light to General Electric, which uses lasers to detect defects in the body panels of the Joint Strike Fighter. The laser technology reduced the amount of time required for some of the aircraft's inspection process by a factor of ten, resulting in a substantial cost savings in manufacturing this next-generation fighter.

Administration and Management

The National Science Foundation's (NSF) leadership in advancing the frontiers of science and engineering research and education is made possible by its commitment to excellence in Administration and Management (A&M). The agency has a solid history of leveraging its expert, motivated workforce, its mission-essential management processes, and its state-of-the-art technological resources to promote the progress of science and engineering through investments in *People, Ideas,* and *Tools*.

The Request is built around the strategic goals identified in the NSF Strategic Plan for A&M:

- Human Capital: A diverse, agile, results-oriented cadre of NSF staff committed to supporting the agency's mission and to expanding their abilities constantly to shape the agency's future.

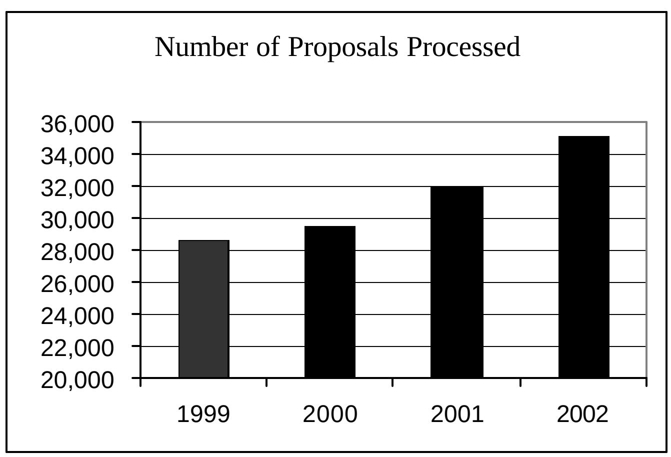
- Business Processes: Effective, efficient, strategically aligned business processes that integrate, capitalize on and are shaped by the agency's human capital and technology resources.

- Technologies and Tools: Flexible, reliable, state-of-the-art business tools and technologies designed to support the agency's mission, business processes, and customers.

These goals provide the framework for the proposed FY 2004 investments in A&M. The budget is built around two principal investments, **Human Capital** and **Technologies and Tools**, which in turn enable NSF's Business Processes.

There is a direct correlation between the growth of the core mission and the amount of funding needed to support operations that achieve the mission. Historically, as NSF programmatic budgets have increased, the A&M budget has not kept pace proportionately, thus straining the ability to maintain high service levels. Special budgetary attention to operations is essential in FY 2004 in order to support recent and future advancements adequately.

In FY 2002, the number of proposals processed at NSF rose to over 35,000, a 10 percent increase over FY 2001. This is the fourth year of significant workload increases. Between FY 1999 and FY 2002 the proposal load increased by nearly 25 percent while staffing increased by less than 4 percent. The NSF workforce has been able to manage this workload increase, in large part, through effective use of technology; however, operational efficiencies through the effective use of information technology alone cannot be relied on to accommodate increases in workload indefinitely.

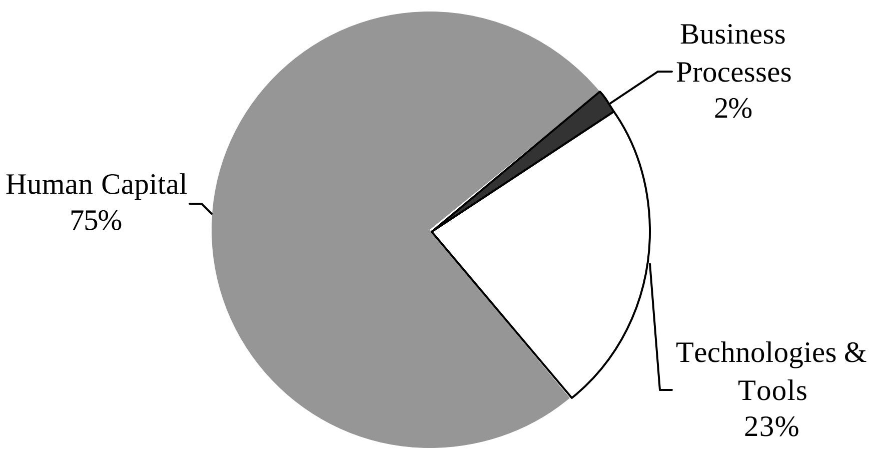


The FY 2004 Request of $291.36 million for A&M, approximately 5.3 percent of the agency's total budget request, represents an increase of $30.79 million, or 11.8 percent, over the FY 2003 Request of $260.57 million.

About two-thirds of the $30.79 million increase supports NSF's investment in Technology and Tools and about one-third of the increase is directed towards Human Capital. The Technology and Tools increase will support a world-class information technology infrastructure and address management challenges identified through various internal and external reviews. The major driver of the increase for human capital investments is funding for 30 Intergovernmental Personnel Act (IPAs) to help manage increased workload.

Overall, for the FY 2004 Budget Request total, 75 percent of A&M is devoted to Human Capital; 23 percent provides resources for Technologies and Tools; and the remaining 2 percent provides resources for the business process analyses being conducted by Booz Allen Hamilton and for the organizational review by the National Academy of Public Administration.

FY 2004 A&M Budget Request by Strategic Goal



Summary of Administration and Management by Function
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	Change Amount	Change Percent
Human Capital					
Personnel Compensation & Benefits	121.28	132.43	133.68	1.25	0.9%
IPA and Program Support (including Travel)	53.95	49.92	56.89	6.97	14.0%
Management of Human Capital	1.65	3.79	4.83	1.04	27.4%
Operating Expenses	4.31	6.51	6.74	0.23	3.5%
Travel - Employee	4.59	5.73	6.11	0.38	6.6%
Subtotal, Human Capital	185.78	198.38	208.25	9.87	5.0%
Business Processes	0.45	4.00	4.50	0.50	12.5%
Technology and Tools					
Space Rental	16.31	17.49	18.65	1.16	6.6%
Other Infrastructure	4.95	7.81	8.46	0.65	8.3%
Information Technology	16.39	25.19	42.73	17.54	69.6%
Subtotal, Technology and Tools	$37.65	$50.49	$69.84	$19.35	38.3%
Office of the Inspector General	$6.70	$7.70	$8.77	1.07	13.9%
Total	$230.58	$260.57	$291.36	$30.79	11.8%
FTE					
Staff -- NSF[1]	1,188	1,217	1,200	-17	-1.4%
Staff -- OIG	51	53	60	7	13.2%
Arctic Research Commission	4	4	4	0	0.0%
IPA	129	140	170	30	21.4%
Detailees to NSF	6	5	5	0	0.0%
Contractors Performing Admn. Functions	175	210	210	0	0.0%
Total, Workforce	1,553	1,629	1,649	20	1.2%

[1]The 17 FTE reduction in NSF staff in FY 2004 is due to employees from programs proposed for transfer to NSF from other agencies in the FY 2003 Request, which are not proposed for transfer in FY 2004.

HUMAN CAPITAL

Personnel Compensation and Benefits

Resources in the Personnel Compensation and Benefits (PC&B) category provide funding for salaries and benefits of federal employees, career ladder promotions, and bonuses. These costs are projected to increase from $132.43 million in FY 2003, by $1.25 million, to $133.68 million in FY 2004. The FY 2004 Request totaling $133.68 million will fund 1,200 full-time equivalents (FTE). The small reduction in the NSF staff from 1,217 in FY 2003 to 1,200 in FY 2004 is due to the employees associated with the programs that were proposed for transfer to NSF in the FY 2003 Request. The base NSF staffing level will remain constant between FY 2003 and FY 2004.

IPA and Program Support

The FY 2004 Request for IPA and Program Support (i.e., administrative activities) funded through programmatic accounts increases by $6.97 million totaling $56.89 million. This funds 170 IPAs through grants to institutions for temporary assignments, associated costs for IPA travel and equipment, and contracts for programmatic-related services. The increase in IPAs is needed to process and help manage the additional workload associated with the increase in proposals.

Management of Human Capital

The FY 2004 Request for Management of Human Capital is $4.83 million. NSF's approach to strategic management of human capital seeks to ensure that the agency has the *right people with the right competencies in the right jobs at the right time*. NSF's approach to workforce and succession planning encompasses both the development of critical talent and core competencies from within, and the identification and recruitment of strategic talent from outside the agency. This two-pronged approach, together with the business analysis, will allow the agency to anticipate and meet its staffing needs in the challenging, dynamic environment that constitutes work at the science and engineering research and education frontiers and ensures that employees are well prepared to meet agency challenges in the near- and longer-terms.

NSF has a long history of drawing upon its current hiring flexibilities to attract a cadre of temporary scientists and engineers who are leaders in their respective fields and who join the agency for periods of one to three years. Through these flexibilities, NSF engages scientists and engineers who bring new perspectives to motivate agency innovation and stimulate investments that might not otherwise occur.

NSF has also made strategic learning and career development a key focus of its long-range human capital plan. In FY 2002, NSF formally established the NSF Academy. The Academy will place the agency at the forefront of both the public and private sectors through its vision of the full integration of life-long learning and career management into the daily work lives of its employees.

Although NSF continuously strives to identify and address strategic human capital needs, the Foundation recognizes that it must make significant investments in human resource initiatives to retain and enhance its position as an employer of choice, particularly with its academic and scientific constituencies. Additionally, with ongoing implementation of technological improvements, advances in science, cross integration of scientific initiatives, and an emphasis on strategic use of limited resources, NSF must continuously upgrade the skills of its business and administrative staff.

NSF's FY 2004 human capital budget will situate the agency to aggressively pursue top talent across scientific and engineering disciplines through the implementation of best practice human resource recruitment, retention, performance and award, and development programs. It will also provide needed impetus in NSF's efforts to address the potential crisis in human capital that has been recognized by both the General Accounting Office and the Office of Management and Budget as a major management challenge for all Federal agencies in the foreseeable future. The FY 2004 Human Capital request includes an increase of $1.04 million to maintain services ($127,000) including those offered through the Academy and to address recommendations stemming from the business analysis ($913,000), as described below.

Implementation of Strategic Human Capital Initiatives ($913,000)

By the end of FY 2003, the business analysis will result in a comprehensive human capital plan that will serve as a strategic tool for the agency to optimize the performance of its workforce. The plan will provide a competency model that will serve as the foundation of a comprehensive, integrated human capital system to include recruitment, retention, classification and pay, automation tools, human resource accountability, and performance management and rewards.

- **Occupation Classification Management ($219,000):** A competency-based Occupation Classification Management process will be implemented to help ensure that NSF has appropriately identified and organized functions into meaningful and effective job relationships focused on current and future skill needs. Competencies will be directly linked to the classification system and, therefore, the pay system. Jobs will be grouped into new families based on competency profiles and will identify career progression opportunities for employees. NSF will work closely with the Office of Personnel Management to effect a smooth transition from previous to new positions and pay plans, and will implement necessary transition processes to guide employees into new endeavors.

- **Recruitment and Retention Enhancements ($219,000)**: Informed by the new occupation classification process, NSF will undertake a comprehensive assessment of recruitment and retention practices and implement forward-looking revisions that will enhance NSF's ability to attract scientists and engineers at the forefront of their professions to work for the Foundation. Similarly, recruitment and retention of high quality business and operations professionals will be addressed.

- **Performance Management and Awards ($219,000)**: The new performance management and awards methodology will link performance appraisals to the new competency models, including performance expectations for each competency. It will incorporate recognized best practices to ensure that the agency rewards high performers and addresses low performers and will be designed to minimize administrative burden.

- **Human Resource Management (HRM) Accountability ($256,000)**: The President's Management Agenda initiative on human capital specifically requires that agencies establish meaningful human resource accountability processes to ensure that management officials and human resource service providers are effectively managing their resources and are in compliance with merit system principles. Building on prior successful efforts, NSF will establish links between existing measures of accountability as well as establish appropriate new measures to have the capability to assess the effectiveness of its programs and its leadership resources.

NSF Academy ($2.30 million)

In order to fulfill its mission, NSF must cultivate a world-class staff by providing them with the knowledge and tools necessary to sustain a high level of excellence. The Academy is the central focus of learning for NSF. It will provide a comprehensive array of learning experiences that are curriculum-based and strategically aligned with the mission of the agency. These programs will emphasize cross-functional learning in order to enhance individual, team, and organizational performance and provide federal service career paths for each individual. Academy programs will provide the basis for the continual learning environment that is central to NSF's values. The Academy's emphasis on excellence, sharing of ideas, information and opportunities, integrity, breadth of knowledge; and flexibility will encourage those values in all employees.

The Academy made significant strides toward the goal of building a learning culture within NSF in FY 2002, particularly in an environment that serves three distinct internal populations: science and engineering; business and operations; and program support staff. In order to provide inclusive learning opportunities for all NSF staff, several new learning venues were created. These venues include the successful launch of an eLearning pilot, which is now fully operational, and the implementation of five eBusiness tutorials. Additionally, NSF is continually benchmarking other corporate universities, and exploring partnership opportunities with other learning institutions to enhance and grow our curriculum.

In addition to curriculum development, in FY 2003 the Academy efforts are focused on Academy governance. The Foundation will transition to the new Academy -- establishing an external Academy Advisory committee and recruiting a dean. Finding the right combination of leadership is critical to the success of the Academy.

The Academy will remain at approximately $2.30 million in FY 2004 the same as in the FY 2003 Request. While resources are relatively constant, the Academy's efforts will continue to support innovative ways to train and educate our staff. Within these resources we will assess learning models to discover the most innovative ways to cultivate a world-class staff.

In subsequent years, once the Academy governance and curriculum is more fully developed, the following areas will require more focus:

- Leadership and Executive Competencies
- Career Management
- NSF Employee Orientation
- Curriculum Based Classes
- University/College Partnerships and Corporate University Development
- Technology Learning Investments
- Strategic Development Initiatives
- Academy Assessment and Evaluation Tools
- Learning Resource Advancements
- Project Management

Operating Expenses

Operating Expenses increase $230,000 to $6.74 million in FY 2004. This includes funding for direct costs of the FTE staff, for supplies, equipment, and other operating expenses necessary for the management of NSF's research and education activities.

Travel

Travel increases by $380,000 to $6.11 million in FY 2004 and provides funds for FTE staff in the S&E appropriation. These resources are sufficient to fund costs associated with a reliable merit review process and the award oversight recommended by the agency's Inspector General. These funds will also be used to intensify oversight activities; participate in national and international science and engineering conferences and workshops; and seek strategic training opportunities.

BUSINESS PROCESSES

NSF's Business Analysis ($4.50 million)

Beginning in FY 2002, NSF initiated a comprehensive, multi-year Business Analysis, the outcomes of which will inform A&M investments for the foreseeable future. The Business Analysis will:

- Document each of the agency's core *Business Processes* and define its contribution to the NSF mission.
- Define process effectiveness and efficiency improvements that leverage past experiences, capitalize on best practices in the public and private sectors, and respond to emerging mission-related trends.
- Develop future-looking *Business Process* scenarios and criteria for success.
- Define a *Human Capital Management Plan* to provide next-generation human capital capabilities. The plan will identify future-looking workforce competencies and describe human capital strategies and approaches to support the *Business Process* scenarios and to capitalize on opportunities afforded by *Technologies and Tools* innovations.
- Define an *Integrated Technologies and Tools Plan* (business infrastructure tools, knowledge bases, and technologies) that describes an overall integrated technical and information architecture for future systems and capabilities in support of the agency's *Business Processes*.

The following mission-focused core *Business Processes* define how the agency delivers value to scientists, engineers, educators and to the nation, and form the framework for the analysis:

- *Resource Allocation: setting the right priorities…*
    - A resource management process that incorporates performance results and other inputs to prioritize agency programmatic and management investments across organizational levels, resulting in optimal administration of a balanced, performance-based portfolio.

- *Merit Review: identifying people, ideas and tools with the greatest potential for impact…*
    - A fair, competitive, transparent merit review process for selecting projects, managed in the context of priorities, and through which the agency realizes its outcome goals.

- *Award Management and Oversight: the award cycle, beginning to end…*
    - A collaborative, multi-functional award management and oversight process that (1) is informed by appropriate risk management strategies, (2) ensures performance outcomes are appropriately identified, (3) optimizes connections between discovery, learning, innovation and widespread practice through effective evaluation and communication, and (4) verifies that projects are in compliance with award agreements and federal regulations.

- *Knowledge Management: developing and sharing new knowledge in a timely and effective manner…*
    - A comprehensive set of information management and communications activities that capture, synthesize and share new knowledge generated by NSF and NSF investments – in order to provide the agency's managers and many stakeholders with reliable, timely and accessible information about agency priorities and opportunities, and resulting science and engineering outcomes and contributions.

- *Performance Assessment and Accountability: the highest standards of excellence and integrity…*
    - A thorough performance assessment and accountability process that develops and measures effective performance indicators and ensures the agency is held accountable for meeting its mission and goals.

The outcome of NSF's Business Analysis is an A&M and investment strategy focused on quality, efficiency, agility, and flexibility and designed to realize the agency's *Human Capital, Business Processes* and *Technologies and Tools* goals.

National Academy of Public Administration Review

NAPA will conduct a review of NSF's organizational, programmatic, and personnel structures to assure that the agency is positioned to maximize scientific opportunities. This review is consistent with the Congressional guidance provided in House Report 107-740. Specific topics to be addressed in the review include: organizational and program structure; establishment of investment priorities; personnel policies, especially those related to temporary appointments; and the role of the National Science Board. This review will cost on the order of $1 million, distributed about evenly between FY 2003 and FY 2004.

TECHNOLOGIES AND TOOLS

For more than 50 years, NSF's high-performing workforce has enabled discovery, learning, and innovation across the science and engineering frontier in research and in education. New customer-focused eGovernment capabilities have significantly improved the agency's ability to solicit, review, select, award, manage and report results on government-funded research and education projects. The agency's paper-based work processes have been replaced and shaped by technology-enabled ways of doing business thereby capitalizing on the latest technological capabilities, improving efficiency, and enabling NSF, to serve as an effective and capable steward of the taxpayer's resources. NSF is a true eGovernment success story. As a result of the technology innovations implemented by NSF, in FY 2002 NSF received and processed electronically more than:

- 35,000 Proposals (over 99 percent of all proposal received)
- 150,000 Reviews
- 6,000 Graduate Research Fellowship applications
- 22,000 Grantee Progress Reports
- 8,000 Post-Award Actions
- 14,000 Cash Requests
- $4.0 Billion in Fund Distribution Requests

In addition to these results, NSF's return on investment has yielded improvements in both effectiveness and efficiency. For example, in FY 2002, technology investments helped NSF achieve its goal of processing 70 percent of proposals within six months. What is even more remarkable is that since FY 2000, the number of proposals processed has increased with very little increase in staffing. In addition, through new electronic panel review processes, NSF significantly reduced processing time and improved the quality of the merit review process for NSF panelists. Enhancements to the award-winning FastLane and FastLane Help Desk have continued to improve the grant application and award process for proposal applicants. With the FastLane system, NSF reduced its proposal handling costs significantly, despite a 10 percent increase in proposals processed and a 19 percent increase in applications for graduate fellowships and a 10 percent increase in proposals processed. As an indication of the dramatic effect the system has had on reducing paper-based transactions, in 2002 alone, NSF reduced its paper and supply costs by 26 percent and its postage costs by 44 percent.

NSF's focus on demonstrating management excellence is sharpened through attention to specific issues. For example, the President's Management Agenda (PMA) mandates that NSF, like other agencies, demonstrate consistent results through proven management practices. While much has been accomplished and a strong foundation for success is in place, NSF's plans for FY 2004 and beyond must respond to new challenges and needs such as:

- Remaining at the cutting edge of innovation and discovery
- Sustaining a knowledge-rich, world class workforce
- Supporting eGovernment mandates
- Delivering technology-enabled business process improvements
- Replacing a rapidly aging infrastructure
- Enhancing physical and cyber security

The *Technology and Tools* portion of NSF's FY 2004 Administration and Management Request addresses critical investments needed to respond to key President's Management Agenda (PMA) initiatives, support a world-class infrastructure, and meet management challenges identified through internal review and oversight as well as those identified by our partners, including the agency's Inspector General, committees of experts representing the science, engineering and education community, and the General Accounting Office. To assure continued linkage with NSF goals and key PMA initiatives, the Technology and Tools Budget Request includes the following investments:

Enabling Human Capital Management ($1.0 Million)

In order to achieve NSF's goal of sustaining a world-class, knowledge-rich workforce, technology investments are critically needed to replace aging, legacy applications that were designed to support 1980s personnel processing needs. eHuman Capital is an integrated technology solution set to address nearly all aspects of Human Capital related requirements, including: recruitment, classification and staffing processes; eLearning technologies to achieve NSF Academy goals and support a continuous learning workforce; and related time and attendance and benefits services. Included in Human Capital initiatives are activities to plan for, select, and transition to a new government-wide mandated payroll system. As part of our payroll migration effort, NSF is evaluating government-wide HR solutions providers so that NSF can leverage best-in-class provider options for human resources as well as payroll services.

Accurate, timely human capital information is essential for effective planning and management of NSF's workforce. A fully integrated system will provide simple, easy to use, cost effective, standardized, and integrated eHuman resources and payroll services to support NSF's mission and to help it plan for future needs. This solution will transform the current human resources and payroll service delivery environment into one that achieves PMA initiatives and is consistent with government-wide eGov initiatives in human resources and payroll.

During FY 2003, NSF will initiate definition of requirements and business processes for the end-to-end human capital system, including selection and migration planning for transition to the new government-wide mandated payroll system and other government-wide human resources initiatives. During FY 2004, NSF plans to complete requirements analysis, evaluate alternatives, including government-wide service providers/solution sets, and begin implementation of high priority capabilities.

Continued Leadership and Innovation in eGovernment ($4.40 million)

NSF is a partner in four eGovernment initiatives: eGrants (led by the Department of Health and Human Services), ePayroll, the Enterprise Human Resources Integration (EHRI) initiative (both, led by the Office of Personnel Management), and eTravel (led by the General Services Administration). NSF continues to support all other endorsed initiatives to achieve government-wide efficiencies.

NSF is a partner with the government-wide eGrants initiative and works closely with the National Institutes of Health and other federal agencies in the development of electronic systems supporting grants processes for the science and engineering research and education community. While other agencies plan for electronic grant submission and administration, in October 2000, NSF started conducting virtually all business interactions and transactions electronically with its grantee community through its FastLane system, and continues to lead in delivering innovations through electronic grants processing.

The following investments are planned for FY 2004 to support continued advances:

- **FastLane Enhancements**: FastLane is an interactive real-time system used to conduct core NSF business processes over the Internet. Over 230,000 scientists, educators, technology experts and administrators, including the country's top researchers, use the over 40 FastLane Web-based applications to conduct business electronically with NSF. Planned enhancements are in response to high priority customer requests and changes needed to complement efforts planned for the government-wide eGrants and eTravel.

- **Continued Implementation of Electronic Jacket**: The Electronic Jacket (eJacket) system is the remaining piece required for total electronic proposal processing at NSF. eJacket meets requirements to support internal grants and awards processing. Staff will eventually have the ability to perform most essential internal business functions related to proposal and award processing without paper jackets (i.e., file folders), facilitating the Foundation's ability to reduce paperwork and improve records management. FY 2004 funding supports deployment of critical program officer work functions and integration with legacy applications.

- **Next-Generation eGrants (PRAMIS):** As a result of the Business Analysis work planned for the Merit Review and Awards Management and Oversight processes, NSF will re-engineer its business practices to improve grant monitoring activities and the processing of large and complex awards, and to include a pre-award review functionality. This system will complement government-wide eGrants and service NSF-specific internal grants and awards management processing and information management requirements. The next generation eGrants system (referred to as the Proposal, Review, and Awards Management Information System or PRAMIS) will implement a redesigned business process aimed at transforming the current mix of electronic and paper-based sequential award processing to enable dynamic, simultaneous processing of NSF program announcements, proposals, and awards. PRAMIS is anticipated to integrate the current capabilities of FastLane, Program Information Management System (PIMS), Electronic Jacket, eGrant, and other internal NSF electronic administrative systems as well as integrate with government-wide eGrants. PRAMIS will also provide capability for electronic solicitation, proposal receipt, award and contract administration functions that interface with outside web-based federal eGovernment resources and relevant NSF internal information systems.

- **Continued Support for Government-Wide eGrants**: The government-wide eGrants initiative is defining interfaces and data structures for program announcements and proposal submissions to be adopted by all agencies. Unlike agencies that are just beginning to implement electronic grants, NSF will need to retrofit existing systems to interface and interact with eGrants. This will be a costly effort, as investments will be needed for government-wide system integration requirements.

The Human Capital and eGovernment initiatives will enable NSF to address key components of the President's Management Agenda including:

Improved Financial Management: During FY 2004, initial planning efforts to enhance technology support for improved financial management include the following activities:

- Through the eHuman Capital initiative, requirements to transition to a new OPM-led government-wide payroll system and to provide continued support to the government-wide Enterprise Human Resources Integration initiative will be addressed. This will include activities to select the new service provider, define an orderly migration strategy from NSF's current payroll system, and establish necessary interfaces with core financial systems.

- Through the Next Generation eGrants (PRAMIS) initiative, business process innovations to ensure prompt, reliable and valid payments and pre- and post-award grant monitoring will be implemented, and contract management activities will be deployed.

In support of the government-wide eGrants, EHRI, ePayroll, and eTravel initiatives, NSF will continue to invest in incremental improvements to the current Financial and Accounting System in FY 2004 and beyond and in the FastLane system. It is not anticipated that a major modernization initiative will be required for the Financial and Accounting System until the FY 2006-08 time frame.

Integrating Budget and Performance

FY 2004 investments to address *Integrating Budget and Performance* are focused on projects that include reporting, trend analysis, GPRA performance assessment, and Committee of Visitors (COV) and advisory committee data services. Inherent in investment plans to address *Integrating Budget and Performance* is the need to develop a strong suite of knowledge bases, derived from various sources, and supplemented by analytic support and executive information system capabilities. The FY 2004 Request includes funding for enhancements to the Enterprise Information System and development of improved, consistent, and readily available data for COVs. Investments in FY 2005 and beyond will focus on the development of key knowledge bases and implementation of recommendations resulting from the NSF Business Analysis and the program framework developed through the ongoing update of the NSF Strategic Plan.

Delivering World Class Customer Services and Secure Infrastructure

The FY 2004 Request includes an increase of $12.10 million to support day-to-day operations of the NSF information technology and physical infrastructure. Adequate funding in these areas is critical to the efficient operations of the agency. While NSF's overall budget has grown, and significant advances have been made through the use of innovative information technology, funding for infrastructure operating expenses has, until the FY 2003 Request, remained essentially flat. Highlights of NSF's plans for infrastructure and operational initiatives include:

- **Continued improvements to NSF's Security Program**. NSF's comprehensive, agency-wide information technology security program encompasses all aspects of information security, including policy and procedures, risk assessments and security plans, managed intrusion detection services, vulnerability assessments, and technical and management security controls. The FY 2004 Request includes key investments needed to sustain and improve NSF's information security program and posture. This includes continued investments to implement a balanced, technology-enabled security program that includes physical and IT security requirements. Included in this investment is the continued deployment of "smart technology" to meet physical and cyber security needs, and expanded penetration testing and vulnerability scanning for defensive measures. This also includes establishing a common, "corporate directory service" that will store and manage user profiles, access privileges, and application and network resource information. This service will help ensure appropriate access policies are followed across NSF applications, facilities, and services.

- **Plans for a Robust Enterprise Architecture to Support Next Generation Capability**. NSF is following a disciplined approach for assuring that new investments are planned and evaluated within the context of an overall Enterprise Architecture framework. Evolving the NSF Enterprise Architecture is a strategic priority for NSF to assure that it is aligned to support changing business practices and associated workforce needs, funding decisions, and technology advances. The NSF Integrated Enterprise Architecture will: (1) provides a blueprint for defining current business processes, applications, information resources, and technical infrastructure; (2) support definition of the knowledge bases, applications, and supporting technology that are needed to support evolving NSF mission needs; and (3) define a crisp transition strategy and plan for achieving an integrated Enterprise Architecture that is consistent with NSF business goals and operational priorities. As changes to *Business Processes* and requirements are made in later phases of the Business Analysis, the Enterprise Architecture and migration strategy will be updated to reflect evolving business and operational priorities.

- **Enhancements and Initiatives to Improve Operational Efficiency.** NSF has developed a multi-year approach to improving the infrastructure and deploying the hardware, software, and tools necessary to manage and operate applications that process approximately $5.0 billion annually. Our multi-year approach to replace aging hardware, software, and enterprise servers, with priority on equipment three years old and older, allows for incremental improvements in the performance, reliability, and security of the operational infrastructure and is consistent with overall government-wide budget constraints. For example, half of network floor servers are more than four years old, and one-third are six years old and older. Until FY 2002, NSF lacked redundancy for mission-critical financial and grants applications or the capability to recover quickly in the event of a server failure. In FY 2002, NSF began a phased approach to acquire and deploy industry standard tools necessary to manage securely the complex information infrastructure. These include software configuration management and testing tools, performance-monitoring tools, and call center software tools to support the tracking of customer service requests. The Request includes funds to continue implementation of critical investments needed in supporting hardware, software, and tools necessary to manage and operate an infrastructure that can support NSF electronic business processes. Increased costs to support and improve the infrastructure and day-to-day services include:

  - Maintenance for FastLane, which is a suite of over 40 web-based applications, used by more than 230,000 scientists, educators, and administrators;
  - Maintenance for legacy information technology applications and the additional costs to maintain new capabilities for the National Science Board, Office of Equal Opportunity, and other administrative functions;
  - Support of government-wide eGovernment initiatives;
  - New integrated contracts to improve the management and efficiency of the NSF data center, help desks, and network management;
  - Maintenance of a balanced security program, operational security, including 24x7 intrusion detection services, internal and external penetration tests, disaster recovery tests, and additional operational security controls;
  - Support the 8,000 (average) customer services calls per month for FastLane and other IT services requests;
  - Corporate software licenses and maintenance fees increased dramatically over the FY 2002 level;
  - Support redundancy and backup for critical services such as major systems production environments, email, and internet access;
  - Implementation and support for tools initially deployed in FY 2002 to improve and manage software lifecycle activities, addressing software engineering standards, program management, quality assurance, testing, and configuration management;

- Administrative services and facilities management.

- **Space Rental**. To relieve crowding in Stafford Place, an additional floor of space is required in an adjoining building. Coupled with the increased costs of existing space, an additional $1.16 million is requested in FY 2004.

THE ADMINISTRATION AND MANAGEMENT PORTFOLIO

The Foundation's Administration and Management activities are funded through four appropriations accounts:

- **Salaries and Expenses** (S&E) increases to $225.70 million in FY 2004. These resources include funding for personnel compensation and benefits, administrative travel, training, rent, IT investments, administrative contractual services, supplies, equipment, and other operating expenses necessary for management of NSF's research and education activities.

- **Office of Inspector General** (OIG) increases to $8.77 million in FY 2004 and funds 60 FTEs. These resources include funding for personnel compensation and benefits, contract audits, training, operational travel, office supplies, materials, and equipment.

- Support costs funded in the **Program Accounts -- Research and Related Activities** (R&RA) and **Education and Human Resources** (EHR) increase to $56.89 million in FY 2004. These costs include funding for personnel appointments under the Intergovernmental Personnel Act (IPA) and administrative contracts and requisitions that directly support programs. Support costs also include funding for Foundation-wide evaluation contracts and development costs associated with NSF customer-focused information technology projects, including FastLane.

Administration & Management by Appropriations Account
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	Change Amount	Change Percent
Salaries and Expenses	174.01	208.95	231.70	22.75	10.9%
Less Reimbursements [1]	4.08	6.00	6.00	0.00	0.0%
Subtotal	169.93	202.95	225.70	22.75	11.2%
Office of Inspector General	6.70	7.70	8.77	1.07	13.9%
Financial Statement Audit [2]	[0.66]	[0.70]	[0.80]	[-0.10]	[-0.14%]
Administrative Activities funded in:					
Research & Related Activities	38.23	35.35	41.52	6.17	17.5%
Education and Human Resources [3]	15.72	14.57	15.37	0.80	5.5%
Travel	[15.00]	[16.00]	[17.00]	[1.00]	[6.3%]
Total	$230.58	$260.57	$291.36	$30.79	11.8%

[1] NSF enters into agreements (including Memoranda of Understanding) with other U.S. government agencies, as authorized by the NSF Act, 42 U.S.C. 1870 (c) and the Economy Act: 31 U.S.C. 1535, under which NSF assumes some responsibility for activities supported by these agencies. Reimbursements in the Salaries and Expenses Account are realized from administrative cost recoveries that are associated with these interagency agreements.
[2] Non-add funded from R&RA and EHR Appropriations and included in those estimates.
[3] Excludes A&M expenses for H-1B Nonimmigrant Petitioner Receipts.

HIGHLIGHTS OF RECENT ACCOMPLISHMENTS IN A&M

Although NSF's budget has nearly doubled in the last ten years, the agency's staffing level has remained relatively constant until the FY 2003 Request. Maintaining operations overhead at approximately five percent of the agency's total budget is an ongoing challenge as workload has grown more complex with involvement in more multi-disciplinary, partnership and international activities, as well as new large research facility projects. The agency has accommodated its increased funding and programmatic responsibilities by leveraging its agile, motivated workforce and continuing to re-engineer business processes to enhance productivity. Currently, NSF is the only federal research agency routinely receiving and processing virtually all of its proposals electronically.

In FY 2002, in line with the Administration's call for better management and improved program performance, NSF engaged considerable efforts in a wide range of activities, several of which are highlighted here:

- *Developed a Strategic Plan for Administration and Management*: In FY 2002, NSF finalized a comprehensive strategic plan for its investments and responsibilities in administration and management (A&M). The plan builds upon efforts begun in FY 2000 and FY 2001, to plan for new information technology (IT) investments and to assess the impact of new systems and processes on the NSF workforce. The A&M Strategic Plan *(http://www.nsf.gov/od/am)* elevates these earlier efforts by linking them directly to the five government-wide initiatives included in the President's Management Agenda (PMA). The Plan serves as a working roadmap, providing a set of goals that will drive the effective development and strategic management of the agency over the next three years. Central to the plan is the comprehensive multi-year business analysis discussed throughout this chapter, which will inform progress in each of the initiatives and will ultimately result in an organization that conducts business with even greater efficiency and productivity.

- *Initiated Business Analysis:* Realization of the strategic goals outlined in the Administration and Management Strategic Plan must begin with a knowledge of the agency – the current staff competencies and skill mix, core business processes and current IT systems and applications. NSF has engaged the services of Booz Allen Hamilton, a global leader in strategic planning and technology consulting, to assist the agency in developing a comprehensive documentation of the Foundation's current business process, human capital and IT environments. The outcomes of this analysis will guide long-term administration and management investments that promise important results for the agency's operations. The analysis will enable NSF to respond to challenges such as the management of an increasingly interdisciplinary research and education portfolio and management and oversight of a growing number of complex large facility projects. It will also help the agency respond to issues raised in the President's Management Agenda, by NSF's Office of Inspector General, and to government-wide issues identified by the General Accounting Office. Initial results are expected in FY 2003.

Cost Efficiencies Realized in FY 2002

Doing more with less and working smarter by instituting more efficient and cost-effective business processes have always been NSF hallmarks. In FY 2002, the agency re-engineered a number of business processes that yielded significant cost savings. It is conservatively estimated that cost efficiencies realized in FY 2002 totaled nearly $540,000.

- *Electronic information dissemination*: NSF launched its external business web site in 1994. As customer access to the Internet expanded over the years, NSF began offering its most popular documents online. Today, virtually all NSF publications are electronically available. In FY 2002, no program announcements were printed or mailed; there were 74,000 online downloads of the *NSF Bulletin*, a monthly document describing NSF funding opportunities; and over 35,000 monthly downloads of the *Grant Proposal Guide*. Compared with the prior year, in FY 2002, printing costs dropped 22 percent -- from $500,000 to $392,000 – for a cost savings of $108,000.

- *Bulk Mailing Costs*: With the decrease in printed publications, bulk mailing costs have also decreased significantly. In FY 2002, there was a 45 percent decrease in the number of pieces of bulk mailings – from nearly 206,000 in FY 2001 to about 114,000 in FY 2002. This resulted in a savings in bulk mailing costs of $35,000 -- from $102,000 in FY 2001 to about $67,000 in FY 2002.

- *POD/Electronic Review*: NSF created "Print on Demand" (POD) to encourage the growth of electronic proposal reviews. POD precludes the need for printing multiple copies of proposals because reviewers can access proposals electronically or, if they prefer, submit a POD request for paper copies to be sent to them. As a result of the availability of POD, in FY 2002, there was a significant increase in the number of programs that adopted the electronic review process. Of the 447 programs that participated in the POD/electronic review program in FY 2002, 48,973 proposals were actually printed compared to the 170,520 proposals that would have been printed if not for POD. It is estimated that, based on an average cost of $3.43 for printing and mailing a proposal, NSF saved at least $203,415.

- *Electronic Signatures/Jackets*: Prior to electronic signature implementation in FY 2002, paper signatures were obtained from organizations submitting proposals and supplements. The majority of these were submitted through express mail, and most were single signature page submissions. With about 35,000 proposals and 6,000 supplements submitted in FY 2002 and assuming express mail costs average about $8.00, savings for NSF's research and education community is conservatively estimated at $300,000. On the NSF side, a computer specialist was freed-up from the full-time task of opening paper signature submissions, entering them in the electronic systems and working with NSF divisions who placed these signatures in paper jackets. These processing steps were eliminated in FY 2002, for a conservative estimated savings of $40,000.

- *Videoconferencing*: Following September 11, there was considerably more interest in videoconferencing, and in FY 2002, videoconferencing became a mainstream meeting technology at NSF. NSF supported 110 videoconferences in FY 2002; program offices have reported that they have been able to reduce travel costs by scheduling videoconferences for a least some of their attendees. For example, one program office estimated that in FY 2002, videoconferencing saved about $140,000 in panel travel costs. The funding was then available for other program costs.

- *Online Self-booking Travel*: In FY 2002, NSF adapted an online self-booking tool, FedTrip, for staff travelers. Advantages in using FedTrip include flexibility for the traveler in making his/her own reservations and the ability to make changes up to the time of ticketing. In terms of cost savings, per ticket fees have dropped by more than half – from $34 to $15 – per ticket. Since November 2001, 520 tickets have been issued, saving NSF nearly $9,880 in fees. This number will continue to grow as users become more comfortable with self-booking.

FY 2004 GPRA PERFORMANCE GOALS FOR MANAGEMENT

PERFORMANCE AREA	NO.	ANNUAL PERFORMANCE GOALS FOR MANAGEMENT
Proposal and Award Management		
Use of Merit Review	IV-1	At least 85 percent of basic and applied research funds will be allocated to projects that undergo merit review.
Implementation of Merit Review Criteria – Reviewers	IV-2	At least 70 percent of reviews with written comments will address aspects of both review criteria.
Implementation of Merit Review Criteria – Program Officers	IV-3	For at least 90 percent of decisions to fund or decline proposals, Program Officers will comment on aspects of both review criteria.
Customer Service – Time to Prepare Proposals	IV-4	Ninety-five percent of program announcements will be publicly available at least three months prior to the proposal deadline or target date.
Customer Service – Time to Decision	IV-5	For 70 percent of proposals, be able to inform applicants whether their proposals have been declined or recommended for funding within six months of deadline or target date, or receipt date, whichever is later.
Efficiency – Award Size	IV-6	NSF will increase the average annualized award size for research grants to $128,000.
Efficiency – Award Duration	IV-7	The average duration of awards for research grants will be 3.0 years.
Facilities – Construction and Upgrade	IV-8	For ninety percent of construction, acquisition and upgrade projects, keep any negative cost and schedule variances to less than 10 percent of the approved project plan.
Facilities – Operations & Management	IV-9	For ninety percent of operational facilities, keep scheduled operating time lost to less than 10 percent.
Business Practices		
Cost Efficiency – Videoconferencing	IV-10	NSF will assess the cost efficiencies associated with administrative processes. Performance Indicator: - Calculation of the agency-wide cost savings realized by the use of videoconferencing.
Electronic Business	IV-11	NSF will continue to integrate its internal electronic grants process with the E- government initiative. Performance Indicators: - 90 percent of program announcements will be posted to Fed Grants. - 75 percent of declined proposals will be processed using E-decline signatures.

FY 2004 GPRA Performance Goals for Management (continued)

Performance Area	No.	Annual Performance Goals for Management (continued)
Security Program – Information Technology & Physical Security	IV-12	NSF will maintain and enhance the agency-wide security program to ensure adequate protection of NSF's infrastructure and critical assets. Performance Indicators: - 95 percent of NSF's major systems will achieve Level 3 compliance in accordance with the NIST Security Self-Assessment Framework. - Implementation of a "Smart ID" pilot to provide staff with a standard identification card for authentication and access control.
Human Capital		
NSF Staff – Diversity	IV-13	NSF will ensure that diversity considerations are embedded in activities related to agency staffing of scientists and engineers. Performance Indicator: - NSF will complete development of the NSF S&E diversity plan initiated in FY 2003 and begin implementation of its recommendations.
NSF Staff – Diversity	IV-14	NSF will show an increase over FY 2000 in the total number of appointments to NSF science and engineering staff and management from underrepresented groups.
Workforce Learning	IV-15	The NSF Academy will develop a broad array of competency-based learning opportunities that will enable all staff to perform critical functions supporting NSF's vision and goals. Performance Indicators: - Identification of staff requiring Facilities / Center Project Management training. - Initiation of development of a curriculum that leads to certification in Facilities / Center Project Management.
Workforce Planning	IV-16	NSF will develop competency-based occupation classification alternatives that support the agency's strategic business processes and capitalize on its technology enabled business systems. Performance Indicators: - Identification of workforce competencies needed to support the majority of NSF's strategic business processes. - Development of new positions or revision of position descriptions in order to address emerging business process requirements.

TECHNICAL INFORMATION

FY 2004 Appropriation Language

National Science Foundation

RESEARCH AND RELATED ACTIVITIES

For necessary expenses in carrying out the National Science Foundation Act of 1950, as amended (42 U.S.C. 1861-1875), and the Act to establish a National Medal of Science (42 U.S.C. 1880-1881); services as authorized by 5 U.S.C. 3109; maintenance and operation of aircraft and purchase of flight services for research support; acquisition of aircraft; $4,106,360,000, of which not to exceed $375,000,000 shall remain available until expended for Polar research and operations support, and for reimbursement to other Federal agencies for operational and science support and logistical and other related activities for the United States Antarctic program; the balance to remain available until September 30, 2005; *Provided*, That receipts for scientific support services and materials furnished by the National Research Centers and other National Science Foundation supported research facilities may be credited to this appropriation and used for authorized purposes of this account.

EDUCATION AND HUMAN RESOURCES

For necessary expenses in carrying out science and engineering education and human resources programs and activities pursuant to the National Science Foundation Act of 1950, as amended (42 U.S.C. 1861-1875), including services as authorized by 5 U.S.C. 3109, and rental of conference rooms in the District of Columbia, $938,040,000, to remain available until September 30, 2005.

MAJOR RESEARCH EQUIPMENT AND FACILITIES CONSTRUCTION

For necessary expenses for the acquisition, construction, commissioning, and upgrading of major research equipment, facilities, and other such capital assets pursuant to the National Science Foundation Act of 1950, as amended, $202,330,000, to remain available until expended.

SALARIES AND EXPENSES

For salaries and expenses necessary in carrying out the National Science Foundation Act of 1950, as amended (42 U.S.C. 1861-1875); services authorized by 5 U.S.C. 3109; hire of passenger motor vehicles; not to exceed $9,000 for official reception and representation expenses; uniforms or allowances therefore, as authorized by 5 U.S.C. 5901-5902; rental of conference rooms in the District of Columbia; reimbursement of the General Services Administration for security guard services; $225,700,000: *Provided*, That contracts may be entered into under “Salaries and Expenses” in fiscal year 2004 for maintenance and operation of facilities, and for other services, to be provided during the next fiscal year.

OFFICE OF INSPECTOR GENERAL

For necessary expenses of the Office of Inspector General as authorized by the Inspector General Act of 1978, as amended $8,770,000, to remain available until September 30, 2005.

SUMMARY OF FY 2004 BUDGET BY APPROPRIATION AND ACTIVITY

(DOLLARS IN THOUSANDS)

	FY 2002 APPROPRIATION	FY 2003 REQUEST	FY 2004 REQUEST	CHANGE FY2004 Req/FY03 Req AMOUNT	CHANGE FY2004 Req/FY03 Req PERCENT
RESEARCH AND RELATED ACTIVITIES					
Biological Sciences	$509,645	$525,620	$562,220	$36,600	7.0%
Computer and Information Science and Engineering	515,015	526,940	584,260	57,320	10.9%
Engineering	470,825	487,980	536,570	48,590	10.0%
Geosciences	609,546	691,070	687,920	-3,150	-0.5%
Mathematical and Physical Sciences	920,424	941,570	1,061,270	119,700	12.7%
Social, Behavioral and Economic Sciences [1]	183,973	195,610	211,740	16,130	8.2%
U.S. Polar Research Programs	230,517	235,740	261,860	26,120	11.1%
U.S. Antarctic Logistical Support Activities	70,270	68,070	68,070	0	0.0%
Integrative Activities	105,755	110,610	132,450	21,840	19.7%
Subtotal R&RA	$3,615,970	$3,783,210	$4,106,360	$323,150	8.5%
Unobligated Balance Available Start of Year	-$1,923				
Unobligated Balance Available End of Year	3,015				
Recoveries of Prior Year Obligations	-7,286				
Adjustments to Prior Year Accounts	-58				
Unobligated Balance Lapsing	2,546				
Reduction Pursuant to P.L. 107-206	40				
Subtotal R&RA	$3,612,304	$3,783,210	$4,106,360	$323,150	8.5%
Transferred from other funds	-13,664				
Appropriation Total	$3,598,640	$3,783,210	$4,106,360	$323,150	8.5%
EDUCATION AND HUMAN RESOURCES					
Math and Science Partnerships	$150,079	$200,000	$200,000	0	0.0%
EPSCoR	90,650	75,000	75,000	0	0.0%
Elementary, Secondary and Informal Education	210,757	211,690	194,450	-17,240	-8.1%
Undergraduate Education	142,697	135,600	142,100	6,500	4.8%
Graduate Education	105,970	128,380	156,880	28,500	22.2%
Human Resource Development	97,009	90,210	103,410	13,200	14.6%
Research, Evaluation and Communication	68,946	67,200	66,200	-1,000	-1.5%
Subtotal EHR	$866,108	$908,080	$938,040	$29,960	3.3%
H-1B Nonimmigrant Petitioner Receipts	57,306	92,500	0	-92,500	-100.0%
Subtotal EHR	$923,414	$1,000,580	$938,040	-62,540	-6.3%
Unobligated Balance Available Start of Year	-$201				
Unobligated Balance Available End of Year	29,198				
Recoveries of Prior Year Obligations	-1,038				
Adjustments to Prior Year Accounts	-12				
Unobligated Balance Lapsing	225				
H-1B Nonimmigrant Petitioner Receipts	-57,306	-92,500	0	92,500	-100.0%
Reduction Pursuant to P.L. 107-206	20				
Appropriation Total	$894,300	$908,080	$938,040	$29,960	3.3%

SUMMARY OF FY 2004 BUDGET BY APPROPRIATION AND ACTIVITY

(DOLLARS IN THOUSANDS)

	FY 2002 APPROPRIATION	FY 2003 REQUEST	FY 2004 REQUEST	CHANGE FY2004 Req/FY03 Req AMOUNT	PERCENT
MAJOR RESEARCH EQUIPMENT & FACILITIES CONSTRUCTION	$115,352	$126,280	$202,330	$76,050	60.2%
Unobligated Balance Available Start of Year	-73,093				
Unobligated Balance Available End of Year	96,551				
Recoveries of Prior Year Obligations	-10				
Adjustments to Prior Year Accounts					
Appropriation Total	$138,800	$126,280	$202,330	$76,050	60.2%
SALARIES AND EXPENSES [1]	$169,927	$202,950	$225,700	$22,750	11.2%
Unobligated Balance Available Start of Year					
Unobligated Balance Available End of Year					
Adjustments to Prior Year Accounts					
Unobligated Balance Lapsing	205				
Reduction Pursuant to P.L. 107-206	244				
Subtotal, S&E	$170,376	$202,950	$225,700	$22,750	11.2%
Transferred from other funds	-336				
Appropriation Total	$170,040	$202,950	$225,700	$22,750	11.2%
OFFICE OF INSPECTOR GENERAL	$6,700	$7,700	$8,770	$1,070	13.9%
Unobligated Balanced Available Start of Year	-73				
Unobligated Balanced Available End of Year	137				
Recoveries of Prior Year Obligations	-14				
Adjustments to Prior Year Accounts					
Unobligated Balance Lapsing					
Reduction Pursuant to P.L. 107-206	10				
Appropriation Total	$6,760	$7,700	$8,770	$1,070	13.9%
TOTAL, NATIONAL SCIENCE FOUNDATION	$4,808,540	$5,028,220	$5,481,200	$452,980	9.0%

Totals may not add due to rounding.

[1] FY 2002 includes an Appropriations Transfer from the Department of State in the amount of $14.0 million for an award to the U.S. Civilian Research and Development Foundation.

LEVEL OF FUNDING BY PROGRAM

(Dollars in Thousands)

PROGRAM	FY 2002 ACTUAL	FY 2003 REQUEST	FY 2004 REQUEST	CHANGE FY 2004 Req/FY03 Req AMOUNT	PERCENT
BIOLOGICAL SCIENCES					
MOLECULAR AND CELLULAR BIOSCIENCES					
Molecular & Cellular Biosciences Research	$112,172	$111,556	$116,860	$5,304	4.8%
Total	112,172	111,556	116,860	5,304	4.8%
INTEGRATIVE BIOLOGY AND NEUROSCIENCE					
Integrative Biology & Neuroscience Research	100,859	98,726	103,380	4,654	4.7%
Total	100,859	98,726	103,380	4,654	4.7%
ENVIRONMENTAL BIOLOGY					
Environmental Biology Research	101,108	99,768	104,770	5,002	5.0%
Total	101,108	99,768	104,770	5,002	5.0%
BIOLOGICAL INFRASTRUCTURE					
Research Resources	48,220	47,944	54,990	7,046	14.7%
Human Resources	24,990	24,376	24,970	594	2.4%
Total	73,210	72,320	79,960	7,640	10.6%
EMERGING FRONTIERS					
Emerging Frontiers	47,297	68,250	82,250	14,000	20.5%
Total	47,297	68,250	82,250	14,000	20.5%
PLANT GENOME RESEARCH					
Plant Genome Research	74,999	75,000	75,000	0	0.0%
Total	74,999	75,000	75,000	0	0.0%
Total, BIO	$509,645	$525,620	$562,220	$36,600	7.0%

LEVEL OF FUNDING BY PROGRAM

(Dollars in Thousands)

PROGRAM	FY 2002 ACTUAL	FY 2003 REQUEST	FY 2004 REQUEST	CHANGE FY 2004 Req/FY03 Req AMOUNT	PERCENT
COMPUTER AND INFORMATION SCIENCE AND ENGINEERING					
COMPUTER-COMMUNICATIONS RESEARCH					
Computer-Communications Research	$69,687	$70,170	$75,870	$5,700	8.1%
Total	69,687	70,170	75,870	5,700	8.1%
INFORMATION AND INTELLIGENT SYSTEMS					
Information and Intelligent Systems Research	51,648	50,610	52,400	1,790	3.5%
Total	51,648	50,610	52,400	1,790	3.5%
EXPERIMENTAL AND INTEGRATIVE ACTIVITIES					
Experimental and Integrative Activities	63,153	62,160	57,670	-4,490	-7.2%
Total	63,153	62,160	57,670	-4,490	-7.2%
ADVANCED COMPUTATIONAL INFRASTRUCTURE AND RESEARCH					
Advanced Computational Infrastructure	80,143	78,490	78,190	-300	-0.4%
Advanced Computational Research	6,612	6,930	14,370	7,440	107.4%
Total	86,755	85,420	92,560	7,140	8.4%
ADVANCED NETWORKING INFRASTRUCTURE AND RESEARCH					
Advanced Networking Infrastructure	47,969	46,620	46,420	-200	-0.4%
Advanced Networking Research	21,798	21,290	21,230	-60	-0.3%
Total	69,767	67,910	67,650	-260	-0.4%
INFORMATION TECHNOLOGY RESEARCH (ITR)					
Information Technology Research (ITR)	174,005	190,670	218,110	27,440	14.4%
Total	174,005	190,670	218,110	27,440	14.4%
CYBERINFRASTRUCTURE					
Cyberinfrastructure	0	0	20,000	20,000	N/A
Total	0	0	20,000	20,000	N/A
Total, CISE	$515,015	$526,940	$584,260	$57,320	10.9%

LEVEL OF FUNDING BY PROGRAM

(Dollars in Thousands)

PROGRAM	FY 2002 ACTUAL	FY 2003 REQUEST	FY 2004 REQUEST	CHANGE FY 2004 Req/FY03 Req AMOUNT	PERCENT
ENGINEERING					
BIOENGINEERING AND ENVIRONMENTAL SYSTEMS					
Bioengineering and Environmental Systems	$41,317	$43,870	$47,910	$4,040	9.2%
Total	41,317	43,870	47,910	4,040	9.2%
CHEMICAL AND TRANSPORT SYSTEMS					
Chemical and Transport Systems	57,214	58,940	66,200	7,260	12.3%
Total	57,214	58,940	66,200	7,260	12.3%
CIVIL AND MECHANICAL SYSTEMS					
Civil and Mechanical Systems	56,087	57,750	64,360	6,610	11.4%
Total	56,087	57,750	64,360	6,610	11.4%
DESIGN, MANUFACTURE, AND INDUSTRIAL INNOVATION					
Design, Manufacture, and Industrial Innovation	55,881	57,580	61,910	4,330	7.5%
Small Business-Industrial Innovation	79,110	83,650	101,150	17,500	20.9%
Total	134,991	141,230	163,060	21,830	15.5%
ELECTRICAL AND COMMUNICATIONS SYSTEMS					
Electrical and Communications Systems	64,746	66,700	70,760	4,060	6.1%
Total	64,746	66,700	70,760	4,060	6.1%
ENGINEERING EDUCATION AND CENTERS					
Engineering Education and Centers	116,470	119,490	124,280	4,790	4.0%
Total	116,470	119,490	124,280	4,790	4.0%
Total, ENG	$470,825	$487,980	$536,570	$48,590	10.0%

LEVEL OF FUNDING BY PROGRAM

(Dollars in Thousands)

PROGRAM	FY 2002 ACTUAL	FY 2003 REQUEST	FY 2004 REQUEST	CHANGE FY 2004 Req/FY03 Req AMOUNT	CHANGE FY 2004 Req/FY03 Req PERCENT
GEOSCIENCES					
ATMOSPHERIC SCIENCES					
Atmospheric Sciences Research Support	$125,832	$145,320	$151,100	$5,780	4.0%
National Center for Atmospheric Research	76,317	73,600	78,820	5,220	7.1%
Total	202,149	218,920	229,920	11,000	5.0%
EARTH SCIENCES					
Earth Sciences Project Support	95,376	116,940	109,160	-7,780	-6.7%
Instrumentation and Facilities	30,897	36,200	35,100	-1,100	-3.0%
Total	126,273	153,140	144,260	-8,880	-5.8%
OCEAN SCIENCES					
Ocean Section	104,044	120,010	115,760	-4,250	-3.5%
Integrative Programs Section	93,635	104,000	104,080	80	0.1%
Marine Geosciences Section	83,445	95,000	93,900	-1,100	-1.2%
Total	281,124	319,010	313,740	-5,270	-1.7%
Total, GEO	$609,546	$691,070	$687,920	-$3,150	-0.5%

LEVEL OF FUNDING BY PROGRAM

(Dollars in Thousands)

PROGRAM	FY 2002 ACTUAL	FY 2003 REQUEST	FY 2004 REQUEST	CHANGE FY 2004 Req/FY 03 Req AMOUNT	PERCENT
MATHEMATICAL AND PHYSICAL SCIENCES					
ASTRONOMICAL SCIENCES					
Astronomical Research	$165,993	$161,250	$183,070	$21,820	13.5%
Total	165,993	161,250	183,070	21,820	13.5%
CHEMISTRY					
Chemistry Research	162,825	160,800	181,710	20,910	13.0%
Total	162,825	160,800	181,710	20,910	13.0%
MATERIALS RESEARCH					
Materials Research	219,371	219,320	246,120	26,800	12.2%
Total	219,371	219,320	246,120	26,800	12.2%
MATHEMATICAL SCIENCES					
Mathematical Sciences	151,529	181,870	201,870	20,000	11.0%
Total	151,529	181,870	201,870	20,000	11.0%
PHYSICS					
Physics Research	195,879	193,310	217,500	24,190	12.5%
Total	195,879	193,310	217,500	24,190	12.5%
MULTIDISCIPLINARY ACTIVITIES					
Research Project Support	24,827	25,020	31,000	5,980	23.9%
Total	24,827	25,020	31,000	5,980	23.9%
Total, MPS	$920,424	$941,570	$1,061,270	$119,700	12.7%

LEVEL OF FUNDING BY PROGRAM

(Dollars in Thousands)

PROGRAM	FY 2002 ACTUAL	FY 2003 REQUEST	FY 2004 REQUEST	CHANGE FY 2004 Req/FY03 Req AMOUNT	PERCENT
SOCIAL, BEHAVIORAL AND ECONOMIC SCIENCES					
SOCIAL AND ECONOMIC SCIENCES					
Social and Economic Sciences	$68,289	$77,610	$83,920	$6,310	8.1%
Total	68,289	77,610	83,920	6,310	8.1%
BEHAVIORAL AND COGNITIVE SCIENCES					
Behavioral and Cognitive Sciences	58,564	65,300	71,120	5,820	8.9%
Total	58,564	65,300	71,120	5,820	8.9%
SCIENCE RESOURCES STATISTICS					
Science Resource Statistics	16,277	25,700	26,700	1,000	3.9%
Total	16,277	25,700	26,700	1,000	3.9%
INTERNATIONAL SCIENCE AND ENGINEERING					
Office of International Science and Engineering	40,843	27,000	30,000	3,000	11.1%
Total	40,843	27,000	30,000	3,000	11.1%
Total, SBE [1]	$183,973	$195,610	$211,740	$16,130	8.2%
UNITED STATES POLAR RESEARCH PROGRAMS	$230,517	$235,740	$261,860	$26,120	11.1%
UNITED STATES ANTARCTIC LOGISTICAL SUPPORT ACTIVITIES	$70,270	$68,070	$68,070	$0	0.0%
INTEGRATIVE ACTIVITIES	$105,755	$110,610	$132,450	$21,840	19.7%
Total, RESEARCH AND RELATED ACTIVITIES	$3,615,970	$3,783,210	$4,106,360	$323,150	8.5%

LEVEL OF FUNDING BY PROGRAM

(Dollars in Thousands)

PROGRAM	FY 2002 ACTUAL	FY 2003 REQUEST	FY 2004 REQUEST	CHANGE FY 2004 Req/FY03 Req AMOUNT	PERCENT
EDUCATION AND HUMAN RESOURCES					
MATH & SCIENCE PARTNERSHIP					
Math & Science Partnership	$150,079	$200,000	$200,000	$0	0.0%
Total	150,079	200,000	200,000	0	0.0%
EXPERIMENTAL PROGRAM TO STIMULATE COMPETITIVE RESEARCH (EPSCoR)					
Innovation Partnership Activities[1]	10,970	0	0	0	N/A
Experimental Program to Stimulate Competitive Research (EPSCoR)	79,680	75,000	75,000	0	0.0%
Total	90,650	75,000	75,000	0	0.0%
ELEMENTARY, SECONDARY AND INFORMAL EDUCATION[2]					
Instructional and Assessment Materials Development	28,861	28,990	28,990	0	0.0%
Teacher & Student Development	126,214	127,700	115,460	-12,240	-9.6%
Informal Science Education	55,682	55,000	50,000	-5,000	-9.1%
Total	210,757	211,690	194,450	-17,240	-8.1%
UNDERGRADUATE EDUCATION					
Curriculum, Laboratory & Instructional Development	85,588	79,740	71,740	-8,000	-10.0%
Workforce Development	57,109	55,860	70,360	14,500	26.0%
Total	142,697	135,600	142,100	6,500	4.8%
GRADUATE EDUCATION					
Graduate Student Support	105,970	128,380	156,880	28,500	22.2%
Total	105,970	128,380	156,880	28,500	22.2%
HUMAN RESOURCE DEVELOPMENT					
Undergraduate/ Graduate Student Support	55,072	50,770	62,970	12,200	24.0%
Research & Education Infrastructure	25,300	23,200	25,200	2,000	8.6%
Opportunities for Women and Persons with Disabilities	16,637	16,240	15,240	-1,000	-6.2%
Total	97,009	90,210	103,410	13,200	14.6%
RESEARCH, EVALUATION AND COMMUNICATION					
Research	55,910	54,560	54,560	0	0.0%
Evaluation	13,036	12,640	11,640	-1,000	-7.9%
Total	68,946	67,200	66,200	-1,000	-1.5%
Subtotal, EHR	866,108	908,080	938,040	29,960	3.3%
H-1B Nonimmigrant Petitioner Receipts[3]	57,306	92,500	0	-92,500	-100.0%
Total, EHR	$923,414	$1,000,580	$938,040	-$62,540	-6.3%

[1]FY 2002 Actual includes $10.97 million for the Partnerships for Innovation program, which is funded in Integrative Activities in the Research and Related Activities Appropriation in the FY 2003 and FY 2004 Requests.

[2]FY 2002 Actual and FY 2003 Request for Elementary, Secondary and Informal Education (ESIE) includes $45.06 million and $40.25 million, respectively, from Education System Reform (ESR). For the FY 2004 Request, EHR proposes to move funds designated for the remaining ESR projects to consolidate K-12 programs into a single subactivity.

LEVEL OF FUNDING BY PROGRAM

(Dollars in Thousands)

PROGRAM	FY 2002 ACTUAL	FY 2003 REQUEST	FY 2004 REQUEST	CHANGE FY 2004 Req/FY03 Req AMOUNT	PERCENT
MAJOR RESEARCH EQUIPMENT AND FACILITIES CONSTRUCTION	$115,352	$126,280	$202,330	$76,050	60.2%
Total, MREFC	$115,352	$126,280	$202,330	$76,050	60.2%
SALARIES AND EXPENSES	$169,927	$202,950	$225,700	$22,750	11.2%
Total, S&E[1]	$169,927	$202,950	$225,700	$22,750	11.2%
OFFICE OF INSPECTOR GENERAL	$6,700	$7,700	$8,770	$1,070	13.9%
Total, OIG	$6,700	$7,700	$8,770	$1,070	13.9%
TOTAL, NATIONAL SCIENCE FOUNDATION	$4,831,363	$5,120,720	$5,481,200	$360,480	7.0%

Totals may not add due to rounding.

[1]FY 2002 includes an Appropriations Transfer from the Department of State in the amount of $14.0 million for an award to the U.S. Civilian Research and Development Foundation. ($13.66 million in SBE and $336,000 in S&E)

OBJECT CLASSIFICATION

NSF Consolidated Budget by Object Classification

(Includes All Appropriation Headings) [1]

Object Class Code	Standard Title	FY 2002 Actual	FY 2003 Request	FY 2004 Request
		(Dollars in Millions)		
11.1	Full-time permanent	92	102	103
11.3	Other than fulltime permanent	7	7	7
11.5	Other personnel compensation	4	5	6
11.8	Special personal service payment	1	1	1
	Total personnel compensation	104	115	117
12.1	Civilian personnel benefits	22	24	24
21.0	Travel and transportation of persons	15	16	17
23.1	Rental payments to GSA	16	17	19
23.3	Communications, utilities, and miscellaneous charges	2	3	3
25.1	Advisory and assistance services	48	53	58
25.2	Other services	24	27	28
25.3	Purchases of goods and services from Government accounts	8	8	9
25.4	Operation and maintenance of facilities	202	202	202
25.5	Research and development contracts[2]	26	15	10
25.7	Operation and maintenance of equipment	6	13	14
26.0	Supplies and materials	2	3	3
31.0	Equipment	14	18	31
41.0	Grants, subsidies, and contributions	4,342	4,607	4,946
	Total, Direct obligations [3]	$4,831	$5,121	$5,481

Totals may not add due to rounding.

[1]Excludes obligations for the Donations Account.

[2]The funding pattern for research and development contracts varies in accordance with annual appropriations for construction of the South Pole Station within the Major Research Equipment and Facilities Construction (MREFC) account.

[3]Excludes carryover and includes H-1B Nonimmigrant Petitioner obligations.

REIMBURSABLE ACTIVITY

Reimbursements for the Research and Related Activities Appropriation and the Education and Human Resources Appropriation are realized from other federal agencies that have entered into interagency agreements with the Foundation. NSF enters into agreements (including Memoranda of Understanding) with other U.S. government agencies, as authorized by the NSF Act, 42 U.S.C. 1870 (c) and the Economy Act: 31 U.S.C. 1535, under which NSF assumes some responsibility for activities supported by these agencies. These activities can include jointly funded projects and programs, support of research operations and logistics, and access to NSF supported research facilities.

REIMBURSABLE AWARDS BY AGENCY

(Dollars in Millions)

DEPARTMENT/AGENCY	FY 2002
DEFENSE	
AIR FORCE	2.8
ARMY	4.5
DARPA	5.6
NAVY	2.8
SUBTOTAL, DOD	$15.7
AGRICULTURE	0.7
ARCHIVES	1.0
ARMY CORP OF ENGINEERS	0.9
CIA	5.5
COMMERCE	5.4
EDUCATION	2.7
ENERGY	8.3
EPA	0.6
HEALTH & HUMAN SERVICES	16.7
HUD	0.9
JUSTICE	1.0
NASA	19.2
TRANSPORTATION	1.1
OTHER (less than $500,000)	1.5
TOTAL REIMBURSEMENTS	**$81.2**

Totals may not add due to rounding.

Since the 1980s, the number of interagency agreements NSF handles has increased dramatically. This increase is indicative of the growth in the breadth and complexity of the Foundation's programmatic activity. Consistent with applicable legislation and GAO decisions, agreements include reimbursement for costs that are incurred in the management and administration of these awards.

In FY 2002, the largest portion of NSF's reimbursable activity came from joint activities with NASA, (23.6 percent) the Department of Health and Human Services (20.6 percent) and the Department of Defense (19.3 percent). Reimbursable activities with NASA were primarily for support of the National Center for Atmospheric Research (NCAR), as well as for the support and use of the national astronomy centers. Reimbursable activities with the Department of Health and Human Services are for non-medical biological research such as the human frontiers science program and the protein data bank.

PERSONNEL SUMMARY

	FY 2002 Actual	FY 2003[1] Request	FY 2004 Request	Change Amount	Change Percent
Full-Time Equivalent Employment	1,243	1,274	1,264	-10	-0.8%
Average GS Grade	10.60	10.43	10.64	0.21	2.0%
Average Salary	$79,109	$86,165	$86,615	$450	0.5%

DETAIL OF PERMANENT APPOINTMENTS

	FY 2002 Actual	FY 2003[1] Estimate	FY 2004 Estimate
Executive Level II	1	1	1
Executive Level III	1	1	1
Subtotal	2	2	2
ES-6	12	14	14
ES-5	9	14	14
ES-4	29	35	35
ES-3	16	12	12
ES-2	11	7	7
ES-1	4	0	0
Subtotal	81	82	82
AD	268	289	282
GS/GM-15	77	80	82
GS/GM-14	88	81	92
GS/GM-13	99	94	102
GS-12	96	118	106
GS-11	52	52	55
GS-10	12	14	15
GS-9	77	72	77
GS-8	64	83	65
GS-7	127	117	127
GS-6	33	43	35
GS-5	22	25	24
GS-4	0	8	4
Subtotal	747	787	784
Total Permanent Appointments	1,098	1,160	1,150
FTE	1,243	1,274	1,264

[1]The source of the FY 2003 figures is the FY 2003 Congressional Request. These figures have not been updated.

EXPLANATION OF CARRYOVER 2002

The National Science Foundation's total unobligated balance of $128.90 million from the FY 2002 Appropriation consists of amounts displayed below.

- In Research and Related Activities (R&RA), $3.02 million is carried over into FY 2003. $1.42 million is for funding of the Small Business Innovation Research (SBIR) Phase II program. The remaining amounts are from several awards in various programs that were not ready for obligation in FY 2002.

- In Education and Human Resources (EHR) $29.20 million is carried over into FY 2003. $9.65 million is for funding of the Math and Science Partnership, $19.37 million for the Federal Cyber Service: Scholarship for Service program included in the FY 2002 Supplemental Appropriations Act (P.L 107-206) and $180,000 for the Presidential Awards for Excellence in Science, Mathematics and Engineering Mentoring.

- In Major Research Equipment and Facilities Construction $96.55 million is carried over into FY 2003. $56.47 million is funding of the South Pole Station Modernization, $35.0 million is for Terascale Computing System, $4.88 million is for IceCube Research and Development, $115,000 is for Polar Support Aircraft Upgrades, and $84,980 for the South Pole Safety project.

- A total of $137,405 in FY 2002 Office of Inspector General appropriated funds is carried over into FY 2003 to cover priority audits that are contracted out, fund the next phase of a contract to develop an OIG knowledge management system, and protect the appropriation against unanticipated variations between obligations and expenditures.

Distribution of FY 2002 Carryover into FY 2003

(Dollars in Thousands)

	FY 2003 Request	FY 2003 Carryover from FY 2002	Total FY 2003 Estimate
Research and Related Activities	3,783,210	3,015	3,786,225
Education and Human Resources [1]	908,080	29,198	937,278
Major Research Equipment and Facilities Construction	126,280	96,551	222,831
Salaries and Expenses	202,950	-	202,950
Office of Inspector General	7,700	137	7,837
Total	5,028,220	128,901	5,157,121

Totals may not add due to rounding.

[1]Carryover excludes $64.14 million of H-1B Nonimmigrant Petitioner Fees. $38.16 million will be obligated by the Division of Undergraduate Education for scholarship awards; $25.98 million will be obligated by the Division of Elementary, Secondary and Informal Education K-12 activities involving private-public partnership.

NATIONAL SCIENCE FOUNDATION
FY 2004 CONGRESSIONAL REQUEST
FULL BUDGETARY COSTING

The tables below show two methods for allocating the full budgetary cost of the NSF FY 2004 Request. The first shows the full budgetary costs allocated to each of NSF's operating directorates. The second shows these costs allocated to NSF's three strategic outcome goals: People, Ideas, and Tools. These allocations represent initial steps, using readily available information, in NSF's plans to achieve the integration of budget, cost, and performance, consistent with the President's Management Agenda.

What is Full Budgetary Cost? OMB Circular A-11 defines "full-cost" as the sum of all budget resources used by an agency to achieve program outputs and outcomes. These include both *direct* program costs and *indirect* costs, which generally include administrative costs and other activities that are not directly attributable to a single program or activity. For two of NSF's appropriations, Research and Related Activities (R&RA) and Education and Human Resources (EHR), all funds are directly attributable to directorates and outcome goals. For NSF's other three appropriations, Major Research Equipment and Facilities Construction (MREFC), Salaries and Expenses (S&E), and the Office of Inspector General (OIG), the funds are distributed using the methodologies described below.

Allocation by Directorate

The current budget structure contains program activities within R&RA and EHR that equate to directorates. Therefore, R&RA and EHR funding is already aligned by directorate. MREFC funds projects that are managed by a particular NSF directorate. Therefore, each MREFC project can be directly associated with a particular directorate. In addition, each managing directorate is responsible for the initial planning, design and follow-on operations and maintenance costs that are funded R&RA. The MREFC program funds were assigned to the managing directorate responsible for oversight of a particular project. (Table 1)

All budget items funded through the S&E and OIG appropriations accounts are defined as A&M and are allocated to directorates. More than half of the S&E account can be precisely associated with an individual directorate. These S&E Direct budget items consist of distributed funding for travel, training, equipment, supplies, incentive awards and premium pay. Also, space rental and personnel compensation and benefits (PC&B) of employees in a particular directorate are attributed to that directorate in the financial accounting system.

Once S&E Direct budget items that are directly associated with a particular directorate have been assigned, then budget items associated with the Office of Information and Resource Management (IRM), Office of Budget, Finance and Awards Management (BFA), the staff offices in the Office of the Director (OD), and OIG are allocated. These S&E Indirect budget items are allocated to a particular directorate based on the proportion of the total FY 2004 Directorate Request. The FY 2004 OIG budgetary costs are assigned using the same methodology as the S&E Indirect costs total. (Table 1)

Allocations by Strategic Outcome Goal

The full budgetary costing by PIT was derived by using the same methodology as stated above, except the Direct S&E budget items, Indirect S&E budget items, and total OIG funding were assigned using the PIT percentages for the applicable directorate. (Table 2)

FY 2004 FULL BUDGETARY COSTING

Table 1: Allocation of Major Research Equipment and Facilities Construction (MREFC), Salaries and Expenses (S&E), and the Office of Inspector General (OIG)
(Dollars in Thousands)

	BIO	CISE	ENG	GEO	MPS	SBE	OPP	IA	R&RA Total	EHR	TOTAL
FY 2004 CONGRESSIONAL REQUEST	**562,220**	**584,260**	**536,570**	**687,920**	**1,061,270**	**211,740**	**329,930**	**132,450**	**4,106,360**	**938,040**	**5,044,400**
MREFC											
Large Hadron Collider (LHC)									**-**	-	**-**
NEES			8,000						**8,000**	-	**8,000**
Terascale Computing Syst (TCS)									**-**	-	**-**
HIAPER				25,530					**25,530**	-	**25,530**
South Pole Station							960		**960**	-	**960**
Earth Scope				45,000					**45,000**	-	**45,000**
NEON	12,000								**12,000**	-	**12,000**
IceCube							60,000		**60,000**	-	**60,000**
ALMA					50,840				**50,840**	-	**50,840**
MREFC Subtotals	**12,000**	**-**	**8,000**	**70,530**	**50,840**	**-**	**60,960**	**-**	**202,330**	**-**	**202,330**
Total Directorate FY 2004 Request including MREFC	**574,220**	**584,260**	**544,570**	**758,450**	**1,112,110**	**211,740**	**390,890**	**132,450**	**4,308,690**	**938,040**	**5,246,730**
Direct S&E											
Space Rental Direct	1,068	910	1,253	939	1,149	1,223	478	-	7,020	1,564	8,584
PC&B Direct	11,265	7,246	14,690	12,977	15,782	18,677	6,405	-	87,042	16,995	104,037
Distributed S&E Direct	961	729	1,168	785	1,208	836	528	-	6,215	969	7,184
Direct S&E Subtotals	**13,294**	**8,885**	**17,111**	**14,701**	**18,139**	**20,736**	**7,411**	**-**	**100,277**	**19,528**	**119,805**
Indirect S&E Cost Allocation	11,839	12,055	11,295	15,748	23,026	4,345	8,146	-	86,454	19,441	105,895
S&E Direct & Indirect Subtotals	**25,133**	**20,940**	**28,406**	**30,449**	**41,165**	**25,081**	**15,557**	**-**	**186,731**	**38,969**	**225,700**
OIG Allocation	**981**	**998**	**936**	**1,305**	**1,906**	**360**	**674**	**-**	**7,160**	**1,610**	**8,770**
NSF TOTAL	**600,334**	**606,198**	**573,912**	**790,204**	**1,155,181**	**237,181**	**407,121**	**132,450**	**4,502,581**	**978,619**	**5,481,200**

FY 2004 FULL BUDGETARY COSTING

Table 2: Allocation by People, Ideas, and Tools
(Dollars in Thousands)

Total Directorate FY 2004	**BIO**	**CISE**	**ENG**	**GEO**	**MPS**	**SBE**	**OPP**	**IA**	**R&RA**	**EHR**	**TOTAL**
People	53,499	59,806	89,053	38,444	130,200	17,504	6,804	14,000	409,310	811,229	**1,220,539**
Ideas	471,885	371,943	464,845	416,030	699,978	173,716	82,394	24,450	2,705,241	147,662	**2,852,903**
Tools	74,950	174,449	20,014	335,730	325,003	45,961	317,923	94,000	1,388,030	19,728	**1,407,758**
FULL BUDGETARY COST	**600,334**	**606,198**	**573,912**	**790,204**	**1,155,181**	**237,181**	**407,121**	**132,450**	**4,502,581**	**978,619**	**5,481,200**

Subtotals may not add due to rounding.

From the Friday, August 30, 2002 *Federal Register* (Vol. 67, No. 169), pages 55728-55729

NATIONAL SCIENCE FOUNDATION

45 CFR Part 672

Antarctic Conservation Act of 1978, Civil Monetary Penalties

AGENCY: National Science Foundation.

ACTION: Final rule with a request for comments.

SUMMARY: The National Science Foundation (NSF) is adjusting civil monetary penalties that may be imposed for violations of the Antarctic Conservation Act of 1978 to reflect inflation since the last effective adjustment.

DATES: This rule is effective September 30, 2002. Comments, however, are welcome at any time and will be considered in making future revisions.

ADDRESSES: All comments should be addressed to: John Chester, Assistant General Counsel, Office of the General Counsel, Room 1265, National Science Foundation, 4201 Wilson Boulevard, Arlington, VA 22230.

FOR FURTHER INFORMATION CONTACT: John Chester on (703) 292–8060 (voice) and (703) 2926–9041 (facsimile)—those are not toll-free numbers—or by electronic mail as *jchester@nsf.gov* through INTERNET.

SUPPLEMENTARY INFORMATION: The Federal Civil Penalties Inflation Adjustment Act of 1990 (104 Stat. 890; 28 U.S.C. 2461 note) as amended by the Debt Collection Improvement Act of 1996 [section 31001(s)(1) of the Omnibus Consolidated Rescissions and Appropriations Act of 1996, Pub. L. 104–134, approved 4/26/96] directs each Federal agency to adjust, by regulation, each civil monetary penalty provided by law within the jurisdiction of that agency to compensate for the effects of inflation. The only civil monetary penalties within the jurisdiction of the National Science Foundation are those imposed for violations of the Antarctic Conservation Act of 1978 (16 U.S.C. 2401 *et seq.*). On June 16, 1998 NSF published an amendment to its rules governing enforcement of that law adding a new section setting out the penalties for inadvertent and deliberate violations and adjusting those penalties for inflation as provided in the Debt Collection Improvement Act. The General Accounting Office recently informed the Foundation that the second adjustment made at that time exceeded the amount allowable under the cited statute. This amendment corrects that error by recognizing that the second adjustment was ineffective and therefore the initial adjustment remained in effect. It also adjusts the penalty amounts for violations occurring after August 31, 2002 to reflect the approximately nine percent inflation from June 1998, the year when the penalty was adjusted, through June 2001. Because of the rounding rules applicable to these adjustments, no change will be made to the penalty for knowing violations. This amendment also changes the language used to describe the two levels of violations to incorporate that used in the relevant section of the Antarctic Conservation Act [16 U.S.C. 2407(a)].

Future adjustments will be made at least once every four years as called for in the amended Debt Collection Improvement Act.

Because this action merely makes adjustments required by statute, public comments were not solicited prior to its issuance.

Determinations

Under the criteria set forth in Executive Order 12866 as amended by Executive Order 13258, that this rule is not a significant regulatory action requiring review by the Office of Information and Regulatory Affairs. Consequently, this rule is also not subject to Executive Orders 13045 and 13211.

The rule is not an economically significant rule or a major rule under the Congressional Review Act. The Congressional Review Act provides that agencies shall submit a report, including a copy of all final rules, to each House of Congress and the Comptroller General of the United States. The Foundation will submit this report, identifying this rule as non-major, upon the publication of this rule in the **Federal Register**.

The Unfunded Mandate Reform Act of 1995, in sections 202 and 205, requires that agencies prepare several analytic statements before proposing a rule that may result in annual expenditures of $100 million by State, local and Indian tribal governments, or by the private sector. As this rule will not result in expenditures of that magnitude, such statements are not necessary. As required by the Regulatory Flexibility Act, it is hereby certified that this rule will not have a significant impact on a substantial number of small businesses.

The provisions of the Paperwork Reduction Act of 1995, Public Law 104– 13, 44 U.S.C. 3501 *et seq.*, and its implementing regulations, 5 CFR Part 1320, do not apply to this rule because there are no new or revised recordkeeping or reporting requirements. This action does not have a substantial direct effect on one or more Indian tribes, on the relationship between the Federal Government and Indian tribes, or on the distribution of power and responsibilities between the Federal Government and Indian tribes as specified by Executive Order 13175 and accordingly is not subject to that Order. Finally, NSF has reviewed this rule in light of Section 2 of Executive Order 12778 and certifies that this rule meets the applicable standards provided in sections 2(a) and 2(b) of that order.

List of Subjects in 45 CFR Part 672

Administrative practice and procedure, Antarctica.

For the reasons set out in the preamble, 45 CFR Part 672 is amended as follows:

PART 672—ENFORCEMENT AND HEARING PROCEDURES; TOURISM GUIDELINES

1. The authority citation for Part 672 continues to read as follows:

   Authority: 16 U.S.C. 2401 *et seq.*, 28 U.S.C. 2461 note

2. Revise § 672.24 to read as follows:

§ 672.24 Maximum civil monetary penalties for violations.

(a) For violations occurring before August 1, 1998, the maximum civil penalty that may be assessed under §§ 672.20(b) and 672.23(a) is set by the statute at $5,000 for any violation and $10,000 for knowing violations.

(b) For violations occurring between August 1, 1998 and August 31, 2002, the maximum civil penalty was adjusted under authority of the Federal Civil Penalties Inflation Adjustment Act of 1990 (28 U.S.C. 2461 note) as amended by the Debt Collection Improvement Act of 1996 (Pub. L. 104–134) to $5,500 for any violation and $11,000 for knowing violations.

(c) For violations occurring after August 31, 2002, the maximum civil penalty is adjusted under authority of the Federal Civil Penalties Inflation Adjustment Act of 1990 (28 U.S.C. 2461 note) as amended by the Debt Collection Improvement Act of 1996 (Pub. L. 104–134) to $6,500 for any violation and $11,000 for knowing violations.

National Science Foundation.
Dated: July 18, 2002.
Lawrence Rudolph,
General Counsel.
[FR Doc. 02–22152 Filed 8–29–02; 8:45 am]
BILLING CODE 7555–01–P

SUMMARY TABLES/ CHARTS

National Science Foundation
By Strategic Goal and Account
FY 2004 Request

			FY 2004 Request Level						
NSF Accounts	FY 2002 Actuals	FY 2003 Request	People	Ideas	Tools	A&M	FY 2004 Request	$ Change Request over 03 Request	% Change Request over 03 Request
FY 2002 Actuals	**$4,774.06**		**$994.79**	**$2,436.28**	**$1,112.41**	**$230.58**			
FY 2003 Request		**$5,028.22**	**$1,086.70**	**$2,559.45**	**$1,121.50**	**$260.57**			
BIO	509.64	525.62	50.78	447.90	59.14	4.40	562.22	36.59	7.0%
CISE	515.01	526.94	56.94	354.12	166.09	7.11	584.26	57.32	10.9%
ENG	391.72	404.33	83.42	334.34	10.75	6.90	435.42	31.09	7.7%
SBIR, STTR	*79.11*	*83.65*	*0.00*	*101.15*	*0.00*	*0.00*	*101.15*	*17.50*	*20.9%*
GEO	609.55	691.07	36.51	395.10	248.31	8.00	687.92	-3.15	-0.5%
MPS	920.42	941.57	124.67	670.25	260.36	5.99	1,061.27	119.70	12.7%
SBE	183.97	195.61	15.23	151.15	39.99	5.37	211.74	16.13	8.2%
OPP	300.79	303.81	6.47	78.35	241.36	3.75	329.93	26.12	8.6%
IA	105.76	110.61	14.00	24.45	94.00	0.00	132.45	21.84	19.7%
Research & Related Activities	**$3,615.97**	**$3,783.21**	**$388.02**	**$2,556.82**	**$1,120.00**	**$41.52**	**$4,106.36**	**$323.15**	**8.5%**
Education & Human Resources	**$866.11**	**$908.08**	**$764.85**	**$139.22**	**$18.60**	**$15.37**	**$938.04**	**$29.96**	**3.3%**
Major Research Equipment & Facilities Constuction	**$115.35**	**$126.28**	**$0.00**	**$0.00**	**$202.33**	**$0.00**	**$202.33**	**$76.05**	**60.2%**
Salaries & Expenses	**$169.93**	**$202.95**	**$0.00**	**$0.00**	**$0.00**	**$225.70**	**$225.70**	**$22.75**	**11.2%**
Office of Inspector General	**$6.70**	**$7.70**	**$0.00**	**$0.00**	**$0.00**	**$8.77**	**$8.77**	**$1.07**	**13.9%**
Total, National Science Foundation	**$4,774.06**	**$5,028.22**	**$1,152.87**	**$2,696.04**	**$1,340.93**	**$291.36**	**$5,481.20**	**$452.98**	**9.0%**
H-1B Visa	*$57.31*	*$65.68*					*$0.00*		
Total NSF, Including H-1B Visa	*$4,831.37*	*$5,093.90*	*$1,152.87*	*$2,696.04*	*$1,340.93*	*$291.36*	*$5,481.20*	*$387.30*	*7.6%*
Percent Increase over Prior Year, excluding H-1B Visa			**6.1%**	**5.3%**	**19.6%**	**11.8%**			

Totals may not add due to rounding.

National Science Foundation
Selected Cross-Cutting Programs
FY 2004

Selected Cross-Cutting Programs		FY 2002 Actuals	FY 2003 Request	FY 2004 Request	$ Change Request over 03 Request	% Change Request over 03 Request
ADVANCE	Research & Related Activities	$15.67	$16.69	$21.16	$4.47	26.8%
	Education & Human Resources	$0.45	$0.45	$0.00	-$0.45	-100.0%
	Total, NSF	**$16.12**	**$17.14**	**$21.16**	**$4.02**	**23.5%**
Faculty Early Career Development - CAREER	Research & Related Activities	$132.21	$122.68	$128.33	$5.65	4.6%
	Education & Human Resources	$0.00	$0.00	$0.00	$0.00	
	Total, NSF	**$132.21**	**$122.68**	**$128.33**	**$5.65**	**4.6%**
Graduate Teaching Fellowships in K-12 Education - GK-12	Research & Related Activities	$3.64	$6.70	$7.64	$0.94	14.0%
	Education & Human Resources	$23.17	$34.75	$42.46	$7.71	22.2%
	Total, NSF	**$26.81**	**$41.45**	**$50.10**	**$8.65**	**20.9%**
Graduate Research Fellowships - GRF	Research & Related Activities	$4.10	$7.11	$8.06	$0.95	13.4%
	Education & Human Resources	$63.30	$73.45	$89.74	$16.29	22.2%
	Total, NSF	**$67.40**	**$80.56**	**$97.80**	**$17.24**	**21.4%**
Integrative Graduate Education and Research Traineeships - IGERT	Research & Related Activities	$23.24	$33.59	$42.40	$8.81	26.2%
	Education & Human Resources	$19.50	$20.20	$24.70	$4.50	22.3%
	Total, NSF	**$42.74**	**$53.79**	**$67.10**	**$13.31**	**24.7%**
Model Institutions of Excellence - MIE	Research & Related Activities	$7.29	$7.29	$7.29	$0.00	0.0%
	Education & Human Resources	$2.50	$2.52	$2.52	$0.00	0.0%
	Total, NSF	**$9.79**	**$9.81**	**$9.81**	**$0.00**	**0.0%**
PostDoctoral Programs	Research & Related Activities	$14.51	$15.04	$20.46	$5.42	36.0%
	Education & Human Resources	$0.00	$0.00	$0.00	$0.00	
	Total, NSF	**$14.51**	**$15.04**	**$20.46**	**$5.42**	**36.0%**
Research Experience for Undergraduates - REU	Research & Related Activities	$47.68	$44.83	$45.58	$0.75	1.7%
	Education & Human Resources	$0.00	$0.00	$0.00	$0.00	
	Total, NSF	**$47.68**	**$44.83**	**$45.58**	**$0.75**	**1.7%**
Interagency Education Research Initiative - IERI	Research & Related Activities	$8.00	$10.00	$10.00	$0.00	0.0%
	Education & Human Resources	$14.67	$15.00	$15.00	$0.00	0.0%
	Total, NSF	**$22.67**	**$25.00**	**$25.00**	**$0.00**	**0.0%**
Science and Technology Centers - STCs	Research & Related Activities	$44.38	$45.10	$44.91	-$0.19	-0.4%
	Education & Human Resources	$0.00	$0.00	$0.00	$0.00	
	Total, NSF	**$44.38**	**$45.10**	**$44.91**	**-$0.19**	**-0.4%**

**Totals may not add due to rounding.*

NSF Funding Profile

The Number of Requests for Funding is a count of all proposals received as well as requests for additional funding on continuing awards. Additional funding on continuing awards is contingent upon availability of funds and whether the results achieved are determined to warrant further support. Dollars Requested includes all dollars associated with the requests for funding.

Total Number of Awards is a count of the awards funded in the fiscal year. It includes both new awards and the second and subsequent years of a continuing award.

Approximately half of the awards that are supported in a particular fiscal year are competitively reviewed in that year through NSF's merit review process. The other awards are continuations of projects that were competitively reviewed in a prior year. As shown in the Number of Competitive Awards, the Funding Rate is the number of competitive awards made during a year as a percentage of total proposals competitively reviewed. It indicates the probability of winning an award when submitting proposals to NSF.

Research Grants are those limited to research projects and excludes other categories of awards that fund infrastructure-type activities such as equipment and conference awards, which do not require multi-year support.

The Annualized Award Size displays the annual level of research grants provided to awardees by dividing the total dollars of each award by the number of years over which it extends. Both the average and the median annualized award size for competitively reviewed awards are shown.

Average Duration is the length of the award in years.

The Quantitative Data Tables, provided under a separate tab, are based on all proposals and awards, including competitive awards, contracts, cooperative agreements, supplements and amendments to existing grants and contracts.

NSF FUNDING PROFILE

	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate
Number of Requests for Funding [1]	45,280	45,940	47,260
Dollars Requested (in millions) [1]	$31,620	$32,190	$33,220
Total Number of Awards	21,670	21,900	22,870
Statistics for Competitive Awards			
Number	10,630	10,460	10,950
Funding Rate	30%	31%	30%
Statistics for Research Grants			
Number of Research Grants	6,850	6,550	6,870
Median Annualized Award Size	$84,290	$87,470	$90,890
Average Annualized Award Size	$115,710	$125,000	$128,000
Average Duration (yrs.)	2.9	3.0	3.0

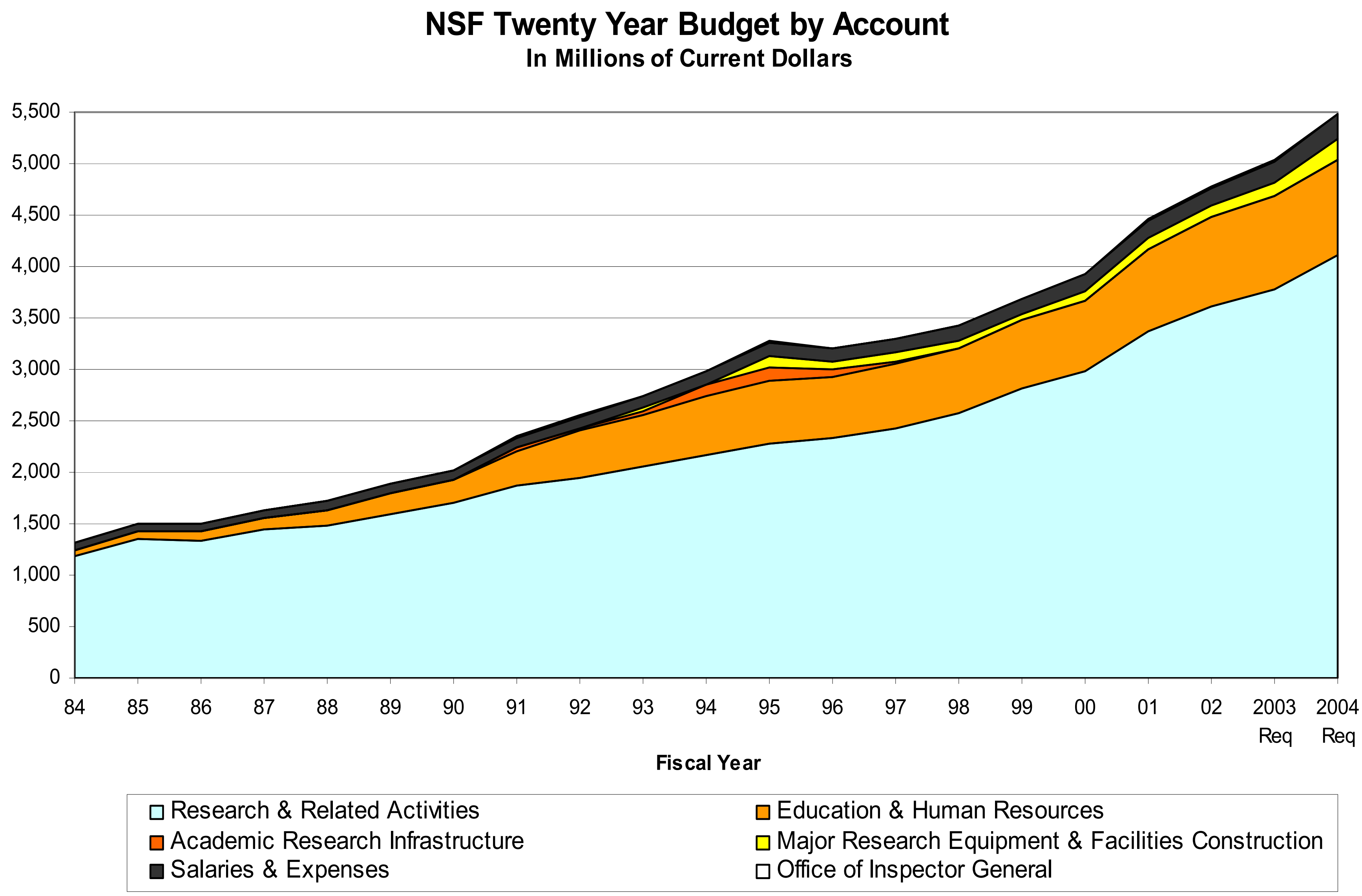
[1] Does not include H-1B scholarship and graduate fellowship applications.

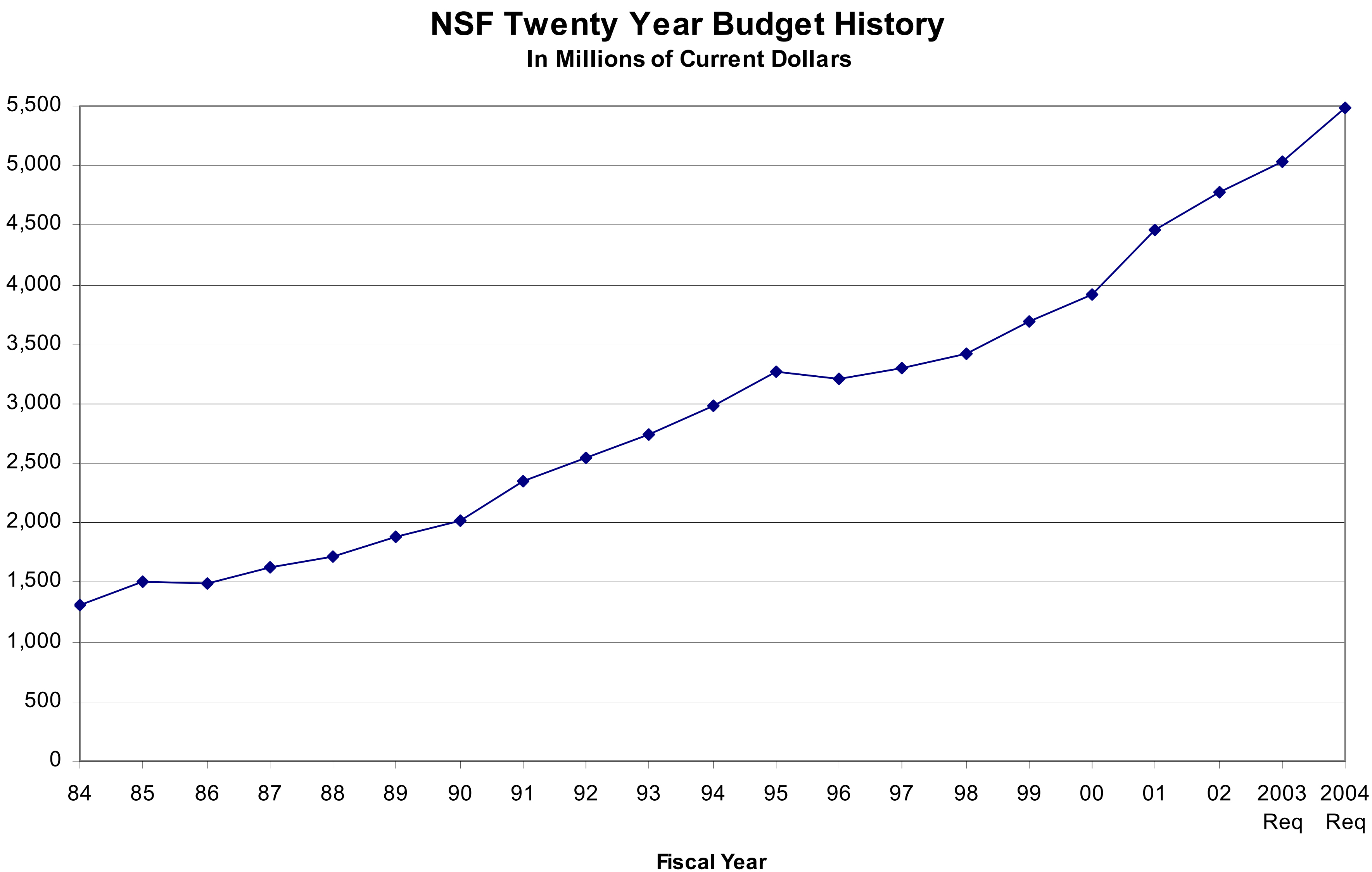
NSF NSTC CROSSCUTS
FY 2004 Budget Request to Congress

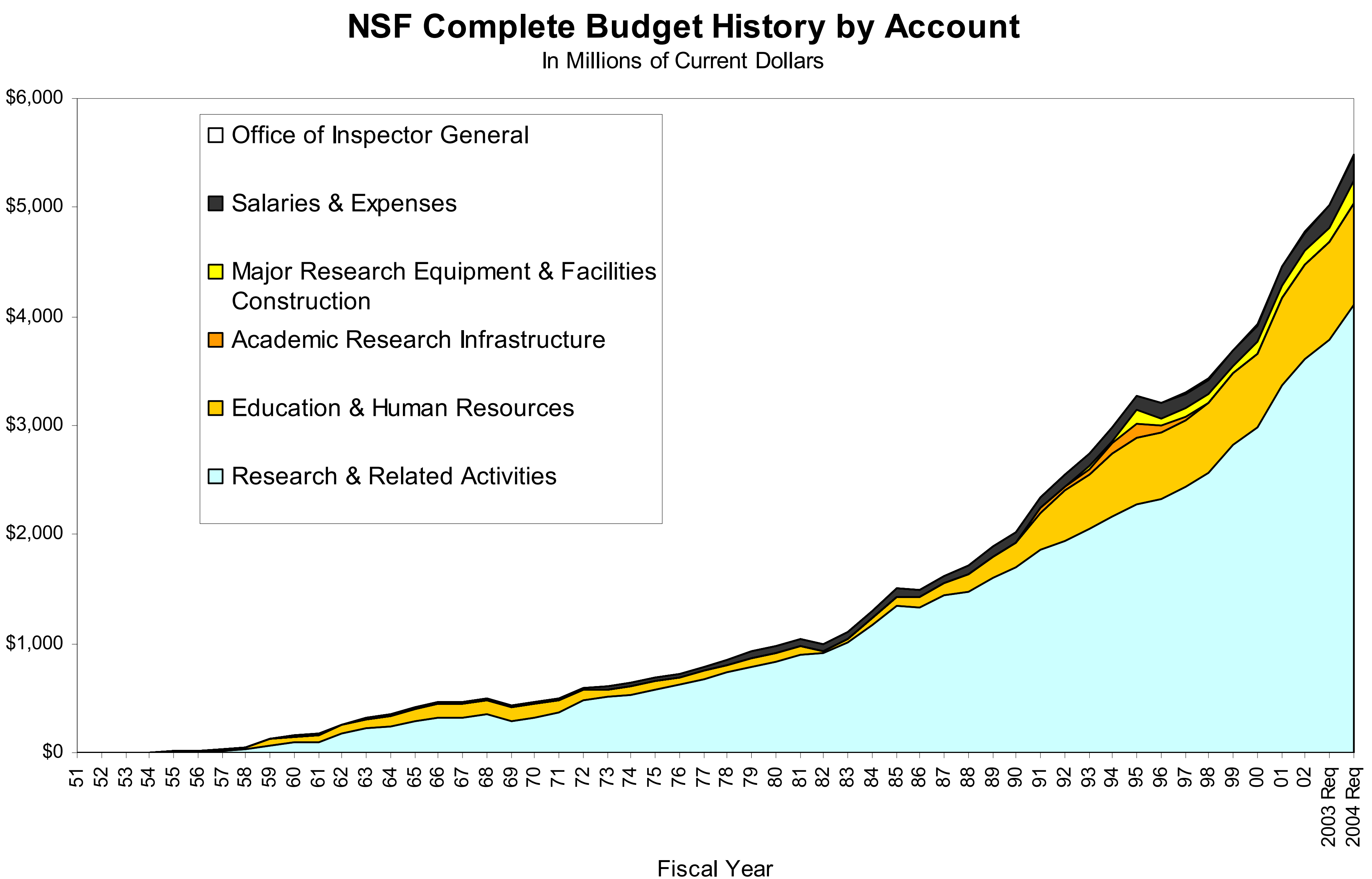
	U.S. Global Change Research Program			Networking and Information Technology Research & Development			National Nanotechnology Initiative		
	FY 2002 Actual	FY 2003 Request	FY 2004 Request	FY 2002 Actual	FY 2003 Request	FY 2004 Request	FY 2002 Actual	FY 2003 Request	FY 2004 Request
BIO	15.10	15.10	15.10	31.00	31.60	32.30	2.50	2.98	4.98
CISE				514.88	526.94	583.18	10.20	11.14	15.14
ENG	0.75	1.00	1.00	10.23	11.17	11.17	86.30	94.35	106.85
GEO	137.49	137.49	137.49	12.16	13.21	14.56	6.80	7.53	7.88
MPS	5.45	5.45	5.45	47.53	59.23	58.75	98.68	103.92	110.42
SBE	16.90	15.48	15.48	7.92	12.78	12.78		1.11	1.50
OPP	13.78	13.78	13.78	1.22	1.33	1.33			
IA									
R&RA	189.47	188.30	188.30	624.94	656.26	714.07	204.48	221.03	246.77
EHR				2.00	2.48	9.53		0.22	2.22
MRE				35.00	20.00				
NSF TOTAL	**$189.47**	**$188.30**	**$188.30**	**$661.94**	**$678.74**	**$723.60**	**$204.48**	**$221.25**	**$248.99**

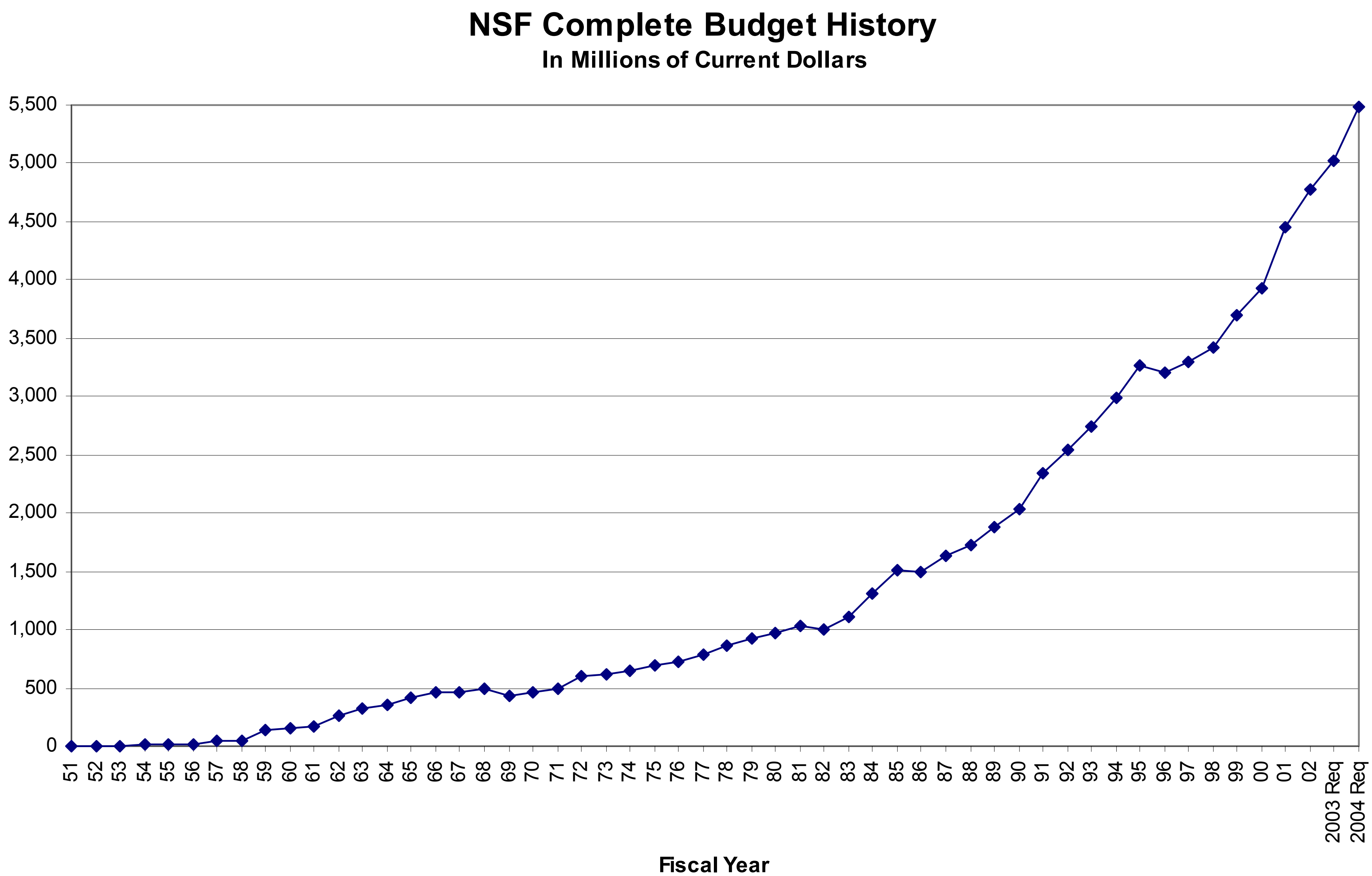
NSF By Account
(Actual Dollars in Millions - Current Dollars)

Fiscal Year	Research & Related Activities	Education & Human Resources	Academic Research Infrastructure	Major Research Equipment & Facilities Construction	Salaries & Expenses	Office of Inspector General	NSF
51	0.0	0.0	0.0		0.1	0.0	0.2
52	1.4	1.5	0.0		0.5	0.0	3.5
53	2.1	1.4	0.0		0.9	0.0	4.4
54	4.5	1.9	0.0		1.5	0.0	8.0
55	8.9	2.1	0.0		1.5	0.0	12.5
56	10.8	3.5	0.0		1.7	0.0	16.0
57	22.0	14.3	0.0		2.4	0.0	38.6
58	27.4	19.2	0.0		2.9	0.0	49.5
59	66.3	61.3	0.0		5.3	0.0	132.9
60	88.4	63.7	0.0		6.5	0.0	158.6
61	104.0	63.4	0.0		7.6	0.0	175.0
62	173.3	78.6	0.0		9.0	0.0	260.8
63	218.9	91.0	0.0		10.9	0.0	320.8
64	239.9	102.6	0.0		12.1	0.0	354.6
65	282.4	120.4	0.0		13.1	0.0	416.0
66	328.6	124.3	0.0		13.1	0.0	466.0
67	327.7	123.4	0.0		14.0	0.0	465.1
68	350.2	134.7	0.0		15.4	0.0	500.3
69	292.9	123.1	0.0		16.5	0.0	432.5
70	316.4	126.4	0.0		19.7	0.0	462.5
71	369.4	105.0	0.0		21.8	0.0	496.1
72	482.4	93.7	0.0		24.6	0.0	600.7
73	519.4	62.2	0.0		28.6	0.0	610.3
74	533.3	80.7	0.0		31.7	0.0	645.7
75	581.2	74.0	0.0		37.9	0.0	693.1
76	619.7	62.5	0.0		42.2	0.0	724.4
77	672.0	74.3	0.0		45.5	0.0	791.8
78	734.7	73.9	0.0		48.7	0.0	857.3
79	791.8	80.4	0.0		54.8	0.0	926.9
80	836.8	80.1	0.0		58.2	0.0	975.1
81	900.4	75.7	0.0		59.2	0.0	1,035.3
82	909.8	26.2	0.0		63.2	0.0	999.1
83	1,013.0	23.0	0.0		65.7	0.0	1,101.7
84	1,177.7	63.0	0.0		66.3	0.0	1,306.9
85	1,344.6	90.6	0.0		72.0	0.0	1,507.1
86	1,329.6	91.7	0.0		71.8	0.0	1,493.2
87	1,440.0	109.9	0.0		77.8	0.0	1,627.6
88	1,481.3	156.8	0.0		84.5	0.0	1,722.6
89	1,600.5	194.1	0.0		91.3	0.0	1,885.9
90	1,696.6	230.4	0.4		96.4	2.3	2,026.1
91	1,868.5	331.9	39.0		101.2	2.9	2,343.5
92	1,940.5	459.4	33.4		110.0	3.9	2,547.1
93	2,046.3	505.1	49.8	34.1	110.8	3.7	2,749.7
94	2,168.4	569.0	105.4	17.0	123.5	3.9	2,987.2
95	2,281.5	611.9	117.5	126.0	129.0	4.5	3,270.3
96	2,327.8	601.2	70.9	70.0	132.5	4.0	3,206.3
97	2,433.9	619.1	30.0	76.1	134.3	5.3	3,298.8
98	2,572.6	633.2	0.0	78.2	136.9	4.8	3,425.7
99	2,821.6	662.5	0.0	56.7	144.1	5.4	3,690.3
00	2,979.9	683.6	0.0	105.0	149.3	5.6	3,923.4
01	3,372.3	795.4	0.0	119.2	166.3	6.6	4,459.9
02	3,616.0	866.1	0.0	115.4	169.9	6.7	4,774.1
2003 Req	3,783.2	908.1	0.0	126.3	203.0	7.7	5,028.2
2004 Req	4,106.4	938.0	0.0	202.3	225.7	8.8	5,481.2


NSF Twenty Year Budget by Account
In Millions of Current Dollars
5,500
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
00
01
02
2003 Req
2004 Req
Fiscal Year
Research & Related Activities
Education & Human Resources
Academic Research Infrastructure
Major Research Equipment & Facilities Construction
Salaries & Expenses
Office of Inspector General


NSF Twenty Year Budget History
In Millions of Current Dollars
5,500
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
00
01
02
2003 Req
2004 Req
Fiscal Year

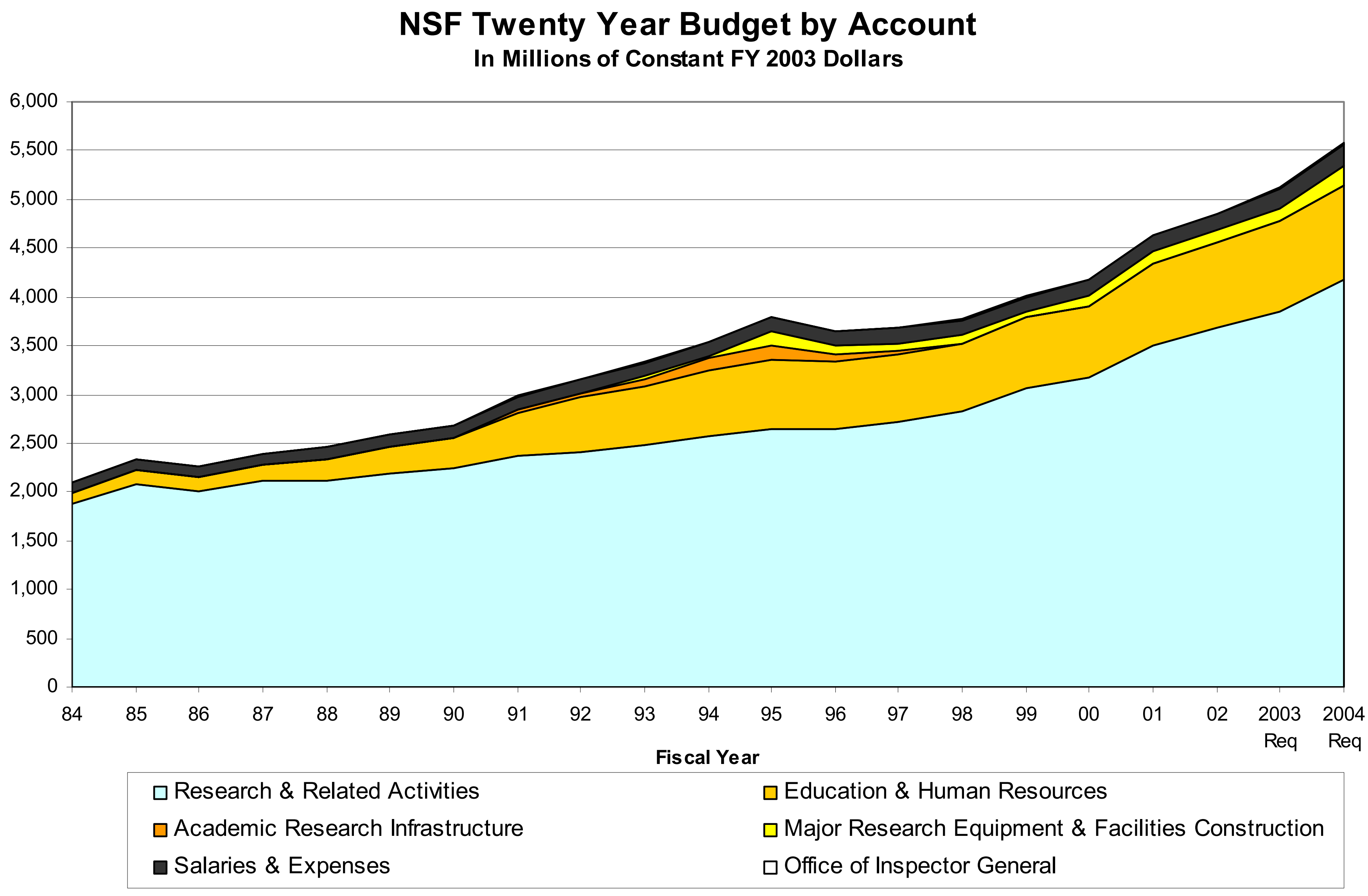

NSF Complete Budget History by Account
In Millions of Current Dollars
$6,000
$5,000
$4,000
$3,000
$2,000
$1,000
$0
Office of Inspector General
Salaries & Expenses
Major Research Equipment & Facilities Construction
Academic Research Infrastructure
Education & Human Resources
Research & Related Activities
51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 00 01 02 2003 Req 2004 Req
Fiscal Year

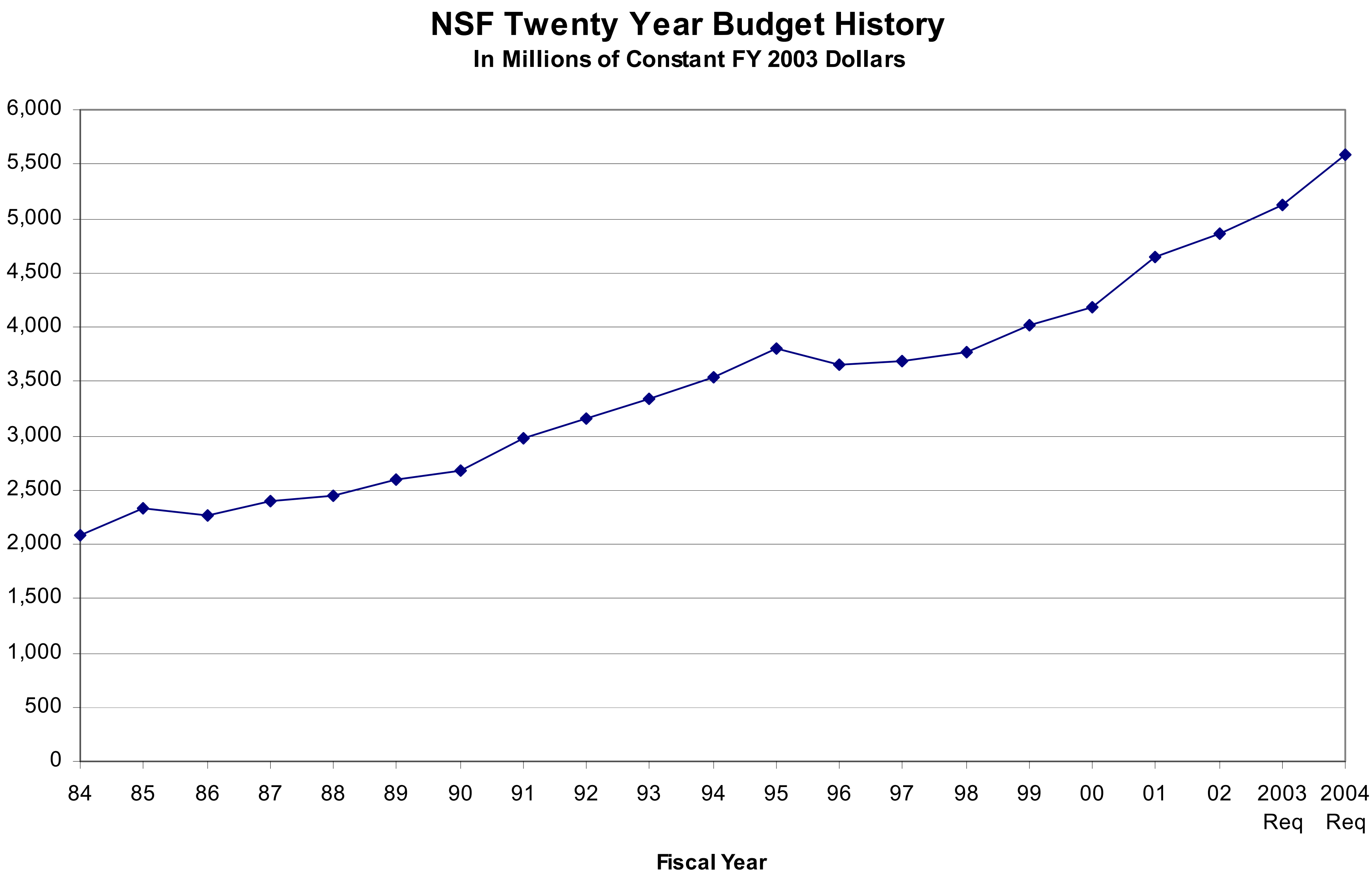

NSF Complete Budget History
In Millions of Current Dollars
5,500
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 00 01 02 2003 Req 2004 Req
Fiscal Year

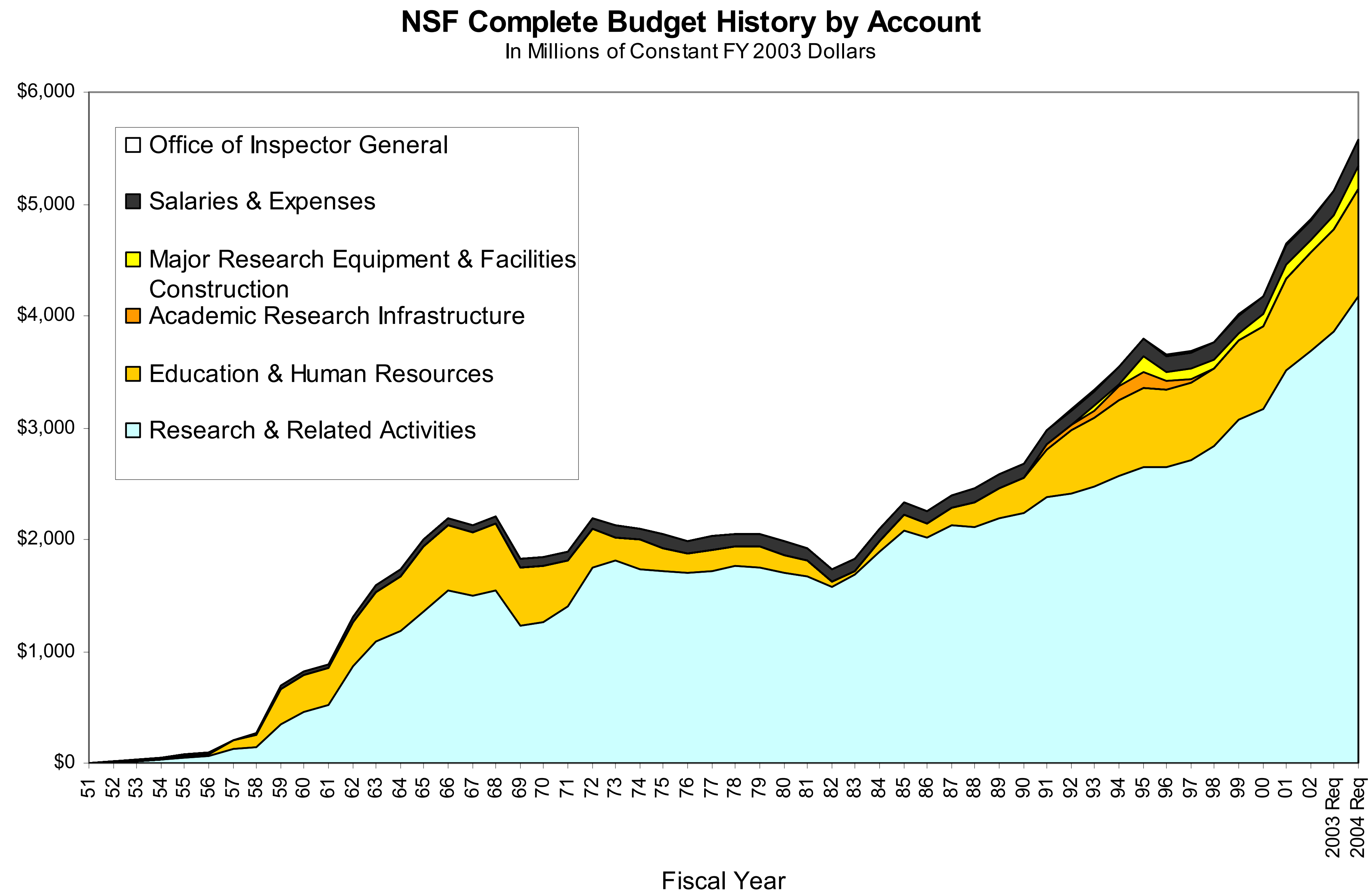
NSF By Account

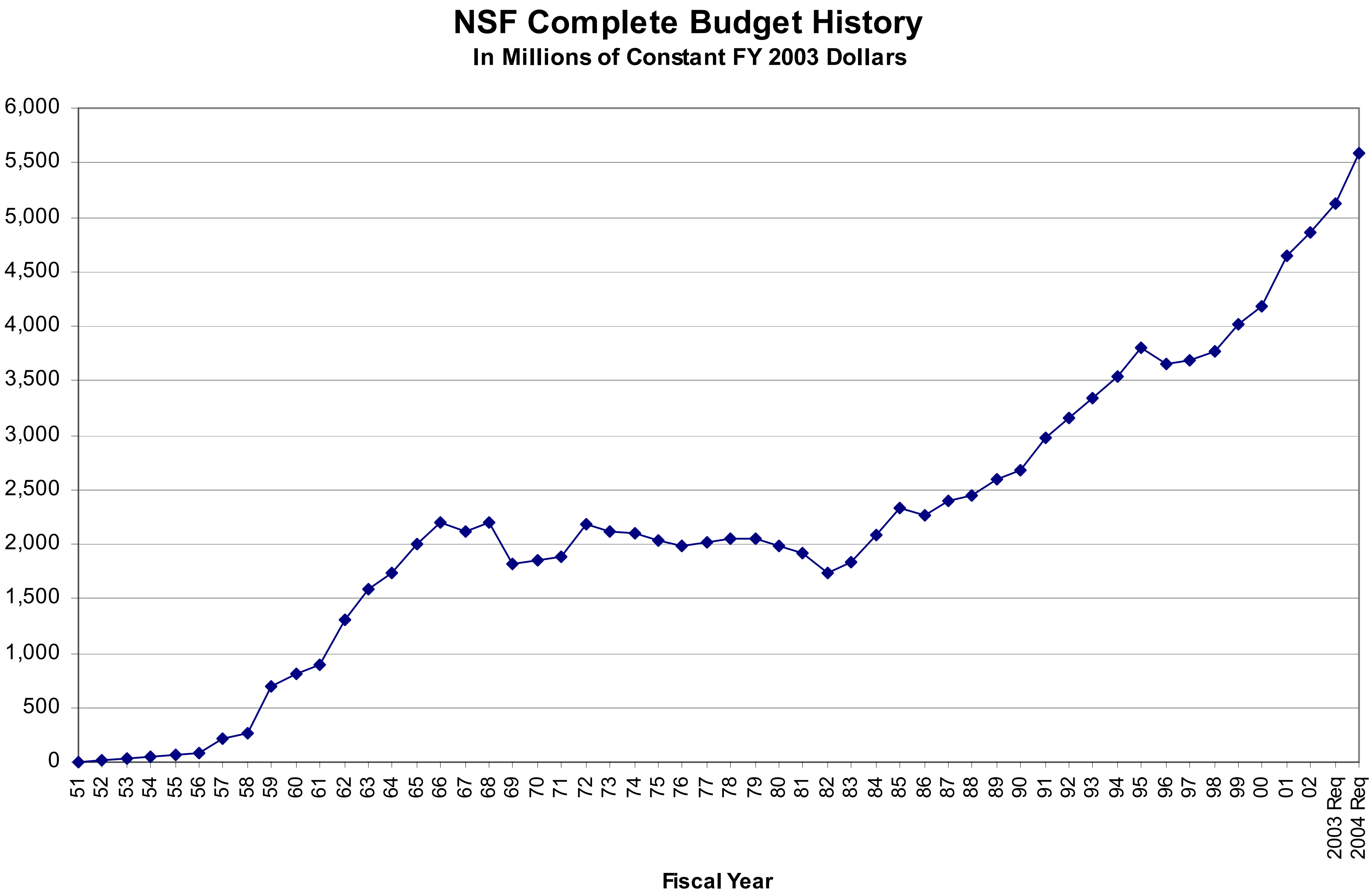
(FY Actuals - FY 2003 Constant Dollars in Millions)

Fiscal Year	Research & Related Activities	Education & Human Resources	Academic Research Infrastructure	Major Research Equipment & Facilities Construction	Salaries & Expenses	Office of Inspector General	NSF
51	0.2	0.0	0.0	0.0	0.8	0.0	0.9
52	8.5	9.3	0.0	0.0	3.2	0.0	20.9
53	12.7	8.3	0.0	0.0	5.2	0.0	26.2
54	26.4	11.1	0.0	0.0	9.0	0.0	46.5
55	51.4	12.1	0.0	0.0	9.0	0.0	72.4
56	61.0	19.9	0.0	0.0	9.5	0.0	90.3
57	119.7	77.9	0.0	0.0	12.8	0.0	210.4
58	144.7	101.5	0.0	0.0	15.5	0.0	261.8
59	345.1	318.9	0.0	0.0	27.4	0.0	691.3
60	454.5	327.9	0.0	0.0	33.5	0.0	815.8
61	527.4	321.8	0.0	0.0	38.4	0.0	887.6
62	869.2	394.2	0.0	0.0	45.0	0.0	1,308.5
63	1,083.8	450.5	0.0	0.0	53.8	0.0	1,588.1
64	1,174.3	502.0	0.0	0.0	59.0	0.0	1,735.2
65	1,358.2	579.0	0.0	0.0	63.1	0.0	2,000.4
66	1,547.0	585.2	0.0	0.0	61.6	0.0	2,193.8
67	1,495.0	562.8	0.0	0.0	64.1	0.0	2,121.9
68	1,542.0	593.2	0.0	0.0	67.7	0.0	2,202.9
69	1,233.8	518.6	0.0	0.0	69.5	0.0	1,821.9
70	1,263.6	504.8	0.0	0.0	78.6	0.0	1,847.1
71	1,404.6	399.3	0.0	0.0	82.8	0.0	1,886.7
72	1,752.6	340.5	0.0	0.0	89.2	0.0	2,182.3
73	1,806.8	216.5	0.0	0.0	99.5	0.0	2,122.8
74	1,731.7	262.1	0.0	0.0	102.8	0.0	2,096.5
75	1,710.2	217.8	0.0	0.0	111.4	0.0	2,039.4
76	1,703.2	171.7	0.0	0.0	116.1	0.0	1,990.9
77	1,717.8	189.8	0.0	0.0	116.4	0.0	2,024.0
78	1,757.6	176.7	0.0	0.0	116.5	0.0	2,050.8
79	1,752.0	177.9	0.0	0.0	121.2	0.0	2,051.1
80	1,700.6	162.7	0.0	0.0	118.4	0.0	1,981.6
81	1,667.9	140.2	0.0	0.0	109.7	0.0	1,917.8
82	1,575.0	45.4	0.0	0.0	109.4	0.0	1,729.8
83	1,679.9	38.1	0.0	0.0	108.9	0.0	1,827.0
84	1,883.6	100.7	0.0	0.0	106.0	0.0	2,090.3
85	2,081.7	140.2	0.0	0.0	111.4	0.0	2,333.3
86	2,010.2	138.6	0.0	0.0	108.6	0.0	2,257.4
87	2,118.7	161.7	0.0	0.0	114.4	0.0	2,394.8
88	2,110.5	223.4	0.0	0.0	120.3	0.0	2,454.2
89	2,195.9	266.2	0.0	0.0	125.2	0.0	2,587.4
90	2,243.3	304.7	0.5	0.0	127.4	3.1	2,679.0
91	2,378.0	422.4	49.7	0.0	128.8	3.7	2,982.6
92	2,406.7	569.8	41.4	0.0	136.4	4.8	3,159.1
93	2,478.8	611.8	60.3	41.3	134.3	4.5	3,330.8
94	2,571.0	674.7	124.9	20.2	146.4	4.6	3,541.9
95	2,647.7	710.1	136.3	146.2	149.7	5.2	3,795.3
96	2,648.6	684.0	80.7	79.6	150.8	4.5	3,648.2
97	2,716.4	691.0	33.5	85.0	149.9	5.9	3,681.6
98	2,831.2	696.8	0.0	86.1	150.7	5.3	3,770.0
99	3,065.1	719.7	0.0	61.6	156.5	5.9	4,008.8
00	3,171.7	727.6	0.0	111.8	158.9	6.0	4,175.9
01	3,508.3	827.5	0.0	124.0	173.0	6.8	4,639.7
02	3,681.0	881.7	0.0	117.4	173.0	6.8	4,859.9
2003 Req	3,851.2	924.4	0.0	128.6	206.6	7.8	5,118.6
2004 Req	4,180.2	954.9	0.0	206.0	229.8	8.9	5,579.8


NSF Twenty Year Budget by Account
In Millions of Constant FY 2003 Dollars
6,000
5,500
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
00
01
02
2003 Req
2004 Req
Fiscal Year
Research & Related Activities
Education & Human Resources
Academic Research Infrastructure
Major Research Equipment & Facilities Construction
Salaries & Expenses
Office of Inspector General


NSF Twenty Year Budget History
In Millions of Constant FY 2003 Dollars
6,000
5,500
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
00
01
02
2003 Req
2004 Req
Fiscal Year


NSF Complete Budget History by Account
In Millions of Constant FY 2003 Dollars
$6,000
$5,000
$4,000
$3,000
$2,000
$1,000
$0
Office of Inspector General
Salaries & Expenses
Major Research Equipment & Facilities Construction
Academic Research Infrastructure
Education & Human Resources
Research & Related Activities
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
00
01
02
2003 Req
2004 Req
Fiscal Year


NSF Complete Budget History
In Millions of Constant FY 2003 Dollars
6,000
5,500
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 00 01 02 2003 Req 2004 Req
Fiscal Year

Centers Supported by NSF in FY 2002

Center	Institution	State
Engineering Research Centers		
Advanced Engineering Fibers and Films	Clemson U	SC
Bioengineering Educational Technology	Vanderbilt U	TN
Biotechnology Process Engineering	Mass Institute of Tech	MA
Computer-Integrated Surgical Systems and Technologies	Johns Hopkins U	MD
Engineered Biomaterials	U of Washington	WA
Engineering of Living Tissue	Georgia Institute of Tech	GA
Environmentally Benign Semiconductor Manufacturing	U of Arizona	AZ
Integrated Media Systems	U of Southern California	CA
Low Cost Electronic Packaging	Georgia Institute of Tech	GA
Marine Bioproducts Engineering	U of Hawaii	HI
Neuromorphic Systems Engineering	California Institute of Tech	CA
Particle Science & Technology	U of Florida	FL
Power Electronic Systems	Virginia Tech U	VA
Reconfigurable Machining Systems	U of Michigan	MI
Subsurface Sensing and Imaging Systems	Northeastern U	MA
Wireless Integrated MicroSystems	U of Michigan	MI
Engineering Research Groups		
Nano Modeling and Simulation Groups:		
Computational Nano-Engineering for Patterned Magnetic Nanostructures	Stanford U	CA
Evolution of Nanoscale Film Morphology	Kansas State U	KA
Molecular Nanoelectronics: Simulation from Molecules to Circuits	Purdue U	IN
Molecular Transport in Nanostructured Materials	U of Delaware	DE
Nanoengineered Materials: Polymer Composites to Structured Adsorbents	U of Pittsburgh	PA
Nanoscale Modeling of Flow of Macromolecules through Microfluidic Devices	U of Wisconsin-Madison	WI
Nanoscale Simulation by Quantum Computation	Mass Institute of Tech	MA
XYZ-on-a-Chip Groups:		
Assembly of Integrated Near-field Optical Microfluidic Devices by Thin-film Transfer and Micromachining of Teflon, Group-III Nitrides and Silicon	U of California-Berkeley	CA
Biomolecular Motor/Nanotube Integration for Actuator Nanotechnology	U of North Carolina-Chapel Hill	NC
Cellular Electrophysiology on a Chip	U of Missouri-Columbia	MO
Development and Fabrication of Three-Dimensional Microdevices	Boston College	MA
Large Area Biosensing Electronics	Carnegie Mellon U	PA
Micromachined Magnetically Reconfigurable Frequency Selective Surfaces	U of California-Los Angeles	CA
A Nanomaterials/Nanoelectrochemical Route for Communication Between Biochemical Processes and IC Chips	U of Florida	FL

Patterning Flow at the Microscale: Open Architecture Design for Integrated Fluidic Chips	Princeton U	NJ
UV Fluorescence/Absorption Micro-Analysis System	Texas Tech U	TX
Science and Technology Centers		
Adaptive Optics	U of California-Santa Cruz	CA
Advanced Materials for Water Purification	U of Illinois	IL
Behavioral Neuroscience	Emory U	GA
Biophotonics Science and Technology	U of California-Davis	CA
Earth Surface Dynamics	U of Minnesota	MN
Embedded Networked Sensing	U of California-Los Angeles	CA
Environmentally Responsible Solvents and Processes	U of North Carolina	NC
Integrated Space Weather Modeling	Boston U	MA
Materials and Devices for Information Technology Research	U of Washington	WA
Nanobiotechnology	Cornell U	NY
Sustainability of Semi-Arid Hydrology and Riparian Areas	U of Arizona	AZ
Industry/University Cooperative Research Centers		
Advanced Electron Devices and Systems	Texas A&M U	TX
Advanced Vehicle Electronics	Auburn U	AL
Aseptic Processing and Packaging Studies	North Carolina State U	NC
Berkeley Sensor & Actuator Center	U of California-Berkeley	CA
Biocatalysis	Polytechnic U of NY	NY
Bioinstrumentation	U of New Hampshire	NH
Biomedical Devices	Colorado School of Mines	CO
Building Environment	U of California-Berkeley	CA
Building Performance and Diagnostics	Carnegie Mellon U	PA
Center for Advanced Manufacturing & Packaging of Microwave, Optical, and Digital Electronics	U of Colorado-Boulder	CO
Center for Communications and Advanced Computing	North Carolina State U	NC
Center for Microengineered Ceramics	U of New Mexico	NM
Center for Particulate Materials	Penn State U	PA
Center for Pharmaceutical Processing Research	Purdue U	IN
Center in Ergonomics	Texas A&M U	TX
Composites	Ohio State U	OH
Computer Technology	U of California-Irvine	CA
Cooperative Research Center in Coatings	Eastern Michigan U	MI
Design of Analog-Digital Integrated Circuits	Washington State U	WA
Dielectric Studies	Pennsylvania State U	PA
Digital Video	Rensselaer Polytechnic Inst	NY
Engineering Tribology	Northwestern U	IL
Fundamentals and Applications of Photopolymerizations	U of Iowa	IA
Glass Research	Alfred U	NY
Health Management Research	U of Washington	WA
Information Management	U of Arizona	AZ
Intelligent Maintenance	U of Wisconsin-Milwaukee	MI
IUCRC for Biosurfaces	State U of New York-Buffalo	NY
Machine Tools Systems	U of Illinois	IL
Measurement and Control Engineering Center	U of Tennessee	TN
Membrane Applied Science and Technology	U of Colorado-Boulder	CO
Metrology	U of North Carolina-Charlotte	NC

Microcontamination Control	U of Arizona	AZ
Nondestructive Evaluation	Iowa State U	IA
Optical Circuitry Cooperative	U of Arizona	AZ
Photopolymerization	U of Iowa	IA
Power Systems Engineering	Cornell U	NY
Quality and Reliability	Rutgers U	NJ
Reinforcing Composites	U of Missouri-Rolla	MO
Silicon	North Carolina State U	NC
Software Engineering Research Center	Purdue U	IN
Surfactants	Columbia U	NY
Tree Genetics	Oregon State U	OR
Virtual Proving Ground	U of Iowa	IA
Water Quality	U of Arizona	AZ
Wireless Reliability	U of Oklahoma	OK
State/Industry/University Cooperative Research Centers		
Advanced Friction Studies	Southern Illinois U	IL
Industrial Sensors and Measurement	Ohio State U	OH
Low Power Electronics	U of Arizona/Arizona State U	AZ
Centers of Research Excellence in Science and Technology		
Advanced Materials and Smart Structures	North Carolina A&T U	NC
Computer Science	Jackson State U	MS
Distributed Computing Theory, Development and Applications	Florida A&M/Florida International U	FL
Environmental Science	Cal State U-Los Angeles	CA
Environmental Sustainability of Semi-Arid Coastal Areas	Texas A&M U - Kingsville	TX
Innovative Manufacturing of Advanced Materials	Tuskegee Institute	AL
Materials Science	Norfolk State U	VA
Mesoscopic Modeling and Simulation	City U of NY-City College	NY
Systems Science Research	Tennessee State U	TN
Theoretical Studies of Physical Systems	Clark Atlanta U	GA
Tropical Applied Ecology and Conservation	U of Puerto Rico-Rio Piedros	PR
Plant Genome Virtual Centers		
A Protein Interaction Database for Rice Protein Kinases	U of Nebraska-Lincoln	NE
Chromatin-based Control of Gene Expression	U of Arizona	AZ
Colinearity of Maize and Sorghum	Rutgers U	NJ
Comparative and Functional Genomics of Tomato	Cornell U	NY
Comparative Evolutionary Genomics of Cotton	Iowa State U	IA
Comparative Genomics of Disease Resistance Genes	U of California-Davis	CA
Dissecting Phytophthora Resistance in Soybean using Expression Profiling and Analysis of Quantitative Train Loci	VA Polytechnic Inst & St U	VA
Evolutionary Genomics of Maize	U of Wisconsin	WI
Functional Genomics of Hemicellulose Biosynthesis	Michigan State U	MI
Functional Genomics of Maize Centromeres	U of Georgia	GA
Gene Inventory and Function of the Model Legume	U of California-Davis	CA
Genetic, Physical and Database Resources for Maize	U of Missouri	MO
Genomics of Plant Stress Tolerance	U of Illinois	IL
Grass Genome Biodiversity	U of Georgia	GA
Identification and Characterization of Cell Wall Mutants in Maize and Arabidopsis using Novel Spectroscopies	Purdue University	IN
Integrative Functional Genomic Resource Development in	U of Nevada-Reno	NV

Vitis vinifera: Abiotic Stress and Wine Quality		
Maize Gene Discovery, Sequencing and Analysis	Stanford U	CA
Plant Genes Involved in Transformation	Purdue U	IN
Structure and Function of Wheat Genomes	U of California	CA
Systematic Transposon Mutagenesis of the Maize Gene	Cold Spring Harbor Lab	NY
The Floral Genome Project	Penn State U	PA
Tools for Potato Structural and Functional Genomics	U of California-Berkeley	CA
Materials Centers		
Advanced Carbon Materials Center	U of Kentucky	KY
Center for Complex Materials	Princeton U	NJ
Center for Materials for Information Science	U of Alabama	AL
Center for Materials Research	Cornell U	NY
Center for Materials Science and Engineering	Mass Institute of Tech	MA
Center for Micro- and Nanomechanics of Materials	Brown U	RI
Center for Nanoscopic Materials Design	U of Virginia	VA
Center for Nanomagnetic Structures	U Nebraska	NE
Center for Nanoscale Science	Pennsylvania State U	PA
Center for Nanostructured Materials	U of Wisconsin	WI
Center on Nanostructured Materials	Johns Hopkins U	MD
Center for Oxide Thin Films, Probes and Surfaces	U of Maryland	MD
Center for Polymer Science and Engineering	U of Massachusetts	MA
Center for Polymers at Engineered Interfaces	SUNY-Stony Brook/ CUNY/ Polytechnic U	NY
Center for Polymer Interfaces and Macromolecular Assemblies	Stanford U/ UC-Davis/IBM	CA
Center for Response-Driven Polymeric Films	U Southern Mississippi	MS
Center for Science and Engineering of Materials	California Institute of Tech	CA
Center for Semiconductor Physics in Nanostructures	U of Oklahoma/ U of Arkansas	OK,AR
Center for Sensor Materials	Michigan State U	MI
Center for Thermal Spray Research	SUNY-Stoney Brook	NY
Ferroelectric Liquid Crystals Materials Research Center	U of Colorado-Boulder	CO
Laboratory for Research on the Structure of Matter	U of Pennsylvania	PA
Materials Research Center	U of Chicago	IL
Materials Research Center	Harvard U	MA
Materials Research Center	Northwestern U	IL
Materials Research Science and Engineering Center	U of California-Santa Barbara	CA
Materials Research Science and Engineering Center	U of Minnesota	MN
Materials Research Science and Engineering Center	Carnegie Mellon U	PA
Center for Ecological Analysis and Synthesis	U of California-Santa Barbara	CA
Long Term Ecological Research Sites		
Arctic Tundra: Toolik Field Station	Marine Biological Lab	MA
Bonanza Creek Experimental Forest	U of Alaska	AK
Cedar Creek Natural History Area	U of Minnesota	MN
Central Arizona-Phoenix Urban LTER	Arizona State U	AZ
Coweeta Hydrologic Laboratory	U of Georgia	GA
Florida Coastal Everglades	Florida International U	FL
Georgia Coastal Ecosystems	U of Georgia	GA
H.J. Andrews Experimental Forest	Oregon State U	OR
Harvard Forest	Harvard U	MA
Hubbard Brook Experimental Forest	Syracuse U	NY

Jornada Experimental Range	Duke U	NC
Kellogg Biological Station	Michigan State U	MI
Konza Prairie Research Natural Area	Kansas State U	KA
Luquillo Experimental Forest	U of Puerto Rico-Rio Piedros	PR
McMurdo Dry Valleys, Antarctica	Desert Research Institute	NV
Metropolitan Baltimore Urban LTER	Institute of Ecosystem Studies	MD
Niwot Ridge-Green Lakes Valley	U of Colorado	CO
North Temperate Lakes	U of Wisconsin	WI
Palmer Station, Antarctica	U of California	CA
Plum Island Sound	Woods Hole	MA
Santa Barbara Coastal LTER	U of California-Santa Barbara	CA
Sevilleta National Wildlife Refuge	U of New Mexico	NM
Shortgrass Steppe	Colorado State U	CO
Virginia Coast Reserve	U of Virginia	VA
Earthquake Engineering Research Centers		
Mid-America Earthquake Center	U of Illinois-Champaign-Urbana	IL
Multidisciplinary Center for Earthquake Engineering Research	State U of NY-Buffalo	NY
Pacific Earthquake Engineering Research Center	U of California-Berkeley	CA
Chemistry Centers		
Chemical and Microbial Interactions at Environmental Interfaces	Stanford U	CA
Chemical Sources and Sinks at Liquid/Solid Interfaces	Columbia U	NY
Environmental Redox-Mediated Dehalogenation Chemistry	Johns Hopkins U	MD
Fundamental Studies of Nonparticle Formation in Air Pollution	Worcester Polytechnic Inst	MA
Institute for Environmental Bioinorganic Chemistry	Princeton U	NJ
Institute for Environmental Catalysis	Northwestern U	IL
Laboratory for Molecular Sciences	California Institute of Tech	CA
Molecular Environmental Chemistry of Mn Oxide Biomineralization	U of California-San Diego	CA
Molecular Isotopic Tools for Environmental Research	Woods Hole	MA
Molecular Level Analysis of Macromolecule-Surface Interactions in Bacterial Adhesion	Penn State U	PA
Molecular Structure and Microstructure of PM2.5 Derived from Stationary and Mobile Fossil Fuel Sources	U of Kentucky	KY
Role of Environmental Molecular Interfaces on the Chemical and Biological Reactivity of Pollutants	Ohio State U	OH
Moderate Resolution Protein Structures by Chemical Cross-Linking and Mass Spectrometry	U of California-San Francisco	CA
Center for Environmental Molecular Science (CEMS)	SUNY-Stony Brook	NY
Role of Environmental Molecular Interfaces on the Chemical and Biological Reactivity of Pollutants	Ohio State U	OH
Actinides and Heavy Metals in the Environment - The Formation, Stability, and Impact of Nano- and Micro-Particles	U of Notre Dame	IN
Atom and Group Transfer Reactions: A Combined Synthetic, Structural, Theoretical, Kinetic, and Solution	Mass Institute of Tech	MA

Calorimetry Investigation		
Next Generation Aromatics	U of Georgia	GA
Multi-dimensional Molecular Metals, Crystal Design, and Superconductivity	Cornell U	NY
An Integrated Approach to Understanding the Air-Water Interface in Atmospherically Relevant Systems	U of California-Irvine	CA
Micro Imaging for Sensory and Materials Applications	Mass Institute of Tech	MA
Mathematical Sciences Research Institutes		
American Institute of Mathematics	Palo Alto	CA
Institute for Mathematics and Its Applications	U of Minnesota	MN
Institute for Pure and Applied Mathematics	U of California-LA	CA
Mathematical Biosciences Institute	Ohio State U	OH
Mathematical Sciences Research Institute	Berkeley	CA
Statistical and Applied Mathematical Sciences Institute	Duke U	NC
Information Technology Centers		
A Mobile Sensor Web for Polar Ice Sheet Measurements	U of Kansas	KS
Active Information Spaces Based on Ubiquitous Computing	U of Illinois-Champaign-Urbana	IL
Adaptable Voice Translation for Minority Languages	Carnegie Mellon U	PA
Adaptive Software for Field-driven Simulations	Cornell U-Endowed	NY
An Ensemble Approach to Data Assimilation in the Earth Sciences	Mass Institute of Tech	MA
An International Virtual-Data Grid Laboratory for Data Intensive Science	U of Florida	FL
Building the Framework of the National Virtual Observatory	Johns Hopkins U	MD
Capturing, Coordinating and Remembering Human Experience	Carnegie Mellon U	PA
Center for Applied Algorithms	Carnegie Mellon U	PA
Center for Bits and Atoms	Mass Institute of Tech	MA
Center for Computational Biophysics	U of California - San Diego	CA
Cognitive and Social Design of Robotic Assistants	Carnegie Mellon U	PA
Collaborative Research: Modular Ocean Data Assimilation	Oregon State U	OR
Computational Geometry for Structural Biology and Bioinformatics	Duke U	NC
Computational Infrastructure for Microfluidic Systems with Applications to Biotechnology	U of California-Santa Barbara	CA
Computational Learning and Discovery in Biological Sequence, Structure and Function Mapping	Carnegie Mellon U	PA
Computational Logic Tools for Research and Education	Stanford U	CA
Computational Tools for Modeling, Visualizing and Analyzing Historic and Archaeological Sites	Columbia U	NY
Creating the Next Generation of Intelligent Animated Conversational Agents	U of Colorado-Boulder	CO
Data Centers - Managing Data with Profiles	Brown U	RI
Design and Simulation of Biologically-inspired Nanolattice	U of Florida	FL
Design Conformant Software	Mass Institute of Tech	MA
Digital Clay for Shape Input and Display	GA Tech Res Corp-GIT	GA
Discrete Models & Algorithms in the Sciences	U of California-Berkeley	CA
Dynamic Cooperative Performance Optimization	U of Massachusetts-Amherst	MA

Enabling the Science Environment for Ecological Knowledge	U of New Mexico	NM
Flexible Environments for Grand-Challenge Climate Simulation	U of Chicago	IL
Foundations of Hybrid and Embedded Software Systems	U of California - Berkeley	CA
Foundations of Solid-State Quantum Information Processing	U of Urbana-Champaign	IL
FrameNet++: An On-Line Lexical Semantic Resource and its Application to Speech & Language Understanding	Int'l Computer Sci Inst	CA
From Bits to Information: Statistical Learning Technologies for Digital Information Management and Search	Mass Institute of Tech	MA
From the Web to the Global InfoBase	Stanford U	CA
The GriPhyN Project: Towards Peta-Scale Virtual Data Grids	U of Florida	FL
Heterogeneous System Integration in System-on-a-Chip Designs	U of Washington	WA
Hierarchical and Reconfigurable Schemes for Distributed Control over Heterogeneous Network	U of Illinois-Champaign-Urbana	IL
High-Speed Wavelength-Agile Optical Networks	U of Urbana-Champaign	IL
Institute for Quantum Information	California Institute of Tech	CA
Interacting with the Visual World: Capturing, Understanding, and Predicting Appearance	Columbia U	NY
Interaction and Participation in Integrated Land Use, Transportation, and Environmental Modeling	U of Washington	WA
Investigation of a Model for Online Resource Creation and Sharing in Educational Settings	Michigan State U	MI
Latent Semantic Analysis: Theory and Technology	U of Colorado-Boulder	CO
Learning-Centered Design Methodology: Meeting the Nation's Need for Computational Tools for K-12 Science Education	U of Michigan-Ann Arbor	MI
Low Frequency Array (LOFAR) - A Digital Radio Telescope	Northeast Radio Obs Corp	MA
Methodologies and Tools for Designing and Implementing Large Scale Real-Time Systems	Vanderbilt U	TN
Molecular Computation in Ciliates	Princeton U	NJ
Multilingual Access to Large Spoken Archives	Suv of the Shoah Vis His F	CA
Multimodal Human Computer Interaction: Toward a Proactive Computer	U of Illinois-Champaign-Urbana	IL
A Multiresolution Analysis for the Global Internet	U of Wisconsin-Madison	WI
New Approached to Human Capital Development through Information Technology Research	Northeastern U	MA
The Open Source Quality Project	U of California-Berkeley	CA
Personalized Spatial Audio via Scientific Computing and Computer Vision	U of Maryland-College Park	MD
A Petabyte in Your Pocket	U of Wisconsin-Madison	WI
Procedural Representation and Visualization Enabling Personalized Computational Fluid Dynamics	Purdue U	IN
Quality-Scalable Information Flow Systems for Environmental Observation and Forecasting	Oregon Health Sciences U	OR
Quantum Computing using Electrons on Helium Films	Case Western Reserve U	OH
Real-Time Long-Distance Terascale Computation for	U of North Carolina-Chapel Hill	NC

Full Bandwidth Tele-Immersion		
A Research Project to Create Cyberinfrastructure for the Geosciences	U of California - San Diego	CA
Responsive Virtual Human Technology Research	Research Triangle Inst	NC
Robust Large-Scale Distributed Systems	MIT	MA
Self-Assembly of DNA Nano-Scale Structures for Computation	Duke U	NC
Simulation of Flows with Dynamic Interfaces on Multi-Teraflop Computers	Carnegie-Mellon U	PA
Social and Economic Implications of IT: What is Really Happening?	Mass Institute of Tech	MA
Societal Scale Information Systems: Technologies, Design and Applications	U of California-Berkeley	CA
Statistical Data Mining for Cosmology	Carnegie Mellon U	PA
Sustainable and Generalizable Technologies to Support Collaboration in Science	U of Michigan-Ann Arbor	MI
Taming the Data Flood: Systems that Evolve, are Available, and Maintainable (SEAM)	U of California-Berkeley	CA
The Impacts of IT on Individuals and Their Organizations: Conditions of Change and Transformation.	U of California-Irvine	CA
The OptIPuter	U of California - San Diego	CA
The SCEC Community Modeling Environment: An Information Infrastructure for System-Level Earthquake Research	U of Southern California	CA
The System Architecture of a Computing Utility	Stanford U	CA
Understanding the Social Impact of the Internet: A Multifaceted Multidisciplinary Approach	U of Maryland-College Park	MD
Virtual Instruments: Scalable Software Instruments for the Grid	U of California-San Diego	CA
Visualization of Multi-Valued Scientific Data: Applying Ideas from Art and Perceptual Psychology	Brown U	RI

Nanoscale Science and Engineering Centers

Integrated Nanopatterning and Detection Technologies	Northwestern U	IL
Nanoscale Systems in Information Technologies	Cornell U	NY
Science of Nanoscale Systems and their Device Applications	Harvard U	MA
Electronic Transport in Molecular Nanostructures	Columbia U	NY
Nanoscience in Biological and Environmental Engineering	William Marsh Rice U	TX
Directed Assembly of Nanostructures	Rensselaer Polytechnic Inst	NY

Physics Frontiers Centers

Center for Cosmological Physics	U of Chicago	IL
Center for Gravitational-Wave Phenomenology	Pennsylvania State U	PA
Frontiers of Optical, Coherent Ultrafast Science	U of Michigan	MI
Center for the Study of the Origin and Structure of Matter	Hampton U	VA
Center for Theoretical Biological Physics	U of California-San Diego	CA

Research Centers on the Human Dimensions of Global Change

Center for Integrated Study of the Human Dimensions of Global Change	Carnegie Mellon U	PA
Center for the Study of Institutions, Population, and Environmental Change	Indiana U	IN

National Consortium for Violence Research	Carnegie Mellon U	PA
Children's Research Centers		
Children's Digital Media Center	Georgetown U	DC
North Carolina Child Development Research Collaborative	U of North Carolina	NC
Cornell Center for Research on Children	Cornell U	NY
Center for Research on Culture, Development and Education	New York University	NY

RESEARCH AND RELATED ACTIVITIES

RESEARCH AND RELATED ACTIVITIES $4,106,360,000

The FY 2004 Budget Request for the Research and Related Activities (R&RA) Appropriation is $4,106.36 million, an increase of $323.15 million, or 8.5 percent more than the FY 2003 Request of $3,783.21 million. Support from the R&RA Appropriation enables U.S. leadership and accelerated progress across the expanding frontiers of scientific and engineering research and education. In turn, these activities support areas of inquiry critical to long-term U.S. economic strength, security, and quality of life.

NSF investments in R&RA reflect the Foundation's three strategic outcomes:

- **People -** developing a diverse, internationally competitive and globally engaged workforce of scientists, engineers and well-prepared citizens.
- **Ideas** - enabling discovery across the frontier of science and engineering, connected to learning, innovation, and service to society.
- **Tools -** providing broadly accessible, state-of-the-art information-bases and shared research and education tools.

Research activities spur the knowledge, ideas, tools and approaches that increase understanding, solve problems, and stimulate opportunities for economic growth. The productive exchange of knowledge, information and technology can accelerate innovation, often yielding new insights into the underlying research. Researchers from different disciplines increasingly transcend traditional boundaries to solve complex problems. Students work with senior scientists performing research, fostering the natural integration of research and education, and obtaining the skills needed for the next generation's workforce of scientists and engineers.

Research and Related Activities Funding
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change from FY 2003 Amount	Change from FY 2003 Percent
Biological Sciences	509.64	525.62	562.22	36.60	7.0%
Computer & Information Science & Engineering	515.01	526.94	584.26	57.32	10.9%
Engineering	470.83	487.98	536.57	48.59	10.0%
Geosciences	609.55	691.07	687.92	-3.15	-0.5%
Mathematical & Physical Sciences	920.42	941.57	1,061.27	119.70	12.7%
Social, Behavioral & Economic Sciences	183.97	195.61	211.74	16.13	8.2%
U.S. Polar Research Programs	230.52	235.74	261.86	26.12	11.1%
U.S. Antarctic Logistical Support Activities	70.27	68.07	68.07	0.00	0.0%
Integrative Activities	105.76	110.61	132.45	21.84	19.7%
Total, Research and Related Activities	$3,615.97	$3,783.21	$4,106.36	$323.15	8.5%

Totals may not add due to rounding.

BIOLOGICAL SCIENCES

BIOLOGICAL SCIENCES $562,220,000

The FY 2004 Request for the Biological Sciences Activity is $562.22 million, an increase of $36.60 million, or 7.0 percent, above the FY 2003 Request of $525.62 million.

BIO Funding
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Molecular and Cellular Biosciences	112.17	111.56	116.86	5.30	4.8%
Integrative Biology and Neuroscience	100.86	98.73	103.38	4.65	4.7%
Environmental Biology	101.11	99.77	104.77	5.00	5.0%
Biological Infrastructure	73.21	72.32	79.96	7.64	10.6%
Emerging Frontiers	47.30	68.25	82.25	14.00	20.5%
Plant Genome Research	75.00	75.00	75.00	0.00	0.0%
Total, BIO	$509.65	$525.62	$562.22	$36.60	7.0%

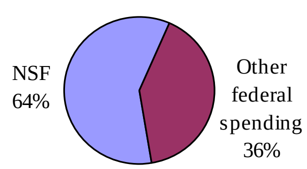
Totals may not add due to rounding

The mission of the Biological Sciences Activity (BIO) is to support the vitality of the biological sciences at U.S. colleges and universities, especially in those areas where NSF has major responsibility. BIO supports research, infrastructure, and education.

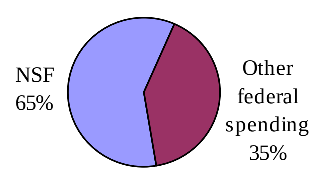
RELEVANCE

BIO is the dominant federal supporter of basic research in non-medical aspects of the biological sciences at academic institutions – providing over 65 percent of the support for these activities. Because most federal support for the life sciences – over 85 percent – goes to health-related research funded by the National Institutes of Health, NSF's contribution to the broader array of the biological sciences is significant and strategically-focused – particularly in such areas as environmental biology and plant sciences.

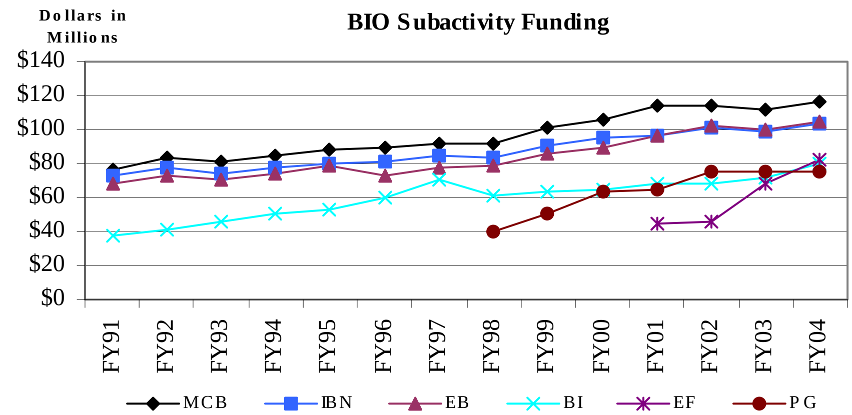
Federal Support for Basic Research in Environmental Biology at Academic Institutions (FY 2000)



Federal Support for Basic Research in Non-Medical Biological Sciences at Academic Institutions (FY 2000)



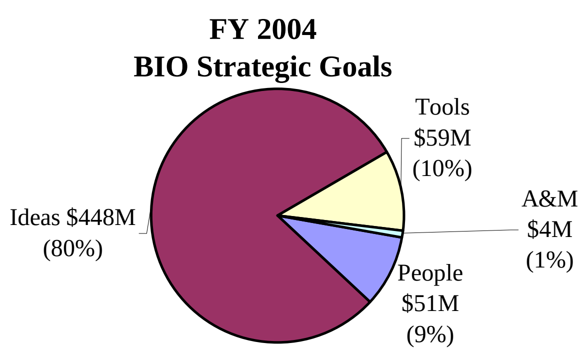
Fundamental research on understanding all aspects of "life" from the cell to whole ecosystems is supported within NSF – where the ability to integrate the range of biological sub-disciplines is unique. BIO support represents 64 percent of all federal funding for basic research in environmental biology and an estimated 55 percent of support in plant biology. Additionally, NSF plays a unique role in interdisciplinary biological research, since collaborations among disciplines represented by the various R&RA Activities are possible. Issues of national importance related to the environment, economy and human welfare require understanding how living organisms function and interact with the non-living systems they sustain and that sustain them. BIO supported research enhances this understanding.



Fundamental research about living organisms and their interactions with non-living systems is by nature complex and risky. Research outcomes are often surprising and unpredictable. These attributes call for the type of sustained support best provided by federal investments. NSF has taken the lead in supporting fundamental research across all levels of biological organization and especially in the areas noted above because increasing our fundamental understanding about life requires interdisciplinary approaches, which NSF is uniquely designed to provide.

STRATEGIC GOALS

Three aims guide BIO's activities:



- PEOPLE: BIO will support improvement of the quality of biological sciences education and training and enhancement of diversity in all the fields of biology. BIO will advance education and training for current biological scientists, increase the diversity of the biological sciences community, facilitate education and training for future generations of biological scientists, and enhance the general public's knowledge about biology. In FY 2004, BIO will support increases in stipends for graduate students and postdoctoral fellows and enhancement of training experiences for K-12 teachers and their students.

- IDEAS: BIO will support advancement of knowledge about major biological questions from a multidisciplinary view, including both maintaining adequate base support across all biological fields and identifying opportunities where more focused support can play a catalytic role in advancing scientific progress. 21st Century Biology is multidimensional, multidisciplinary, integrative, data-driven, education-oriented and global, encompassing conceptual and experimental approaches much different from those of the last century. Advances in areas such as genomics, information technology, high throughput instrumentation, imaging and wireless technologies, sensors and Geographic Information Systems (GIS) now enable novel and integrative approaches to major challenges in biology. As a result, biological research has become increasingly integrative and interdisciplinary. An activity, Frontiers in Biological Research (FIBR), invites high-risk proposals for new ideas or approaches to address fundamental questions in biology that do not fit within the boundaries of traditional disciplinary or subdisciplinary areas.

- TOOLS: BIO will support enhancement of the infrastructure for the conduct of biological research. BIO will invest in instrumentation and facilities, including operational support costs for the National Ecological Observatory Network (NEON); mid-size facilities; biological research resources; and nano-sensor development.

Summary of BIO Funding by Strategic Goal
(Dollars in Millions)

	FY 2002	FY 2003	FY 2004	Change	
	Actual	Estimate	Estimate	Amount	Percent
People	51.68	50.24	50.78	0.54	1.1%
Ideas	402.66	419.39	447.90	28.51	6.8%
Tools	50.81	52.04	59.14	7.10	13.6%
Administration & Management	4.49	3.95	4.40	0.45	11.4%
Total, BIO	$509.64	$525.62	$562.22	$36.60	7.0%

Totals may not add due to rounding.

People (+$540,000, for a total of $50.78 million)

BIO places a high priority on programs to develop a diverse, internationally competitive workforce of scientists, engineers and well-prepared citizens. These programs seek to achieve a participation in biology that reflects the diversity of the U.S. population. This emphasis ensures that the next generation of scientists will be adequately prepared for a scientific future that increasingly blurs borders between scientific disciplines, and that is increasingly dependent on technology and on the sharing and analysis of information from distributed resources. These efforts also aid in the development of a scientifically and technologically literate populace.

BIO People Investments
(Dollars in Millions)

	FY 2003	FY 2004	Change	
	Estimate	Estimate	Amount	Percent
K-12	0.04	1.04	1.00	2500.0%
Undergraduate	14.07	12.07	-2.00	-14.2%
Graduate & Professional	36.13	37.67	1.54	4.3%
Total, People	$50.24	$50.78	$0.54	1.1%

Totals may not add due to rounding.

Support for People programs will increase by $540,000, or 1.1 percent, over the FY 2003 Request.

- A total of $1.04 million, an increase of $1.0 million, reflects enhanced investment in the Research Experiences for Teachers (RET) program, an activity designed to provide hands-on research experiences to K-12 science teachers and their students.
- A total of $12.07 million, a decrease of $2.0 million from the FY 2003 Request, will be used to support undergraduate activities to broaden participation in science. Examples of some of the programs supported include Research Experiences for Undergraduates (REU); Undergraduate Mentorships in Environmental Biology (UMEB), begun in FY 1995 specifically to encourage participation of underrepresented groups within environmental biology; and Collaborative Research at Undergraduate Institutions (C-RUI), which supports new multidisciplinary collaborative research groups at primarily undergraduate institutions. Each group is composed of faculty members representing at least two disciplinary areas and includes up to 10 undergraduates. Funding for C-RUI and UMEB will be provided in alternate years resulting in the decrease in funding of $2.0 million in FY 2004.

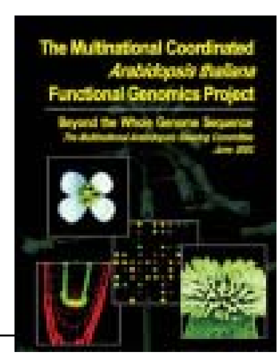
- A total of $37.67 million, an increase of $1.54 million over the FY 2003 Request of $36.13 million, will be used to support graduate, postdoctoral, and professional-level programs, including the NSF Graduate Teaching Fellows in K-12 Education (GK-12) program. BIO increases its contribution to the Integrative Graduate Education and Research Training program in FY 2004 by $2.03 for a total of $11.20 million to allow for an increase in stipends. Support for the ADVANCE program, designed to increase the participation and advancement of women in academic science and engineering careers, program will continue at $2.43 million. Decreased support for postdoctoral fellowships within BIO to a level of $4.90 million, a reduction of $710,000 or seven postdoctoral fellows, reflects a shift in priorities in FY 2004 towards support for Research Resources (Tools).

Ideas (+$28.51 million, for a total of $447.90 million)

The Biological Sciences Activity provides support for research to advance understanding of the underlying principles and mechanisms governing life. BIO's support for discovery spans all the biological disciplines. BIO-supported research effectively builds the knowledge base for resolution of societal concerns in areas as diverse as food, nutrition, agriculture, the environment, and education.

Disciplinary Research: Through all programs BIO will provide priority support to areas of emerging importance, such as integrative research focused on complex biological systems; research that integrates rapidly accumulating, massive amounts of disparate data into understanding biological processes; genome sequencing and the assembly of primary sequence databases especially for microbes and plants; and functional analyses, also known as "functional genomics".

Functional genomics has revolutionized biological research. This multidisciplinary area provides a new paradigm in biology by linking sequence data to the biological functions at the cellular, organismal, ecological, and evolutionary levels. Functional genomics tools allow researchers to conduct sequence comparisons among several different species to determine which genes are common to all life forms and which genes are unique to specific species. Identifying the function of genes has many practical applications, for example, in developing improved or novel crop plants of added value.



To capture the unprecedented opportunities offered by functional genomics, in FY 2001 BIO began the next phase of the *Arabidopsis* project, a major program in functional genomics, the **"2010 Project."** The goal is to determine the functions of the approximately 26,000 genes of the flowering plant, *Arabidopsis* by 2010.

Projects include applying the latest bioinformatic software tools to fill a publicly accessible web database cataloguing gene functions related to nitrogen metabolism. Because nitrogen is a key element in the biosphere and essential for the growth of all plants, this research will have a broad impact on the understanding of plant growth and reproduction.

In FY 2004, support for the "2010 Project" will be maintained at a total of $25.0 million. Scientists anticipate that the "2010 Project" will lead to construction of an integrated database of a "virtual plant" that will allow predictive approaches to the science of plant biology. The transfer of knowledge from research supported in this area to the private sector is almost instantaneous, as biotechnology companies seek to transform this information into better products for society, from food to pharmaceuticals to environmentally benign products. Continued support at this level will permit achievement of the goal of the project by the year 2010.

Modern biological science increasingly involves teams of scientists and students at all levels of education, and requires increasing access to supplies, equipment, and data, the latter often requiring the ability to access, analyze, and visualize remote databases. For these reasons, the cost of modern biological research is increasing sharply. BIO will continue to increase award size.

BIO Investments in Priority Areas
(Dollars in Millions)

	FY 2002	FY 2003	FY 2004	Change	
	Actual	Request	Request	Amount	Percent
Biocomplexity in the Environment	16.90	35.86	39.86	4.00	11.2%
Information Technology Research	6.08	6.80	7.50	0.70	10.3%
Nanoscale Science & Engineering	2.50	2.98	4.98	2.00	67.1%
Mathematical Sciences	N/A	0.91	2.21	1.30	142.9%
Human and Social Dynamics	N/A	N/A	0.5	0.50	N/A

Priority Areas

The NSF priority areas of Biocomplexity in the Environment (BE), Information Technology Research (ITR), Nanoscale Science and Engineering (NSE), Mathematical Sciences, and Human and Social Dynamics (HSD) represent important areas of scientific inquiry.

Biocomplexity in the Environment (BE) research on the dynamics that occur within biological systems and between these systems and the physical environment will be increased by $4.0 million for a total of $39.86 million in FY 2004. This will increase support for the NSF-wide competition as well as for the Tree of Life Project. Two special competitions, the Ecology of Infectious Disease and Microbial Sequencing, will be continued.

- Ecology of Infectious Diseases ($6.0 million) activity continues an interagency partnership between NSF and NIH. The goal of the effort is to encourage the development of predictive models and discovery of the principles for relationships between environmental factors and the transmission of infectious agents. Funded research will focus on understanding the ecological determinants of transmission by vectors or abiotic agents, the population dynamics of reservoir species, and transmission to humans or other hosts. The potential benefits of interdisciplinary research in this area include: development of disease transmission models, improved understanding of unintended health effects of environmental changes, increased capacity to forecast outbreaks, and improved understanding of how diseases (re) emerge.

- The Microbial Sequencing ($15.0 million) activity will fund projects for high-throughput sequencing of the genomes of selected microorganisms including viruses, bacteria, archaea, fungi, and protozoa. The microorganisms are chosen based on their fundamental biological interest, importance to the productivity and sustainability of agriculture and forestry, and relevance to the safety and quality of the nation's food or water supply. Genome sequence information provides the foundation for understanding how organisms function and live, and how organisms interact with the environment and with other organisms. This knowledge can be used to detect unknown microorganisms and to understand their properties, e.g. why an organism may be pathogenic or beneficial to a plant or animal, or how its properties might be exploited industrially.

- BIO will increase support for the Tree of Life (ToL) Project**.** Capitalizing on new and powerful computational and genomic technologies, biologists plan to construct a universal genealogy for all 1.7 million named species of living organisms on earth. The goal is to complete the Tree within 10 years. The "family tree" will elucidate the relationships of all species of life, providing the infrastructure to guide research in many biological sub-disciplines. Inter-disciplinary, inter-agency, and international collaborations will be required. Conceptual challenges in integrating genomic data in comparisons of thousands of species will attract biologists, mathematicians, software engineers, and natural resource managers.

Information Technology Research (ITR) in FY 2004 will increase by $700,000 to $7.50 million over the FY 2003 Request of $6.80 million for the NSF-wide ITR competition, and especially for database development and management and information networking. Examples of BIO relevant areas include: algorithms for designing, managing, and linking primary biological databases, development of new tools for microbial genomics, development of innovative database structures (both hardware and software) that support distributed storage of very dense files of genetic sequence and genomic data; development of relational authority files (databases) and development of real time information networks linking researchers worldwide engaged in Tree of Life research.

Nanoscale Science and Engineering (NSE) research, focused on studying the structure and regulation of macromolecular machines and macromolecular complexes that are capable of self-replication and self-assembly, will increase by $2.0 million to $4.98 million in FY 2004. The increase will specifically support research on nanoscale biosensors and information processors, which could provide new tools for understanding cellular communication and detection of environmentally important signals.

Mathematical Sciences support within BIO, as part of the NSF-wide priority area, will be increased by $1.30 million for a total of $2.21 million, to support interdisciplinary research involving mathematics and biology with a focus on mathematical and statistical challenges posed by large biological data sets, managing and modeling uncertainty, and modeling complex, non-linear systems.

Human and Social Dynamics (HSD) support within BIO, as part of the NSF-wide priority area, will be supported for a total of $500,000. One of HSD's long-term goals is to exploit the convergence of biology, engineering and information technology to advance understanding of human cognition. This emphasis, in line with the emergence of 21st Century Biology, will support research on behavior, cognition, development and neuroscience.

BIO-supported centers are another important component in its portfolio of activities. The BIO centers facilitate the development of new knowledge and techniques and include Science and Technology Centers (STCs), Long Term Ecological Research (LTER) sites, the Center for Ecological Analysis and Synthesis (CEAS), and Plant Genome Virtual Centers. In FY 2004, BIO will continue support for all centers.

BIO Centers
(Dollars in Millions)

	FY 2003 Estimate	FY 2004 Estimate	Change Amount	Change Percent
Science and Technology Centers	4.00	4.00	0.00	0.0%
Center for Ecological Analysis and Synthesis	2.86	3.15	0.29	10.1%
Long Term Ecological Research Program	15.35	15.70	0.35	2.3%
Plant Genome Virtual Centers	31.00	31.70	0.70	2.3%
Total, BIO Centers	$53.21	$54.55	$1.34	2.5%

Totals may not add due to rounding.

The **Science and Technology Center** for Behavioral Neuroscience at Emory University was established in FY 2000. Now in its third year, this Center will move to Georgia State University where it will continue to meet the scientific goals of understanding how neural processes regulate and are regulated by complex social behaviors across animal species. Collaborating institutions include Emory University, Georgia Institute of Technology, Morehouse School of Medicine, and Atlanta University Center. The Center provides a unique opportunity to integrate research with education for a broadly diverse set of students in the Atlanta metropolitan area.

The **Center for Ecological Analysis and Synthesis** (CEAS), established in FY 1995 and recompeted in FY 1999, promotes integrative studies of complex ecological questions and serves as a locus for synthesis of large data sets. The goals of the Center are to advance the state of ecological knowledge through the search for universal patterns and principles and to organize and synthesize ecological information. Increases in support reflect the enhancement of IT capabilities.

In FY 2004, NSF will continue support for 24 **Long Term Ecological Research** (LTER) sites, which are representative of major ecosystems. Four sites are located in coastal ecosystems, two are in human-dominated, urban ecosystems, and the remaining 18 sites cover a broad range of ecosystems including the Arctic tundra of Alaska, the deserts of New Mexico, the rainforests of Puerto Rico, and the Dry Valleys of Antarctica. BIO provides full support for 16 of these sites, and partial support for 6 sites; OPP, GEO and SBE provide additional support.

Plant Genome Virtual Centers (centers without walls) are collaboratories where coordinated, multi-investigator teams pursue comprehensive plant genome research programs relevant to economically important plants or plant processes. Currently active centers range in size and scope, some with a focus on functional genomics and others with a focus on developing tools and resources for plant genomics studies for the scientific community. One award will develop a protein interaction database for rice protein kinases. Rice is a major food crop worldwide but productivity is seriously limited by environmental stresses such as drought. Kinases are part of the signaling pathways involved in plant response to stress. The outcomes of this project, which builds on the recently released rice genome sequence as well as prior projects studying kinases in the model plant Arabidopsis, should yield insights into how plants tolerate stress.

Tools (+$7.10 million, for a total of $59.14 million)

Support for Tools in BIO will increase by $7.1 million over the FY 2003 Request of $52.04 million for a total of $59.14 million. In FY 2004, BIO will increase support for research resources by $4.00 million for a total of $51.94 million to expand support for operations, maintenance and sustainability of mid-size scientific facilities and resources unique to biological research. The BIO Activity supports research resources for the biological sciences that include databases, multi-user instrumentation, development of instrumentation and new techniques, living stock centers, marine laboratories, and terrestrial field stations. Support for infrastructure ranging from databases and the informatics tools and techniques needed to manage them to instrumentation development are essential for all areas of research, including the priority areas.

BIO Investments in Tools
(Dollars in Millions)

	FY 2003	FY 2004	Change	
	Estimate	Estimate	Amount	Percent
Research Resources	47.94	51.94	4.00	8.3%
NEON	3.00	6.00	3.00	100.0%
NNIN	0.30	0.40	0.10	33.3%
CHESS	0.80	0.80	0.00	0.0%
Total, BIO	$52.04	$59.14	$7.10	13.6%

Totals may not add due to rounding.

FY 2004 proposes the second year of support for the National Ecological Observatory Network (NEON). Operational support for two NEON observatories is planned. In addition, strategic planning and coordination activities will continue. NEON IT infrastructure and systems integration will be designed and evaluated using the observatories established in FY 2003 and 2004. Construction funding for the NEON observatories is discussed in the Major Research Equipment and Facilities Construction (MREFC) section.

Administration and Management

Administration and Management provides for administrative activities necessary to enable NSF to achieve its strategic goals. This includes the cost of Intergovernmental Personnel Act appointments and contractors performing administrative functions.

QUALITY

BIO maximizes the quality of the R&D it supports through the use of a competitive, merit-based review process. In FY 2002, 98 percent of basic and applied research funds were allocated to projects that underwent merit review.

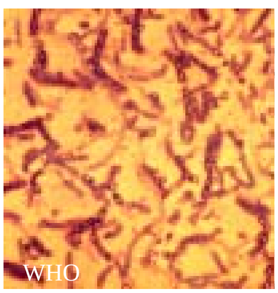
To ensure the highest quality in processing and recommending proposals for awards, BIO convenes Committees of Visitors, composed of qualified external evaluators, to review each program every three years. These experts assess the integrity and efficiency of the processes for proposal review and provide a retrospective assessment of the quality of results of NSF's investments.

The Directorate also receives advice from the Advisory Committee for Biological Sciences (BIOAC) on such issues as: the mission, programs, and goals that can best serve the scientific community; how BIO can promote quality graduate and undergraduate education in the biological sciences; and priority investment areas in biological research. The BIOAC meets twice a year and members represent a cross section of biology with representatives from many different sub-disciplines within the field; a cross section of institutions including small colleges, large universities, and industry representatives; broad geographic representation; and balanced representation of women and under-represented minorities.

PERFORMANCE

Biological Sciences Research Highlights for FY 2002

- In a BIO supported study, researchers have discovered that signals serving as "mental pointers" are produced in the brains of zebra finches while they sing, and also while they dream about, or "rehearse," their song during sleep. This long-term, fundamental neural research is helping scientists understand brain mechanisms and, specifically, how the brain produces signals for motor control and learning. By studying how songbirds learn their songs, scientists hope to understand how humans learn to speak.



- With NSF funding, the genome of the bacterium from the Florida anthrax victim was sequenced and compared to the sequence of a standard anthrax "type" strain. The project revealed important information about the relatedness of the Florida strain to the type strain and generated an innovative and powerful technique for comparing and distinguishing closely related bacterial strains. This technology will be invaluable for studying genetic variability and tracking the sources of disease-causing bacteria.

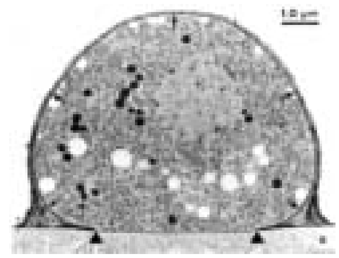
- A recent research project is building a sequence-indexed library of mutations in the Arabidopsis genome. The library consists of approximately 140,000 Arabidopsis mutants, with each mutation tagged with insertion of a molecular tag called T-DNA. The insertion sites are sequenced and aligned with the Arabidopsis genome sequence completed in December 2000. All the data and mutant seeds are immediately made available for the community's use without restriction. The creation of a searchable database containing the insertion site information and the availability of the corresponding mutant lines in public stock centers are providing researchers with ready access to mutants in their genes of interest, allowing the testing of hypotheses about gene function at an unprecedented rate.

- The newly discovered remains in China of the oldest, most complete flowering plant show it probably lived underwater nearly 125 million years ago, which challenges assumptions about the origins of flowering plants. The discovery is important because it provides clues about how these now-extinct ancestors evolved into modern living flowering plants, which comprise today's major agricultural crops.

- Colorado's Green Lakes were studied under NSF's Long-Term Ecological Research (LTER) program and it was found that atmospheric nitrogen from auto emissions and agriculture on the heavily populated Front Range of the Colorado Rockies was a possible cause of increased algal growth in high alpine lakes, which supply 40 percent of Boulder's water.

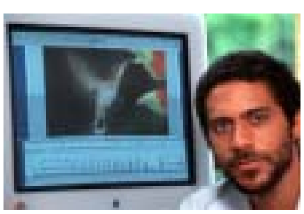
Plant diseases are a major threat to food security worldwide. Currently, there is no way to rapidly track the spread of any pathogen, naturally occurring or otherwise. Our current ability to counteract disease is limited and is mainly based on using potentially toxic chemicals that may breed resistant varieties. These age old practices while often effective in the short term are putting excessive strain on the environment and on the economy of some nations. An alternative strategy for safeguarding our well being and our food supply is to obtain a complete genetic blue print – the DNA sequence – of these noxious pathogens. Two examples of these efforts are:

- Researchers are studying the rice blast fungal pathogen, the most devastating disease of rice. The data will be available for the research community to help understand the molecular basis of plant disease as well as provide the foundation for designing novel environmentally sound strategies to more effectively manage this and other fungal diseases. The figure shows a cross section of the infectious stage of the fungus.



- A multi-disciplinary team of researchers from several universities and colleges have identified and sequenced potato genes responsible for late potato blight resistance. Late potato blight has reemerged in the United States as a serious threat to the nation's potato industry.

Awards to BIO Researchers



Duke scientist Eric Jarvis was chosen for the prestigious NSF Waterman Award in April 2002. A performing artist turned scientist, Eric overcame economic disadvantage as a child growing up in New York City's Harlem to become a top young researcher at Duke University--one of only 52 African American men out of more than 4,300 biologists who received Ph.D.s. in 1995. Jarvis was chosen for his individual achievements and leadership in studying the brain system of how birds vocalize. While conducting his groundbreaking research into how birds learn their songs, he discovered "how little scientists know about the language-fostering structures in our own brains."

President Bush named 15 individuals to receive the National Medal of Science in May 2002. BIO supported three of those named that have made lasting contributions to a burgeoning list of discoveries and technology breakthroughs in the biological sciences. Ann M. Graybiel of M.I.T. did pioneering work on the functional anatomy and physiology of the brain systems involved in disorders such as Parkinson's and Huntington's diseases and obsessive-compulsive disorder. Francisco J. Ayala of the University of California, Irvine revolutionized molecular biology in the study of the origins of species. Gene E. Likens of the Institute of Ecosystem Studies in Millbrook, N.Y., documented for the first time in North America the environmental consequences of the phenomenon known as acid rain.

Other Performance Indicators

The tables below show the growth in the number of people benefiting from BIO's funding, and trends in growth of award size, duration and number.

Number of People Involved in BIO Activities

	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate
Senior Researchers	2,911	2,910	3,025
Other Professionals	1,651	1,650	1,715
Postdoctorates	1,355	1,355	1,410
Graduate Students	2,292	2,300	2,390
Undergraduate Students	2,246	2,250	2,340
K-12 Teachers	51	5	125
Total Number of People	10,506	10,470	11,005

BIO Funding Profile

	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate
Number of Requests for Funding	7,303	7,303	7,303
Dollars Requested (in thousands)	$4,506,000	$4,506,000	$4,506,000
Total Number of Awards	3,494	3,494	3,494
Statistics for Competitive Awards:			
Number	1,400	1,345	1,300
Funding Rate	27%	26%	25%
Statistics for Research Grants:			
Number of Research Grants	974	935	900
Median Annualized Award Size	$110,000	$117,600	$130,124
Average Annualized Award Size	$136,517	$164,569	$165,200
Average Award Duration, in yrs	3.1	3.1	3.1
Percent of Competitive Research Grants to New Investigators	33%	33%	33%

MOLECULAR AND CELLULAR BIOSCIENCES $116,860,000

The FY 2004 Request for the Molecular and Cellular Biosciences (MCB) Subactivity is $116.86 million, an increase of $5.30 million, or 4.8 percent, from the FY 2003 Request of $111.56 million.

Molecular and Cellular Biosciences Funding
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Molecular & Cellular Biosciences Research Projects	112.17	111.56	116.86	5.30	4.8%
Total, Molecular & Cellular Biosciences	$112.17	$111.56	$116.86	$5.30	4.8%

MCB supports research on the fundamental properties and dynamics of the molecular and cellular components of living organisms. This research provides the foundation and framework for understanding multi-scale, complex biological systems and their interactions with the physical world. Study of complex biological questions increasingly requires the tools of genomics, information science, the physical sciences, and mathematics to achieve insights into the mechanisms by which genetic information is transmitted and expressed and the processes by which living cells are organized, communicate, and respond to environmental signals.

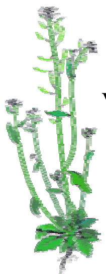
Such challenging questions require collaborations of biological scientists with those in the physical sciences, mathematics, computer science, and engineering. MCB is forging partnerships with these disciplines, with the goals of introducing new analytical and conceptual tools to the biological scientist, as well as providing unique training environments for the biologists of the future. This approach is consistent with the overarching goal of **21st Century Biology,** which is to understand life at both its most fundamental level and in all its complexity. Exciting progress and integration of advances in genomics, informatics, computer science, mathematics, physics, chemistry, and engineering offer the promise of realizing these ambitious goals.

In FY 2004, core activities in the MCB Subactivity are increased by $5.30 million to enhance support for multidimensional, multidisciplinary, integrative and data-driven **21st Century biological research** on the fundamental properties and dynamics of the molecular and cellular components of living organisms. From such knowledge can emerge the innovative ideas and insights that transform our understanding of the natural world, contribute to our economy through new applications in biotechnology, agriculture and the environment, and provide new knowledge that will contribute to our ability to detect and defend against biological threats.

Highlights of areas supported:

Microbial Biology: MCB, through its core activities and through the Microbial Observatories effort, encourages research on microbes at all levels of biological organization. New **genome-enabled** and biochemical approaches are being used to identify and characterize attributes of microbes, most of which have never before been described. Analysis of microbial genomes is leading to discovery of new organisms and to appreciation of the diversity of their metabolic functions that enable them to occupy diverse habitats and to interact in complex communities. These efforts are consistent with priorities of the interagency effort, “The Microbe Project.”

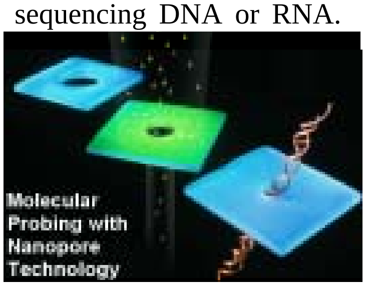
Little is known about wetland bacteria that turn organic matter into the greenhouse gas methane. Now, for the first time, scientists are collecting methane-generating bacteria (called methanogens) from oxygen-poor wetlands, and bringing them to a lab alive. No one has ever cultured and grown methanogens from acidic wetlands in a lab. If the researchers succeed in duplicating the carbon-rich, anaerobic, acidic conditions where methanogens thrive, the organisms may have a future in bioengineering – perhaps in bioremediation of contaminated sites or in the controlled production of methane.



"2010 Project:" Unsolicited research initially funded in MCB led to the discovery of the value of *Arabidopsis thaliana* as a model flowering plant. The MCB Subactivity will continue to support research enabled by the availability of the complete genome sequence of *Arabidopsis* to determine the functions of all the genes of this model flowering plant by the year 2010.

Natural nanomachines: MCB core activities support research on the structure, mechanisms of action, and control of the molecules that represent the machinery of the living cell. These natural nanomachines provide models and paradigms for science and technology at the nanoscale.

Capitalizing on the potential of nanotechnology, researchers proposed a new method for rapidly sequencing DNA or RNA. They hypothesized that if single-stranded DNA or RNA could be drawn through a nano-pore in a membrane then changes in the ionic current of the membrane would reflect the properties of the DNA (length, nucleotide composition, etc.). A MCB Small Grants for Exploratory Research award allowed the researchers to successfully test their hypothesis. This method has fewer steps than currently used methods and depends on rapid, molecular events. This can reduce the time and cost of DNA/RNA sequencing by several orders of magnitude. This is being heralded as an extraordinarily important advance. Several publications and patents have resulted and the technology is being tested for commercial application.



Living Networks: Theoretical, computational, and mathematical modeling approaches are playing increasingly critical roles in all areas of the molecular and cellular biosciences - in formulating and testing physical and mathematical models of the structure and function of complex molecules and cellular processes; in analysis of genome data; and in addressing one of the greatest computational challenges facing 21st Century Biology, creating multi-scale models that can integrate our understanding of biological structure, function, and interactions at all levels into a predictive whole.

INTEGRATIVE BIOLOGY AND NEUROSCIENCE $103,380,000

The FY 2004 Budget Request for the Integrative Biology and Neuroscience (IBN) Subactivity is $103.38 million, an increase of $4.65 million, or 4.7%, from the FY 2003 Request of $98.73 million.

Integrative Biology and Neuroscience Funding
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Integrative Biology & Neuroscience Research Projects	100.86	98.73	103.38	4.65	4.7%
Total, IBN	$100.86	$98.73	$103.38	$4.65	4.7%

Research supported by the Integrative Biology and Neuroscience Subactivity seeks to understand how complex living organisms, such as plants, animals, and microbes, work. IBN researchers study the mechanisms by which organisms develop, grow, reproduce, regulate their physiological activity, and respond to their environment. The integration of molecular, subcellular, cellular, and functional genomics approaches provides insight into the development, functioning, and behavior of organisms in both laboratory and natural settings. In addition, the development and use of a wide diversity of organisms as biological models contributes to identifying unifying principles common to all organisms and documents the variety of mechanisms that have evolved in specific organisms.

IBN supports research whose goal is to understand life at both its most fundamental level and in all its complexity. Such research requires an integrated approach that utilizes exciting advances in genomics, proteomics, informatics, computer science, mathematics, physics, chemistry, and engineering. In FY 2004, core activities in the IBN Subactivity are increased by $4.65 million. IBN will emphasize 21st Century Biology projects that are multidimensional, multidisciplinary, integrative and data-driven, to understand the development, physiology, neurobiology, and behavior of living organisms.

Highlights of areas supported:

Characterization of biological systems has reached an unparalleled level of detail. To organize quantities of data and achieve integrative understanding of fundamental life processes, it is imperative that powerful computational approaches be applied. IBN supports research that utilizes advanced computational approaches and tools to understand biological systems in all their complexity. Computational biology deals with two pressing needs – the management and the analysis and interpretation of biological information. Computational biology is an important component of 21st Century biological research.

Biologists collaborating with computer scientists are using advanced information technology to determine the genetic basis of drought stress in loblolly pine and Arabidopsis. A software system has been designed that stores, mines, and analyzes microarray data. This system is being expanded to process other types of data thereby providing an automated means for merging new and existing data and identifying patterns of responses. A new method for determining relationships in multidimensional data, Inductive Logic Programming, will be used to find associations between gene expression patterns and responses to stressful stimuli. The software will also support statistical methods for clustering gene expression data.

One benefit of having the Arabidopsis genome completely sequenced is that researchers can now study the multiple ways that flowering plants and their pollinators interact. One well-known mechanism for long- and mid-range attraction of pollinators to plants is floral scent. Research enabled by Arabidopsis genome data is revealing the complexity of the floral scent system, including the genes that control scent compound synthesis, the interactions of the flowers with the pollinating insects, and how scent and pollination systems evolve over time. Since many important crop plants are insect pollinated, results from these studies that lead to improvements in crop management can have important economic benefit.

Although the science of aeronautics is used to design airliners, space shuttles and stealth fighters, scientists are only just beginning to understand the aerodynamic mechanisms that enable tiny insects to fly and maneuver. Recent discoveries used a variety of experimental and theoretical techniques to construct a comprehensive theory of animal flight. The techniques include three-dimensional high-speed videography to capture the complex wing motions of tiny fruit flies as they actively steer and maneuver. The research also employs a giant robotic model of flapping insect wings, immersed in a 3-ton tank of mineral oil. By 'replaying' the wing and body motion of real insects on the large robot, the researchers directly measure the flows and forces created by flapping wings. This makes it possible to determine not simply how insects manage to stay in the air, but how they carefully manipulate aerodynamic forces to actively steer and maneuver.

Robot-wing in tank

By providing experimental verification of the solutions to complicated flow problems, this research will help mathematicians around the world improve the accuracy of their computer models. Also, knowledge gathered in this study on the aerodynamics of flapping wings will provide new and creative design concepts for the aeronautics industry.

ENVIRONMENTAL BIOLOGY $104,770,000

The FY 2004 Request for the Environmental Biology (DEB) Subactivity is $104.77 million, an increase of $5.0 million, or 5.0 percent, from the FY 2003 Request of $99.77 million.

Environmental Biology Funding
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Environmental Biology Research Projects	101.11	99.77	104.77	5.00	5.0%
Total, Environmental Biology	$101.11	$99.77	$104.77	$5.00	5.0%

The Environmental Biology Subactivity supports fundamental research on the origins, functions, relationships, and evolutionary history of populations, species, and higher taxa, and on the interactions within and dynamics of biological communities and ecosystems. Studies can be conducted in any natural or human-impacted biotic system of the world, and can address the species of or genealogical relationships among plants, animals, and microbes; the flux of energy and materials in ecosystems; and the principles or rules by which species function in communities and evolve through time.

In FY 2004, core activities in the DEB Subactivity are increased by $5.0 million to enhance support for multidimensional, multidisciplinary, integrative and data-driven research focused on understanding ecological and evolutionary patterns and processes. Such research seeks to achieve the overarching goal of **21st Century Biology:** to understand life at both its most fundamental level and in all its complexity. Exciting progress and integration of advances in genomics, informatics, computer science, sensors, GIS and satellite imagery, mathematics, physics, chemistry, and engineering offer the promise of realizing this ambitious goal as DEB supported researchers collaborate in multidisciplinary teams.

Highlights of areas supported:

Multidisciplinary research on complex systems. Recent advances in computation, mathematics and modeling techniques support studies of the functioning of complex ecosystems. In the world's first large-scale rainfall manipulation experiment, researchers studying the Amazon are using empirical and modeling approaches over a five-year period to establish the level of drought stress that this rainforest can tolerate before large trees begin to die. These results are invaluable for understanding climate change since rainforests contribute substantially to the carbon dioxide dynamics of the atmosphere and worldwide they are experiencing stronger droughts as El Niño episodes become more frequent and severe.

Living Networks research involves fundamental analytical and synthetic studies on interactions between and among organisms, humans and their abiotic settings. During the summer of 2002, western North America experienced one of the largest forest fires in recorded history. The Biscuit Fire burned nearly one

half million acres of mostly pristine habitats in Oregon and California. One project is using burned and unburned sites left by this fire to address questions in community ecology. At replicated sites, researchers will exclude ants, a major seed dispersal agent, and test for effects on plant community composition and growth. This work will significantly extend our knowledge of ant-plant community interactions and re-establishment after catastrophic fire.

Population-level **genome-enabled** research incorporates new methods and tools from genomics, computer science and mathematics to study the properties and processes that lead to variation within and between populations, both in the present and through evolutionary time. Fragmentation of populations, reproductive isolation, and population declines jeopardize the survival of many species. A representative project is examining the evolutionary dynamics of gene flow and its landscape scale conservation and restoration consequences using California Valley oak (Quercus lobata), a threatened species experiencing habitat loss from residential and agricultural development. The project will develop novel experimental approaches to generate data that can be integrated into spatially explicit simulation models of landscape changes, which will be useful for future species management and policy decisions.

Recent **genome-enabled** science and information technologies also underpin DEB support for exploration of the diversity and history of life on earth. Madagascar is home to some of the most rare and endangered organisms on Earth. A DEB supported study of the evolutionary history of Malagasy vertebrates using genomic tools will help us understand the consequences of environmental change for vertebrate speciation and human impact on genetic diversity of forest-dependent species. This research can inform conservation policy for one of earth's most ecologically diverse and threatened environments.


Ring-Tail Lemurs

BIOLOGICAL INFRASTRUCTURE $79,960,000

The FY 2004 Budget Request for the Biological Infrastructure (DBI) Subactivity is $79.96 million, an increase of $7.64 million, or 10.6 percent, from the FY 2003 Request of $72.32 million.

Biological Infrastructure Funding
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Research Resources	48.22	47.94	54.99	7.05	14.7%
Human Resources	24.99	24.38	24.97	0.59	2.4%
Total, Biological Infrastructure	$73.21	$72.32	$79.96	$7.64	10.6%

Totals may not add due to rounding.

The goal of the Biological Infrastructure Subactivity is to ensure that essential infrastructure for contemporary research is available to scientists in all areas of biological science, from the molecular to the ecosystem level, for both disciplinary and interdisciplinary efforts. Innovations in infrastructure support are vital to the advancement of 21st Century Biology across the BIO Activity. Resources supported range from physical infrastructure, such as multi-user instrumentation, to training in biological research for students at undergraduate and postdoctoral levels. In addition, teams of scientists including biologists, mathematicians, physicists, chemists, computer scientists, and engineers are supported to develop new research tools. Development of research resources, such as genome sequence databases and improvement of natural history collections and biological field stations, is also supported.

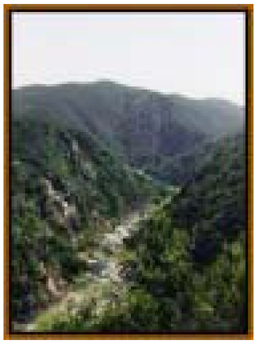
Research Resources supports a range of activities including operation and management of the National Ecological Observatories Network (NEON), multi-user instrumentation; the development of instruments with new capabilities, improved resolution or sensitivity; upgrades to biological field stations and marine laboratories; support of living stock collections ranging from microbes to plants and animals; development of biological databases and informatics tools; and research collections in biological sciences. These various research resources provide the essential platforms and tools for effective research in modern biology.

Research Resources will provide infrastructure support of $54.99 million, an increase of $7.05 million, for:

- Support for Mid-Size Facilities increased by $4.05 million over FY 2003. BIO will expand support for operations, maintenance and sustainability of mid-size scientific facilities, such as field stations, marine labs, natural history collections and living stock centers, all resources unique to biological research; and

- Support for NEON, totaling $6.0 million, an increase of $3.0 million in FY 2004. Funding will be used for operational support for and coordination of two National Ecological Observatory Network (NEON) sites. Construction and instrumentation costs for NEON are discussed in the Major Research Equipment and Facilities Construction section.

Highlights of areas supported:



Research Resources provided support to the Santa Margarita Ecological Reserve field station to develop a wireless communication system and install an array of sensing devices. These improvements to a remote field station will feed into major collaborations with other NSF-funded projects, such as ROADNet (Real-time Observatories, Applications, and Data Management Network) and HPWREN (High Performance Wireless Research and Education Network). With improved data collection and distribution, scientists and field station staff will be able to better inform policy makers, natural resource managers, and the general public on how to address critical questions about the environment and to teach students about environmental research.

Human Resources supports a range of activities centered on ensuring adequately and appropriately trained scientists for the future, broadening participation, and fostering the integration of research and education. Increasingly, emphasis is being placed on training a new generation of scientists who are well equipped to advance biology of the 21st Century. **Human Resources** will provide support of \$24.97 million for programs that broaden participation while fostering the integration of research and education. This includes: NSF-wide activities such as Integrative Graduate Education and Research Training (IGERT) program, Graduate Teaching Fellows in K-12 Education (GK-12), and ADVANCE; increased stipends for students on IGERT and GK-12 awards; Research Experiences for Undergraduates (REU) Sites projects, the Undergraduate Mentorship in Environmental Biology (UMEB), and the Collaborative Research at Undergraduate Institutions (C-RUI) programs, designed to encourage interdisciplinary research experiences for faculty and students at predominantly undergraduate institutions. Beginning in FY 2004, C-RUI and UMEB will be funded in alternate years. Support will increase for Research Experience for Teachers (RET).

A specific example of the impact of the DBI investment in the human resources program is the Research Experiences for Undergraduate (REU) Sites program. Broadening participation has been emphasized in BIO-supported REU sites. As a result, 10 REU sites are now based at minority-serving institutions. In addition, several sites successfully recruited 100% of their participants from underrepresented groups, including the University of Montana (Native American students), Northern Arizona University (Native American students), Massachusetts Bay Community College (African American, Hispanic and non-traditional students), University of Missouri at Columbia (primarily African American students), Emory University (African American students) and Michigan State University (African American and Hispanic students).

EMERGING FRONTIERS $82,250,000

The FY 2004 Budget Request for the Emerging Frontiers (EF) Subactivity is $82.25 million, an increase of $14.0 million, or 20.5 percent, from the FY 2003 Request of $68.25 million.

Emerging Frontiers Funding
(Dollars in Millions)

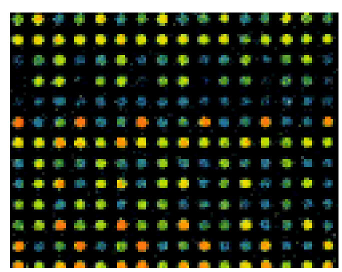
	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Emerging Frontiers	47.30	68.25	82.25	14.00	20.5%
Total, Emerging Frontiers	$47.30	$68.25	$82.25	$14.00	20.5%

The Emerging Frontiers Subactivity was proposed in FY 2003 to serve as an incubator for 21st Century Biology. EF supports evolving multidisciplinary research opportunities and networking activities that arise from advances in disciplinary research. By encouraging synergy between disciplines, Emerging Frontiers provides a mechanism by which new initiatives will be fostered and subsequently integrated into core programs.

In FY 2004 BIO will increase support for **Frontiers in Integrated Biological Research (FIBR),** an activity proposed to begin in FY 2003. FIBR invites new ideas for integrative research on major biological questions from a multidisciplinary point of view. Relevant scientific questions will be those recognized both as major challenges in biology and as beyond the scope of traditional single-investigator or small-team approaches.

BIO continues support for **Research Coordination Networks (RCN)**, which seeks to encourage and foster communications and collaborations among scientists with common goals and interests. RCN provides support for groups of investigators to communicate and coordinate their research efforts across disciplinary, organizational, institutional and geographical boundaries. Networks are formed around a focal theme and can involve a broad research question, group of organisms, or particular technologies or approaches.

One Research Coordination Network was designed to develop, evaluate, and disseminate methods for the analysis of gene expression using microarrays. The network involves an interdisciplinary, inter-institutional group of scientists and students with varying backgrounds but common interests in microarrays. As a result of these interactions, a subgroup of participating investigators has developed a collaborative research project with plant biologists. This research will contribute novel statistical techniques to the analysis of plant gene expression using microarray technologies.


microarray

NSF-wide Priority Areas will be supported out of EF in order to introduce new ideas into these model 21st Century Biology activities and to provide a mechanism through which the priority areas can be integrated with disciplinary activities. Support includes:

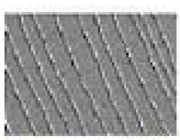
Biocomplexity in the Environment (BE) research on the dynamics that occur within biological systems and between these systems and the physical environment. Support will be increased by $4.0 million over the FY 2003 level of $35.86 million for a total of $39.86 million in FY 2004. The increase will enhance support for the NSF-wide competition as well as for the Tree of Life Project. Two special competitions, the Ecology of Infectious Disease and Microbial Genome Sequencing, that were initiated in FY 2003, will be continued.

Microorganisms capable of using hydrogen as an energy source and carbon dioxide as an electron acceptor for the production of methane are well known but generally rare in microbial communities. Recently, researchers found an environment in a geothermal spring in Idaho where the hydrogen and inorganic carbon levels were high enough to sustain bacteria, but the organic carbon was too low to be the primary energy source. In this environment, the dominant species were a number of novel microbes. The fact that organisms can adapt to this extreme environment, that may be representative of extraterrestrial environments, bolsters the possibility of extraterrestrial life.

Information Technology Research (ITR) in FY 2004 will increase by $700,000 to $7.50 million for the NSF-wide ITR competition, and for database development and management and information networking. Examples of BIO relevant areas include: algorithms for designing, managing, and linking primary biological databases, development of new tools for microbial genomics, development of innovative database structures (both hardware and software) that support distributed storage of very dense files of genetic sequence and genomic data; and development of real time information networks linking researchers worldwide engaged in Tree of Life research.

Nanoscale Science and Engineering (NSE) research, focused on studying the structure and regulation of macromolecular machines and macromolecular complexes that are capable of self-replication and self-assembly, will increase by $2.0 million to $4.98 million in FY 2004. The increase will specifically support research on nanoscale biosensors and information processors that could provide new tools for understanding cellular communication and detection of environmentally important signals.

A new method for creating bioelectronic circuits that allows electrically interfacing specific molecules on the membrane of living cells and then incorporate the cells into larger electrical circuits is being developed. This method is based on a new technique that allows the assembly of long, electrically conductive micro wires directly from suspensions of metallic nanoparticles. The Principal Investigators will devise techniques for controlled growth of micro wires in thin chambers and micro fluidic channels, and will develop experimental and theoretical tools for cell and wire manipulation in the electrical field leading to cell interfacing. The success of this project could lead to development of new sensors for detecting biological or chemical.



Nano-wires (~3nm)

Mathematical Sciences (MSI) will increase by $1.30 million in FY 2004 to a total of $2.21 million to support interdisciplinary research involving mathematics, science and engineering, and focus on mathematical and statistical challenges posed by large data sets, managing and modeling uncertainty, and modeling complex, non-linear systems.

Human and Social Dynamics (HSD) will be supported for a total of $500,000 in FY 2004 and will focus on research in behavior, cognition, development and neuroscience.

PLANT GENOME RESEARCH $75,000,000

The FY 2004 Budget Request for the Plant Genome Research (PGR) Subactivity is $75.0 million, equal to the FY 2003 Request.

Plant Genome Research Funding
(Dollars in Millions)

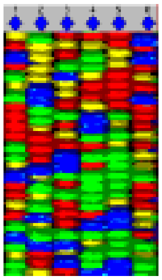
	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Plant Genome Research Projects	75.00	75.00	75.00	0.00	0.0%
Total, Plant Genome Research	$75.00	$75.00	$75.00	$0.00	0.0%

The Plant Genome Research Subactivity was initiated in FY 1998, building upon an existing base of genome research supported throughout the BIO activity. PGR supports projects that make significant contributions to our understanding of plant genome structure and function. Emphasis is placed on plants of economic importance, as well as plant processes of potential economic value. Long-term benefits of this research include fundamental breakthroughs in our understanding of plant biology and practical applications to crop improvement, and the development of novel, plant-based products.

The program was established as part of the National Plant Genome Initiative (NPGI). NSF plays a major role in the NPGI. Other participating agencies are USDA, DOE, and NIH. The NSF program is managed according to the guidelines and objectives of the NPGI, and it works closely with the other agencies in coordinating funding activities.

Significant progress toward the NPGI goals has been made. Research resources and research tools have been developed that now make it possible for scientists located anywhere in the U.S. to participate in plant genome research. For example, in 1998, only 50,000 plant Expressed Sequence Tags (ESTs) were publicly available. By 2002, PGR-supported projects had produced and deposited over 2 million ESTs in public databases. These resources are now being used by thousands of plant biologists to identify genes and conduct research on many different species. In FY 2002, efforts to sequence gene-rich regions of the maize genome began. Maize is the most economically important crop in the US and knowledge of its genome sequence can help improve crop yield and nutritional quality, and expand its uses. The maize sequencing effort is also pioneering a novel method to sequence large genomes more efficiently.

PGR has supported large-scale genome projects that address major biological questions in plants, such as plant responses to environmental and biological stresses. Many of the projects are conducted by virtual centers each of which involves scientists from multiple institutions and disciplines. NSF's investment in plant genome research has stimulated international collaboration, including the international wheat genome research group, the international rice functional genomics consortium, and the international *Medicago trancatula* (a model legume) research consortium.



A new method, massively parallel signature sequencing (MPSS), is being used to identify expressed genes and determine the level of expression. This method has the advantage of being very sensitive compared to other current approaches and is likely to detect sequences that would otherwise be missed. The outcomes of this project will allow a far more complete and accurate understanding of the Arabidopsis genome and will also provide a valuable database of which genes are expressed during different stages of plant development and under a wide range of stress conditions.

The National Plant Genome Initiative has issued its new five-year plan for 2003-2008. The FY 2004 Budget Request will support activities to meet the goals of the new NPGI plan, including:

- **Functional Genomics including Rice Functional Genomics**: Taking advantage of the recently completed sequence of the rice genome by an international consortium, PGR will support efforts to identify the function of all the rice genes and to develop functional genomics tools for rice. These efforts will be coordinated internationally. Functional genomics research in other plant systems will continue to be supported utilizing the large amounts of data and resources accumulated over the last five years as a result of PGR supported projects.

- **Young Investigator Awards in Plant Genome Research:** This activity is designed to increase participation of new investigators in plant genome research. Young investigators are encouraged to submit individual or small collaborative projects to establish themselves as active members of the plant genome research community and become tomorrow's leaders.

- **Large-scale Sequencing of Genomes of Economically Important Plants**: The recent success in using new methods to concentrate gene-rich regions of large genome species, like maize, for sequencing will likely lead to increased efforts to sequence gene-rich regions of several other economically important plant species.

- **Individual and Small Group Awards in Plant Genome Research**: Plant genome research by individual or small group of scientists will be supported in order to increase participation of a broader segment of the scientific community.

- **Plant Genome Virtual Centers:** These are "centers without walls" or collaboratories where coordinated, multi-investigator teams pursue comprehensive plant genome research programs relevant to economically important plants or plant processes. Currently active centers range in size and scope, some with a focus on functional genomics and others with a focus on developing tools and resources for plant genomics studies for the scientific community.

COMPUTER AND INFORMATION SCIENCE AND ENGINEERING

COMPUTER AND INFORMATION SCIENCE AND ENGINEERING $584,260,000

The FY 2004 Request for the Computer and Information Science and Engineering Activity is $584.26 million, an increase of $57.32 million, or 10.9 percent, above the FY 2003 Request of $526.94 million.

CISE Funding
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Computer-Communications Research	69.69	70.17	75.87	5.70	8.1%
Information and Intelligent Systems	51.65	50.61	52.40	1.79	3.5%
Experimental and Integrative Activities	63.15	62.16	57.67	-4.49	-7.2%
Advanced Computational Infrastructure and Research	86.76	85.42	92.56	7.14	8.4%
Advanced Networking Infrastructure and Research	69.77	67.91	67.65	-0.26	-0.4%
Information Technology Research	174.01	190.67	218.11	27.44	14.4%
Cyberinfrastructure	0.00	0.00	20.00	20.00	N/A
Total, CISE	$515.02	$526.94	$584.26	$57.32	10.9%

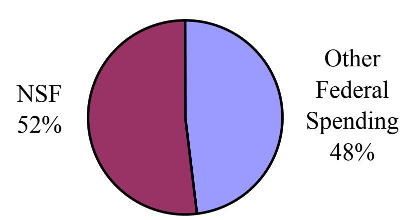
Totals may not add due to rounding.

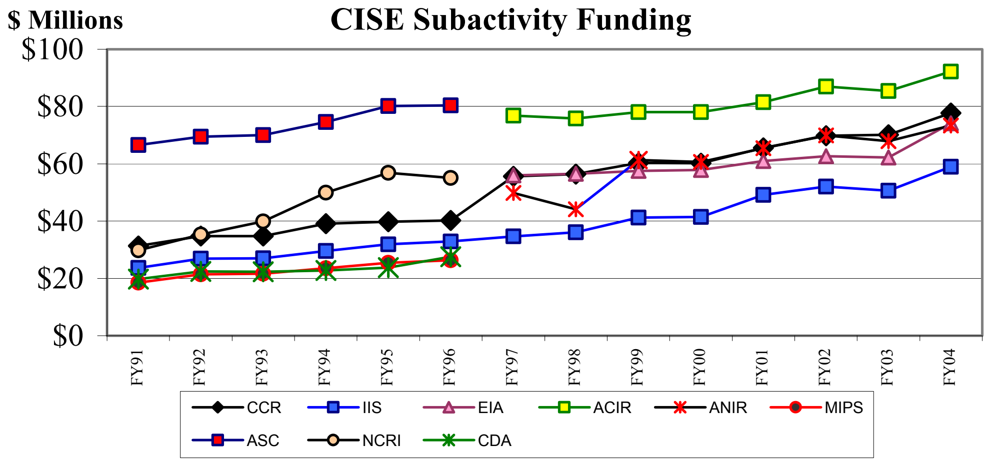
The Computer and Information Science and Engineering (CISE) Activity supports research, infrastructure, and education in the computer science, computer engineering, information science, networking and computational science disciplines.

RELEVANCE

CISE is the principal source of federal funding for university-based basic research in the computer science, computer engineering, information science, networking, and computational science disciplines, providing over half of the total federal support in this area. The directorate exerts a lead role in the multi-agency Networked Information Technology Research and Development program by providing 28% of total funding and chairing many of the working groups. CISE is one of the leading supporters of research in many fundamental areas of computing such as computer security, human-computer interaction, computer networking, and other areas. Building on past accomplishments, such as developing the Internet and fundamental advances in computer languages and systems, CISE is positioning its activities for the future with new efforts to address growing concerns about the vulnerability and trustworthiness of computers and networks, to develop cyberinfrastructure to address the data demands of science and engineering research across the frontier, and continuing needs for a US workforce to maintain leadership in the information technology arena.

Federal Support for Basic Research in Computer & Info Science & Engineering at Academic Institutions (FY 2000)





ITR Funding FY2000-2004: $90.4, $155.4, $173.5, $190.7, $218.1 million
FY 1991-1996: MIPS, Microelectronic Information processing Systems;
ASC, Advanced Scientific Computation; NCRI, Networking & Communication Research & Infrastructure;
CDA, Cross-Directorate Activities

The CISE Activity, working in close cooperation among its divisions and with other directorates, supports programs across the leading edge of information technology. Computer-Communications Research focuses on computer systems and the foundations of computing including algorithms, geometric methods, computer security research, and hardware systems. Information and Intelligent Systems focuses on information systems, robotics, cognitive science, digital libraries research and the social implications of computing technologies. Experimental and Integrative Activities supports a range of programs to expand the IT workforce and increase its diversity, to provide mid-scale infrastructure for computer science research, and a research focus on areas where IT and the life sciences intersect. Advanced Computational Infrastructure and Research supports the needs of computational scientists across the range of NSF disciplines through infrastructure for high-performance computing and with a research program creating innovative methods for computational science. Advanced Networking Infrastructure and Research supports networking to advance uses of the existing Internet and high performance networks such as Internet2/Abilene, and to foster invention for new network technologies. ITR, begun in FY 2000, supports IT research that is larger in scale, fosters interdisciplinary studies, and requires larger, longer duration awards. Cyberinfrastructure is a new effort, building on advanced computing infrastructure and advanced networking infrastructure and capitalizing on growing data from networked sensors and instruments and advance capabilities to share, interpret and understand fundamental science and engineering phenomena.

STRATEGIC GOALS

Three aims guide CISE's activities:

- PEOPLE: Improvement in the quality of education, training and diversity in the fields of computer science, computer engineering, information science, and computational science. CISE advances education and training for current computer scientists and engineers, increases the diversity of these communities, facilitates education of future generations of computer scientists and engineers, and enhances the public's knowledge of IT related disciplines.

- IDEAS: Advancement of knowledge across the computer science and engineering spectrum including both maintaining adequate base support across all IT fields and identifying opportunities where more focused support can play a catalytic role in advancing scientific progress.

- TOOLS: Enhancement of the infrastructure for the conduct of computational science research supporting computational methods such as data mining, simulation, and modeling used in all areas of NSF sponsored research and education. CISE will identify and make investments in instrumentation and facilities, including Partnerships for Advanced Computational Infrastructure, Terascale computing, high-performance networking, and a new effort on cyberinfrastructure that will enable a new generation of data and information based research in all science and engineering disciplines.

CISE's support for ongoing core and new activities contributes to NSF's efforts to achieve its strategic goals, and to the administration and management activities necessary to realize these goals.

Summary of CISE Funding by Strategic Goal
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	Change Amount	Change Percent
People	44.84	53.33	56.94	3.61	6.8%
Ideas	321.36	328.58	354.12	25.54	7.8%
Tools	141.70	139.29	166.09	26.80	19.2%
Administration & Management	7.11	5.74	7.11	1.37	23.9%
Total, CISE	$515.02	$526.94	$584.26	$57.32	10.9%

Totals may not add due to rounding.

The FY 2004 Request level for the Computer and Information Science and Engineering (CISE) activity is $584.26 million, an increase of $57.32 million, or 10.9 percent, over the FY 2003 Request of $526.94 million.

In FY 2004, CISE will emphasize new and increased activity in three areas:

Information Technology Research (ITR), begun in FY 2000, has diversified modes of funding for CISE researchers and established a new Terascale Computing facility. With ITR funding, CISE has been able to fund larger and longer duration projects with multiple investigators, cross-disciplinary teams, and more realistic project scales. This funding continues to transform research in information technology areas and is effectively building bridges between CISE disciplines and other fields. Terascale Computing is exploring new models for teraflop computing to provide the most advanced computing facility available to civilian researchers in the nation. In FY 2004, CISE will emphasize growth in ITR to continue improving the modes of funding. Additional Terascale investments are addressing the needs to link the three terascale computing facilities with other computational and data resources enabling modeling and simulation at unprecedented scale and resolution.

Cybersecurity research has recently benefited from increased coordination and funding. There are presently programs in three CISE Subactivites addressing computer system security, computer network security, and secure data resources. ITR also addresses security in larger projects. In FY 2004, CISE will increase funding and cooperation for all of these efforts.

A cyberinfrastructure focus will begin in FY 2004 with requested funding of $20 million. Cyberinfrastructure will link computational and data resources (building on experience being gained with Terascale efforts) with sensors and instruments, advanced software and middleware to enable distributed systems and analysis, and visualization resources and facilities to promote understanding of science and engineering applications. The promise and demand for cyberinfrastructure has been articulated in a draft NSB report on "Science and Engineering Infrastructure for the 21st Century: the Role of the National Science Foundation." (NSB-02-190) and in an upcoming report from CISE's Advisory Committee on Cyberinfrastructure. Both reports concur that the needs and opportunities are great at this time, due to rapidly increasing volumes of data generated by scientific instruments and sensors, the increasing capability (with decreasing costs) of computing, networking and sensors, and the demonstration in all fields of the potential for revolutionizing science and engineering.

People (+$3.61 million for a total of $56.94 million)

CISE places high priority on programs to develop the advanced IT workforce. This workforce, including researchers, educators, and technology leaders for industry, is key to the health of the computing and communications sectors. The strong demand for a workforce with advanced information technology knowledge continues even while unemployment in other sectors has risen.

The principal strategies to develop this workforce include increasing graduate training and improving the attractiveness of university careers for computer scientists and engineers; increasing participation of under-represented groups in the workforce; and enhancing the ability of all citizens to benefit from the expanded use of computing and communications technologies. The following table shows investments in training programs, but does not include the extensive support for graduate training supported under research grants (see Ideas, below), the support enabled by advanced computational and network infrastructure, or the programs supported in centers.

CISE People Investments
(Dollars in Millions)

	FY 2003 Estimate	FY 2004 Estimate	Change Amount	Percent
K-12	-	-	-	-
Undergraduate	9.32	10.27	0.95	10.2%
Graduate & Professional	44.01	46.67	2.66	6.0%
Total, People	$53.33	$56.94	3.61	6.8%

Enhancement of multidisciplinary education, teaching, and training activities include:

- **Curriculum Development** (+$800,000 to $3.60 million): In cooperation with ENG, CISE sponsors projects that draw on research advances to create university curriculum materials that prepare students for the research and development opportunities of the future. In response to strong proposal pressure, this increase will allow 2 to 3 additional projects to be funded.
- **CAREER** (+$2.20 million to $29.55 million): Increasing CISE CAREER award size will encourage young scientists and engineers to continue in academic career paths and develop strong professional programs that integrate research and education.
- **Graduate Stipends** (+$1.01 million to $5.63 million): CISE will increase stipends to $30,000 for graduate research fellowships for women, IGERT, and GK-12 to meet the need to provide adequate support for advanced training. Above the increased stipends, this will also support an increase in the number of graduate students.
- **Postdoctoral Support** (-$550,000): CISE will phase out its targeted postdoctoral program in FY 2004, though postdoctoral fellows will continue to be supported through individual and group awards. The need for a dedicated program in computer fields is small, and the field is well served through the other awards.

Ideas (+$25.54 million for a total of $354.12 million)

CISE supports research across the full range of disciplines that increase understanding of information, communication, and computing – from the basic principles and technologies to new applications. Support for discovery across the frontier of science and engineering connected to learning, innovation and the service of society underlies all the research areas in the CISE activity; it accounts for about 60 percent of the funding in the CISE activity. Projects that support research as well as the university training environment are the highest priority across CISE. As part of this support for discovery, funding for ITR will increase to $218.11 million, with approximately two-thirds of this support going to individual and small group projects and one-third to large, interdisciplinary, multi-investigator projects designated as centers.

Enhancement of multidisciplinary research activities, inter-agency partnerships, and international activities through:

- **Cybersecurity** (+$20.0 million to approximately $35.0 million): Increasing support of research addressing security needs for IT systems, involving computers, networks, and databases, and adding a network security component. This will build a foundation of knowledge to build a next generation of secure systems that will benefit all sectors of society.
- **Vulnerabilities Analysis, Consequence Management, and Threat Reduction** ($2.0 million): Initiating support of research that creates and manages integrated multidisciplinary and multi-sector resources for response to extreme events, such as: data repositories, tools for planning and decision-making, communications infrastructures, sensor infrastructures, and real-time data-driven simulations.
- **Language Technologies** (+$2.0 million to $7.0 million): Initiating support for new opportunities in language technologies include natural language processing, speech recognition by computer, and applications such as use of language for human-computer interaction in ubiquitous computing environments. Enables the start of a ‘new core’ program that will provide a comprehensive approach to technologies for human languages. This supports national security and homeland defense by sponsoring the basic research that enables automated understanding of natural language resources, automatic translations, and other services.

- **Biologically Inspired Computing** (+$1.0 million to $4.0 million): Supports improvements on fundamental capabilities of computer and information systems by incorporating insights from deeper understanding of the information mechanisms of biological systems at all levels ranging from the atomic to systems of organisms.

Funding for CISE Centers
(Dollars in Millions)

	FY 2003 Estimate	FY 2004 Estimate	Percent Change
Information Technology Centers	70.00	74.00	5.7%
Science and Technology Centers[1]	-	4.00	N/A
Total, Centers Support	$70.00	$78.00	11.4%

[1]The increase in STC funding reflects new awards made in September 2002. These funds are shown in Integrative Activities in the FY 2003 Request, and are transferred to the appropriate managing R&RA Activity in the FY 2004 Request.

Information Technology Centers are large projects funded in the Information Technology Research program that are typically multi-disciplinary and multi-investigator projects. Many involve more than one university. These projects support IT researchers to address problems of larger scale and complexity than CISE was previously able to support - projects that are more representative of actual practice in the IT focused sector. Such projects give students a more realistic experience than was previously possible.

The Center for Embedded Networked Sensing (CENS) at UCLA is the Science and Technology Center supported by CISE. CENS is developing Embedded Networked Sensing Systems and applying this revolutionary technology to critical scientific and social applications. Like the Internet, these large-scale, distributed systems, composed of smart sensors and actuators embedded in the physical world, will eventually infuse the entire world, but at a physical level instead of virtual.

Priority Areas

In FY 2004, CISE will support research and education efforts related to broad, Foundation-wide priority areas in Biocomplexity in the Environment, Information Technology Research, Nanoscale Science and Engineering, Mathematical Sciences, and Human and Social Dynamics.

CISE Investments in Priority Areas
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Biocomplexity in the Environment	6.10	7.36	8.00	0.64	8.7%
Information Technology Research	173.51	190.67	218.11	27.44	14.4%
Nanoscale Science and Engineering	10.20	11.14	15.14	4.00	35.9%
Mathematical Sciences	N/A	2.29	2.29	0.00	0.0%
Human and Social Dynamics	N/A	N/A	3.00	3.00	N/A

- **Biocomplexity in the Environment**: Funding for BE in FY 2004 increases by $640,000 or 8.7 percent for a total of $8.00 million. These funds will contribute to NSF's coordinated central competition and will support focused environmental informatics activities such as multi-scale modeling and simulation, dynamic data analysis and interpretation, synthesis studies, and data mining and data management, as well as enabling increased award size for new projects in the Tree of Life emphasis area.

- **Information Technology Research**: Funding within CISE for the Foundation's ITR priority area will total $218.11 million in FY 2004, a $27.44 million increase or 14.4 percent over the FY 2003 Request of $190.67 million.

  Information technology (IT) was responsible for a third of the nation's economic expansion during the 1990s, primarily due to advances in fundamental understanding of computing, communications, and information systems. The Internet, personal computers, Web browsers, software for medical, scientific, educational, and business applications, as well as many other features of daily life are rooted in the basic IT research achievements of the past few decades. In the future, IT will have an even greater impact on the quality of our lives, the state of the economy, and national security.

  ITR continues the Foundation's effort to address computing, communications, and information research and related education and training and infrastructure efforts essential for maintaining the nation's preeminence in IT and its wider applications to all sectors of society. In response to the need for more long-range IT research, the ITR program will support research that often entails a higher risk than that prevailing in established areas. In managing the award process, CISE will ensure that at least 10 percent of funding is used for these high-quality, higher-risk proposals. ITR funds larger, more ambitious projects than CISE has been able to fund in the past.

  In FY 2004, CISE will focus on broad thematic, large-scale, long-term, basic computer science research challenges, such as the following:

  - Increased research will address the theory and technology for building safe and secure, complex, embedded, networked and autonomous systems. This will include methods to assess and measure risk and performance assurance, an essential step to improve confidence in information and communications systems. This is the principal priority for increased support.
  - Human Augmentation research will expand the capabilities of computers by exploring new interfaces, such as speech, touch/tactile sensing, and telepresence. This new focus will serve the increasing population of aging Americans. These advances will allow the disabled and elderly to more fully participate in the information age and will expand the abilities of all people to enjoy the power of computing and communications. Speech technology will be an area of particular emphasis.
  - Research at the interface of biology and information technology will be conducted in computational biology to understand biological and social systems, biological systems informatics to understand the "IT" mechanisms of biological systems, biomolecular computation to explore new biological and chemical mechanisms that may form the basis of a new generation of computing, and biologically inspired computing to understand how biological systems process information.
  - Interdisciplinary research funded in ITR will continue to prepare the foundation for cyberinfrastructure. This research is leading new efforts in grid computing, large databases for science and engineering along with new methods to gain understanding from data, and a new effort on sensors and sensor networks.

- **Nanoscale Science and Engineering**: CISE support for Nanoscale Science and Engineering Research will focus on quantum computing, self-assembly of biomolecular computer components, nano-robotics, and design automation to support a new approach to molecular architectures and totals $15.14 million for FY 2004, an increase of $4.0 million over the FY 2003 Request of $11.14 million.

- **Mathematical Sciences**: CISE will participate in this priority area at the level of $2.29 million for FY 2004, continuing the same level of support as in the FY 2003 Request. One emphasis area will be on research to improve comprehension and presentation of data focusing on research in massive data analysis, algorithms, storage, computer input/output issues, networking, digital libraries, etc. A second area will be on continuous computing, specifically at the interface of discrete and combinatorial systems research, which is the traditional preserve of computer science, with the continuous domain research, which is the traditional domain of mathematics.

- **Human and Social Dynamics**: CISE will provide $3.0 million in research funding in FY 2004 for this new priority area. Research support focused on improving use of IT systems including visualization, human-computer interaction, and language interfaces; modeling uncertainty, representing uncertainty of data objects, reasoning with uncertain objects, and semantics of distributed reasoning on uncertain objects; and mechanisms for how humans and groups interact with them. This will also support research on Vulnerabilities Analysis, Consequence Management, and Threat Reduction that will initiate research that creates and manages integrated multidisciplinary and multi-sector resources for response to extreme events, such as: data repositories, tools for planning and decision-making, communications infrastructures, sensor infrastructures, and real-time data-driven simulations. These areas have elements of compelling applications of IT and research areas that promise to improve the effectiveness of IT to serve citizens in roles as varied as learners, scientists, or users of technology in the home.

Tools (+$26.80 million for a total of $166.09 million)

Funding is concentrated in the followiong areas: the Advanced Computing Infrastructure in ACIR, the Advanced Networking Infrastructure in ANIR, additional CISE facilities supported in Experimental and Integrative Activities, and a new subactivity, Cyberinfrastructure. Tools also supports operations for the MREFC-funded Terascale Computing effort.

CISE Investments in Tools
(Dollars in Millions)

	FY 2003 Estimate	FY 2004 Estimate	Change Amount	Percent
PACI	71.49	76.49	5.00	7.0%
Terascale Computing Operations	7.00	7.00	0.00	0.0%
Advanced Networking Infrastructure	46.62	46.42	-0.20	-0.4%
Cyberinfrastructure	N/A	20.00	20.00	N/A
Additional CISE Facilities	14.18	16.18	2.00	14.1%
Total, Tools	$139.29	$166.09	26.80	19.2%

Enhancement of national and international facilities and laboratories includes:

- **Cyberinfrastructure:** (+$20.0 million): A new investment of $20.0 million in Cyberinfrastructure will begin to transform the existing S&E infrastructure of high-performance computers and networks and raise it to a new level by integrating these resources with sensors, data resources, and new analysis and visualization capabilities. These resources will enable new types and depths of research using massive data resources, supporting deeper detail for computational analysis and opening new frontiers for analysis and understanding. Funding will allow 3 to 5 large projects to be funded to introduce these new capabilities to support a greater range of science and engineering and will also allow additional components addressing edge connectivity (to the "lab") to these resources along with visualization or interpretation facilities.
- **PACI** (+$5.0 million to $76.49 million): Additional funds for PACI will support increased operations costs, small projects that often support outreach and training, and additional costs the PACI sites incur as part of working with the Pittsburgh-based Terascale Computing System.
- **Additional CISE Facilities** (+$2.0 million to $16.18 million)**:** Increased support for the CISE's Research Resources Program, supporting multi-investigator instrumentation needs and distributed resources; the CISE Research Infrastructure program, supporting large-scale research synergizing more complex projects; and the CISE Minority Institutions Infrastructure program, building the research capacity at minority institutions and facilitating CISE-related advanced degrees.

Administration and Management

Administration and Management provides for administrative activities necessary to enable NSF to achieve its strategic goals. Requested funding for FY 2004 is $7.11 million, an increase of $1.37 million over the FY 2003 Request of $5.74 million. This includes the cost of Intergovernmental Personnel Act appointments and contractors performing administrative functions.

QUALITY

CISE maximizes the quality of the R&D it supports through the use of a competitive, merit-based review process. The percent of basic and applied research funds that were allocated to projects that undergo merit review was 97 percent in FY 2002, the last year for which complete data exist.

To ensure the highest quality in processing and recommending proposals for awards, CISE convenes Committees of Visitors, composed of qualified external evaluators, to review each program every three years. These experts assess the integrity and efficiency of the processes for proposal review and provide a retrospective assessment of the quality of results of NSF's investments.

The CISE Activity also receives advice from the Advisory Committee for CISE (CISE-AC) on such issues as: the mission, programs, and goals that can best serve the scientific community; how CISE can promote quality graduate and undergraduate education in the biological sciences; and priority investment areas in biological research. The CISE-AC meets twice a year and members represent a cross section of computer and information science and engineering with representatives from many different sub-disciplines within the field; a cross section of institutions including industry; broad geographic representation; and balanced representation of women and under-represented minorities.

PERFORMANCE

Recent Research Highlights

Examples of significant discoveries or advances resulting from CISE-supported research include:

- As part of the NPACI-supported eTEACH Learning on Demand project, University of Wisconsin researchers incorporated a multimedia format into their "Problem Solving with Computers." Students "attend" virtual lectures for this introductory course in computational science via streaming video on the Web. They do homework in active, faculty-facilitated team laboratories that focus on realistic problems. Students and faculty are giving high marks to the redesigned course.

After faculty lectures are recorded on video, they are delivered on demand to each student via streaming video on the Web. Making use of technology to automate time-consuming lectures allows instructors to spend more time interacting with the students. This increased contact takes place in a weekly lab, co-created by students who have already taken the course. Instead of being a solitary activity, homework now becomes an active environment for contact between faculty and students.

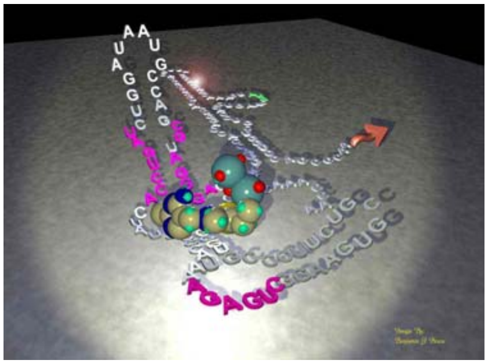
The first eTEACH offering is in a course focusing on NPACI's primary mission -- using computers to solve scientific problems. SDSC is providing technological support with the SDSC Storage Resource Broker software, which will be used to index and store lectures and other video materials.

For more information see: http://www.npaci.edu/envision/v17.3/eteach.html

- Richard Lipton at Georgia Institute of Technology received funding for *Improving Nash's Nobel Prize Result.* Nash received the Nobel Prize for defining and proving that any non-zero sum game between two or more players has a solution. This is known as the Nash Equilibrium Point (NEP), a major generalization to the classical result on zero-sum games. Since real life games are usually non-zero sum and often multiple player games, this is a superb result, but there are two problems with it:

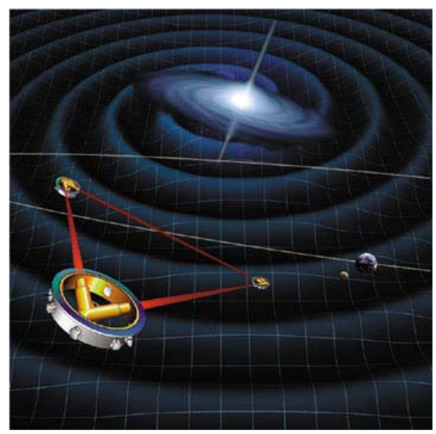
  First, no one knows how to find the NEPs. Second, if the game has a huge number of strategies, then one must generally use all of them. Lipton showed that if a game has n strategies for a player, that player need only use a modest number of strategies (about log n) to get approximately the same value from the game as if he or she used all the strategies, independent of what the other players do. Such strategies can be found much more efficiently then previously.

  Using fewer strategies is important since real life strategies cost money. Imagine a situation where we are deciding on what weapons to purchase for DoD. Clearly, we want to be at or near an optimal point, but cost issues favor strategies that use less choices. Lipton's result shows that this is always possible.



- Yale University researcher Ronald Breaker conducts research on Molecular Switches. Molecular engineering is being used to create new nucleic acid molecular switches analogous to electronic logic gates. In this project, the phenomenon of molecular "survival-of-the-fittest" is used to identify unique RNA switches that have AND gate and other logic functions. Researchers plan to assemble these into biocomputing devices.

- A collaborative effort among the Scripps Research Institute, the University of Utah, and the University of Washington aims to develop novel human-computer interfaces to convey concepts in structural molecular biology using auto-fabricated physical molecular models in an augmented reality environment. This is the first application to blend computer auto-fabrication technology and augmented reality into an educational tool for teaching concepts in molecular biology. The manipulation tools have already begun to show great value in teaching fundamental concepts of structure and assembly of biological molecules to students of all ages and backgrounds.



- NPACI-supported Rutgers University researchers are using supercomputers to model one of the most dramatic events in astronomy–the behavior of black holes when their host galaxies collide. From revealing strong and unexpected effects on surrounding stars to the potential to produce rogue black holes wandering the universe, these simulations–among the largest of their kind ever run–are shedding new light on the life cycle of gravitationally bound black holes in the nucleus of a pair of merging galaxies. Observations have yet to definitively detect black hole pairs, but simulation results of Merritt's team, published in the December 13, 2001, issue of *The Astrophysical Journal*, are helping astronomers find new evidence for the elusive objects.

  A key question is whether the two black holes quickly coalesce into a single, larger black hole, or continue to orbit each other in the new galaxy. Simulations predict that black hole pairs could continue orbiting each other for one billion years or more–long enough to collide with a third galaxy. The researchers' simulations showed for the first time that the binary black hole efficiently scours away stars around it, hurling the stars outward and resulting in a new, emptier galaxy core with a uniform star density. Once the core is relatively devoid of stars, the black holes lose little additional energy and their orbits become stable. Eventually, the black hole binary will undergo a brief, final coalescence into a single black hole, during which energy radiates in the form of gravitational waves. Such gravitational waves, if detected, would not only provide a "signature" revealing the black holes, but also yield information about their orbits, masses, and spins–and furnish the first-ever test of Einstein's Theory of General Relativity under such extreme conditions.

  The simulations are also useful to the designers of gravitational wave detectors, including the planned Laser Interferometer Space Antenna (LISA). For more information see: http://www.npaci.edu/envision/v18.2/blackhole.html

Other Performance Indicators

The tables below show the growth in the number of people benefiting from CISE's funding, and trends in growth of award size, duration and number.

Number of People Supported in CISE Activities

	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate
Senior Researchers	3,686	3,400	3,800
Other Professionals	974	890	990
Postdoctorates	407	510	450
Graduate Students	4,308	4,500	4,600
Undergraduate Students	780	860	860
K-12 Students	230	250	250
K-12 Teachers	130	140	140
Total Number of People	10,515	10,550	11,090

CISE Funding Profile

	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate
Number of Requests for Funding	4,540	5,300	4,700
Dollars Requested (in millions)	$4,500	$4,800	$5,100
Total Number of Awards	2,355	2,150	2,400
Statistics for Competitive Awards:			
Number	1,093	980	1,150
Funding Rate	24%	26%	25%
Statistics for Research Grants:			
Number of Research Grants	949	870	1,000
Median Annualized Award Size	$93,311	$99,000	$99,000
Average Annualized Award Size	$140,084	$151,000	$143,000
Average Award Duration, in years	3.0	3.0	3.0

COMPUTER-COMMUNICATIONS RESEARCH $75,870,000

The FY 2003 Budget Request for the Computer-Communications Research (C-CR) Subactivity is $75.87 million, an increase of $5.7 million or 8.1 percent, over the FY 2003 Request of $70.17 million.

Computer-Communications Research Funding
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Percent
Computer-Communications Research	69.69	70.17	75.87	$5.70	8.1%
Total, C-CR	$69.69	$70.17	$75.87	$5.70	8.1%

C-CR supports research underlying the design, construction, and utilization of information and communications systems of all kinds. It covers theory and implementation for both hardware and software research. The design of algorithms and architectures as well as the tools and technologies for exploiting them are in the scope of this subactivity. The goal is to promote fundamental understanding of computing and communication and to enable development of the advanced, highly reliable systems needed for critical applications in science, engineering, transportation, environment, industrial control, commerce, national defense, education, and health care. Because of the breadth of research it supports, C-CR has 8 standing programs and also takes part in other wide-ranging priority efforts. C-CR activities address two broad areas:

- Funding of approximately $45.0 million supports research on basic issues in the science and technology of computing and information that includes the trusted systems, embedded and hybrid systems, theory of computing, algorithms for scientific computation, computer graphics, operating systems, compilers, software design and productivity, computer architecture, and programming languages. This research provides the bridge from computing and communication systems to application systems with ideas used to design new types of computers and build operating systems and other software systems. Improvements in software quality and productivity are also important benefits of this research.
- Funding of approximately $30.0 million supports research in the design and engineering of computer hardware and communications and signal processing systems and addresses coding and compression techniques, design automation, and computer architecture. This research develops the ideas embodied in new computer and communications systems. Computing and communication improvements come from this research and continue to provide rapid improvements in technology.

Some examples of the research promoted by C-CR are:

- NSF-supported researcher, Andre Scedrov at the University of Pennsylvania is analyzing the widely used Kerberos protocol for secure, authenticated transactions. Scedrov and coworkers have found three anomalies that may occur when the protocol is used. Research on security is finding flaws and identifying needed repairs for the security of deployed systems; it also creates a knowledge base to improve future system designs.
- Eric Torng and Richard Enbody of Michigan State University are examining skew caches and other new cache designs that address the critical bottleneck for computer processor performance. They have developed new algorithms to efficiently manage these new cache methods. Research such as this is needed before these new designs can be incorporated into faster processor chips.
- Game theory, traditionally an economic sciences field, is being applied to the Internet by Vijay Vazirani at Georgia Tech. Understanding the evolving use of the Internet in terms of complex

interactions of many economic agents working with different degrees of collaboration, cooperation and competition, and using new concepts of algorithmic game theory is leading to new approaches to problems such as fair cost allocation and computing market equilibrium prices.

- David Koppelman at Louisiana State University has developed a visualization tool to help researchers visualize data sets from computer processor simulations. Tools such as this help researchers examine detailed data from processor simulations and to develop new techniques to reduce latency or branch costs for new processor designs. Successes from this research lead to improved computer processor performance.

In FY 2004, C-CR will emphasize increases for three research areas:

- Trusted Computing. C-CR will increase support for research in theory and technologies to increase the trustworthiness of computing and communications systems. Protection of computing and communication systems is critical to the privacy of citizens, the safety of transportation systems, the financial health of business organizations, stability of the global economy, and assurance of national security. Trusted Computing will focus on critical hardware and software technologies that are necessary to achieve high levels of system safety, security and privacy, and survivability. The research directions will include sound theoretical bases for assured construction of safe, secure systems; principles and methodology for secure and dependable hardware, software, and network design; and techniques to verify and validate high confidence systems against security breaches and hardware/software faults.

- Embedded and Hybrid Systems. These are typically small, stand-alone devices that are hybrids of digital and analog designs or devices that have embedded small digital systems along with other functions, such as cell-phones, personal digital assistants (PDAs), or medical devices. Research challenges in hybrid systems range from developing a fundamental, mathematical understanding of how discrete (digital) and analog systems interact to developing techniques for design and optimization of systems. Research on embedded devices includes new techniques for low power computing and design methods for small systems in which neither processing nor memory is ample.

- Molecular Architectures. Computer science has developed a very successful tradition for analyzing and synthesizing complex systems by imposing on them a conceptual "architecture." The architecture utilizes multiple layers of abstraction to represent component interactions within these layers as well as to provide clear interfaces between layers. The goal of this emphasis area is to develop new architectural notions for this emerging area of nanotechnology, with the goal of systematizing the design of nanoscale artifacts. The research will be coordinated through the NSF-wide Nanoscale Science and Engineering priority area.

CCR will manage a new Science and Technology Center, the Center for Embedded and Networked Sensing, headed by Dr. Deborah Estrin at UCLA. Funded at $4.0 million per year, the center will conduct basic research on sensors for use as varied as environmental sensing, airflows over airplane wings, and medicine. They will also study networking of sensors to improve signal quality, data management, power management and other research objectives.

INFORMATION AND INTELLIGENT SYSTEMS $52,400,000

The FY 2004 Request for the Information and Intelligent Systems (IIS) Subactivity is $52.40 million, an increase of $1.79 million, or 3.5 percent, above the FY 2003 Request of $50.61 million.

Information and Intelligent Systems Funding
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Information and Intelligent Systems	51.65	50.61	52.40	$1.79	3.5%
Total, IIS	$51.65	$50.61	$52.40	$1.79	3.5%

The IIS Subactivity is the major source of support for research in the important and rapidly growing areas of human-computer interaction, databases, digital libraries, robotics, computers and society, and knowledge and cognitive systems.

Research in the IIS Subactivity is oriented broadly around two thematic areas: human-computer systems and information systems. Approximately 44 percent of this subactivity's funds, or about $23 million, support human-computer systems activities in human-computer interaction, universal access, and robotics and human augmentation. This research addresses areas such as graphics and language to enable new ways to communicate between computers and humans; new techniques to support access for those with limited vision, hearing or dexterity; and robotic devices to assist people or to complement the abilities of humans.

Approximately $29 million of this subactivity's funds support research in information systems and includes programs in information and data management, knowledge and cognitive systems, computers and social systems, and digital libraries. This research addresses topics such as visualization of data; data mining in scientific databases; analysis of imagery from medical and other sources; artificial intelligence and case-based reasoning, learning systems; understanding human learning and its relationship to machine learning; and the economic, ethical, and social impacts of IT.

The following are examples of major research efforts supported by IIS.

- Universal access projects exploit interface technology to assist the disabled, the elderly, and those with limited experience with computer systems. Research in these areas is leading to new methods for voice synthesis and recognition, multi-media information interfaces, haptic (force-feedback) interfaces, and the synthesis of systems to ease interaction with computers. Expanding the choices for interacting with electronic systems will have wide benefits.
- The Digital Libraries program (DLI), which combines resources from NSF, the Defense Advanced Research Projects Agency (DARPA), the National Endowment for the Humanities (NEH), and the National Library of Medicine (NLM), is also supported in the "Information Management" theme of the ITR program. It has expanded its international activities, supporting joint research programs with the United Kingdom, Germany, the European Union, and several Asian countries. Digital Library research now includes new applications of computer techniques to resources in education, for example in the use of digital libraries by children; these are further developed in the National STEM Digital Library program (NSDL) in the Education and Human Resources Activity (aimed at improving science, engineering, mathematics, and technology education).

- Data mining and data handling in general are rapidly expanding, with new work on long-term preservation of data, on understanding the provenance of data so that its reliability can be judged, and on extracting data from research to be used in many applications. For example, research on data mining in medical patient records not only assists doctors trying to treat a patient but also can help with epidemiological studies. This research has also proven useful for national intelligence efforts to enable analysis of foreign data sources. IIS has supported innovations leading to search engines such as Google.

The following are successes from recent IIS supported research.

- Tom Furness of the University of Washington is exploring uses of computer and visualization technology for partially sighted people. Some people with limited vision have at least part of their retina usable, but cataracts or other problems prevent them from seeing much. This project is exploring the use of a display that projects an image directly on an area of the retina, bypassing the lens in the eye and thus compensating in part for some visual defects. Recently this project has discovered and measured user preferences for display techniques; in particular, blue seems to be the easiest color to read with this technique. This will improve our ability to use such devices to help the partially sighted.
- Fred Jelinek of Johns Hopkins University, for several years has organized a summer workshop on language technologies; the workshop has been a training ground for graduate students and young faculty. The most recent topic was summarization techniques that automatically read and summarize documents. The workshop has been very influential in training, promoting this research area and disseminating state of the art knowledge to U.S. researchers.
- Shree Nayar of Columbia University is conducting research on using polarized light to compensate for the low contrast and bad light scattering in bad weather that degrade vision. His techniques work in haze, mist, fog, and other conditions; and they apply to grey-scale, color, or even IR imagery. This work can be applied to areas such as vehicle navigation and video surveillance and may improve road and airplane safety.

IIS plans to reallocate resources to support increased research on natural language processing including translation, summarization, and spoken language recognition. These research areas are timely and reach across the range of uses of information technologies; the recent emphasis on combating terrorism has also demonstrated the growing need for a strong research presence in these areas to serve long term needs in national and homeland security.

IIS is also increasing efforts on new generation data management systems that manage large amounts of structured and unstructured data, extract information from the data, as well as manage complex relationships between the data. These data management systems are being used in numerous applications and are vulnerable to malicious attacks. Data and applications security will provide new models for developing secure information applications.

EXPERIMENTAL AND INTEGRATIVE ACTIVITIES $57,670,000

The FY 2004 Request for the Experimental and Integrative Activities (EIA) Subactivity is $57.67 million, a decrease of $4.49 million, or 7.2 percent, below the FY 2003 Request of $62.16 million.

Experimental and Integrative Activities Funding
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Experimental and Integrative Activities	63.15	62.16	57.67	-$4.49	-7.2%
Total, EIA	$63.15	$62.16	$57.67	-$4.49	-7.2%

The EIA Subactivity facilitates new ventures and the evolution of CISE-related disciplines, and encourages activities that cross traditional boundaries. Specifically, EIA promotes new and typically multidisciplinary research initiatives; builds capacity in terms of people and facilities; and assesses the impact of IT research, education, and technology on society.

EIA has a balanced portfolio across NSF's three strategic goals. Multidisciplinary research supports NSF's Ideas strategic goal; instrumentation and infrastructure supports Tools for CISE research; education, human resources, and workforce activities support the People goal; and EIA provides approximately $2.0 million to support workshops, symposia, studies, travel, and international activities. Approximately $28.0 million in multidisciplinary research funding supports projects that cross the disciplinary boundaries within CISE as well as projects that have a core of CISE research and application outside of CISE areas. Approximately $21.0 million for instrumentation and infrastructure efforts provides funding for groups of investigators for equipment (such as high-performance computers, robots, or visualization devices) and operations that enable multi-investigator research. Education, human resources, and workforce efforts provide approximately $11.0 million to support research on uses of technology to improve learning, to transfer research into college and graduate level curriculum, and to increase the participation of under-represented groups in educational and career paths in IT.

The following are areas of emphasis for FY 2004.

- EIA plans to continue to emphasize biomolecular computing, biologically-inspired information technology, and bioinformatics as well as coordinate CISE participation in the NSF-wide Biocomplexity and the Environment priority area. EIA will also continue its investment in the Digital Government.
- The portfolio of instrumentation and infrastructure programs will provide research equipment generally unavailable on individual research awards, ranging from specialized instrumentation for small research groups, to large-scale infrastructure, to nationally and internationally shared facilities, which are closely tied to research. Participation by regionally disadvantaged and underrepresented groups will be ensured through partnerships and special programs.

- Activities in education, human resources, and workforce will focus on the underlying issues, needs, and components of teaching and learning, workforce needs, pipeline problems, and under-representation in information technology. Demonstration projects to follow research on reasons for underrepresentation of women and minorities in the IT workforce are planned. The Information Technology Workforce Program is the primary program in this area, and EIA will continue to participate in many cross-directorate activities, including the Combined Research Curriculum Development (CRCD) program, the Graduate Teaching

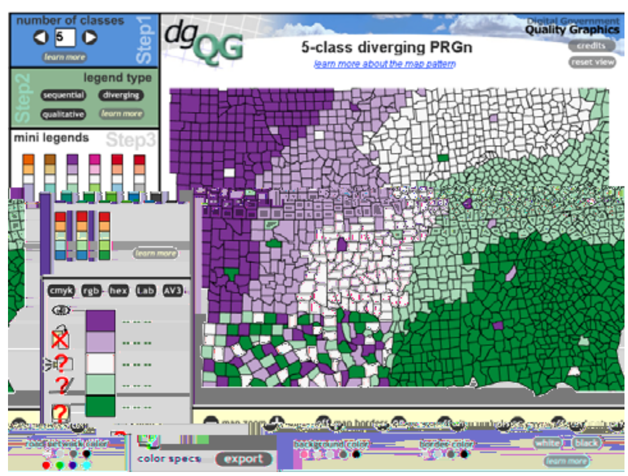
Fellowships in K-12 Education (GK-12) program, and in the Interagency Education Research Initiative (IERI).

Priority activities for reallocated funding are as follows.

- An increase in support for curriculum development projects will respond to strong interest from universities and use this strategy to improve curriculum and attract students to IT programs in colleges and universities.
- CISE support for the ADVANCE program to promote opportunities for women to develop careers in computer science and engineering research will be funded at $2.39 million. Increases in stipends for IGERT, and other graduate fellowships will attract more US students to graduate study.

To better align programs with the focus of divisions, CISE has transferred a research program, Next Generation Software, with annual funding of $7.50 million to the ACIR division. The program funds research on improving high performance computing, and this management transfer will improve its overall effectiveness and coordination. Only some of the successes resulting from prior EIA funding include:

- Mark Kimmel of Rice University with NSF support is developing an innovative new curriculum in computational biology. His project will develop and disseminate curriculum for a new course based on recent multi-disciplinary research. Graduates will be prepared to work on leading research problems and able to apply bio-informatics to a wide range of problems.
- Supporting NSF's Tools goal, Christopher Kitts and Garrett Okamoto of Santa Clara University have developed a comprehensive mission control architecture enabling globally distributed researchers to monitor/control tele-robotic science missions and to verify/validate advanced command and control technology. Users can remotely monitor and control satellites or robots. This project is oriented to developing a shared resource and has already engaged 20 collaborators; demonstration projects to control satellites and undersea robots have been successful.
- The Digital Government program supports Alan MacEachren and Cynthia Brewer at the Pennsylvania State University in developing a new approach to exploratory data analysis. Working with the National Cancer Institute and the National Center for Health Statistics they have developed the ColorBrewer tool and demonstrated applications visualizing disease incidence. An outreach project to K-12 students is encouraging students to deepen understanding of maps and statistical information.



Tools – ColorBrewer is an online tool designed to help people select good color schemes for maps and other graphics.

ADVANCED COMPUTATIONAL INFRASTRUCTURE AND RESEARCH $92,560,000

The FY 2004 Request for the Advanced Computational Infrastructure and Research (ACIR) Subactivity is $92.56 million, an increase of $7.14 million, or 8.4 percent, over the FY 2003 Request of $85.42 million.

Advanced Computational Infrastructure and Research Funding
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Advanced Computational Infrastructure	80.14	78.49	78.19	-0.30	-0.4%
Advanced Computational Research	6.61	6.93	14.37	7.44	107.4%
Total, ACIR	$86.76	$85.42	$92.56	$7.14	8.4%

Totals may not add due to rounding.

The ACIR Subactivity provides access to, and support for, high-end computing for the national scientific community, and research on the development, use, and applications of these computing systems.

Within the Advanced Computational Infrastructure (ACI) line item, the Partnerships for Advanced Computational Infrastructure (PACI) program in FY 2004 will be supported at $76.49 million, an increase of $5.0 million over the FY 2003 Request of $71.49 million. The Advisory Committee for Cyberinfrastructure is currently evaluating the PACI program and will make recommendations for its future in the context of broader cyberinfrastructure planning. ACI also provides operations support for the recently established Terascale Computing Facilities funded in the MREFC Account.

PACI consists of two partnerships, each consisting of a leading edge site and a number of partners. More than 60 geographically distributed partner institutions from 27 states and the District of Columbia are associated with PACI. The leading edge sites maintain a variety of high-end computer systems and together with their partners, develop, apply, and test software, tools, and algorithms to further the growth of a set of interconnected resources. These resources consist of advanced visualization and data handling capabilities linked with high-end computing capabilities.

PACI activities include the following.

- Access - making available a diverse set of advanced and mid-range compute engines, data storage systems, and experimental machine architectures.
- Enabling Technologies - developing parallel software and computation tools to enable effective exploitation of the partnerships' widely distributed, architecturally diverse, machines and data sources.
- Application Technologies - developing and optimizing discipline-specific codes and software infrastructures, making these broadly available to researchers.
- Education, Outreach, and Training - ensuring awareness and understanding of how to use high-end computing and communications resources, and broadening participation in advanced computational science and engineering.

Advanced Computational Research (ACR) complements PACI activities through single-investigator or small-group research grants to advance the state of the art in high-performance computation. It has three principal technical thrusts: visualization, data handling, and parallel numerical algorithms. In FY 2004, funding support totals $14.37 million, an increase of $7.44 million over the FY 2003 Request of $6.93 million.

ACIR-funded advances include Globus and Legion, two middleware components that play an increasing role in building computational, information, and access grids. Grids are connected resources that enable researchers to access the best resources over networks without complex human brokering for those resources or requiring users to adapt data or software to unfamiliar computing environments. Researchers working with these grids are developing methods for security and privacy, distributed storage, grid measurement, and other techniques to enable seamless and efficient access to resources.

An example of what the PACI program enables is illustrated by the computational support it provides for research funded across NSF's other programs. The National Virtual Observatory (NVO), whose research is funded by the Information Technology Research program, is headed by astronomer Alex Szalay of Johns Hopkins University and computer scientist Paul Messina of Caltech. They plan to unite the astronomical databases of many earthbound and orbital observatories, taking advantage of the latest computer technology and data storage and analysis techniques. The goal is to maximize the potential for new scientific insights from the data by making them available in an accessible, seamlessly unified form to professional researchers, amateur astronomers, and students.

ADVANCED NETWORKING INFRASTRUCTURE AND RESEARCH $67,650,000

The FY 2004 Request for the Advanced Networking Infrastructure and Research (ANIR) Subactivity is $67.65 million, a decrease of $260,000, or 0.4 percent, below the FY 2003 Request of $67.91 million.

Advanced Networking Infrastructure and Research Funding
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Advanced Networking Infrastructure	47.97	46.62	46.42	-0.20	-0.4%
Advanced Networking Research	21.80	21.29	21.23	-0.06	-0.3%
Total, ANIR	$69.77	$67.91	$67.65	-$0.26	-0.4%

Totals may not add due to rounding.

The ANIR Subactivity supports the research and development of high performance networking for the nation's science and engineering community, as well as fundamental research on networking and network interoperability and scaling in distributed information systems. ANIR also supports extensive collaborative development of national and international networks with other agencies and other countries. This is essential to the development of future generations of networks that will enable new applications such as nationwide and worldwide scientific collaboration, distributed high performance computation, and large scale distributed multimedia networked knowledge repositories. Distance education, digital libraries, and e-commerce activities are a few of the rapidly expanding applications enabled by the underlying network research and development that this Subactivity supports.

The FY 2004 Request for Advanced Network Infrastructure (ANI) is $46.42 million, a decrease of $200,000 from the FY 2003 Request of $46.62 million. ANI investments have changed the way that research is conducted in many areas of science and engineering by enabling almost instantaneous communications among researchers and educators worldwide. The very High-Speed Network Service (vBNS), together with the high performance connections program, has led to the development of a new level of networking for the nation's research universities. This work has gained additional momentum through important developments in the university-led Internet2 community. A critical mass of connected sites and research activities is now in position to exploit these important resources.

In FY 2004, ANI will emphasize testbeds for networking research and near term deployment. The research testbeds will provide realistic scale settings to for researchers to explore transformative new ideas in networking. Near term activities will work closely with applications to support knowledge transfer of promising technologies into the working high performance networks. ANI will also continue the High Performance Network Connectivity (HPNC) program begun in 2001 that extends connectivity to additional members of the research and education community; develop middleware used to build high performance network applications under a new program in Middleware (MWIR) begun in 2001; and continue research in new directions in access network technology through its Strategic Technology for the Internet (STI) program to extend the reach of high performance network environments.

FY 2004 funding for Advanced Networking Research (ANR) is $21.23 million, a decrease of $60,000 from the FY 2003 Request. The focus will be to continue the fundamental research necessary to enable the continued expansion of the capabilities of communications networks. Underlying goals of network research are handling greater volumes of information and increased numbers of users, more complex protocols, greater diversity of service types, and greater flexibility of use in mobile and fixed environments. Areas for increased support are network security, wireless network access with improved data rates and improved interoperability with fixed networks; very high performance access networks including optical networks; and improved network architectures, protocols, monitoring, and management tools. Multidisciplinary small group projects bridging traditional disciplinary boundaries will continue to receive greater emphasis. Experimental aspects will be emphasized in small projects.

Examples of outcomes from ANIR support include:

- Panos Crysanthis and Vicenzo Loberatore, of the University of Pittsburgh and Case Western Reserve University, are developing open source middleware and grid services software that will be enablers for distributed science and engineering applications that rely on networking and high performance computation. Users include NSF's Grid Physics Network, the International Virtual Data Grid Laboratory, the Particle Physics Grid, the Network for Earthquake Engineering Simulation and many others. The software was downloaded over 3,900 times in the first 9 months after becoming available.
- Jeffrey Cole of the UCLA Center for Communication Policy is supported for research on the effects of the Internet. Recent findings show that the Digital Divide is closing – the most rapid growth in users of the Internet is among people of lower income and education levels; that people who are active online are more social than average and feel more empowered politically; and that children are the age group most likely to make new friends online and to reveal details about themselves. These findings help us understand the changes underway and inform policy.

INFORMATION TECHNOLOGY RESEARCH $218,110,000

The FY 2004 Request for the Information Technology Research (ITR) Subactivity is $218.11 million, an increase of $27.44 million, or 14.4 percent, over the FY 2003 Request of $190.67 million.

Information Technology Research Funding
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Information Technology Research	174.01	190.67	218.11	27.44	14.4%
Total, ITR	$174.01	$190.67	$218.11	$27.44	14.4%

Advances in computing and communications theory and practice and their implementation have made information technologies a transcendent agent of change. A cyber future is emerging, whose details are amorphous and unpredictable, but it is certain to impact individuals through its effects on such diverse areas as science and engineering research, education, commerce, health, and national security. Fundamental research in computer science and engineering is critical to laying the basis for advances and to utilizing the increasing power of computing and communications technologies.

As part of the Foundation's ITR priority area, $218.11 million is requested for FY 2004.

- Funding for large-scale networking will total $24.79 million for efforts that include ubiquitous connectivity, wireless networks, and advanced networked applications.
- High end computing at $19.94 million will support projects that include scaling systems to hundreds of thousands of processors and software to fully utilize the computing power, in addition to new architectures such as those based on bio-molecules or quantum principles.
- Support for high end computation and infrastructure efforts will total $30.39 million and provide research in integrated computing, storage systems, connections to high-data volume instruments, and visualization facilities.
- High confidence software and systems, funded at $27.90 million, reflecting an increase for cybersecurity of $10.0 million over the FY 2003 Request, will address the theory and technology of building safe and secure, complex embedded and autonomous systems and measurement of risk and performance assurance.
- Human-computer interaction and information management, funded at $48.12 million, will support technology for successful aging; universal access to expand the sensory and manipulation capabilities of all people; and new uses of computing and communications technology in the social sciences, humanities, and the arts.
- Software design and productivity, funded at $29.04 million, will focus on the creation of a new generation of information systems to support research and education.
- The social, economic and workforce implications of IT and IT workforce development efforts, funded at $37.93 million, will support research on technologies for assisting teaching, learning, collaboration, and creating educational environments to expand the pipeline for students and professionals in IT careers.

Research to enable cyberinfrastructure. This area will support research for creating a new generation of information systems to support research and education. The next transformations of the information revolution will integrate content sources, storage, and new modes for humans to access information with computing and communications. Scientific research is moving to large, shared instruments; to wide-area sensing and observing; and to shared data resources. These changes are creating massive amounts of data that will require new methods for storage, search, and access; new techniques for distribution and sharing in the scientific community; and new tools for analyzing and presenting data and analysis. CyberInfrastructure research will build on many CISE research efforts to catalyze the next transformation of information systems including Grid Computing, Digital Libraries, Virtual Reality / Telepresence, and High Performance Networking and Middleware Applications.

The Terascale Computing Systems, formerly requested through the Major Research Equipment and Facilities Construction Account, will provide advanced computing capabilities for the most demanding scientific and engineering applications. This facility, in cooperation with the PACI centers and Advanced Networking Infrastructure, will provide computing and communications facilities for many of the application and research needs. Research awards will support novel databases and networking tools that enable broader communities of users to build state-of-the-art, distributed collaboratories, and other needs. CISE funding for operations totals $7.0 million in FY 2004, equal to the FY 2003 Request.

Within ITR, IT education and workforce activities will also be supported. IT has emerged as a delivery vehicle for education at all levels – from traditional school settings to workforce education – helping to maintain and improve skills. Education in IT itself addresses the shortage of skilled workers and the rapidly changing needs in this area. This effort will reach broader segments through programs collaborating with K-12 and improvement in curriculum for IT at the college level. Underrepresentation of minorities and women in the IT education and career paths will be addressed by research on the underlying causes of this phenomenon.

ITR also supports research on the social impacts of information technology. This is deepening our understanding of how computing and the Internet are changing society, as well as developing new knowledge about the factors that determine the acceptance and success of IT innovations.

Representative outcomes of ITR include:

- William Seales and colleagues at the University of Kentucky are conducting research to create high resolution displays at low cost. Combining multiple low resolution projectors and cameras to observe the project images, they can compute overlap and light levels. An observer 2 meters from the screen sees perfect registration of high resolution images. These techniques will enable low cost data displays that could be deployed widely in research and education.
- Nancy Leveson at MIT directs a center level activity on Safety-Critical Embedded Software. The project supports theoretical and experimental research as well as application to practical methodologies; a safety driven, human-centered specification together with modeling and formal analysis is being experimentally applied to air-traffic collision detection and conflict detection.

CYBERINFRASTRUCTURE $20,000,000

The FY 2004 Request for the Cyberinfrastructure Subactivity is $20.0 million.

Cyberinfrastructure Funding
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Cyberinfrastructure	-	-	20.00	N/A	N/A
Total, Cyberinfrastructure	$0.00	$0.00	$20.00	N/A	NA

Focus on cyberinfrastructure will begin in FY 2004 with requested funding of $20.0 million. This new investment enhances base funding related to cyberinfrastructure of about $124.0 million. Cyberinfrastructure will link computational and data resources (building on experience being gained with Terascale efforts) with sensors and instruments, advanced software and middleware to enable distributed systems and analysis, and visualization resources and facilities to promote understanding of science and engineering applications. The promise and demand for cyberinfrastructure has been articulated in a draft NSB report on "*Science and Engineering Infrastructure for the 21st Century: the Role of the National Science Foundation*." (NSB-02-190). CISE's Advisory Committee on Cyberinfrastructure will also release a report. Both reports will concur that the needs and opportunities are great at this time, due to rapidly increasing volumes of data generated by scientific instruments and sensors, the increasing capability (with decreasing costs) of computing, networking and sensors, and the demonstration in all fields of the potential for revolutionizing science and engineering.

Cyberinfrastructure will transform the existing S&E infrastructure of high-performance computers and networks by integrating these resources with sensors, data resources, and new analysis and visualization capabilities. These resources will enable new types and depths of research using massive data resources, supporting deeper detail for computational analysis and opening new frontiers for analysis and understanding. Funding will allow for 3 to 5 large projects to introduce these new capabilities to support a greater range of science and engineering and will also allow additional components addressing connectivity to campus research laboratories along with visualization facilities.

ENGINEERING

ENGINEERING $536,570,000

The FY 2004 Budget Request for the Engineering Activity (ENG) is $536.57 million, an increase of $48.59 million, or 10.0 percent, over the FY 2003 Request of $487.98 million.

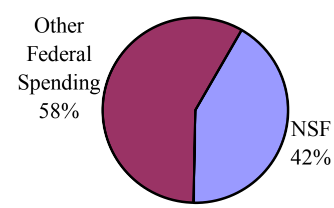
ENG Funding
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Bioengineering and Environmental Systems	41.32	43.87	47.91	4.04	9.2%
Chemical and Transport Systems	57.21	58.94	66.20	7.26	12.3%
Civil and Mechanical Systems	56.09	57.75	64.36	6.61	11.4%
Design, Manufacture, and Industrial Innovation[1]	134.99	141.23	163.06	21.83	15.5%
Electrical and Communications Systems	64.75	66.70	70.76	4.06	6.1%
Engineering Education and Centers	116.47	119.49	124.28	4.79	4.0%
Total, ENG	$470.83	$487.98	$536.57	$48.59	10.0%

Totals may not add due to rounding
[1]SBIR/STTR are included in the DMII funding line. DMII increases (excluding SBIR/STTR) equal 7.5%.

The Engineering Activity supports fundamental research on engineering systems, devices and materials, and their underpinning processes and methodologies. ENG investments contribute to technological innovation vital to the nation's economic strength, security and quality of life.

RELEVANCE

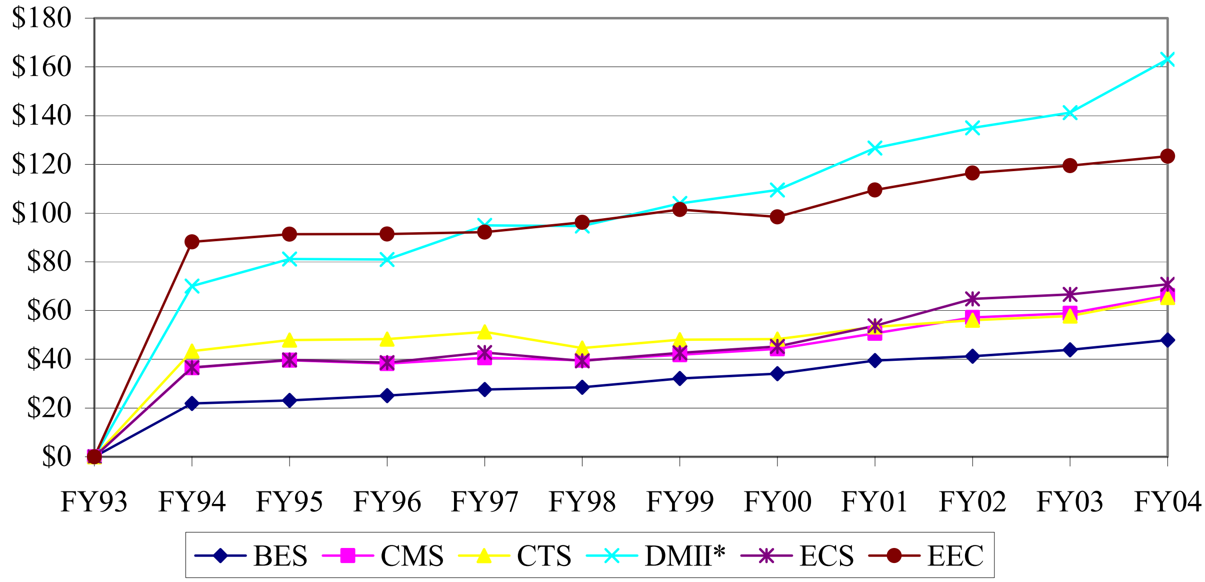


ENG is the principal source of federal funding for university-based fundamental engineering research, providing over 42 percent of the total federal support in this area.

NSF uses various internal and external mechanisms to review the relevance of proposed and existing programs and to help the Directorate identify emerging opportunities and goals for the future. These include Advisory Committees, Committees of Visitors, academy and other reports, Blue Ribbon panels, workshops, and long-range planning documents, among others.

ENG promotes the progress of engineering in the United States in order to enable the Nation's capacity to perform. Its investments in engineering research and education aim to build and strengthen a national capacity for innovation that can lead over time to the creation of new shared wealth and a better quality of life. A major focus of ENG investments is in emerging technologies—nanotechnology, information technology and biotechnology. Support for research in these areas contributes to major advances in health care, manufacturing, business, education, and the service industry.

ENG Subactivity Funding
(Dollars in Millions)



*SBIR/STTR increases 304% over the period; other DMII programs increase 57%

STRATEGIC GOALS

Three strategic focus areas guide ENG activities:

- PEOPLE: Activities to better attract and retain engineering graduates and to ensure that they receive a quality education. ENG plays a key role in promoting curriculum reform to respond to industry's needs, and to emerging technologies that are transforming the economy. ENG supports engineering graduates who will lead currently emerging technology areas, and positions these graduates to push technological frontiers.

- IDEAS: Advancement of knowledge about fundamental engineering research, including support for core research as well as the exploration of new and emerging industrial technologies, high risk and innovative research, and expanding opportunities for discovery in NSF priority areas.

FY 2004 ENG Strategic Goals

- TOOLS: Enhancement of infrastructure to conduct engineering research, identifying and developing state-of-the-art tools for increasingly collaborative engineering research activities.

Engineering's support for ongoing core and new activities contributes to NSF's efforts to achieve its strategic goals, and to the administration and management activities necessary to achieve these goals.

Summary of ENG Funding by Strategic Goal
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
People	81.66	78.09	83.42	5.33	6.8%
Ideas	376.52	399.11	435.49	36.38	9.1%
Tools	5.77	4.30	10.75	6.45	150.0%
Administration & Management	6.88	6.47	6.90	0.43	6.6%
Total, ENG	$470.83	$487.98	$536.57	$48.59	10.0%

Totals may not add due to rounding.

People (+$5.33 million, for a total of $83.42 million)

People are ENG's most important product. Across its programs, ENG supports more than 14,100 people, including students, researchers, post-doctorates, and trainees. ENG is committed to maintaining this number, while progressing with the NSF goal of longer award durations and larger grants. Support for programs specifically addressing NSF's strategic goal of "People – A diverse, internationally competitive and globally-engaged workforce of scientists, engineers and well-prepared citizens" totals $83.42 million in FY 2004, an increase of $5.33 million, or 6.8 percent over FY 2003. Research grants support researchers and students, including approximately 8,084 postdoctoral researchers, trainees, and graduate and undergraduate students.

ENG also invests in focused human resources development and education activities to develop the next generation engineering and technological workforce and to enhance opportunities for women and minorities. Through these investments, ENG will cultivate future leaders in engineering, anxious to explore new and emerging ideas. In FY 2004, ENG will support such focused activities as Faculty Early Career Development (CAREER), Research Experiences for Undergraduates (REU), Research Experiences for Teachers (RET), Graduate Research Fellowships for Women in Engineering, Integrative Graduate Education and Research Traineeships (IGERT), and Postdoctoral Faculty Fellowships.

Students also benefit from ENG-supported partnerships with industry and from ENG-supported centers. ENG promotes partnerships with industry through the Grant Opportunities for Academic Liaison with Industry (GOALI) program, the Engineering Research Centers (ERCs) and the Industry/University Cooperative Research Centers (I/UCRC) program. These partnerships allow students to interact with industrial researchers and to gain exposure to industrial operations. At ENG-supported centers, students participate in multi-disciplinary research teams and contribute to the development of new technologies.

ENG People Investments
(Dollars in Millions)

	FY 2003 Estimate	FY 2004 Estimate	Percent Change
K-12	2.50	2.50	0.0%
Undergraduate	24.68	23.85	-3.4%
Graduate & Professional	50.91	57.07	12.1%
Total, People	$78.09	$83.42	6.8%

The FY 2004 Budget Request for People is $83.42 million, an increase of $5.33 million over the FY 2003 Request. This funding will support:

- Postdoctoral Faculty Fellowships, a new program funded at $3.0 million, to provide 15 promising postdocs with opportunities to enhance interdisciplinary research expertise and learning pedagogy needed to become outstanding new research faculty;

- The Department-Level Reform of Undergraduate Engineering Education and Bridges for Engineering Education Programs, increasing by $3.0 million over the FY 2003 Request of $6.00 million, to enable engineering departments to develop innovative curricula incorporating interdisciplinary knowledge and allow engineering schools to develop active partnerships with schools of education, for their mutual benefit;

- Engineering graduate students supported by the IGERT, GRF and GK-12 programs, increasing by $3.16 million over the FY 2003 Request of $14.26 million to a total of $17.42 million, to allow higher stipends and to increase the number of students; and

- Centers for Learning and Teaching, increasing by $120,000 over the FY 2003 Request of $1.0 million, to allow for planned scale-up of the activities of the Center for Learning and Teaching of Engineering.

Ideas (+$36.38 million, for a total of $435.49 million)

ENG support for discovery across the frontiers of science and engineering enables continued support of fundamental research in the engineering disciplines and enhanced funding for the NSF priority areas. They also provide enhanced support for research in areas such as nanotechnology, sensors, and multi-hazard engineering using the Network for Earthquake Engineering Simulation (NEES).

In its core programs, ENG supports fundamental research on sensor technologies related to nano/micro-scale sensors; wireless communications; functional materials with selective adsorption capabilities; nondestructive evaluations and remote sensing. An increase in funding for sensor technologies will enhance health and environmental monitoring and the efficiency of industrial processes. It will also augment homeland security capabilities while creating a workforce knowledgeable in the operation and deployment of sensor technologies. These technologies include: sensors with higher sensitivity and lower rate of false alarms in the detection of chemical and biological agents; sensing material properties and processes at the nano and micro scales under extreme conditions; sensors for detection, monitoring and control of engineering operations; sensor arrays for enhanced observation of natural and social environments; and imaging and sensing of complex systems, such as critical infrastructure, health and environment.

The Small Business Innovation Research (SBIR) program provides funding at the mandated level of 2.5 percent of extramural research, as required by P.L. 106-554. It will be funded at $90.93 million, an increase of $11.95 million over the FY 2003 Request of $78.98 million. The program emphasizes commercialization of research results at small business enterprises through the support of high quality research across the entire spectrum of NSF disciplines. Recent improvements to the SBIR program include redefinition of research topics to address significant technologies and more emphasis on "commercialization potential" in the SBIR review process.

In FY 2004, ENG will provide $10.22 million, an increase of $5.55 million over the FY 2003 Request of $4.67 million, for the Small Business Technology Transfer (STTR) program, which partners small businesses with academic institutions to promote industrial innovation. Recent congressional action raised the mandated agency spending target from 0.15 percent to 0.30 percent of an agency's extramural research budget in FY 2004.

Total ENG support for the National Earthquake Hazards Reduction (NEHRP) program is $24.99 million, an increase of $4.0 million over the FY 2003 Request of $20.99 million, including support for fundamental research that leads to more earthquake-resistant buildings and facilities. Foundation-wide, support for NEHRP in FY 2004 is $45.74 million, including $8.0 million in the Major Research Equipment and Facilities Construction (MREFC) Account for the Network for Earthquake Engineering Simulation (NEES).

The Engineering Research Centers (ERCs) program provides an integrated environment for academe and industry to focus on next-generation advances in complex engineered systems, with synergy among engineering, science, and industrial practice. ERCs integrate research with education at both the graduate and undergraduate levels, producing curriculum innovations derived from the systems focus of the ERCs' strategic research goals. ERCs aim to build trusted partnerships with industry, develop shared infrastructure, and increase the capacity of engineering and science graduates to contribute to the U.S. competitive edge. They provide a system perspective for long-term engineering research and education, enabling fresh technologies, productive engineering processes, and innovative products and services.

ENG Centers
(Dollars in Millions)

	FY 2003 Estimate	FY 2004 Estimate	Change Amount	Change Percent
Engineering Research Centers & Groups	56.22	60.22	4.00	7.1%
Earthquake Engineering Research Centers	5.99	5.99	0.00	0.0%
Industry/University Cooperative Research Centers	5.29	5.18	-0.11	-2.1%
Nanoscale Science & Engineering Centers[1]	6.10	6.10	0.00	0.0%
State/Industry/University Cooperative Research Centers	0.60	0.00	-0.60	-100.0%
Science and Technology Centers[2]	4.00	8.00	4.00	100.0%
Total, Centers Support	$78.20	$85.49	$7.29	9.3%

[1]Funding for Nanoscale Science and Engineering Centers was previously reported in Engineering Research Centers & Groups.
[2]The increase for STC funding reflects new awards made in September 2002. These funds are shown in Integrative Activities in the FY 2003 Request, and are transferred to the appropriate managing R&RA Activity in the FY 2004 Request.

The FY 2004 ENG Budget Request for Centers involves:

- $60.22 million to support a steady state of 16-17 university-based Engineering Research Centers (ERCs). NSF provides about 30 percent of the total support to the centers, with the remaining funding support coming from industry, other Federal agencies, universities, and the states.

- $5.99 million to support three earthquake engineering research centers at approximately $2.0 million each per year to provide knowledge to mitigate damage to the built environment; provide outreach to the private, educational, and government sectors; and educate professionals for cross-disciplinary careers.

- \$5.18 million for Industry/University Cooperative Research Centers (I/UCRC). The I/UCRC program as a whole will support about 48 I/UCRCs. These highly leveraged centers form close-knit partnerships with their industrial members.

- FY 2003 marks the final year of funding for the three State Industry/University Cooperative Research Centers (S/I/UCRCs). No funding is requested in FY 2004.

- \$6.10 million to support three Nanoscale Science and Engineering Centers (NSEC). Research at these centers aims to advance the development of the ultra-small technology that will transform electronics, materials, medicine, environment, and many other fields. These centers have strong partnerships with industry, national laboratories and international centers of excellence.

- \$8.0 million to support two Science and Technology Centers (STCs). The FY 2004 increase of \$4.0 million over the FY 2003 Request of \$4.0 million represents a transfer into the Chemical and Transport Systems (CTS) Subactivity of annual funding for a new STC on new materials for water purification. ENG also funds an existing STC – within the Electrical and Communications Systems Subactivity – focused on nanobiotechnology.

Priority Areas

In FY 2004, ENG will support research and education efforts related to broad, Foundation-wide priority areas in Biocomplexity in the Environment, Information Technology Research, Nanoscale Science and Engineering, Mathematical Sciences, and Human and Social Dynamics.

ENG Investments in Priority Areas
(Dollars in Millions)

	FY 2002	FY 2003	FY 2004	Change	
	Actual	Request	Request	Amount	Percent
Biocomplexity in the Environment	3.60	6.00	6.00	0.00	0.0%
Information Technology Research	10.23	11.17	11.17	0.00	0.0%
Nanoscale Science and Engineering	86.30	94.35	106.85	12.50	13.2%
Mathematical Sciences	N/A	0.91	2.91	2.00	219.8%
Human and Social Dynamics	N/A	N/A	2.00	2.00	N/A

Biocomplexity in the Environment: In FY 2004, ENG will provide a total of \$6.0 million, equal to FY 2003, for the Biocomplexity in the Environment priority area. Half of this amount will support the central competition, and the other half will support the Materials Use: Science, Engineering, and Society (MUSES) Program.

Information Technology Research: In FY 2004, ENG will provide \$11.17 million, equal to FY 2003, for ITR. Areas for special emphasis within ITR include:

- Computational simulation and modeling of complex materials, structures and processes; and
- Research focused on developing high end computing tools to accelerate the design of next generation IT manufacturing techniques in areas such as photonic crystals, optical and electronic switching devices, sensors and detectors.

ENG also supports a broad range of other IT-related activities, such as quantum computing and molecular logic, domain-specific software, IT for the service sector, modeling and simulation, and real-time sensing and control.

Nanoscale Science and Engineering: In FY 2004, ENG will provide $106.85 million for Nanoscale Science and Engineering activities, an increase of $12.50 million over the FY 2003 Request of $94.35 million. ENG will support comprehensive research on nanotechnology for functional nanostructures, processing and fabrication of nanostructured materials, new devices and architectures, tools for investigation at nanoscale, and technologies with applications ranging from biology to environmental sensing. Requested funds expand research in the following areas:

- Manufacturing processes at the nanoscale;
- Bio-chemical-radiological-explosive detection and protection;
- Infrastructure; and
- Education and societal implications.

Mathematical Sciences: ENG will provide $2.91 million in FY 2004, an increase of $2.0 million over FY 2003, to support synergistic collaborations between mathematicians and engineering researchers to strengthen engineering modeling and experimental work and enhance undergraduate and graduate engineering education.

Human and Social Dynamics: ENG will provide $2.0 million for the Human and Social Dynamics priority area in FY 2004. Of this, $1.0 million will be invested in Complex Systems to support studies on the security and reliability of critical infrastructure networks, and $1.0 million in Enhancing Human Performance to focus on integration of nanotechnology, biotechnology, information technology and cognitive science for improving human physical and mental abilities, as well as a new generation of tools and processes to achieve this goal.

Tools (+$6.45 million, for a total of $10.75 million)

In FY 2004, ENG support for the enhancement of infrastructure to conduct engineering research is funded at $10.75 million, an increase of $6.45 million over the FY 2003 Request of $4.30 million.

Of this funding, $8.80 million will be provided to the National Nanotechnology Infrastructure Network (NNIN), an integrated national network of user facilities that will support the future infrastructure needs for research and education in the burgeoning nanoscale science and engineering field. The facilities comprising this network will be diverse in capabilities, research areas, and geographic locations, and the network will have the flexibility to grow or reconfigure as needs arise. The NNIN will broadly support nanotechnology activities outlined in the National Nanotechnology Initiative investment strategy. It will provide users across the nation access to leading-edge fabrication and characterization tools and instruments in support of nanoscale science and engineering research, develop and maintain advanced research infrastructure, contribute to the education and training of a new workforce skilled in nanotechnology and the latest laboratory techniques, conduct outreach to the science and engineering communities, and explore the social and ethical implications of nanotechnology. The NNIN will supersede the National Nanofabrication Users Network (NNUN), initiated in 1994 and coming to the completion of NSF support at the end of 2003.

The remaining $1.95 million in ENG Tools funding will initiate support of mid-size infrastructure awards with a total cost of less than $200,000 per award, funded by individual or multiple programs within the Chemical & Transport Systems (CTS) and the Civil and Mechanical Systems (CMS) Subactivities.

Within the Major Research Equipment and Facilities Construction (MREFC) account, \$8.0 million is requested to continue the Network for Earthquake Engineering Simulation (NEES), a project to construct, upgrade, network and integrate a complete system of test facilities in earthquake engineering. For additional information on this project, see the MREFC Chapter.

Administration and Management

Administration and Management provides for administrative activities necessary to enable NSF to achieve its strategic goals. Requested funding for FY 2004 is \$6.90 million, an increase of \$430,000 over FY 2003. This includes the cost of Intergovernmental Personnel Act appointments and contractors performing administrative functions.

QUALITY

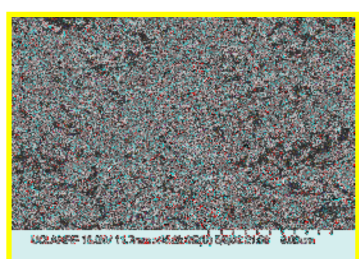
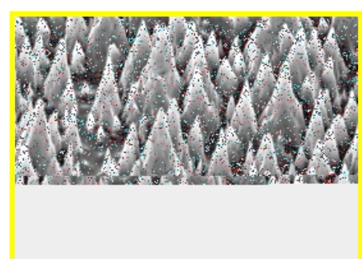
ENG maximizes the quality of its research and development portfolio through the use of a competitive, merit-based review process. In FY 2002, 96 percent of basic and applied research funds were allocated to projects that undergo merit review.

ENG Committees of Visitors, composed of expert external peer evaluators, review each program every three years. These experts assess the integrity and efficiency of the processes for proposal review and provide a retrospective assessment of the quality of results of NSF's investments.

The Directorate also receives advice from the Advisory Committee for Engineering (AC/ENG) on a breadth of issues: the mission, programs, and goals to best serve the scientific community; methods of improving the quality of engineering graduate and undergraduate education; and priority research investments, to name a few. AC/ENG meets twice yearly. Its membership represents a cross section of engineering's diverse workforce and geographical orientation, as well as its diverse sub-disciplines and institutions.

PERFORMANCE

- Chang-Jin Kim of UCLA created a nearly frictionless surface using "nanoturf" and "nanopebble" technology. These surfaces will cut costs in devices with moving parts, lubricants, or liquid components by saving energy usually lost to friction. http://cjmems.seas.ucla.edu/

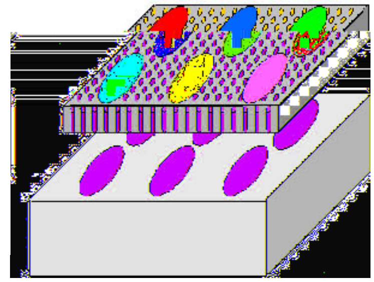



Scanning electron micrographs of a lotus leaf surface (left) and the first-generation, nano-engineered surface (right). Such low-friction surfaces are needed for the development of practical, energy-efficient microfluidic devices such as labs-on-a-chip.

- Alok Chaturvedi of Purdue University developed software to simulate certain business operations. The program has now demonstrated usefulness for homeland security. In cooperation with state emergency officials in Indiana, Chaturvedi's research team demonstrated the effects of an outbreak of small pox in an Indiana city. http://www.mgmt.purdue.edu/MIS/alok.htm

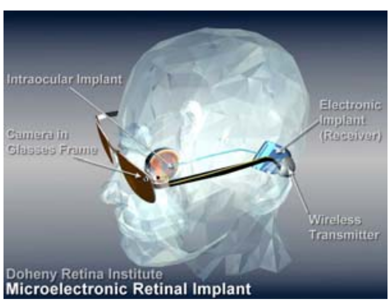
- Charles Martin of the University of Florida combined nanometer-scale tubes, wires and enzymes directly onto a chip. The result is an array of sensors that may be able to detect a variety of biological warfare agents. http://www.chem.ufl.edu/~crmartin/contact.html

Schematic of the multifunctional biosensor on a single chip. Such bio/nano assemblies of immobilized enzymes on top and nanostructures transmitting signals to a computer chip below have demonstrated their potential to act as highly sensitive and selective biological detectors.

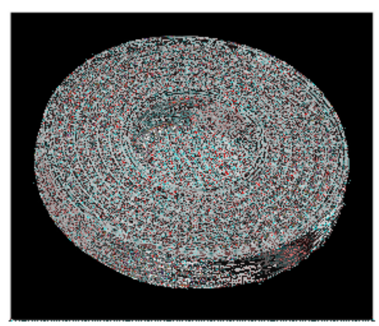


- Matthew Tirrell and his team at the University of California, Santa Barbara and at the University of Delaware, collaborating on the project *Creating Functional Nano-Environments by Controlled Self Assembly,* are advancing the science for the self-assembly processing of nano-scale materials and devices in this NIRT project. Molecular structures, such as the triple helix shown, have been designed to arrange themselves spontaneously into bilayer walls of structures, such as tubules, vesicles, and micelles. These structures, which mimic effects found in nature, can be synthesized to produce useful chemical and mechanical interactions because the functional groups appearing on the outer surfaces of the structures control external interactions. Thus, this NIRT group is producing advanced biomimetic materials as well as components for micro-machines. Potential biomedical implications include controlled release of drugs with more specificity, embedded biological signaling, and many other therapeutic approaches.

- Mark S. Humayun of the Doheny Eye Institute, Keck School of Medicine, University of Southern California, has been testing an implantable chip that may restore vision in patients rendered blind by disease. NSF was the first federal agency to support this "high risk" project, beginning with an SGER award in 1996. In 2002, with additional funding from the National Eye Institute (BRP Award) and DARPA, the efforts resulted in the successful implantation of a test version of the wireless, artificial retina. http://www.usc.edu/hsc/doheny/



- J.A. Lewis of the University of Illinois has been working on a project entitled: Directed Colloidal Assembly of Mesoscale Periodic Composites. The goal of this research was to develop fundamental process knowledge required to reliably manufacture mesoscale periodic composites. The PI has developed a direct assembly approach that relies on robotic deposition of concentrated colloidal gel-based inks. This technique allows for the facile fabrication of complex 3-D structures, such as the ferroelectric lattice shown. These structures, when infiltrated with a polymeric resin, serve as piezoelectric composites. This research is likely to lead to new deposition schemes and colloidal inks that will enable the next generation of functional ceramics.



Other Performance Indicators

The tables below show the growth in the number of people benefiting from ENG's funding, and trends in growth of award size, duration and number.

Number of People Supported in ENG Activities

	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate
Senior Researchers	4,402	4,025	4,427
Other Professionals	1,160	925	1,218
Postdoctorates	491	550	565
Graduate Students	4,315	4,425	4,485
Undergraduate Students	2,952	2,500	3,150
K-12 Students		100	
K-12 Teachers	250	115	265
Total Number of People	13,570	12,640	14,110

ENG Funding Profile

	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate
Number of Requests for Funding	8,389	7,800	8,580
Dollars Requested (in millions)	$3,488	$3,500	$3,850
Total Number of Awards	3,204	3,100	3,550
Statistics for Competitive Awards:			
Number	1,726	1,525	1,765
Funding Rate	25%	25%	24%
Statistics for Research Grants:			
Number of Research Grants	1,021	850	1,015
Median Annualized Award Size	$83,965	$83,000	$85,000
Average Annualized Award Size	$102,075	$105,000	$107,000
Average Award Duration, in years	2.7	3.0	3.0

BIOENGINEERING AND ENVIRONMENTAL SYSTEMS $47,910,000

The FY 2004 Budget Request for the Bioengineering & Environmental Systems Subactivity is $47.91 million, an increase of $4.04 million, or 9.2 percent, above the FY 2003 Request of $43.87 million.

Bioengineering and Environmental Systems Funding
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Bioengineering and Environmental Systems	41.32	43.87	47.91	4.04	9.2%
Total, BES	$41.32	$43.87	$47.91	$4.04	9.2%

The Bioengineering and Environmental Systems (BES) Division supports research and education in the rapidly evolving fields of bioengineering and environmental engineering. BES has two principal objectives: enabling and facilitating the deployment of new technologies in these fields for society's use in the medical, biotechnology, and environmental arenas; and advancing bioengineering and environmental engineering education, particularly through the development of innovative programs by new faculty.

BES focuses these objectives through three program clusters:

- Biochemical Engineering/Biotechnology (BEB);
- Biomedical Engineering and Research to Aid Persons with Disabilities (BME/RAPD); and
- Environmental Engineering and Technology (EET).

Current BES high-emphasis research and education areas include post-genomic engineering, tissue engineering, biophotonics, nano-biosystems, and engineering environmental assessment and problem-solving options development. These high-emphasis research areas are built on a continuing base that includes biosensors, biomaterials, biomechanics, controlled release, bioimaging, medical devices and instrumentation, artificial organs, therapeutic agent bioprocessing, industrial bioproducts bioprocessing, bioremediation, ecological engineering, water and waste treatment, biomining, and food engineering.

Within the U.S. and international research communities, BES support has played a key role in catalyzing and developing highly promising new cutting edge bioengineering and environmental engineering research fields, such as tissue engineering and metabolic engineering. BES has also led the formation of interagency coordination and collaboration in these fields, including the Multi-Agency Tissue Engineering Science (MATES) working group (http://tissueengineering.gov), and the Metabolic Engineering Working Group (http://www.epa.gov/opptintr/metabolic/index.htm). The NSF/DARPA/NIH Biophotonics Partnership (http://www.nsf.gov/pubs/2003/nsf03005/nsf03005.htm) is another joint effort initiated by BES.

Scientific drivers and opportunity areas for BES include:

Post-Genomic Engineering: As a consequence of the genomics revolution that is underway in the biological sciences, engineers now have an entirely new, and explosively growing database on which to build new engineering developments and innovations that will provide important advances in the medical, biotechnology, and environmental arenas.

Tissue Engineering (TE): TE for ENG includes gene and drug delivery. A common thread throughout TE areas is the unique biocompatible (and often biologically based) polymers that act as the matrix for cells to develop into three-dimensional tissues, and shield drugs and genes until they are delivered to the proper organs or specific target cells without causing side effects on healthy cells. The search for these key materials, and understanding the nature of their function, are key BES goals. A renewed research thrust in tissue culture engineering will be an important contributing factor in the rapid development of practical ex vivo cell culture techniques and stem cell culture technology for medical applications.

Biophotonics: Biophotonics seeks to exploit the power of photonics to advance bioengineering. Low cost diagnostics will require novel integration of photonics, molecular biology and material science. Complex biophotonic sensors capable of detecting and discriminating among large classes of biomolecules are important not only to biology and medicine but also to environmental sensing.

Nano-Biosystems: Many nanoscale systems and phenomena are based on biological systems. BES plays a key role in funding exploratory research on biosystems at nanoscale. Chips and sensors, combined with microfluidics, are intimately integrated with the nanobiotechnology area, since many of these systems are used on chips for medical, environmental, and other sensing applications.

Research to provide access to affordable municipal sanitation services to underserved communities worldwide, such as Trinidad & Tobago (as shown). Support development of theory in risk assessment and performance evaluation and disseminate best practices to assure the sustainable capacity for safe, reliable, and affordable municipal systems for under-served communities worldwide.

Engineering Environmental Assessment and Problem-Solving Options Development: Rapidly expanding cyberinfrastructure capabilities are enabling the potential for developing radically new approaches to engineering assessment of environmental problems. Building on such new assessment approaches, it will be possible to generate problem-solving options for implementation alternatives that are based on strong participation not only by engineers, but the full complement of stakeholders, including biological and physical scientists, social scientists, community members, and government officials at the local, state, federal, and in some cases, international levels. On the technical side, development of new sensors, databanks, communication networks, analytical models, and even conceptual frameworks is required.

Increases in the BES budget request, combined with reallocation of base funds, are summarized below:

- Sensor research totals \$5.0 million, an increase of \$1.0 million over the FY 2003 level of \$4.0 million, with particular emphasis on homeland security;
- Support for the Nanoscale Science and Engineering priority area and National Nanotechnology Infrastructure Network (NNIN) totals \$9.10 million, increasing by \$2.40 million over the FY 2003 level of \$6.70 million. Emphasis will be on detection of and protection from biological and chemical agents critical to homeland security;
- Collaborative Large-scale Engineering Assessment Network for Environmental Research (CLEANER) planning, with initial support of \$200,000, will focus on potential avoidance and mitigation of anthropogenically induced environmental problems; and
- Support for the Mathematical Sciences priority area increases by \$400,000 to a total of \$630,000, focusing on modeling research of multi-scale biosystems.

CHEMICAL AND TRANSPORT SYSTEMS $66,200,000

The FY 2004 Budget Request for the Chemical and Transport Systems Subactivity is $66.20 million, an increase of $7.26 million, or 12.3 percent, above the FY 2003 Request of $58.94 million.

Chemical and Transport Systems Funding
(Dollars in Millions)

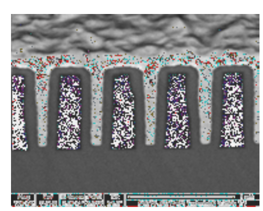
	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Chemical and Transport Systems	57.21	58.94	66.20	7.26	12.3%
Total, CTS	$57.21	$58.94	$66.20	$7.26	12.3%

The Chemical and Transport Systems (CTS) Division supports research and education in areas that involve the transformation and/or transport of matter and energy by chemical, thermal, or mechanical means. CTS research and education investments contribute significantly to the knowledge base and to the development of the workforce for major components of the U.S. economy. These include the process industries (chemicals, pharmaceuticals, forest products, materials, petroleum, food, and textiles), utilities, microelectronic component manufacturers, and producers of consumer products of all kinds. CTS-funded research in areas such as fluid flow, combustion, heat transfer, catalysis, fuel cells, sensors, and membranes contribute to advances that are important for the environment, energy, transportation, information technologies, and other areas that impact our daily lives.

CTS will continue to support research in traditionally important areas such as chemical reaction engineering, interfacial phenomena and separations, fluid dynamics and particle processes, and combustion and thermal processing. These areas are essential to ensure continued growth of the fundamental engineering knowledge base, which is the foundation for advances in a wide range of technologies. In addition to sustaining the vitality of these core research areas, the Division actively supports the following key areas of particular NSF emphasis.

In addition to a redistribution of funds within the four core research areas to support high-potential proposals, requested FY 2004 funding will be distributed among:

Nanoscale Science and Engineering: NSE support totals $21.88 million, an increase of $1.50 million over the FY 2003 level of $20.38 million. Funding will allow expansion of research in the synthesis and processing of matter at the nanometer-length scale, producing materials with novel physical, optical, chemical, and biological properties. Understanding structural morphologies and properties from the molecular scale up to bulk scale via new experimental tools and simulation capabilities will permit major advances in many areas central to CTS. The fields of catalysis, microfluidics, electronic materials, membranes and adsorption media for selective chemical and biochemical separations, fuel cells, plasma processing, sensors, and environmental technologies will be significantly impacted. The synthesis of particles, films, and 3D structures with functional nanoscale features by methods involving nucleation, molecular and particle self-assembly, controlled thermal and molecular transport, as well as chemical reactions, is a priority area for CTS. Furthermore, in order to accelerate the benefits from increased investments in fundamental research on these topics, CTS will allocate funds for infrastructure



Nanoscale copper interconnects formed by chemical-fluid deposition from solutions in supercritical carbon dioxide to achieve very compact printed circuits.

investment to address issues that deal with scale-up of the synthesis processes, development of new instrumentation, and refined methods for characterization.

Information Technology Research (ITR): ITR funding totals $2.56 million, an increase of $250,000 over the FY 2003 level of $2.31 million. Continuing support will enhance computational tools (algorithms, data mining and visualization) and infrastructure, coupled with advances in basic science. New investments will permit more robust and precise modeling and simulation of complex materials processing and manufacturing techniques. Such improved simulations are enabled by a significant increase in the breadth and depth of the CTS research portfolio in ITR-related areas. The target applications include the design and utilization of next-generation chemical and plasma vapor-deposition techniques for microelectronics manufacturing; analysis of growth mechanisms of next-generation photonic crystals leading to better control of microstructure formation and segregation of dopants and impurities; the manufacturing of optical fibers needed in wide-band networking applications with optimum product quality; and the processing of high-performance polymers (plastics) that involves chemical reactions and multi-scale flow phenomena of non-Newtonian fluids. In addition to reducing the time required to introduce new products and processes, advances in process modeling result in more efficient and environmentally sound processing and manufacturing systems.

Environmental Technologies: Support for environmentally relevant technologies totals $2.24 million, increasing by $1.50 million over the FY 2003 level of $740,000, primarily in the areas of MUSES, CLEANER, and projects aimed at pollution prevention and containment of greenhouse gases. Research leading to products and processes that avoid negative environmental impact will continue to be a CTS priority. Examples of CTS interest areas are production processes that minimize undesirable side products, new biocatalysis methods that permit the use of renewable feedstocks, and separation and purification processes that use less energy, as well as environmentally sound solvents, cleaner combustion processes, and reliable process-design methods that reduce or eliminate environmental impact. Novel techniques for control of greenhouse gases will receive increased emphasis. These topics are strongly embedded in the core of CTS programs. By participating in the MUSES component of Biocomplexity in the Environment, which involves development of new materials and processes, CTS will provide enhanced funding to these environmental technology areas.

Sensor Technologies: Funding for sensor technologies totals $5.0 million, an increase of $1.0 million over the FY 2003 Request. As part of its programs related to chemical-process control as well as interfacial phenomena and catalysis, CTS has invested in development of various types of sensors for monitoring levels of specific chemicals and biochemical materials, temperature, pressure, and flow conditions. With the increased needs for improved sensors arising from security requirements, CTS will expand its investments in this area. Developments in nanotechnology have opened many new opportunities for the creation of more selective and sensitive sensors, including detectors for target biological materials that will be extremely valuable for security applications as well as in the safe and efficient operation of industrial processes.

A major increase of $4.0 million in FY 2004 represents the transfer into ENG of the annual funding for a new Science and Technology Center (STC) on New Materials for Water Purification, a topic that has direct relevance to several of the CTS program areas. The award was made in September 2002. These funds are shown in Integrative Activities in the FY 2003 Request and are transferred to the appropriate managing R&RA Activity in the FY 2004 Request.

CTS will also participate in the Mathematical Sciences priority area at a level of $630,000. Research will focus on quantitative modeling of multi-scale molecular and processing systems.

CIVIL AND MECHANICAL SYSTEMS $64,360,000

The FY 2004 Budget Request for the Civil and Mechanical Systems Subactivity is $64.36 million, an increase of $6.61 million, or 11.4 percent, above the FY 2003 Request of $57.75 million.

Civil and Mechanical Systems Funding
(Millions of Dollars)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Civil and Mechanical Systems	56.09	57.75	64.36	6.61	11.4%
Total, CMS	$ 56.09	$ 57.75	$ 64.36	$ 6.61	11.4%

The Civil and Mechanical Systems (CMS) Subactivity has two major goals: investing in research and workforce development that provides the fundamental and quantitative underpinning for the engineering profession in application to civil and mechanical systems and the built environment; and supporting the rapid development and deployment of new knowledge and technology to decrease vulnerability to natural and technological hazards.

CMS research increases the knowledge base and intellectual growth in the disciplines of construction, geotechnology, structures, dynamics, sensors and control, engineering mechanics and materials, as well as the application of IT to enhance reliability and performance of critical infrastructure systems. At the heart of the CMS mission is the improved understanding and design of materials and structures across all physical scales, from nano-level to mega-system integration-level. Research activities funded by CMS include a strong focus on integrated experiments and modeling to enhance the fundamental understanding of complex structures and systems, including nonlinear dynamic behaviors and processes. Linking physical model experimentation and computational model simulation demands sensor technologies to measure and observe fundamental processes. New sensors are also needed for “smart” civil and mechanical systems, and for applying the information technology required to sustain the nation’s infrastructure. Real-time data acquisition and visualization will enhance critical infrastructure performance analysis and prediction.

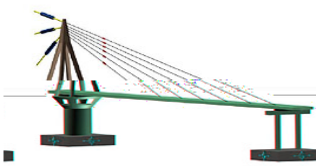
CMS encourages cross-disciplinary research and education investments to produce innovative and integrated engineered services. Recent events have underscored the nation’s increasingly interdependent, complex and vulnerable human, social, natural and physical systems. The U.S. needs better databases and tools for prediction, risk, decisions and uncertainty, and CMS pursues cross-directorate and interagency partnerships that promise the requisite knowledge and advanced tools for vulnerability assessment.

In support of NSF's participation in the National Earthquake Hazards Reduction Program (NEHRP), CMS invests in research on the mitigation of impacts from natural and technological hazards on constructed, natural, and human environments. CMS funds rapid-response reconnaissance investigations following extreme events in the U.S. and abroad. Interdisciplinary and international studies involving hazard assessment, preparedness and response, societal and economic impacts, decision sciences are supported in coordination with NSF’s Geosciences and the Social, Behavioral, and Economic Sciences Activities.

The $6.61 million increase in the CMS budget will be combined with $690,000 from core funding reallocations to support expanded research in the following:

Sensor Technologies: Increases by $1.30 million over the FY 2003 level of $4.0 million to enhance research on sensor technology and applications. CMS investments include research on miniaturization, new device sensitivities and enhanced reliability, improved active sensors and robotic devices for rapid detection and search and rescue application, and intelligent deployment of sensor arrays. CMS also invests in complex and distributed systems of sensors, and systems integration for seamless and real-time use of information, including study of changing attributes of materials, understanding of basic mechanics and chemistry of processes, and life-cycle performance under conditions of exposure, operation and aging. Compelling applications include real-time assessment of damage and repair to reduce recovery periods after disasters; rapid real-time assessment of critical system vulnerabilities; and removal of personnel from hazardous operations and maintenance roles.

Nanoscale Science and Engineering: Increases by $1.20 million over the FY 2003 level of $5.27 million to support integrated design and simulation of the behavior of nanomaterials and nanostructures. This research leads to development of new technologies in civil and mechanical systems, and for understanding long-term performance and durability of new materials in new applications and extreme environments. Computational and experimental advances in model-based simulation, when integrated with physical testing and system simulation software in a virtual test environment, will reduce development time and cost. CMS will also invest $200,000 of the total increase into the National Nanotechnology Infrastructure Network (NNIN).



The State University of New York at Buffalo is building a new NEES facility at which complex large-scale experiments are combined with real-time computer simulations for the most complete picture of how earthquakes affect large buildings and bridges.

NEES Grand Challenge Research: Initial support of $4.0 million will support research in multi-hazard engineering involving experimental and theoretical simulations at one or more of the Network for Earthquake Engineering Simulation (NEES) facilities that will be brought on line during FY 2004. This research will focus on new technologies and design tools to identify and communicate infrastructure system vulnerabilities under risk of extreme events. Within the Major Research Equipment and Facilities Construction (MREFC) Account, $8.0 million has been requested to complete NEES, a project to construct, upgrade, and network an innovative system of test facilities in earthquake engineering, as well as promote international collaborations for earthquake engineering research. Oversight of this project is provided through CMS.

Complex System Vulnerabilities and Interdependencies: Initial support of $890,000 will enhance systems research on the nation's complex and interdependent physical infrastructure, leading to scalable systems of high reliability, decreased vulnerability, and decreased life-cycle cost and environmental impact. With the Human and Social Dynamics priority area, CMS will support new paradigms and IT-tools for information interpretation and decision-making, leading to systems models that efficiently simulate complex phenomena and that improve performance prediction of complex infrastructure service.

Engineering and the Environment: Initial support of $200,000 introduces the CMS research community to the CLEANER program, concerned with anthropomorphically stressed environments.

Mathematical Sciences: Initial support of $400,000 involves interdisciplinary research leading to knowledge and development of tools for the analysis, design and control of complex and nonlinear materials, processes and systems.

DESIGN, MANUFACTURE, AND INDUSTRIAL INNOVATION $163,060,000

The FY 2004 Budget Request for the Design, Manufacture, and Industrial Innovation Subactivity is $163.06 million, an increase of $21.83 million, or 15.5 percent, above the FY 2003 Request of $141.23 million.

Design, Manufacture, and Industrial Innovation Funding
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Design, Manufacture and Industrial Innovation	55.88	57.58	61.91	4.33	7.5%
Small Business-Industrial Innovation	79.11	83.65	101.15	17.50	20.9%
Total, DMII	$134.99	$141.23	$163.06	$21.83	15.5%

The Design, Manufacture, and Industrial Innovation (DMII) Subactivity supports research and education activities that spur innovation and enhanced productivity in a broad range of U.S. industries. DMII also supports the development of a well-educated and diverse human resource base, vital to U.S. global competitiveness. DMII identifies the underlying design and manufacturing theories for the innovation of new products, processes and systems in a wide variety of enterprises. The DMII core is comprised of discoveries and major advances in engineering design, operations research, manufacturing enterprise systems, service enterprise engineering, nanomanufacturing, materials processing and manufacturing machines and equipment.

Nanomanufacturing, a key component of the Nanoscale Science and Engineering priority area, focuses on converting discoveries from nanoscience into new products for the benefit of society. While nanoscience is uncovering novel physical, mechanical, electrical, magnetic, chemical and biological properties, many broad manufacturing issues need to be addressed to build products, devices and components that take advantage of these unique properties. Simultaneously, an entirely new manufacturing workforce needs to be educated and trained in nanotechnology to pursue its exciting opportunities.

The Materials Use: Science, Engineering, and Society (MUSES) Program is an area within the Biocomplexity in the Environment (BE) priority area, supporting the design and synthesis of new materials with environmentally benign impact on biocomplex systems. The Collaborative Large-scale Engineering Assessment Network for Environmental Research (CLEANER) also aligns with DMII's focus on environmentally benign design and manufacture. Opportunities exist to integrate life cycle product design methodologies with manufacturing enterprise systems to realize benefits of reduced energy consumption without adverse environmental impact.

DMII support for service processes as engineered systems contributes to enhanced productivity. Optimizing container ship design reduces labor costs and has the potential to increase the rate of return for this sector by 25 %.

Information Technology Research (ITR) applied to production systems has reaped significant economic benefits in manufacturing, such as applications of Supply Chain Management. Engineering research has an opportunity to make similarly significant contributions to the fast growing service sector such as health care delivery systems.

More scientists and engineers are now employed in high technology small businesses than in large businesses. The Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs support small businesses for research in advanced materials and manufacturing, biotechnology, electronics and information technology, aiming to convert scientific discoveries to innovations for society via job and wealth creation.

The orbiTouch is the first 128-character keyboard with an integrated mouse that uses the hands and arms, instead of the fingers, to type. Enabled by a series of SBIR awards, the research results provide a solution for people unable to use traditional keyboards due to disability or injury.

DMII promotes partnerships between industry and university through the Grant Opportunities for Academic Liaison with Industry (GOALI) program, as well as the STTR program. DMII, in collaboration with the Social, Behavioral and Economics (SBE) Activity, will continue to support research in understanding of the innovation process through the Innovation and Organizational Change (IOC) program.

Retrospective assessments have found that DMII grants have resulted in fundamental contributions and, in some cases, led either to the creation of new research fields or the production of seminal knowledge in design and manufacturing. These studies have also documented the eventual commercialization and economic impact of many DMII investments. Results include breakthrough advances in solid free-form fabrication technology, pioneering work in nanotechnology for mass storage devices, and the establishment of supply chain management as a bonafide research field.

FY 2004 plans, with some reallocation of base funds, include new funds for:

- The Nanoscale Science and Engineering priority area, increasing by $2.40 million over the FY 2003 level of $10.72 million, for nanomanufacturing, covering nano-features enhancement in micro/meso products and devices, nano-assembly and connectivity, nano-process control and nano-system integration; initial support of $900,000 for the National Nanotechnology Infrastructure Network will ensure a full array of interconnected resources to address synthesis and scale-up of nanosized materials and structures into functional devices, architectures and integrated systems across dimensional scales, leading eventually to useful products and services;
- The Human and Social Dynamics priority area; initial support of $1.00 million with a focus on integration of nanotechnology, biotechnology, information technology and cognitive science for improving human physical and mental abilities, as well as a new generation of tools and processes to achieve this goal;
- The Mathematical Sciences priority area is funded at $630,000 in FY 2004, to support synergistic collaborations between mathematicians and engineering researchers to strengthen engineering modeling and experimental work and enhance undergraduate and graduate engineering education;
- The Sensors and Sensor Networks for Information, Decision and Action research totals $5.0 million, an increase of $1.0 million over the FY 2003 level to support new discoveries and methods to design and manufacture products that are self-protecting and correcting;
- The Collaborative Large-scale Engineering Assessment Network for Environmental Research, with initial funding of $200,000, will support one proposal on the industrial ecology impact on watersheds;
- The Small Business Innovation Research (SBIR) Program is funded at $90.93 million, an increase of $11.95 million over the FY 2003 Request of $78.98 million; and the Small Business Technology Transfer (STTR) Program is funded at $10.22 million, an increase of $5.55 million over the FY 2003 Request of 4.67 million. Recent congressional action raised the mandated agency spending target from 0.15 percent to 0.30 percent of an agency's extramural research budget in FY 2004.

ELECTRICAL AND COMMUNICATIONS SYSTEMS $70,760,000

The FY 2004 Budget Request for the Electrical and Communications Systems Subactivity is $70.76 million, an increase of $4.06 million, or 6.1 percent, over the FY 2003 Request of $66.70 million.

Electrical and Communications Systems Funding
(Millions of Dollars)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Electrical and Communications Systems	64.75	66.70	70.76	4.06	6.1%
Total, ECS	$64.75	$66.70	$70.76	$4.06	6.1%

The Electrical and Communications Systems Subactivity (ECS) addresses the fundamental research issues underlying both the device technologies and the engineering systems principles of complex systems and applications. It also seeks to ensure the education of a diverse workforce prepared to support the continued rapid development of these technologies as drivers for the global economy. The research and education supported by ECS are key to enabling the synergy between micro/nanotechnology, biotechnology, and information technology by supporting programs that address the technological challenges facing the economy of the 21st Century.

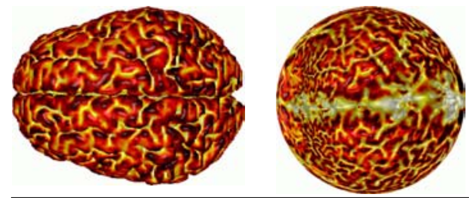
The study of microelectronic, nanoelectronic, micromagnetic, photonic, and micro-electromechanical devices - and their integration into circuits and microsystems - is rapidly expanding in technical scope and applications. New generations of integrated microsystems incorporate microchip technology with mechanical, biological, chemical and optical sensors, actuators and signal processing devices to achieve new functionality. Modern computing and communications systems are based on these devices. Due to trends toward smaller and faster devices and to address the challenges posed by the physical limitations to Complimentary Metal Oxide Semiconductor (CMOS) technologies, ECS is funding programs in new molecular based nanoscale electronic devices and storage technologies and understanding of the quantum principles which dominate their behavior. These programs will play a key role in addressing the challenges identified in the Semiconductor Technology Roadmap.

ECS has provided leadership in initiating new research directions for intelligent sensing systems with wireless, reconfigurable, agile networks of sensor arrays for interpretation, decision and action. These systems, which learn new functions and adapt to changing environments, are of special relevance to the monitoring of the nation's critical infrastructure and security.

The integration of device research and systems principles has broad applications in telecommunications, power and energy, environment, transportation, medicine, agriculture, manufacturing, and other areas.

ECS also provides support for specialized resources and infrastructure that facilitate research and educational activities, such as the National Nanotechnology Infrastructure Network (NNIN), the Science and Technology Center on Nanobiotechnology at Cornell University and the Major Research Instrumentation program. ECS also actively participates in the development and management of cross-disciplinary programs, industry-related programs and graduate traineeship programs and research centers. ECS provides significant support to the Nanoscale Science and Engineering and Information Technology Research priority areas.

ECS holds a number of grantees workshops to assess the results of research and education grants it funds and to encourage interaction among the Principal Investigators. In addition, ECS holds a number of workshops to evaluate and assess the technologies of current and future importance.



Flat rendering of brain images for improved visualization of the cortical surface in magnetic resonance imaging.

Recent achievements of ECS grantees include:

- Ultrafast Photoconduction Techniques have enabled electronic transport in Carbon Nanotubes;
- Construction of Nanoscale Molecular Sorters powered by F1-Atpase Biomolecular Motors;
- High resolution Bio-medical imaging using Ultra-short Pulsed Lasers;
- Development of extreme UV lasers;
- Advanced computational models for high-density photonic integrated circuits;
- "Chip Camps" that open young minds to the wonders of nanotechnology for over 400 middle and high school students using the National Nanofabrication Users Network (NNUN);
- NNUN supported the experimental education of over 1100 graduate and undergraduate students and over 300 PhD awards depended on the use of NNUN resources;
- Summer programs have motivated over 200 African American and Hispanic high school students to pursue electrical engineering degrees at some of the top schools in the nation;
- The Photonics Technology Access Program (PTAP) is enabling researchers to have access to leading-edge prototype photonics devices and fabrication facilities in industry; and
- Development of a highly sensitive acoustic wave biosensor array for identification and quantification of bacterial pathogens.

Some of the special research foci funded by ECS are:

- Enabling Technologies for Space Solar Power (SSP) co-funded by NASA and EPRI
- Electric Power Network Security and Efficiency (EPNES) co-funded by ONR
- Spin Electronics co-funded by ONR
- Integrated Sensing for Decision and Action.

Reallocation within core areas and increases in the FY 2004 request encompass:

- Funding of $25.61 million, an additional $1.50 million over the FY 2003 level of $24.11 million, will support Nanoscale Science and Engineering research on fundamental principles of electronic and photonic devices, manipulation of nanostructures, and modeling and simulation of new device architectures and systems. Nanodevices and nanosystems will create opportunities for new electronics, biotechnology, bioengineering, and information and communications systems. Increased investments are planned in support of the new National Nanotechnology Infrastructure Network (NNIN) for shared instrumentation facilities for nanoscale research, characterization and nanomanufacturing;
- Research on sensors totals $5.0 million, an increase of $1.0 million over the FY 2003 level;
- A research emphasis in the area of Organic Electronics and Photonics to address the challenges in flexible, inexpensive, mass manufacturable electronics and solid-state lighting; and
- A small grants program to develop 'out of the box' research ideas far beyond CMOS technologies.

ENGINEERING EDUCATION AND CENTERS $124,280,000

The FY 2004 Budget Request for the Engineering Education and Centers Subactivity is $124.28 million, an increase of $4.79 million, or 4.0 percent, over the FY 2003 Request of $119.49 million.

Engineering Education and Centers Funding
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Engineering Education and Centers	$116.67	$119.49	$124.28	$4.79	4.0%
Total, EEC	$116.67	$119.49	$124.28	$4.79	4.0%

The Engineering Education and Centers (EEC) Subactivity funds U.S. engineering schools to adapt the engineering education and research enterprise to technological, economic, and social change, in partnership with government and the private sector. This evolution is required to ensure a diverse and highly capable technical workforce, achieved by providing early experience in discovery through research and creation through design and by incorporating new learning theories, teaching methods, and new scientific disciplines into engineering curricula. EEC programs address interdisciplinary research, pursue systemic curriculum and workforce development issues critical to all fields of engineering, engage centralized management, and complement the research and education portfolios of other ENG divisions. Its programs benefit from a scope encompassing all of engineering and a scale that both facilitates the incorporation of new scientific knowledge into engineering and requires rigorous monitoring and evaluation systems.

In FY 2004, EEC will support the Engineering Research Centers (ERC), Nanoscale Science and Engineering Centers (NSEC), Earthquake Engineering Research Centers (EERC) and Industry/University Cooperative Research Centers (I/UCRC). Industry and universities develop long-term, interdisciplinary partnerships in NSF-supported centers and groups, which spin off a broad range of fundamental knowledge and new invention. The stream of advanced technologies these centers produce is carried into industry by new generations of graduating engineers, well equipped to lead technological innovation.

In FY 2002, the 16 Engineering Research Centers conducted research and developed educational materials on key technologies related to the engineering of living tissues, marine bioproducts, computer-integrated surgical systems, biotechnology, biofilms, biomaterials for implants, semiconductor manufacturing, advanced fibers and films, ultrafine particles, reconfigurable manufacturing systems, advanced semiconductor packaging, wireless integrated microsystems, subsurface sensing and imaging, integrated media systems, and power electronics. These centers bring together faculty and students from multiple disciplines and leverage industry expertise and resources to define areas of critical need.

The six Nanoscale Science and Engineering Centers fully or partially supported by EEC perform research to advance the development of the ultra-small technology that will transform electronics, materials, medicine and many other fields. The centers address challenges and opportunities that are too complex and multi-faceted for individual researchers or small teams to tackle. They involve key partnerships with industry, national laboratories and other sectors and support education programs from the graduate to the pre-college level designed to develop a highly skilled workforce and advance pre-college training and the public understanding of science and engineering.

In FY 2002, the 50 I/UCRCs worked closely with industry to develop enabling technologies needed to manage the electrical power system, improve manufacturing and biological processes, develop new materials, information and telecommunications technologies, and innovate new products and services. EEC provides modest seed funds and management expertise to these highly leveraged centers, with States joining in many partnerships to expand the centers' activities in local economic development.

The three Earthquake Engineering Research Centers bring together multi-institutional teams of investigators to provide the knowledge and technology base for industry and public agencies to build and retrofit structures and other infrastructure to prevent damage from earthquakes. These centers take a systems approach, integrating engineering, seismological, and societal response knowledge. The centers integrate research and education and develop partnerships with industry and the public agencies responsible for earthquake hazard mitigation at the regional, state, and local levels. These centers are producing structural design models and earthquake hazard mitigation technology for buildings and transportation and lifeline systems and engaging designers and policy-makers in the development of hazard mitigation strategies for communities with earthquake risks.

EEC-funded educational innovations and human resource development programs attract students to engineering, implement new educational technologies to give students greater flexibility in how, where and when they learn, and give them the capacity to learn, lead, and innovate throughout their careers. Pre-college students and their current and future teachers are exposed to the challenges and rewards of engineering at the pre-college level and, undergraduates are given earlier and more relevant design and research experiences. Successful engineering education innovations are being disseminated to and adopted by a broad range of universities. Efforts are also directed at attracting underrepresented groups to engineering careers and increasing retention and graduation rates.

Recent graduates of the Manufacturing Engineering Program at the Greenfield Education Coalition.

The FY 2004 Budget Request for EEC is $124.28 million, an increase of $4.79 million over the FY 2003 Request. This growth, along with reallocations in the FY 2003 base, will support:

- Engineering Research Centers, increasing by $4.0 million over the FY 2003 level of $56.22 million, to a total of $60.22 million. This encompasses $1.0 million to expand nanoscale simulation network activities and $3.0 million to increase ERC award size, outreach and educational activities;

- Postdoctoral Faculty Fellowships to increase opportunities in the Engineering Professoriate, a new program funded at $3.0 million, to provide 15 promising postdocs with opportunities to enhance interdisciplinary research expertise and learning pedagogy skills needed to become outstanding new faculty and researchers;

- The Department-Level Reform of Undergraduate Engineering Education and Bridges for Engineering Education Programs, increasing by $3.0 million to a total of $9.0 million, to enable engineering departments to develop innovative curricula incorporating interdisciplinary knowledge and allow engineering schools to develop active partnerships with schools of education, for their mutual benefit;

- Funding for engineering students supported by the IGERT, GRF and GK-12 programs totals $17.42 million, increasing by $3.16 million over the FY 2003 level of $14.26 million, to allow higher stipends: and

- Centers for Learning and Teaching, increasing by $120,000 to a total of $1.12 million, to allow for planned scale-up of the activities of the Center for Learning and Teaching of Engineering.

GEOSCIENCES

GEOSCIENCES $687,920,000

The FY 2004 Budget Request for the Geosciences Activity (GEO) is $687.92 million, a decrease of $3.15 million, or 0.5 percent, below the FY 2003 Request of $691.07 million.

GEO Funding
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Atmospheric Sciences	202.15	218.92	229.92	11.00	5.0%
Earth Sciences	126.27	153.14	144.26	-8.88	-5.8%
Ocean Sciences	281.12	319.01	313.74	-5.27	-1.7%
Total, GEO[1]	$609.55	$691.07	$687.92	-$3.15	-0.5%

Totals may not add due to rounding

[1] FY 2003 funding includes $74.0 million in transferred programs not re-proposed in FY 2004. Excluding the transfers, GEO would increase by $70.85 million (11.5%).

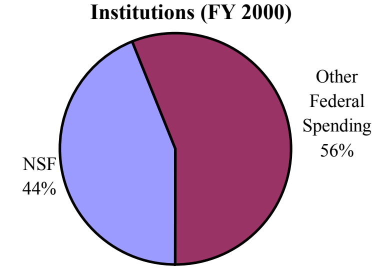
The Geosciences Activity (GEO) supports the research, infrastructure, and education in the atmospheric, earth, and ocean sciences needed to advance our understanding of the integrated Earth system. Breakthroughs in observing, modeling, and understanding complex Earth systems are coming just at the time when society is in critical need of sound scientific advice on how to mitigate or adapt to changes in the habitability of the planet. The geosciences stand poised to make tremendous contributions to improve the quality of life by providing useful information to decision makers about the key planetary processes, their complex interactions, and where possible, their future implications.

RELEVANCE

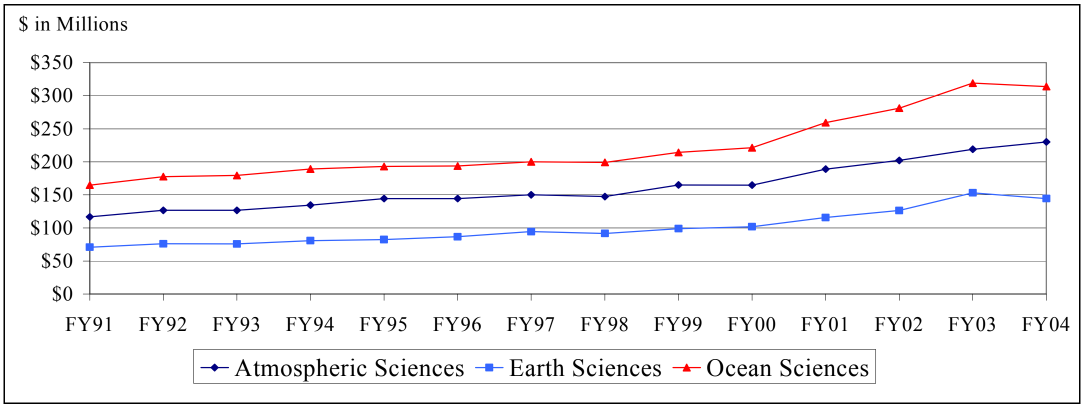
The Earth is ever-changing. Its energy input from the Sun varies; its physical and chemical structure, climate, weather, and capacity to support life change on many time scales; ocean currents shift; sea level rises and falls; continents drift; mountains build and erode; animal and plant species evolve; and terrestrial and marine ecosystems change. Most of these variations occur and will continue to occur as the result of persistent natural forces.

GEO is the principal source of federal funding for university-based basic research in the geosciences, providing about 44 percent of the total federal support in this area. GEO plays a critical role in addressing the nation's need to understand, predict and respond to environmental events and changes and to use Earth's resources wisely. Fundamental research in the geosciences advances scientific knowledge of Earth's environment, including resources such as water, energy, minerals, and biological diversity. GEO-supported activities also advance our ability to predict natural phenomena of economic and human significance, such as weather, climate change, earthquakes, fish-stock fluctuations, and disruptive events in the solar-terrestrial environment.

Federal Support for Basic Research in Geosciences at Academic Institutions (FY 2000)



GEO Subactivity Funding



STRATEGIC GOALS

Three strategic focus areas guide GEO activities:

- PEOPLE: Improvement of the quality of geoscience education and training and enhancing diversity in all the fields of geoscience. GEO will advance education and training for current geoscientists, increase the diversity of the geoscience community, facilitate education and training for future generations of geoscientists, and enhance the general public's knowledge about the integrated components of the Earth system.

- IDEAS: Advancement of knowledge about the Earth system, including both maintaining adequate base support across all geoscience fields and identifying opportunities where more focused support can play a catalytic role in advancing scientific progress.

- TOOLS: Enhancement of the infrastructure for the conduct of geoscience research. GEO will identify and make investments in instrumentation and facilities, including ships, aircraft, computers, radars, seismographs, and data management systems needed to perform world-class research.

GEO's support for new and ongoing activities contributes to NSF's efforts to achieve its strategic goals, and to the administration and management activities necessary to achieve these goals.

Summary of GEO Funding by Strategic Goal
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	Change Amount	Change Percent
People	24.94	35.02	36.51	1.49	4.3%
Ideas	362.34	413.31	395.10	-18.21	-4.4%
Tools	217.06	234.74	248.31	13.57	5.8%
Administration & Management	5.21	8.00	8.00	0.00	0.0%
Total, GEO[1]	$609.55	$691.07	$687.92	-$3.15	-0.5%

[1] FY 2003 funding includes $74.0 million in transferred programs not re-proposed in FY 2004.

People (+1.49 million, for a total of $36.51 million)

At NSF, placing research and learning hand in hand is our highest priority, and the people involved in our projects represent both the focus of our investments and the most important products of them. Across its programs, GEO provides support for over 10,000 people, including teachers, students, researchers, post-doctorates, and trainees. Support for programs specifically addressing NSF's Strategic Goal of "People – developing a diverse, internationally competitive and globally-engaged workforce of scientists, engineers and well-prepared citizens" totals $36.51 million in FY 2004, an increase of $1.49 million, or 4.3 percent, over the FY 2003 Request of $35.02 million.

GEO People Investments
(Dollars in Millions)

	FY 2003 Estimate	FY 2004 Estimate	Change Amount	Change Percent
K-12	5.78	6.18	0.40	6.9%
Undergraduate	11.47	11.87	0.40	3.5%
Graduate & Professional	10.77	11.46	0.69	6.4%
Other	7.00	7.00	0.00	0.0%
Total, GEO	$35.02	$36.51	$1.49	4.3%

Totals may not add due to rounding.

FY 2004 highlights include:

- $2.41 million, an increase of $800,000 over the FY 2003 Request level of $1.61 million, to maintain the network of coordinated centers to facilitate collaborations and communications between ocean science researchers and educators initiated in FY 2002. These Centers for Ocean Science Education Excellence (COSEE) will foster the integration of ocean research into high quality educational materials, allow ocean researchers to gain a better understanding of educational organizations and pedagogy, provide educators with an enhanced capacity to understand and deliver high-quality educational programs in the ocean sciences, and provide material to the public that will promote a deeper understanding of the ocean and its influence on each person's quality of life and our national prosperity;

- $3.42 million, an increase of $620,000 over the FY 2003 Request level of $2.80 million, to support the Integrative Graduate Education and Research Training (IGERT) program, which reflects an emphasis on multidisciplinary training in all areas of NSF-supported research;

- $2.81 million, unchanged from FY 2003, to support the Foundation-wide ADVANCE program to increase the representation and advancement of women in academic science and engineering careers; and

- $4.0 million, unchanged from FY 2003, to support the Opportunities to Enhance Diversity in the Geosciences (OEDG) program, which seeks to increase the participation in geosciences education and research by students from groups historically underrepresented in the geosciences. A secondary goal of the program is to strengthen the understanding of the geosciences and their contribution to modern society by a broad and diverse segment of the population.

Ideas (-$4.4 million, for a total of $395.10 million)

Support for ideas, spanning the geosciences and encompassing a wide range of topics, totals $395.10 million in FY 2004, a decrease of $18.21 million, or 4.4 percent, from the FY 2003 Request of $413.31 million. Projects in the Atmospheric Sciences Subactivity improve the understanding and prediction of climate, weather, space weather, and the global environmental system. Earth Sciences Subactivity research advances knowledge of the structure, composition, and history of the solid Earth and of the geological and hydrological processes that modify Earth. Projects in the Ocean Sciences Subactivity improve knowledge of the global climate system, coastal environments, the character of the ocean floor, as well as processes that control the chemical composition, motion, and biological production of ocean waters.

GEO will continue to participate in the Climate Change Research Initiative, with a FY 2004 investment of $20.0 million, that doubles investments proposed in 2003 totaling $10.0 million. Emphasis in FY 2004 will be placed on understanding the Earth's carbon cycle and advancing our ability to model dynamic multivariate systems.

In FY 2004, GEO will emphasize research on the key physical, chemical and geologic cycles within the Earth system, the characteristics and dynamics of which are of paramount importance to science and society. These activities will be complementary to, and well coordinated with, the biologically oriented studies of Earth cycles that will be carried out within the context of the Foundation-wide Biocomplexity in the Environment priority area. Specific priority activities include:

- Studies of abrupt and rapid climate change through interdisciplinary studies of ocean circulation combined with those of paleoclimate records to document the frequency, temporal resolution, and spatial extent of past rapid climate change;
- Continued examination of important biogeochemical cycles including emphasis on understanding the sources, sinks and processes which control the atmospheric abundance and distribution of carbon and water;
- Implementation of the Oceans and Human Health Initiative in partnership with the National Institutes of Health to understand the linkages between oceans and human health, including water-borne diseases, harmful algal blooms and marine pharmaceuticals;
- Multidisciplinary studies of the processes that govern water quantity and quality, the character and dynamics of the Earth's surface, and the interactive processes at the intersection of the geosphere and biosphere;
- Improving understanding of natural hazards such as floods, earthquakes, volcanic eruptions, hurricanes, and solar storms; and
- Research projects and field programs focused on understanding dynamics of the ocean mantle and its effect on the structure and evolution of the lithosphere, and on the dynamics of the atmosphere and atmospheric coupling.

GEO-supported centers include Science and Technology Centers (STCs), the Consortium for Materials Properties Research in the Earth Sciences (COMPRES), the Southern California Earthquake Center (SCEC), and Long Term Ecological Research sites (LTERs).

GEO Centers
(Dollars in Millions)

	FY 2003 Estimate	FY 2004 Estimate	Change Amount	Change Percent
Science and Technology Centers[1]	3.21	10.69	7.48	233.0%
Consortium for Materials Properties Rsch (COMPRES)	2.50	2.70	0.20	8.0%
Southern California Earthquake Center (SCEC)	2.63	2.76	0.13	4.9%
Long Term Ecological Research Sites	1.70	1.70	0.00	0.0%
Total, GEO	$10.04	$17.85	$7.81	77.8%

Totals may not add due to rounding.

[1] The increase in STC funding reflects new awards made in September 2002. These funds are shown in Integrative Activities in the FY 2003 Request, and are transferred to the appropriate managing R&RA Activity in the FY 2004 Request.

In FY 2004, GEO will support three Science and Technology Centers: the ongoing Center for Sustainability of Semi-Arid Hydrology and Riparian Areas (SAHRA), the new National Center for Earth-surface Dynamics (NCED), and the new Center for Integrated Space Weather Modeling (CISM).

GEO will continue to support the Science and Technology Center on the Sustainability of Semi-Arid Hydrology and Riparian Areas (SAHRA). The Center's scientific foci are: 1) spatial and temporal properties of hydrologic variables; 2) processes controlling water and chemical balances in catchments; 3) functioning of riparian systems; and 4) integrated modeling of catchment-scale processes. Promoting researcher-user partnerships across the breadth of water resources management through technology transfer is an integral part of the day-to-day operation of the Center. Educational initiatives contribute to sustainability by bringing water resources issues to the forefront of K-16 science education and by promoting hydrologic literacy among the public. SAHRA is educating a new generation of water resources professionals in the interdisciplinary perspective and technological skills required for practicing sustainable water resources management.

The National Center for Earth-surface Dynamics (NCED) is a Science and Technology Center focused on understanding the processes that shape the Earth's surface, and on communicating that understanding to a broad range of stakeholders. NCED's work supports a large, community-based effort to develop a suite of quantitative models of the Earth's surface: a Community Sediment Model (CSM). Results of the NCED-CSM collaboration will help solve pressing societal problems through both short-term prediction of surface response to natural and anthropogenic change and long-term interpretation of how past conditions are recorded in landscapes and sedimentary strata. NCED education and knowledge transfer programs include exhibits and educational programs at the Science Museum of Minnesota, internships and programs for students from tribal colleges and other underrepresented populations, and research opportunities for participants from outside core NCED institutions.

The Center for Integrated Space Weather Modeling (CISM) focuses its activities around building a comprehensive, physics-based, numerical simulation model that describes the space environment from the Sun to the Earth. In the course of developing this model, CISM will achieve three complementary goals: better understanding of the complex, closely coupled Sun-Earth system; transition of the results of space weather research into robust and operationally useful forecasting tools; and improved public awareness of space weather and its effects. Model development activities will lead to new techniques for model coupling, data assimilation, and visualization. Knowledge transfer will be performed through partnerships with operational support personnel at the National Oceanic and Atmospheric Administration (NOAA) and the Department of Defense. Education and public outreach activities will be integrated with the CISM research program, and will concentrate on creating and preparing a diverse pool of qualified scientists to face space weather challenges of the future.

GEO also supports other center activities, including the Southern California Earthquake Center, the Center for Materials Properties Research, and co-funds Long Term Ecological Research sites with the Biological Sciences Activity.

The Southern California Earthquake Center (University of Southern California) has emerged as a leader in earthquake research. The Center is a regionally focused organization with the mission to gather new information about earthquakes in southern California, integrate knowledge into a comprehensive and predictable understanding of earthquake phenomena, and communicate this understanding to engineers, emergency managers, government officials, and the general public.

The Center for Materials Properties Research in the Earth Sciences (COMPRES) has emerged as a focal point for mineral-physics research and education in the U.S. The scientists of COMPRES are developing an understanding of fundamental processes within the Earth and other planets by studying natural materials at the high pressure and temperature conditions that exist in the interior of the Earth.

Long Term Ecological Research (LTER) sites support projects requiring long periods of study; the sustained nature of studies allows scientifically sound evaluations of major environmental phenomena. The LTERs represent many disciplines that enhance our understanding of general ecological phenomena that occur over long temporal and broad spatial scales, provide information for the identification and solution of environmental problems, and enable interdisciplinary collaborative activities.

Priority Areas

In FY 2004, GEO will support research and education efforts related to broad, Foundation-wide priority areas in Biocomplexity in the Environment, Information Technology Research, Nanoscale Science and Engineering, Mathematical Sciences, and Human and Social Dynamics.

GEO Investments in Priority Areas
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Biocomplexity in the Environment	23.00	22.22	37.22	15.00	67.5%
Information Technology Research	12.16	13.21	14.56	1.35	10.2%
Nanoscale Science and Engineering	6.80	7.53	7.88	0.35	4.6%
Mathematical Sciences	N/A	4.57	7.07	2.50	54.7%
Human and Social Dynamics	N/A	N/A	1.35	1.35	N/A

Biocomplexity in the Environment: In FY 2004, GEO will provide $37.22 million, an increase of $15.0 million over the FY 2003 Request of $22.22 million, to support the NSF-wide Biocomplexity competition and a set of coordinated activities in environmental science, engineering and education that advance scientific knowledge about the connection between the living and non-living Earth system. These funds will enable the continuation of four interdisciplinary activities:

- Planetary Ecology focuses on understanding the Earth's marine and terrestrial ecosystems and their evolution, and the interaction of the biosphere with earth system processes. GEO will support research focused on microbial habitats in the terrestrial and submarine deep subsurface to study processes including: biologically controlled mineralization, the production of gas hydrates, microbiological controls on seawater chemistry and productivity, and soil and rhizosphere processes. Included is $4.0 million to study the ecology of infectious diseases;
- Planetary Metabolism aims to understand the links and feedbacks among the Earth's physical, chemical, geological, and biological, as well as social, systems; how they have evolved; and how they affect the planet's biosphere and geosphere;
- Planetary Energetics and Dynamics attempts to understand the links between physical and biochemical processes by focusing on energy exchange. This includes an effort to understand, mitigate and predict natural hazards – for example, hurricane genesis and storm tracking, earthquake nucleation, and energetic processes in the upper atmosphere; and
- Earth Observatories will make sustained time-series observations to understand the temporal evolution of environmental systems that are central to the study of biocomplexity in the environment.

Information Technology Research: In FY 2004, GEO will provide $14.56 million, an increase of $1.35 million over the FY 2003 Request of $13.21 million, to support information-based activities that focus on:
- Development of comprehensive coupled models that include ensemble forecasting, nesting and/or data assimilation techniques to understand the complex interactions taking place in the Earth system;
- Development of tools for knowledge discovery, visualization and interpretation of large-scale heterogeneous data sets;
- Development of the infrastructure to find, access, retrieve, and integrate geospatial data from distributed, heterogeneous sources in a way that makes them useful for scientific research; and
- Extension of local networking and computing capabilities in support of large-scale modeling and database activities in the geosciences.

Nanoscale Science and Engineering: In FY 2004, GEO will support Nanoscale Science and Engineering at a level of $7.88 million, an increase of $350,000 over the FY 2003 Request of $7.53 million, for activities that focus on:
- The development and application of chemical and biological sensor technology for making rapid, high-precision observations at submicroscopic spatial and volumetric scales;
- Support for crosscutting studies aimed at understanding the distributions and behavior of nanoscale structures throughout the Earth, atmosphere, and oceans; and
- The development of heavily instrumented interdisciplinary Earth System Observatories that facilitate our understanding of nanoscale geoscience processes, including platforms to detect and characterize nanoscale particles and their interactions throughout the atmosphere and oceans.

Mathematical Sciences: In FY 2004, GEO will support multidisciplinary research involving the partnering of mathematicians and geoscientists to investigate topics spanning the earth, atmospheric, and ocean sciences at a level of $7.07 million, an increase of $2.50 million over the FY 2003 Request of $4.57 million.

Human and Social Dynamics: In FY 2004, GEO will initiate participation in the Human and Social Dynamics priority area at a level of $1.35 million to engage the social science community in understanding and predicting behavior in response to extreme events (earthquakes, hurricanes, tornados, solar disruptions, etc.) and other natural processes affecting society.

Tools (+13.57 million, for a total of $248.31 million)

The GEO Activity supports user facilities necessary for the conduct of research in the geosciences. These include large national user facilities such as the National Center for Atmospheric Research (NCAR) and the U.S. academic fleet, and smaller facilities in the atmospheric, earth, and ocean sciences.

GEO Investments in Tools
(Dollars in Millions)

	FY 2003 Estimate	FY 2004 Estimate	Change Amount	Change Percent
Academic Research Fleet/Ship Operations	62.00	65.00	3.00	4.8%
EarthScope Operation	0.00	1.00	1.00	N/A
Incorporated Research Institutions for Seismology	13.10	14.10	1.00	7.6%
National Center for Atmospheric Research	73.60	78.82	5.22	7.1%
Ocean Drilling Program Operations	30.00	8.40	-21.60	-72.0%
Digital Library	2.90	4.20	1.30	44.8%
Research Resources	20.79	20.79	0.00	0.0%
Other GEO Facilities[1]	32.35	56.00	23.65	73.1%
Total, Facilities Support	$234.74	$248.31	$13.57	5.8%

[1]Other GEO facilities include multi-user accelerator-based mass spectrometers, synchrotron beamlines, radar facilities to study weather and the upper atmosphere (including the National Astronomy and Ionosphere Center), facilities to support the scientific use of the Global Positioning System, and activities related to the Integrated Ocean Drilling program.

NSF support provides for ongoing operations and maintenance, including upgrades to existing facilities as well as regularly scheduled repairs. FY 2004 plans include:

- $78.82 million, an increase of $5.22 million, or 7.1 percent, over the FY 2003 Request of $73.60 million, for the operation and maintenance of observational and computer facilities at NCAR. NCAR is a world-renowned center for atmospheric research that makes facilities available – including supercomputers, instrumented research aircraft and ground-based portable observing systems – to scientists at universities, NCAR, and elsewhere. In FY 2004 NCAR will focus on: research on Earth's natural cycles, including climate system modeling and the operation of the computation facilities for the Climate Simulation Laboratory; projects within the U.S. Weather Research Program (USWRP) and the National Space Weather Program (NSWP), which aim to achieve a better understanding and improved predictive capability of costly and disruptive storms on Earth and in space; and continued development of observational and computational capabilities;

- $8.40 million, a decrease of $21.60 million, or 72.0 percent, from the FY 2003 Request of $30.0 million, to support core storage and data distribution infrastructure associated with the Ocean Drilling Program (ODP). In 2003, the *Resolution* will complete its contracted drilling operations for the ODP, with research cruises examining the formation of ocean crust produced by rapid periods of sea-floor spreading in the eastern Pacific, and by extremely slow periods of spreading in the central Atlantic. Additional drilling cruises in the south Atlantic will examine the Mesozoic-Cenozoic history of ocean circulation by drilling sediments along the Brazilian and African continental margins. Finally, the ODP will address the geologic processes during continental rifting through recovery of sediment and crustal rock off Newfoundland. A follow-on international program, the Integrated Ocean Drilling Program, is being developed, and is discussed under Other Geosciences Facilities.

- $65.0 million, an increase of $3.0 million, or 4.8 percent, over the FY 2003 Request of $62.0 million, for the continued operation of the U.S. Academic Research Fleet. Approximately 325 projects with about 2,500 scientists and students will use the fleet's 27 ships. The projects range from individual investigator studies of coastal waters to integrated multi-investigator studies of global ocean processes. NSF-funded researchers are the primary users of the ships, accounting for about 65 percent of their total use. NSF ship operation funds support the costs associated with the use of the fleet by these researchers;

- $14.10 million, an increase of $1.0 million, or 7.6 percent, over the FY 2003 Request of $13.10 million, to continue support for the Incorporated Research Institutions for Seismology (IRIS). IRIS facilities provide rapid analysis of earthquakes, aid in monitoring nuclear proliferation, and permit imaging of the internal physical structure of Earth;

- $1.0 million will initiate preliminary operation of the EarthScope facility. EarthScope, construction of which is funded through the Major Research Equipment and Facilities Construction Account, is a distributed, multi-purpose geophysical instrument array that will make major advances in our knowledge and understanding of the structure and dynamics of the North American continent.

- $56.0 million, an increase of $23.65 million, or 73.1 percent, over the FY 2003 Request of $32.35 million, for Other Geosciences Facilities, which includes facilities to support the use of the Global Positioning System for scientific research, multi-user analytical facilities such as accelerator-based mass spectrometers, synchrotron beamlines, and operation, upgrade, development, and construction of radar facilities to study precipitation and upper atmospheric phenomena. Of particular note is the initiation of support to develop a new deep submergence capability, expected to total approximately $12.50 million in FY 2004 depending on recommendations from the National Academy of Sciences expected in late FY 2003. FY 2004 sees growth in the new Integrated Ocean Drilling Program (IODP), with $7.0 million being used to facilitate planning for U.S. participation in the new program. Major Research Equipment and Facilities Construction (MREFC) Account funding for conversion, outfitting and acceptance trials of a deep-sea drilling vessel is planned to begin in FY 2005. Further information on the Scientific Ocean Drilling project of the IODP can be found in the MREFC chapter. Finally, in FY 2004 construction of the Advanced Modular Incoherent Scatter Radar (AMISR) will continue at a level of $12.50 million, pending National Science Board approval in FY 2003.

Administration and Management

Administration and Management provides for administrative activities necessary to enable NSF to achieve its strategic goals. Requested funding for FY 2004 is $8.0 million, level with FY 2003. This includes the cost of Intergovernmental Personnel Act appointments and contractors performing administrative functions.

QUALITY

GEO maximizes the quality of the R&D it supports through the use of a competitive, merit-based review process. In FY 2002, the last year for which complete data exist, 76 percent of basic and applied research funds were allocated to projects that undergo merit review. OMB’s definition of competitive, merit-based review does not include Federally Funded Research and Development Centers; therefore support for the National Center for Atmospheric Research, although regularly merit reviewed, is not considered as funding that undergoes competitive, merit-based review for this calculation.

To ensure the highest quality in processing and recommending proposals for awards, GEO convenes Committees of Visitors, composed of qualified external evaluators, to review each program every three years. These experts assess the integrity and efficiency of the processes for proposal review and provide a retrospective assessment of the quality of results of NSF's investments.

The Geoscience Activity also receives advice from the Advisory Committee for Geosciences (AC/GEO) on such issues as: the mission, programs, and goals that can best serve the scientific community; how GEO can promote quality graduate and undergraduate education in the geosciences; and priority investment areas in geoscience research. AC/GEO meets twice a year and members represent a cross section of the geosciences with representatives from many different sub-disciplines within the field; a cross section of institutions including industry; broad geographic representation; and balanced representation of women and traditionally under-represented minorities.

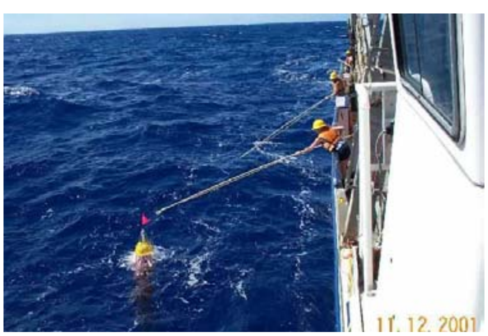
PERFORMANCE

Several recent activities highlight the successes of past investment in the geosciences:

Thomas Windham, University Corporation for Atmospheric Research, ATM 00-90060

The University Corporation for Atmospheric Research's mentoring program, Significant Opportunities in Atmospheric Research and Science (SOARS), was selected as one of ten institutions receiving the sixth annual Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring. The award recognizes ten institutions and ten individuals for promoting participation among women, minorities, and persons with disabilities in scientific and engineering careers. The Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring is administered and funded through NSF and goes to people and institutions who work with students in K-12, undergraduate, or graduate-level education.

Now in its sixth year, SOARS is designed to interest students from traditionally underserved communities in academic degrees and careers in atmospheric science and its related fields. SOARS is a year-round program that includes a ten-week paid internship each summer. Protégés have come from over 40 participating universities and colleges.



Raymond W. Schmitt, James R. Ledwell, John M. Toole, Kurt L. Polzin, Woods Hole Oceanographic Institute, OCE 00-81502;

The decades-old problem of ocean mixing took one step closer to resolution with the recent results reported from the Salt Finger Tracer Experiment (SFTRE). Researchers from WHOI injected an inert tracer (SF_6) into a stable layer between two layers of salt fingers, bodies of water with distinct heat and salt content, and returned almost a year later to find the dye had mixed more than 120 meters above and below the release level, 10X greater than what could be induced turbulent mixing (currents and eddies). This thermodynamically driven process, speculated upon for years but never proven, provides a much-needed explanation of mixing between cold, fresh waters and warm, saltier water. (*Science*, 2002. 295:1821)

M. Meghan Miller, Central Washington University, EAR 96-15640

Dr. M. Meghan Miller and her colleagues at Central Washington University recently reported discovery of a repeating pattern of slow earthquakes along the Cascadia subduction zone. Slow earthquakes are caused by slip along a fault but, unlike more familiar earthquakes that cause rapid ground movements, fault slip occurs over hours to months. These curious transient events have been recognized in several seismically active regions around the world, but this is the first report of a repeating pattern. The Central Washington University team found that the slow earthquakes occur on average every 14.5 months over the ten-year observation period, last about 8 weeks, and are the equivalent of a magnitude 6.7 (moment magnitude) earthquake.

The mechanisms of repeating pattern are not yet understood. Miller and co-worker T. Melbourne will be pursuing that question as part of new research project to begin this summer. Some researchers think slow earthquakes may quietly release energy on the Cascadia subduction whereas others are concerned the slow events may trigger a large catastrophic earthquake. In either case, the new discovery may lead to better understanding of the earthquake cycle in this heavily populated region where large devastating earthquakes seem to occur about every 500 years.

Albert M. Bradley and Dana R. Yoerger, Woods Hole Oceanographic Institute, OCE 97-30690

The Autonomous Benthic Explorer (ABE) is the first vehicle of its kind. This vehicle was developed because of scientists' frequent need to monitor an area over long periods of time, which is very expensive using a surface ship with submersibles such as Alvin. ABE is a true robot, able to move on its own with no pilot or tether to a ship, designed to perform a predetermined set of maneuvers to take photographs and collect data and samples within an area about the size of a city block. It will then "go back to sleep," conserving power for months of repeating these tasks. A team of engineers at the Woods Hole Oceanographic Institution developed ABE to follow a set of instructions placed in its memory before deployment. After a mission these data are downloaded, however, its developers envision that in the future underwater acoustic transmission systems now being developed will allow scientists anywhere in the world to receive video and data from ABE and to control its movement and measurements from their home laboratories. This year ABE played a major role in the Dive and Discover program that was funded in part by NSF. As part of this program ABE produced highly detailed maps of seafloor that were used to search for hydrothermal vents.

John Kelly, SRI International, ATM 00-89937

Advanced Modular Incoherent Scatter Radar (AMISR)

SRI International has constructed a small array of antenna elements for testing a new concept in incoherent scatter radar design. The tests are to demonstrate the feasibility of constructing a large phased-array that can easily be disassembled and moved to different locations. The most basic element in the AMISR design is the Antenna Element Unity (AEU), which consists of a power amplifier, polarization and transmit/receive circuitry, an antenna, a low noise amplifier, calibration paths, and control and monitoring electronics. Thirty-two identical AEUs are placed in fixed locations on a panel, with the locations determined by the desired grating lobe-free scanning of the final antenna. A single panel thus represents the minimum-size phased array antenna, with multiple panels typically combined to form a face.

Two panels were constructed and shipped to an Air Force antenna testing facility in Massachusetts. The panels were later shipped to a remote site in Alaska for testing. Test results show that the radar is working very close to design specifications. SRI is beginning design for manufacturing in anticipation of mass-producing the antenna units to build large, transportable incoherent scatter radars for deployment at scientifically strategic locations.

Other Performance Indicators

The tables below show the growth in the number of people benefiting from GEO's funding, and trends in growth of award size, duration and number.

Number of People Supported in GEO Activities

	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate
Senior Researchers	3,652	4,290	4,290
Other Professionals	2,404	2,750	2,750
Postdoctorates	574	660	660
Graduate Students	2,040	2,530	2,530
Undergraduate Students	1,139	1,600	1,600
K-12 Students			
K-12 Teachers			
Total Number of People	9,809	11,830	11,830

GEO Funding Profile

	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate
Number of Requests for Funding	5,063	5,800	6,000
Dollars Requested (in millions)	$2,851	$2,640	$2,730
Total Number of Awards	2,929	3,310	3,300
Statistics for Competitive Awards:			
Number	1,450	1,620	1,620
Funding Rate	35%	39%	37%
Statistics for Research Grants:			
Number of Research Grants	1,112	1,230	1,200
Median Annualized Award Size	$80,168	$82,246	$85,000
Average Annualized Award Size	$103,449	$104,246	$107,000
Average Award Duration, in years	2.8	3.0	3.0

Program Assessment Rating Tool (PART)

A new performance assessment undertaken in FY 2002 was the Program Assessment Rating Tool (PART). The PART assesses program performance in four areas: Program Purpose and Design, Strategic Planning, Program Management and Program Results. During formulation of the FY 2004 Budget, OMB completed PARTs on select programs for each agency. Two "programs" at NSF were assessed – the TOOLS strategic outcome goal and the Geosciences Activity.

Overall, GEO received a score of 81 percent (out of a possible 100 percent) and a rating of Moderately Effective. With respect to program purpose and design, the PART review found that GEO has a clear purpose and is designed to make a unique contribution. It is the principal source of federal funding for university-based basic research in the geosciences. The program is optimally designed, utilizing the competitive merit-review process to allocate the vast majority of its basic and applied research funds.

With respect to strategic planning, the assessment found that that NSF's annual goals are too broad to be useful in tracking how GEO will improve scientific understanding and its application. NSF will consider a revision of annual goals following the agency's revision of its Strategic Plan. It was noted that GEO collaborates and coordinates effectively with other agencies that share similar goals and objectives. Independent evaluations, such as Committee of Visitor reviews and Directorate Advisory Committee assessments are conducted regularly in order to inform program improvements and influence program planning.

The PART assessment indicates that NSF still needs to make progress in aligning program budgets with program goals so that the impact of funding, policy and legislative changes on performance can be readily assessed.

The PART assessment recognizes that GEO utilizes information on both management goals and grantee achievements to manage and guide future directions. All funds are obligated in a timely manner. NSF uses strong financial management practices and takes steps to address identified deficiencies. GEO has demonstrated adequate progress in achieving NSF's long-term outcome goals – PEOPLE, IDEAS and TOOLS. GEO's performance is effective and compares favorably to other programs with similar purpose and goals.

Finally, defining GEO as a program for the purpose of the PART analysis was not very useful, since primary budget decisions were not made at the Directorate level. The Administration will likely not use Directorates as a category for future PART assessments.

ATMOSPHERIC SCIENCES $229,920,000

The FY 2004 Request for the Atmospheric Sciences Subactivity is $229.92 million, an increase of $11.0 million, or 5.0 percent, above the FY 2003 Request of $218.92 million.

Atmospheric Sciences Funding
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Atmospheric Sciences Research Support	125.83	145.32	151.10	5.78	4.0%
National Center for Atmospheric Research	76.32	73.60	78.82	5.22	7.1%
Total, ATM	$202.15	$218.92	$229.92	$11.00	5.0%

Totals may not add due to rounding.

Research in the Atmospheric Sciences Subactivity (ATM) furthers our understanding of weather, climate, and the solar-terrestrial system by expanding the fundamental knowledge of the composition and dynamics of Earth's atmosphere and geospace environment. Almost 40 percent of the funds for ATM support the operation and maintenance of large, complex facilities required for research in the atmospheric and solar-terrestrial sciences. These facilities are shared by the atmospheric science community for fundamental research by individuals and groups of investigators participating in national and international scientific field programs and experiments.

Recent research supported by NSF included one of the largest weather-related studies in U.S. history. The International H_20 Project (IHOP) tracked water vapor across the southern Great Plains from Texas to Kansas in order to improve predictions of timing, location, and intensity of summertime storms. Led by University and NCAR scientists, IHOP2002 was based in central Oklahoma from May 13 to June 25, 2002. The National Science Foundation provided the bulk of the project's $7.0 million funding, with additional support from other agencies.

Better precipitation outlooks are a key goal of the U.S. Weather Research Program, which has organized a number of agencies in support of IHOP. The study, involving over 100 scientists and technicians, aimed to improve forecasts from 1 to 12 hours ahead of heavy rain, which could help in flash-flood safety and other applications. Six aircraft from the United States and Germany participated. A futuristic, semi-autonomous research craft, the Proteus (sponsored by NASA, NOAA and DOD), carried instruments up to 56,000 feet. In addition, 30 weather-tech vehicles, including four Doppler radars on flatbed trucks, participated on the ground in Oklahoma, Kansas, and Texas.

One of the key technologies for determining the solar contribution to Global Change is accurate measurement of the solar diameter. The main difficulties with precise measurement of the solar diameter are: (1) the atmospheric "seeing" is systemic and one cannot simply decrease its effects by making the same measurement several times, (2) the solar diameter is large in angular terms and is affected by optical aberrations that increase with distance from the optical axis, and (3) calibration is difficult. NSF-supported scientists have developed a balloon-borne instrument called the Solar Disk Sextant (SDS), which largely circumvents each of these difficulties through innovative design and by observing the sun from the 3-mbar pressure level of the atmosphere. Flights of the instrument have been made from Fort Sumner, New Mexico, in the fall of 1992, 1994, 1995, 1996 and 2001. The principal objective of the work is to understand the details of the physical mechanism for solar variability on decades to centuries, and to measure and understand the logarithmic derivative of the solar radius with respect to luminosity.

Once this is determined, historical eclipse data extending back for some 250 years (which provide the solar radius) can be inverted to deliver to infer the solar luminosity for this entire time period.

The FY 2004 Budget Request includes $151.10 million for Atmospheric Sciences Research Support, which provides funding for individual and group research projects in physical meteorology, large-scale dynamic meteorology, experimental meteorology, climate dynamics, atmospheric chemistry, aeronomy, magnetospheric physics and solar-terrestrial relations. Research studies develop the scientific basis for understanding the dynamic and physical behavior of climate and weather on all scales, the natural global chemical cycles of gases and particles in Earth's atmosphere, the composition, energetics, and particularly the dynamics of the coupled upper atmospheric system, and the sun as it relates to Earth's upper atmosphere and space environment. Support is also provided for lower atmospheric facilities at several universities and for upper atmospheric observatories in Massachusetts, Puerto Rico, Greenland and Peru that are operated by U.S. universities and research institutions. Also included is support for Unidata, a national program to help universities use computing technology and atmospheric data for teaching and research. Highlights for FY 2004 include:

- Continued examination of important biogeochemical cycles including emphasis on understanding the sources, sinks and processes which control the atmospheric abundance and distribution of carbon, water and other nutrient elements;
- Development of improved computer systems and numerical models, smart instrumentation, and collaboratories which will allow new discoveries, greater access to atmospheric data, and improved understanding of the atmospheric environment which will be supported as part of the ITR priority area;
- Support for new environmental modeling that employ data assimilation and innovative mathematic and statistical techniques to improve predictions of fundamental atmospheric and Earth system processes;
- Continued support of the U.S. Weather Research Program, the National Space Weather Program, disciplinary research and cooperative international science programs; and
- Continued development and construction of the Advanced Modular Incoherent Scatter Radar, a next-generation upper atmospheric observational system. This system will eventually provide key data to further our understanding of space weather and, thereby, to mitigate society’s vulnerability to space storms.

FY 2004 support for the National Center for Atmospheric Research (NCAR) totals $78.82 million. During FY 2004 NCAR will focus on:

- Research in the atmospheric and related sciences, including climate system modeling and the operation of the computation facilities for the Climate Simulation Laboratory;
- The U.S. Weather Research Program and the National Space Weather Program, which aim to achieve a better understanding and improved predictive capability of costly and disruptive storms on Earth and in space; and
- Continued support and development of new and improved observational and computational capabilities.

EARTH SCIENCES $144,260,000

The FY 2004 Request for the Earth Sciences Subactivity is $144.26 million, a decrease of $8.88 million, or 5.8 percent, from the FY 2003 Request of $153.14 million.

Earth Sciences Funding
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Earth Sciences Project Support	95.38	116.94	109.16	-7.78	-6.7%
Instrumentation and Facilities	30.90	36.20	35.10	-1.10	-3.0%
Total, EAR	$126.27	$153.14	$144.26	-$8.88	-5.8%

Totals may not add due to rounding.

The Earth Sciences Subactivity (EAR) supports research and educational activities designed to improve our understanding of processes that govern the behavior and characteristics of the Earth's surface environment and determine its internal structure, composition and dynamics. Funding is provided for theoretical, computational, laboratory and field studies, and for state-of-the-art scientific infrastructure needs. The new understanding gained from such studies provides the scientific basis for 1) the prediction of natural hazards such as earthquakes, volcanic eruptions, floods and droughts, and the mitigation of their impacts; 2) the discovery and management of mineral, energy, and water resources; and 3) for environmentally sound decision-making. Supported projects often occur in partnership with and complement focused efforts by other federal and state agencies. EAR plays a crucial role in advancing both research and education in the Earth Sciences.

EAR is increasing its support of educational activities. These activities are emerging at a time when there is growing national awareness of the need to improve science education and an appreciation of the opportunities offered by the Earth Sciences to engage students of all levels in the exploration of the world around them. With strong encouragement and support, education activities have become an integral part of EAR facilities and research programs. The Consortium of Universities for the Advancement of the Hydrologic Sciences (CUAHSI), for example, is developing a focused education and outreach effort for the water sciences. CUAHSI has embraced the integration of research and education. A central emphasis of this emerging consortium will be outreach to the educational community and the general public through activities designed to provide an understanding and appreciation for water resources and associated science and technology.

Educational and public outreach activities are also linked to the research activities of the new EarthScope facility. By working at both the national and local levels, the EarthScope effort will focus on (1) resource development and dissemination, and (2) program development and implementation. Resource development and dissemination includes creating public educational information, posters, fact sheets, and news releases; producing educational videos; developing curriculum resources and visualization and analysis tools; and sponsoring museum exhibits. Program development and implementation activities include formal education activities such as teacher professional development, and informal education activities at parks and community centers. This philosophy exemplifies EAR's intention to impact education nationally but also locally through engaging our EAR researchers in broader educational endeavors.

The FY 2004 Budget Request includes $109.16 million for Earth Sciences Project Support to provide funds for three main activities. The first is support for individuals and groups of scientists whose research provides the foundation of excellence and capability across all disciplines of the Earth Sciences. Supported programs include disciplinary studies in geology, paleontology, geophysics, geochemistry, and the hydrologic sciences. The second is support for interdisciplinary research to help understand the parameters and processes that govern the behavior of complex global systems and gain insight into the character and behavior of the Earth's environment. This funding will enable continued support for U.S. scientists and engineers to participate in coordinated national and international research activities as well as an increased emphasis on natural hazards, the water sciences and collaborative multidisciplinary studies to understand the Earth as a functioning dynamic system. The third is the integration of research, education and public awareness through the support of outreach projects, digital libraries and other human resources activities within the geosciences. Priorities for FY 2004 include support for:

- Multidisciplinary studies of the hydrological and biogeochemical cycles, processes that govern water quantity and quality, the character and dynamics of the Earth's surface, and the interactive processes at the intersection of the geosphere and biosphere;
- Improving understanding of natural hazards such as floods, earthquakes and volcanic eruptions;
- Implementation of the EarthScope geophysical and geodetic observational capabilities of the Earth Sciences in order to better understand the physics of earthquakes and the structure, dynamics and evolution of the North American continent;
- Expanding capabilities for computationally challenging planetary research such as dynamic modeling of Earth system processes, managing very large data sets, and integrating and synthesizing data between disciplines while meeting interagency information technology goals; and
- Enabling national and international continental scientific drilling focusing on the mechanics of earthquake initiation, and the detailed mechanisms that control eruptive volcanism.

Support for the Instrumentation and Facilities Program and infrastructure activities totals $35.10 million. This supports shared research facilities such as Incorporated Research Institutions for Seismology (IRIS) for seismological research, the University Navstar Consortium (UNAVCO) for precision geodetic measurements using Global Positioning Systems (GPS), accelerator-based mass spectrometers, ion-beam microprobes, and synchrotron beam lines. The program also funds the research and educational needs for instrumentation and computational infrastructure at universities and colleges throughout the nation. Priorities for FY 2004 include support for:

- Through the EarthScope facilities, enhancement of seismic, geodetic and other geophysical observational platforms on the North American continent to obtain unprecedented resolution imaging of Earth structures underneath the continent and improved understanding of earthquakes, volcanic eruptions and related active tectonic processes;
- Development and deployment of ultra-high pressure technology enabling laboratory investigations of Earth and other planetary bodies under extreme conditions existing in deep planetary interiors;
- The IRIS facility, to enhance operation and deployment of the Global Seismic Network for deep earth research and monitoring associated with nuclear nonproliferation and verification, continue making available portable seismic arrays to facilitate focused geophysical research, and to sustain the Data Management System which makes available data on seismic events to researchers world-wide; and
- Development of a dedicated InSAR (Interferometric Synthetic Aperture Radar) satellite mission, carried out jointly with partner agencies, to provide spatially-continuous strain measurements over wide geographic areas.

OCEAN SCIENCES $313,740,000

The FY 2004 Request for the Ocean Sciences Subactivity is $313.74 million, a decrease of $5.27 million, or 1.7 percent from the FY 2003 request of $319.01 million.

Ocean Sciences Funding
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Oceans Section	104.04	120.01	115.76	-4.25	-3.5%
Integrative Programs Section	93.64	104.00	104.08	0.08	0.1%
Marine Geosciences Section	83.44	95.00	93.90	-1.10	-1.2%
Total, OCE	$281.12	$319.01	$313.74	-$5.27	-1.7%

Totals may not add due to rounding.

The Ocean Sciences Subactivity (OCE) supports research to improve knowledge of the physical, chemical and biological processes that characterize both coastal seas and deep ocean basins, and the geological and geophysical processes that shape the continental shelves and deep sea floor. Support is also provided for the facilities required to gain access to the ocean, including research vessels, manned deep diving submersibles and a wide range of technologically advanced observational instrumentation. Oceanography is a highly interdisciplinary research endeavor that is fundamental to the understanding of the Earth's climate, to resource and hazard assessment, and to the health of the ocean's complex and diverse ecological systems.

Recent discoveries demonstrate that the ocean has much yet to reveal. Recent studies using cores collected by the Ocean Drilling Program provide a landmark change in our understanding of deep-ocean circulation. During the transition from the most recent glacial conditions (~20,000 years ago) to the more recent interglacial period, the most important source of salt for deep ocean waters switched from the Antarctic to the North Atlantic. Deep ocean circulation is a key process affecting the global heat budget, and this discovery has profound implications for modeling studies of the glacial climate.

The FY 2004 Request includes $115.76 million, a decrease of $4.25 million from the FY 2003 Request of $120.01 million, for Oceans Section research support. Studies span a wide range of research topics involving processes occurring within the water column from the air/sea interface to the ocean floor. Research problems increasingly require focused, collaborative, and coordinated programs of observation and interpretation that are often interdisciplinary. Projects range from individual investigator laboratory-based work to multi-investigator collaborations and international programs that require substantial amounts of ship-time and other facility resources. Priorities for FY 2004 include support for:

- Increased attention for studies of abrupt and rapid climate change through interdisciplinary studies of ocean circulation combined with those of paleoclimate records to document the frequency, temporal resolution, and spatial extent of past rapid climate change;
- Implementation of the Oceans and Human Health Initiative (with NIH) to understand the linkages between oceans and human health, including vector and water-borne diseases, harmful algal blooms and marine pharmaceuticals;
- Studies of marine biocomplexity, particularly marine ecosystems at all levels of organization from functional genomics of marine organisms at the molecular level to open ocean non-linear processes;
- Continued development of capabilities for data assimilation and modeling for ocean circulation and biogeochemical flux studies, resulting from a growing history of sustained time-series observations;

- Encourage interdisciplinary collaborations between mathematicians, statisticians and geoscientists to develop new approaches to solve problems and provide new insights in quantitative oceanography;
- Research to identify, understand, and quantify the processes controlling carbon cycling in the oceans; and
- Enhanced long-term process studies of deep ocean and coastal systems using sustained time-series observations, and development of new technology for ocean and seafloor observation systems.

The Integrative Programs Section totals $104.08 million, an increase of $80,000 over the FY 2003 Request of $104.0 million, and coordinates critical functions integral to the Ocean Sciences Subactivity. They include education and diversity programs, ship operations, upgrades, construction, instrumentation, technical services, and oceanographic facilities, new technology development, ocean observatories and observation systems, the National Oceanographic Partnership Program (NOPP) and its emerging OCEANS.US coordination office. Priorities for FY 2004 include:

- Replacement and enhancement of deep submergence capabilities using the results of an National Research Council study to guide plans for replacing the 38-year old submersible ALVIN;
- Development of concept designs for new Regional Class vessels as part of the Federal Oceanographic Facilities Committee's (FOFC) plan for renewal of the academic fleet;
- The academic research fleet to ensure that required ship time and capabilities are provided to satisfy merit reviewed research project requirements for NSF-sponsored studies;
- Enhancement of technical and shared-use instrumentation for projects for sea-going scientists;
- Continued maintenance and ship-improvement programs and increased support for quality improvement activities in operations and technical services programs; and
- Technology development, particularly for smart environmental sensors and the design of infrastructure to support seafloor observatories.

The Marine Geosciences Section totals $93.90 million, a decrease of $1.10 million from the FY 2003 Request of $95.0 million, and supports research to improve fundamental understanding of the composition, structure and evolution of the oceanic crust and continental margins; the record of global environmental and biologic change; and geochemical cycling produced by plate tectonic processes and fluid flow in sedimentary and crustal rock. This includes support for core research in marine geology, geochemistry and geophysics; coordinated community initiatives focused on thematic priorities in planetary dynamics and earth system cycles; and U.S. management and participation in the Ocean Drilling Program (ODP), which is jointly financed with seven international partners. Planning and preparations for the Integrated Ocean Drilling Program (IODP) are high priorities. Additional priorities for FY 2004 include support for:

- Research projects and field programs focused on understanding dynamics of the ocean mantle and its effect on the structure and evolution of the lithosphere;
- Increased use of observatory instrumentation and experiments at integrated ridge crest study sites to evaluate biological and hydrothermal dynamics and their roles in planetary metabolism and ecology;
- Integrated observational, laboratory and theoretical studies of continental rifting process in coordination with the Earth Sciences subactivity, and
- Coordinated geologic, geochemical, geophysical and drilling studies of fluid flow in ocean crust and continental margin sediments.

MATHEMATICAL AND PHYSICAL SCIENCES

MATHEMATICAL AND PHYSICAL SCIENCES $1,061,270,000

The FY 2004 Request for the Mathematical and Physical Sciences Activity (MPS) is $1,061.27 million, an increase of $119.70 million, or 12.7 percent, over the FY 2003 Request of $941.57 million.

MPS Funding
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Astronomical Sciences	165.99	161.25	183.07	21.82	13.5%
Chemistry	162.82	160.80	181.71	20.91	13.0%
Materials Research	219.37	219.32	246.12	26.80	12.2%
Mathematical Sciences	151.53	181.87	201.87	20.00	11.0%
Physics	195.88	193.31	217.50	24.19	12.5%
Multidisciplinary Activities	24.83	25.02	31.00	5.98	23.9%
Total, MPS	$920.42	$941.57	$1,061.27	$119.70	12.7%

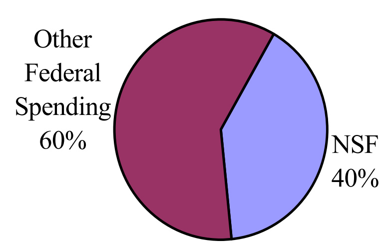
Totals may not add due to rounding.

The Mathematical and Physical Sciences Activity supports research, infrastructure, and education in the mathematical and physical sciences. The purpose of this work is threefold: to deepen our understanding of the physical universe; to use this understanding in service to society; and to prepare the next generation of scientists who are essential for continued progress.

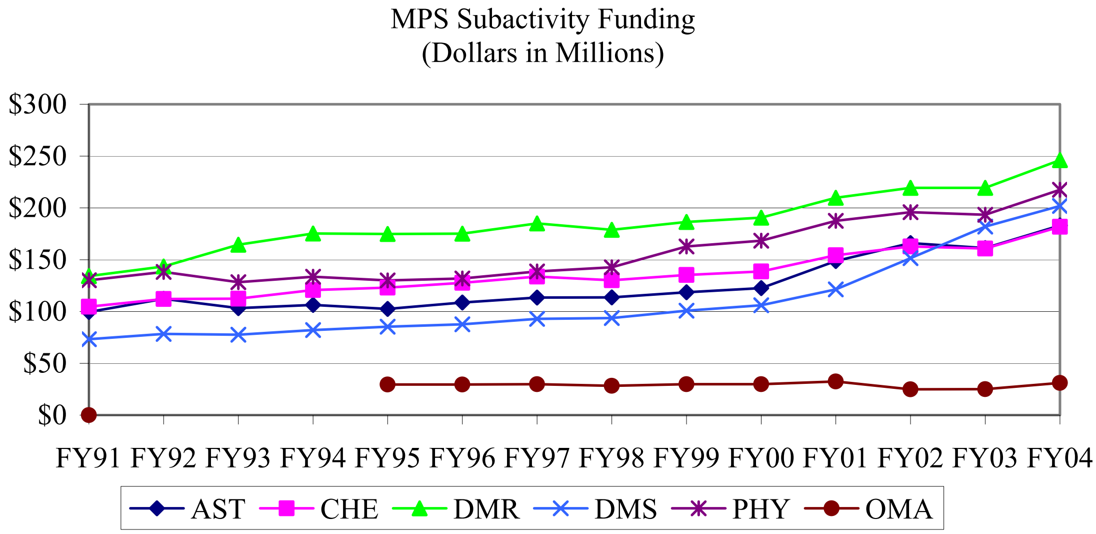
RELEVANCE

MPS provides about 40 percent of the federal funding for university-based basic research in the mathematical and physical sciences. Within the astronomical sciences, MPS provides about 33 percent of the federal support in this area; in chemistry, 31 percent; in physics, approximately 31 percent; in materials research approximately 50 percent; and in mathematics more than 58 percent.

Federal Support of Basic Research in Math and Physical Sciences at Academic Institutions (FY 2000)



MPS-supported research in the physical and mathematical sciences provides the backbone for advances in other technical, engineering, and health-related disciplines, and provides a broad basis for industrial and technological development. Knowledge of the fundamental processes of matter, of the structure and evolution of the universe, of the complex laws governing chemical interactions, of the behavior and control of molecules at the nanoscale, and of the mathematical tools needed to formulate and solve such problems has played a fundamental role in the technological leadership of the United States and in maintaining its health, economy, defense, and homeland security. Most of the research is of an exploratory nature and is long-term in duration and in impact. It is often difficult for industry to support such investigations. This research support provides training for the future U.S. science, engineering, and technology workforce. It is appropriate for NSF to be the lead agency in this area, as it is the only federal agency whose mission is to support basic research.

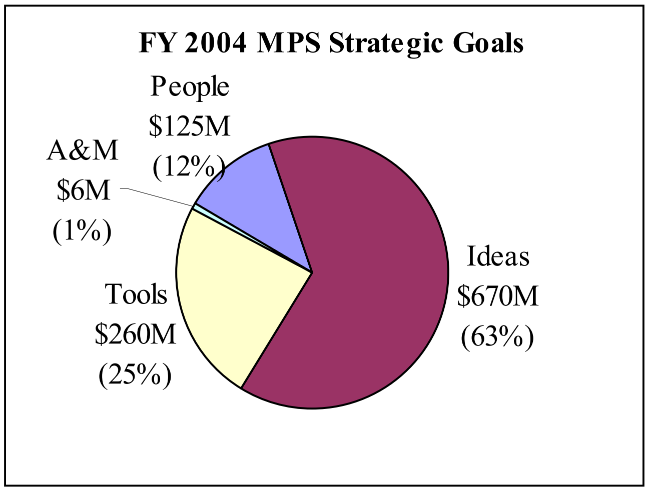


STRATEGIC GOALS

NSF's three strategic focus areas guide MPS activities:

- PEOPLE: Improvement in the quality of education, training and diversity in the fields of astronomy, chemistry, mathematics, materials research and physics. MPS advances education and training for current mathematical and physical scientists, increases the diversity of these communities, facilitates education of future generations of mathematical and physical scientists, and enhances the public's knowledge of astronomy, chemistry, mathematics, materials research and physics.

- IDEAS: Advancement of knowledge of the mathematical and physical sciences, including both maintaining base support across all the physical and mathematical science fields and identifying opportunities where more focused support can play a catalytic role in advancing scientific progress.



- TOOLS: Enhancement of the infrastructure for the conduct of research in the physical sciences. MPS will identify and make investments in instrumentation and facilities, including support and upgrade of existing state-of-the-art facilities needed to perform world-class research.

MPS's support for ongoing core and new activities contributes to NSF's efforts to achieve its strategic goals, and to the administration and management activities necessary to achieve these goals.

Summary of MPS Funding by Strategic Goal
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	Change Amount	Change Percent
People	95.81	116.53	124.67	8.14	7.0%
Ideas	594.91	597.11	670.25	73.14	12.2%
Tools	223.41	222.49	260.36	37.87	17.0%
Administration & Management	6.29	5.44	5.99	0.55	10.1%
Total, MPS	$920.42	$941.57	$1,061.27	$119.70	12.7%

People (+$8.14 million, for a total of $124.67 million)

People represent NSF's most important investment in the mathematical and physical sciences. The strength of our technical and instructional workforce is dependent on an adequate supply of talented scientists and teachers. In FY 2002, MPS spent over $95 million on this strategic resource, which represents about one-third of the total MPS investment in researchers and students. To ensure a 'diverse, internationally-competitive and globally-engaged workforce of scientists, engineers and well-prepared citizens,' investments will be made in all phases of education. This includes K-12 through undergraduate, graduate, and continuing education, as well as outreach activities. Along this continuum, undergraduate education represents a "pressure point" in the system. Decisions to enter research and teaching involving mathematical and physical sciences are typically made during the undergraduate years. Undergraduates provide a considerably more diverse talent pool than is currently represented in the mathematical and physical sciences. Funding will support new programs and enhance existing ones at the undergraduate level that draw from this large, diverse group of students and provide more effective preparation for research and teaching. Partnerships will be supported that lead to enhanced teacher preparation, broadened graduate and postdoctoral opportunities, and more informed teaching and learning strategies. New instruments and approaches will be developed that increase access to mathematical and physical sciences for both specialist and non-technical audiences. MPS support for People totals $124.67 million in FY 2004, an increase of $8.14 million, or 7.0 percent, over the FY 2003 Request of $116.53 million.

MPS People Investments
(Dollars in Millions)

	FY 2003 Estimate	FY 2004 Estimate	Change Amount	Change Percent
K-12	5.23	6.13	0.90	17.2%
Undergraduate	23.46	25.21	1.75	7.5%
Graduate & Professional	85.34	90.33	4.99	5.8%
Other People Support	2.50	3.00	0.50	20.0%
Total, People	$116.53	$124.67	$8.14	7.0%

To enhance multidisciplinary education, teaching, and training activities MPS will:

- Increase support for the Research Experiences for Teachers (RET) program by $500,000 to a total of $3.0 million.

- Increase support for the NSF Graduate Teaching Fellows in K-12 Education (GK-12) program by \$430,000 to \$2.40 million.
- Increase support for stipends by \$970,000, for a total of \$8.03 million, in the Astronomy and Astrophysics Postdoctoral Fellowship program, Discovery Corps program and the MPS Distinguished International Postdoctoral Research Fellowship program. The Discovery Corps program will both enhance postdoctorals' research skills and contribute to the development of national research infrastructure.
- Increase support for Research Experiences for Undergraduates (REU) sites by \$100,000 to \$15.0 million.
- Initiate support for a new activity, Undergraduate Research Centers (URCs) in Chemistry that will markedly increase opportunities for undergraduate research. URCs will be supported initially by a combination of new funding and redirected funds for a total of \$3.0 million.
- Increase support for CAREER program by \$3.50 million to \$40.0 million resulting in an increase of approximately 35 awards.
- Increase support for the Integrative Graduate Education and Research Traineeship (IGERT) program by \$1.58 million to \$8.76 million.
- Increase support for MPS programs in public science education by \$500,000 to \$2.80 million to support the MPS Internships in Public Science Education (IPSE) program and the educational outreach program for "Telescopes for Teaching."
- Initiate two new research activities through an investment of \$300,000 – one aimed at understanding the barriers to women and minorities in the academic chemistry profession and the other at supporting research within academic chemistry departments into how students learn chemistry concepts.

Ideas (+\$73.14 million, for a total of \$670.25 million)

Research supported by the MPS Activity pushes the limits of our fundamental understanding of the universe in which we live. Discoveries and advances in the fundamental sciences of astronomy, chemistry, materials research, mathematical sciences and physics drive the productivity and growth of the economy. Innovations from the results of MPS-sponsored research have generated entirely new industries. In today's global economy, it is crucial that substantial investments are made in science and engineering if the United States is to maintain its competitive lead. MPS support for Ideas totals \$670.25 million in FY 2004, an increase of \$73.14 million, or 12.2 percent, over the FY 2003 Request of \$597.11 million.

For the country to maintain a healthy economy, provide a better life for its citizens, and promote national security, it is important to maintain a balance across all disciplines of science and engineering. Advances in the medical sciences, from the discovery of techniques to synthesize new pharmaceuticals to the development of lasers for eye surgery, have relied heavily on the fundamental research of the past two decades, as has the phenomenal advances in computer hardware and information management and analysis. In addition, MPS supports research aimed at addressing some of the most fundamental questions that can be asked about the universe in which we live. MPS-supported scientists are investigating the origins of the universe and the solar system and developing theories of why matter exists.

The field of Quantum Science and Technology (QST) is emerging from discoveries at the interface between classical and quantum phenomena in physics, chemistry, materials research, engineering and computation. QST comprises the science and engineering underlying the creation and manipulation of material in quantum states. Such states have unique properties and the laws of quantum mechanics are needed to characterize their behavior. Quantum phenomena are at the heart of an understanding of the origins of the universe, the nature of chemical bonding, the phenomena that occur in nanoscale materials, and the relationship between physical forces. QST has the potential for profound impact on all areas of science, on the convergence of information technology and nanoscale science and engineering, and on the future of computing and communications. The next five to ten years are likely to see the emergence of QST as a key to 21st Century technology.

To enhance the effectiveness of individual investigators, stimulate multidisciplinary research activities and interagency partnerships, and expand efforts in international activities, MPS will:

- Increase support for individual investigators and groups by $43.44 million to support the NSF goal of increasing the average research award size to $128,000 with a duration of 3 years.
- Increase support for MPS Centers by $28.10 million to $131.84 million.
- In addition to the International Materials Institutes discussed below, MPS will continue to develop research programs that contribute to the development of a globally aware and internationally engaged scientific workforce.
- Increase support for Research at Undergraduate Institutions by $1.60 million to $11.10 million.
- Develop programs, in collaboration with the intelligence community, to emphasize scientific research of particular relevance to national security needs.

MPS supports a variety of multidisciplinary research centers and groups through programs such as Mathematical Science Research Institutes, Collaborative Research in Chemistry, Materials Research Science and Engineering Centers, and Physics Frontiers Centers. MPS also plays a significant role in supporting Science and Technology Centers and Nanoscale Science and Engineering Centers. In addition, MPS promotes international research collaborations through activities such as the International Materials Institutes. In FY 2004, MPS will establish up to five new Partnerships for Research and Education in Materials (formerly Collaboratives for Materials Research and Education) at minority-serving institutions.

MPS Centers
(Dollars in Millions)

	FY 2003	FY 2004	Change	
	Estimate	Estimate	Amount	Percent
Chemistry Centers	10.39	19.70	9.31	89.6%
Mathematical Science Research Inst.	14.00	15.00	1.00	7.1%
Materials Centers[1]	52.76	56.56	3.80	7.2%
Nano Centers	6.31	12.81	6.50	103.0%
Physics Frontier Centers	13.00	13.00	0.00	0.0%
STCs [2]	7.28	14.77	7.49	102.9%
Total, Centers Support	$103.74	$131.84	$28.10	27.1%

[1]Materials Centers includes support for MRSECs, International Materials Institutes and Partnerships for Research and Education in Materials.
[2]The increase for STC funding reflects new awards made in September 2002. These funds are shown in Integrative Activities in the FY 2003 Request, and are transferred to the appropriate managing R&RA Activity in the FY 2004 Request.

MPS support for centers in FY 2004 will include:

- Increase support for Chemistry Centers and Groups by $9.31 million to $19.70 million. This includes both Collaborative Research in Chemistry and Environmental Molecular Science Institutes (EMSI). New Chemical Bonding Centers will be established to explore fundamental aspects of chemical bonding, the bond that links atoms together into myriad forms of matter that define our existence. These centers will address grand challenges in the chemical sciences such as small molecule interactions, chiral chemistry, glycochemistry, protein folding, the molecular origins of life, and sensors. The EMSI program is a collaborative activity among MPS, the Directorate for Geosciences and the Department of Energy Office of Basic Energy Sciences.
- Enhance the Mathematical Sciences Research Institutes by $1.0 million, to a total of $15.0 million.
- Increase total funding for materials centers, collaborations and institutes by up to $3.80 million to a total of $56.56 million. This includes an increment of $1.80 million to establish two to three new International Materials Institutes (IMIs) at U.S. universities in partnership with NSF's Office of International Science and Engineering. IMIs foster enhanced international collaboration in materials research and education and serve as the initial U.S. nodes in developing a virtual Materials World Network. It also includes funds to establish four to five new Partnerships for Research and Education in Materials (PREMs -- formerly Collaboratives for Materials Research and Education in the FY 2003 Request). PREMs link materials research and education at minority-serving institutions with existing materials centers, facilities and focused research groups. The new PREMs will support research and training for up to 100 undergraduate and graduate students annually.
- Provide full or partial support for up to five additional Nanoscale Science and Engineering Centers, an increase of $6.50 million to a total of $12.81 million.
- Maintain the Physics Frontiers Centers (PFC) program at $13.0 million.
- STC support includes two additional centers from the FY 2002 competition transferred from the Office of Integrative Activities: University of Washington Center for Materials and Devices for Information Technology Research and University of California, Davis Center for Biophotonics Science and Technology. Total funding is $14.77 million for four centers.

Priority Areas

In FY 2004, MPS will support research and education efforts related to broad, Foundation-wide priority areas in Biocomplexity in the Environment, Information Technology Research, Nanoscale Science and Engineering, Mathematical Sciences, and Human and Social Dynamics.

MPS Investments in Priority Areas
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Biocomplexity in the Environment	4.95	4.70	4.70	0.00	0.0%
Information Technology Research	32.66	35.52	35.04	-0.48	-1.4%
Nanoscale Science and Engineering	98.68	103.92	110.42	6.50	6.3%
Mathematical Sciences	30.00	47.39	70.19	22.80	48.1%
Human and Social Dynamics	N/A	N/A	0.50	0.50	N/A

Biocomplexity in the Environment (BE): MPS will provide $2.35 million for the NSF-wide BE competition. In addition, another $2.35 million will be spent on research and education in BE-related areas. New Environmental Molecular Science Institutes will be supported with a particular emphasis on molecular level processes occurring in water and aqueous media. In addition MPS will support research in the modeling of environmental phenomena and the development of environmentally benign materials and chemical and materials processing methods.

Information Technology Research (ITR): MPS will provide $35.04 million for the ITR priority area that will focus on:

- Essential contributions to algorithm development, statistical analysis, optimization theory, network design, the physics of information, understanding the limits to computation, and the fundamentals of quantum, biological, molecular and optical computing.
- Remote access and control of experimental facilities such as accelerators (Large Hadron Collider) and telescopes.
- Advanced computational methods resulting, for example, in the design of more effective drugs and specialized materials, and better understanding of the formation of galaxies.
- Development of specialized Web-based tools and digital libraries for the physical sciences.
- Development of tools for the transparent manipulation and rapid dissemination of the information contained in huge databases, including, for example, efforts to unify astoronomical data (National Virtual Observatory).
- New support for interdisciplinary groups of physical scientists and pure and applied mathematicians focused on solving problems with significant time horizons, needing long-term investment in software development and infrastructure.

Nanoscale Science and Engineering (NSE): The early 21st Century may come to be seen as the start of the nanotechnology revolution. MPS is a primary player in the NSF nanoscale science and engineering priority area, and MPS grantees play a key role in developing the fundamental understanding that must undergird future technological applications of this exciting area of science and engineering. The intellectual challenges to be overcome are formidable. In FY 2004, MPS investment in the NSE priority area will increase by $6.50 million to $110.42 million, and will focus on the following:

- Support for the National Nanofabrication Infrastructure Network (formerly the NNUN).
- Full or partial support for five to six new Nanoscale Science and Engineering Centers (NSECs) addressing research and education at the interface between NSE and other priority areas.
- Fundamental research addressing such areas as nanoscale structures, novel phenomena and quantum control, nanoscale processes in the environment, multiscale modeling theory and simulation.
- Interdisciplinary teams pursuing major long-term objectives, including nanoscale materials ‘by design’, nanoscale electronics, photonics and magnetics.

Mathematical Sciences: In FY 2004, the MPS request includes $70.19 million, an increase of $22.80 million over the FY 2003 Request of $47.39 million, for the Mathematical Sciences priority area. MPS investments in this area will be through individual investigator grants, focused research groups, institutes, and partnerships, all within three categories: (1) fundamental mathematical and statistical sciences, (2) interdisciplinary research connecting the mathematical sciences with science and engineering, and (3) mathematical sciences education.

Education and training activities will support the advancement of mathematical skills and the mathematical sciences workforce, with support for undergraduate and graduate education and postdoctoral training coupled with curriculum reform.

Interdisciplinary emphases will include:

- The mathematical and statistical challenges posed by large data sets such as those generated by genomics research, satellite observation systems, seismic networks, global oceanic and atmospheric observation networks, automated physical science instruments, and modern engineering sensor and actuator systems.
- Managing and modeling uncertainty, where improved methods for assessing uncertainty will increase the utility of models across the sciences and engineering and result in better predictions of extreme or singular events, thus improving the safety and reliability in such systems as power grids, the Internet, and air traffic control.
- Modeling complex nonlinear systems where, across the sciences and engineering, there is a great need to analyze and predict emergent complex properties, from social behaviors to brain function, and from communications networks to multi-scale business information systems and complex engineering systems. For example, tremendous opportunities exist on the interface with the life sciences, where new mathematical models can significantly advance understanding of biological processes.

Human and Social Dynamics: In FY 2004 MPS requests $500,000 for the Human and Social Dynamics priority area. MPS activities in this area include: the development of statistical tools for decision making under uncertainty, modeling and analysis of cellular automata to understand how human and social dynamics between individuals translate into behavior of large groups and organizations, further development and application of spatial statistical methods as they apply to the social sciences, and development of computational tools for extracting information from large databases.

Tools (+$37.87 million, for a total of $260.36 million)

The pace and breadth of scientific discovery are growing at unprecedented rates, driven by revolutions in tools for science. The U.S. has a leadership role in this process. Today's scientific agenda involves phenomena at or beyond the limits of our measurement capabilities, requiring new generations of powerful, complex, costly tools. Investments in facilities and instrumentation will not only have great scientific payoffs but also will provide training for the next generation of researchers. MPS support for Tools totals $260.36 million in FY 2004, an increase of $37.87 million, or 17.0 percent, over the FY 2003 Request of $222.49 million.

State-of-the-art user facilities are essential to astronomy, physics, and many areas of materials research. Investment in facilities necessarily includes not only support for ongoing operations and maintenance, but also periodic upgrades to the core facility and to ancillary instrumentation. Further, R&D toward new capabilities to meet the needs of the MPS disciplines is essential to assure continued leadership.

MPS investments in tools was over $223 million in FY 2002, and the portfolio of world-class facilities that MPS maintains for the science and education communities represents a capital investment of well over $1 billion. The increase of annual support by $37.87 million is greatly leveraged in terms of enabling new science opportunities: providing for full operations of the Laser Interferometer Gravitational-Wave Observatory (LIGO) and for early operations of the Large Hadron Collider (LHC) ATLAS (A Toroidal Large Angle Spectrometer) and CMS (Compact Muon Solenoid) detectors, exploiting unique capabilities for particle physics at the Cornell Electron Storage Ring (CESR) and for radioactive ion beams at Michigan State University's National Superconducting Cyclotron Laboratory, and supporting operations of the National Astronomy Centers, the Gemini Observatories, and the National High Magnetic Field Laboratory (NHMFL). While increases for operations of some of the astronomy, physics, and materials research facilities are modest, the additional funds will enhance instrumentation development, facility operations reliability, and community access to these facilities.

Importantly, this increase will provide a start towards critical support for some mid-scale instrumentation needs – a scale between the Major Research Instrumentation and the Major Research Equipment and Facilities Construction funding – identified as a serious funding gap by the National Science Board Infrastructure Task Force. This level of opportunity has become important for researchers across MPS disciplines. There is an emerging need for leveraging science such as can be enabled by the development of instrumentation for neutron and light sources, high magnetic field laboratories, moderate-scale detector experiments, and astronomical observing facilities. In addition, support for upgrades such as new detectors or data collection techniques can dramatically improve the efficiency and sensitivity of existing instrumentation at much-reduced cost.

MPS Investments in Tools
(Dollars in Millions)

	FY 2003 Estimate	FY 2004 Estimate	Change Amount	Percent
Cornell Electron Storage Ring	19.49	21.00	1.51	7.7%
Gemini	12.60	14.20	1.60	12.7%
LHC ATLAS and CMS Detector Operations[1]	[5.00]	10.00	[5.00]	100.0%
LIGO	29.50	29.00	-0.50	-1.7%
MSU National Superconducting Cyclotron Lab	14.70	15.20	0.50	3.4%
National Astronomy Centers	84.33	91.63	7.30	8.7%
National High Magnetic Field Laboratory	24.00	24.50	0.50	2.1%
Other Facilities[2]	14.87	16.18	1.31	8.8%
Research Resources	23.00	38.65	15.65	68.0%
Total, Tools Support	$222.49	$260.36	$37.87	17.0%

[1] Funding for LHC operations in FY 2003 was in disciplinary research within Ideas.
[2] Includes the Wisconsin Synchrotron Radiation Center, Cornell High-Energy Synchrotron Source, National Nanofabrication Users Network, National Center for Atmospheric Research, and Digital Library.

In FY 2004, MPS support for Tools includes:

- An increase of $1.51 million, to a total of $21.0 million, for the Cornell Electron Storage Ring (CESR).
- An increase of $1.60 million for the Gemini Observatories, to a total of $14.20 million. Both the northern and southern Gemini telescopes are now in regular science operations. Included in this amount is $1.0 million for partial return of Chile's share of construction funding, with which the U.S. assumes a portion of the Chilean share of the Observatory, along with increased observing access for U.S. astronomers.
- An increase of $5.0 million for early operations of the U.S. groups participating in the ATLAS and CMS detectors at the Large Hadron Collider (LHC), including computing and software development. Funding of operations was requested through Ideas in FY 2003.
- A total of $29.0 million for full operations of the Laser Interferometer Gravitational-wave Observatory (LIGO) to run their interferometers at sites at Hanford, WA and Livingston, LA in coincidence with each other and with gravitational wave detectors abroad.
- An increase of $500,000 for Michigan State University's National Superconducting Cyclotron Laboratory (NSCL), to a total of $15.20 million, providing full operations and research at this unique radioactive ion beam facility.
- An increase of $7.30 million, to a total of $91.63 for support of the National Astronomy Centers:

- NAIC will be supported at the level of $10.30 million, an increase of $1.30 million, to enable continued operation and maintenance of the renovated Arecibo telescope and the development of instrumentation to take advantage of its greater sensitivity. Additional support of $1.80 million is provided through the Geosciences Activity.
- NOAO/NSO is planned at the level of $38.60 million, an increase of $2.90 million. NSO facilities provide solar telescopes for use by the U.S. astronomical community. Activities in FY 2004 include continued design and planning for the Advanced Technology Solar Telescope (ATST), an instrument that will use new techniques such as adaptive optics to provide a unique capability for investigating a wide range of important questions in solar physics. Within this amount, $4.0 million, unchanged from FY 2003, is included for the Telescope System Instrumentation Program (TSIP), which is administered for the community through NOAO.
- NRAO is supported at the level of $42.73 million, an increase of $3.10 million. This level of support will provide for operations, maintenance, and instrumentation for the unique telescopes of NRAO, such as the Robert C. Byrd Green Bank Telescope, the Very Large Array (VLA), and the Very Long Baseline Array (VLBA). Activities in FY 2004 include making continued improvements and enhancements to the expanded VLA and optimization of science operations of the Byrd Telescope.

- Funding for the National High Magnetic Field Laboratory (NHMFL) increases by $500,000 in FY 2004 to a total of $24.50 million. The increase reflects the integrating of the National High Field Mass Spectrometry Facility, which was supported as a separate facility in FY 2003 by the Chemistry Subactivity, into the NHMFL.
- An increase of $15.65 million to a total of $38.65 million for Research Resources reflects a new emphasis on intermediate-scale instrumentation. Examples of such activities include new developments in adaptive optics hardware and techniques for current and future generations of optical and infrared telescopes, support for grid computing for information-intensive experiments in physics and astronomy, and instrumentation for NSF-supported users of beam lines at synchrotron and neutron facilities such as the DOE Spallation Neutron Source (SNS). The SNS will produce the most intense beam of neutrons in the world, and provide unprecedented performance for neutron scattering research. The Department of Energy and NSF will work in coordination to develop and support a world-class suite of instruments that makes optimal use of the SNS beams, and that will meet the needs of users across a broad range of disciplines including chemistry, physics, materials research, engineering, geology and biology. The instrumentation phase of this project is currently estimated to cost approximately $300 million over 10 years. To date, NSF has provided approximately $1.50 million for initial R&D. Up to $2.0 million in additional support for planning neutron scattering beam line instrumentation at the SNS will be provided in FY 2004.

Administration and Management

Administration and Management provides for administrative activities necessary to enable NSF to achieve its strategic goals. Requested funding for FY 2004 is $5.99 million, an increase of $550,000 over FY 2003. This includes the cost of Intergovernmental Personnel Act appointments and contractors performing administrative functions.

QUALITY

MPS maximizes the quality of the R&D it supports through the use of a competitive, merit-based review process. The percent of basic and applied research funds that were allocated to projects that undergo merit review was 88 percent in FY 2002, the last year for which complete data exist. This percent excludes support for the National Radio Astronomy Observatory, the National Optical Astronomy Observatories, and the National Astronomy and Ionosphere Center, which, although regularly merit reviewed using NSF's peer review system, because of their designation as Federally Funded Research and Development Centers, are not included.

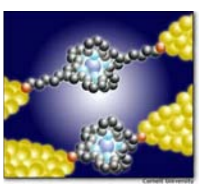
To ensure the highest quality in processing and recommending proposals for awards, MPS convenes Committees of Visitors, composed of qualified external evaluators, to review each program every three years. These experts assess the integrity and efficiency of the processes for proposal review and provide a retrospective assessment of the quality of results of NSF's investments.

The Directorate also receives advice from the Advisory Committee for Mathematical and Physical Sciences (MPSAC) on such issues as: the mission, programs, and goals that can best serve the scientific community, how MPS can promote quality graduate and undergraduate education in the mathematical and physical sciences, and priority investment areas in MPS-supported research. The MPSAC meets twice a year and members represent a cross section of the mathematical and physical sciences with representatives from many different sub-disciplines within the fields as well as a cross section of institutions including industry, broad geographic representation, and balanced representation of women and under-represented minorities.

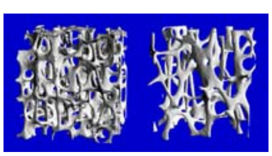
PERFORMANCE

Mathematical and Physical Sciences Research Highlights for FY 2002

Examples of significant discoveries or advances resulting from MPS-supported research include:



- An interdisciplinary team of physicists and chemists led by Paul McEuen, Dan Ralph and Hector Abruna at Cornell University has fashioned transistors from single molecules. When electronic devices are shrunk to the nanometer scale, they enter a physical regime different than larger devices. As part of their explorations of electron motion on the smallest possible length scales, the group has demonstrated a transistor device that reaches the ultimate limit in which an electron hops on and off a single atom between two contacts.

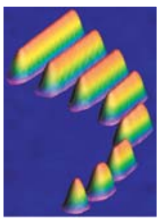


- Scientists at the University of Houston have developed computer-based models of the structure of porous bones, discovering a new relationship between the loss of bone strength and reductions of bone density. The findings may improve bone density tests as well as serving as a new diagnostic tool for estimating the strength of elastic networks.

- For the first time, scientists have detected the seeds of matter that led to the formation of clusters of galaxies. The techniques used by researchers at the California Institute of Technology to make this discovery will also provide more accurate measurements of the fundamental parameters that determine the structure and evolution of the universe.

- At Hampton University, the Center for the Study of the Origin and Structure of Matter will help develop detectors for the Large Hadron Collider at CERN, a facility that will examine the structure of matter. In addition to participating in the research, the Center will build and strengthen a collaborative network of researchers at Historically Black Colleges and Universities, and will encourage K-12 students to pursue careers in science.

- At the University of North Carolina, the Science and Technology Center for Environmentally Responsible Carbon Dioxide Processes is devising ways to replace aqueous and organic solvents in key manufacturing and service processes with liquid carbon dioxide. The Center is expected to have a significant impact in replacing solvents that can harm the environment, such as those used in textile dying, degreasing, and cleaning.



- Scientists at the University of California, Irvine have been able to construct gold wires a single atom in diameter. At left is a scanning tunneling microscope image of a series of gold chains, with the chain in the upper left being 20 atoms long. Although this technology is in its infancy, such wires might be used to connect molecules to form a molecular circuit, with the possibility of controlling and altering the behavior of the individual molecules in the circuit. In principle, it might be possible to construct a motor that could be controlled to carry out specific functions at the molecular level (Image courtesy of Wilson Ho, University of California, Irvine).

- **The 2002 Nobel Prize in Chemistry:** One of the recipients is John Fenn of Virginia Commonwealth University. Fenn developed techniques that allow large biologically important molecules such as proteins to be placed in a gaseous state, where their components can be analyzed and identified by the technique of mass spectroscopy. This ability to "make elephants fly," as Fenn describes it, is used to analyze the chemical composition of proteins rapidly and accurately. The technique has been critical to advances in the development of pharmaceuticals and to progress in the field of proteomics.

- **The 2002 Nobel Prize in Physics:** One of the recipients is Raymond Davis, Jr., of the University of Pennsylvania and the Brookhaven National Laboratory, who pioneered experiments in the 1960s to detect neutrinos from the Sun. His experiment detected significantly fewer neutrinos than predicted by models of the interior of the Sun, stimulating decades of theoretical and experimental work to resolve the discrepancy. This result played a major role in development of the theory that neutrinos change from one type to another and that at least one type actually does have mass.

- **The 2002 Fields Medal:** Vladimir Voevodsky, currently at the Institute for Advanced Study in Princeton, New Jersey, shared the 2002 Fields Medal with Laurent Lafforgue of the Institut des Hautes Études Scientifiques (IHÉS) in France. The Fields Medal is the world's highest honor for mathematical research. Voevodsky conducted his prize-winning research in algebraic geometry and number theory, developing novel ways to describe the geometric shapes of solutions to algebraic equations.

Other Performance Indicators

The tables below show the growth in the number of people benefiting from MPS's funding, and trends in growth of award size, duration and number.

Number of People Supported in MPS Activities

	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate
Senior Researchers	5,769	6,400	6,000
Other Professionals	1,149	1,170	1,100
Postdoctorates	2,215	2,240	2,300
Graduate Students	7,002	6,400	7,000
Undergraduate Students	6,068	3,200	6,000
K-12 Students	225	285	390
K-12 Teachers	784	700	800
Total Number of People	23,212	20,395	23,590

MPS Funding Profile

	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate
Number of Requests for Funding	8,835	8,500	9,000
Dollars Requested (in millions)	$6,739	$6,800	$6,900
Total Number of Awards	4,879	4,750	4,800
Statistics for Competitive Awards:			
Number	2,105	1,900	2,100
Funding Rate	35%	35%	35%
Statistics for Research Grants:			
Number of Research Grants	1,613	1,550	1,600
Median Annualized Award Size	$83,319	$88,000	$100,000
Average Annualized Award Size	$111,601	$124,000	$145,000
Average Award Duration, in years	3.1	3.0	3.2

ASTRONOMICAL SCIENCES $183,070,000

The FY 2004 Request for the Astronomical Sciences (AST) Subactivity is $183.07 million, an increase of $21.82 million, or 13.5 percent, over the FY 2003 Request of $161.25 million.

Astronomical Sciences Funding
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Astronomical Research	165.99	161.25	183.07	21.82	13.5%
Total, AST	$165.99	$161.25	$183.07	$21.82	13.5%

NSF is the lead federal agency for ground-based astronomy, providing about two-third of the federal support for this area of science, including almost all federal support for radio astronomy.

AST includes support for astronomical and astrophysical studies of the origins and characteristics of planets, the Sun, other stars, our galaxy, extragalactic objects such as clusters of galaxies and quasars, and the structure and origin of the Universe. The development of advanced technologies and instrumentation, and university radio observatories are also supported. Support includes funding for undergraduate and graduate students and postdoctoral fellows. Also supported within this area is NSF's Electromagnetic Spectrum Management (ESM) program, which participates with other federal agencies in coordinating the use of the electromagnetic spectrum for research and other activities.

The FY 2004 Request includes $77.24 million for research and instrumentation support in the Astronomical Sciences that will advance research in cosmology and the origin and evolution of the universe, the formation of stars and planets, and particle astrophysics. A number of these activities involve interagency partnerships. A new focus on providing support for mid-scale instrumentation needs will address community priorities such as the development of adaptive optics systems for telescopes and the availability of modern, instrumented small aperture telescopes for programs of student training, research, and educational/public outreach. Support will also be provided for research and development that may lead to highly recommended new facilities such as the Giant Segmented Mirror Telescope (GSMT) and Large-Aperture Synoptic Survey Telescope (LSST). Through the Information Technology Research priority area, support will be provided for research and applications in databases, data mining, and high-speed computation. The Science and Technology Center (STC) for Adaptive Optics will be funded within AST in FY 2004.

- Researchers supported by NSF in the Astronomical Sciences and the Office of Polar Programs extended their work to measure the very faint fluctuations in the microwave light emitted by the hot gas in the early universe, from a time before stars and galaxies formed. Pushing the limits of available technology, the Cosmic Background Imager (CBI) detected minute variations in the cosmic microwave background radiation that show, for the first time, the seeds of matter and energy that would later evolve into clusters of hundreds of galaxies. Their images are the sharpest and most sensitive yet made of the point at which photons were first emitted 14 billion years ago. As the universe expanded, the gravity of dark matter within the clumps made them collapse into clusters of galaxies. (http://www.astro.caltech.edu/~tjp/CBI/)

- A team of astronomers from the Sloan Digital Sky Survey (SDSS) collaboration has discovered a stream of stellar debris emanating from a star cluster that is being torn apart by the Milky Way. The

detection of this stream, the first of its kind, supports theorists' view that star clusters are destroyed by the tidal forces of the Milky Way. Such extended streams of tidal debris provide a new way to determine the mass distribution of the dark matter halo of our galaxy.
(http://www.sdss.org/news/releases/20020603.pal5.html)

Astronomical Sciences includes support for four national facilities: the National Astronomy and Ionosphere Center (NAIC), the National Optical Astronomy Observatories (NOAO), the National Solar Observatory (NSO), and the National Radio Astronomy Observatory (NRAO). Also included is the U.S. share of operations for the International Gemini Observatory, twin 8-meter telescopes located in the northern and southern hemispheres. These facilities together provide world-class observing capabilities throughout the electromagnetic spectrum, from radio to infrared and optical regimes of the electromagnetic spectrum.

FY 2004 support for national facilities totals $105.83 million, an increase of $8.90 million, and includes:

- Support for Gemini Observatory at a level of $14.20 million, an increase of $1.60 million. Both the northern and southern Gemini telescopes are now in regular science operations. The Gemini Observatory, an international partnership with six other countries, and the premier optical/infrared facility available to the entire U.S. astronomical community, remains the highest priority among our optical and infrared facilities. Included in this amount is $1.0 million for partial return of the Chilean construction capital, with which the U.S. assumes a portion of the Chilean share of the Observatory, gaining increased observing access for U.S. astronomers.

- NAIC will be supported at the level of $10.30 million, an increase of $1.30 million. This level of support will enable continued operation and maintenance of the renovated Arecibo telescope and the development of instrumentation to take advantage of its greater sensitivity. Additional support of $1.80 million is provided through the Geosciences Activity.

- Support for NOAO/NSO at the level of $38.60 million, an increase of $2.90 million. NOAO provides optical/infrared observational facilities to the U.S. astronomical community in both the northern and southern hemispheres, and operates the U.S. Gemini Science Center, which provides support for U.S. astronomers to use the Gemini Observatory. NOAO is leading the community effort to establish a detailed scientific justification and conceptual design for the Giant Segmented Mirror Telescope (GSMT) and the Large-Aperture Synoptic Survey Telescope (LSST), both of which were highly recommended future facilities in recent community reports. NSO facilities provide solar telescopes for use by the U.S. astronomical community. Activities in FY 2004 include continued design and planning for the Advanced Technology Solar Telescope (ATST), an instrument that will use new techniques such as adaptive optics to provide a unique capability for investigating a wide range of important questions in solar physics. ATST will be of significant value to studies in atmospheric sciences and space weather in addition to astronomical research. Included also within this amount is $4.0 million for the Telescope System Instrumentation Program (TSIP), which is administered for the community through NOAO. TSIP, which began in FY 2002, is a program to unify the privately held and the national optical and IR observatory facilities through a program of support for instrument development and facility improvement in exchange for public access to private facilities.

- NRAO is supported at the level of $42.73 million, an increase of $3.10 million. This level of support will provide for operations, maintenance, and instrumentation for the unique telescopes of NRAO, such as the Robert C. Byrd Green Bank Telescope, the Very Large Array (VLA), and the Very Long Baseline Array. Activities in FY 2004 include making continued improvements and enhancements to the expanded VLA and optimization of science operations of the Byrd Telescope.

CHEMISTRY $181,710,000

The FY 2004 Request for the Chemistry (CHE) Subactivity is $181.71 million, an increase of $20.91 million, or 13.0 percent, over the FY 2003 Request of $160.80 million.

Chemistry Funding
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Chemistry Research	162.82	160.80	181.71	20.91	13.0%
Total, CHE	$162.82	$160.80	$181.71	$20.91	13.0%

The single unifying theme in chemistry is the chemical bond, the bond that links atoms together into myriad forms of matter that define our existence. CHE supports research that enables matter to be manipulated, measured, and modeled through management of chemical bonds. The level of sophistication with which this can now be done is illustrated by the ability to image and position individual atoms and molecules; to watch chemical bonds form and break on time scales as short as femtoseconds; to prepare and screen enormous libraries of chemical compounds for desired characteristics; and to calculate physical and chemical properties of matter with great accuracy. Chemical advances are leveraged by sharing them with researchers in other disciplines, including interdisciplinary fields like nanotechnology and biotechnology.

Chemistry directly impacts our daily lives through its contributions to production of food, shelter, clothing, energy, medicine, and countless products that enhance our quality of life. Basic research, education, and instrumentation supported by CHE contribute to environmental quality and to industrial strength through advancements in fundamental knowledge and the professional development of our technical workforce. Approximately three-fourths of the CHE investment is in individual investigators and collaborative research centers, with the balance in instrumentation and human resource development.

Noteworthy developments involving CHE-supported scientists this year included the following:

- One of the recipients of the 2002 Nobel Prize in Chemistry is John Fenn of Virginia Commonwealth University. Fenn developed techniques that allow large biologically important molecules such as proteins to be placed in a gaseous state, where their components can be analyzed and identified by the technique of mass spectroscopy. This ability to "make elephants fly," as Fenn describes it, is used to analyze the chemical composition of proteins rapidly and accurately. The technique has been critical to advances in the development of pharmaceuticals and to progress in the field of proteomics.

- Joseph DeSimone of the University of North Carolina-Chapel Hill and colleagues, in collaboration with DuPont, introduced a new technology for manufacturing Teflon® and related fluoropolymers based on environmentally benign supercritical carbon dioxide as a solvent. DuPont has built a $40 million pilot plan in North Carolina to exploit these scientific advances. This work also shows promise for use in industries ranging from dry cleaning to microelectronics.

- Bruce Lipshutz of the University of California at Santa Barbara and co-workers developed a method to synthesize Coenzyme Q10 in fewer steps and in higher yield than had previously been accomplished. Q10 has been described as a “miracle nutrient” because of its potential to invigorate our cells, fight a variety of diseases, and perhaps even slow the aging process. Lipschutz’s discovery promises to provide an inexpensive commercial synthesis to this important compound.

The FY 2004 Request of $181.71 million, an increase of $20.91 million, includes:

- Support for CHE core programs devoted to basic chemical research will grow by $5.85 million to $134.45 million in FY 2004. Additional funds will be used largely to increase average grant size and duration and to support new principal investigators.

- Support for chemistry centers will increase by $9.31 million to $19.70 million. In addition to the Environmental Molecular Science Institutes and Collaborative Research in Chemistry centers, Chemical Bonding Centers (CBCs), will be launched. The CBCs will allow large teams of researchers to attack grand challenges in chemical bonding, such as “How are bonds made and broken as reactants transform into products?” Quantum Science and Technology (QST) will receive enhanced emphasis, both in center and core individual investigator projects, reflecting the critical role that quantum mechanics plays in understanding and manipulating chemical bond formation.

- Support will be initiated for mid-scale instrumentation that exceeds what is available in cost and scope through the Chemistry Research Instrumentation and Facilities program and the NSF Major Research Instrumentation program. Pilot projects and workshops that identify appropriate investment strategies will be supported with an additional $1.21 million. Support for ruggedized, miniaturized, low-cost instrumentation that can make workhorse instruments like mass spectrometers and nuclear magnetic resonance spectrometers more accessible will be provided through existing programs.

- CHE will provide $2.10 million for new undergraduate and postdoctoral programs that draw on the nation’s rich geographic, institutional, and demographic diversity. Undergraduate Research Centers will support faculty teams working with teams of first- and second-year college students to attract a larger and more diverse group of students to the technical workforce. Additional international Research Experience for Undergraduates sites will be supported. Discovery Corps, a postdoctoral program, will be piloted to enhance research skills and contribute to the development of national research infrastructure.

- CHE support for the NSF priority area in nanoscale science and engineering will increase by $910,000 and will include the Nanotechnology Undergraduate Education initiative, whose impact on technical workforce development and science literacy will be evaluated.

- CHE will increase funding for programs designed to increase the participation of underrepresented groups in chemistry research and the overall number of students going into chemistry by $1.53 million.

- Support for the National High Field Mass Spectrometry Facility is being integrated into the National High Magnetic Field Laboratory (NHMFL) and future funding will be provided through NHMFL. CHE will provide $500,000 in FY 2004 for the NHMFL to support this facility. Total funding for the NHMFL in FY 2004 is $24.50 million, with the remainder of funds coming from the Materials Research Subactivity.

MATERIALS RESEARCH $246,120,000

The FY 2004 Request for the Materials Research (DMR) Subactivity is $246.12 million, an increase of $26.80 million, or 12.2 percent, from the FY 2003 Request of $219.32 million.

Materials Research Funding
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Materials Research	219.37	219.32	246.12	26.80	12.2%
Total, DMR	$219.37	$219.32	$246.12	$26.80	12.2%

DMR supports research and education to advance the fundamental understanding of materials, to enable the development of materials with superior properties, and to enhance the understanding of the interconnections among synthesis, processing, composition, structure and properties of materials and how these factors affect their performance. Materials research integrates a wide range of activities spanning both science and engineering. It extends from investigations of fundamental phenomena in condensed matter physics and solid-state chemistry to research on functional materials including metals, ceramics, polymers, biomaterials, and electronic, photonic and magnetic materials. Its practitioners include physicists, chemists, materials scientists, and engineers, and, increasingly, it benefits from the participation of researchers from an even wider range of disciplines such as biochemistry, biology, earth sciences, mathematics, computer science, and medicine.

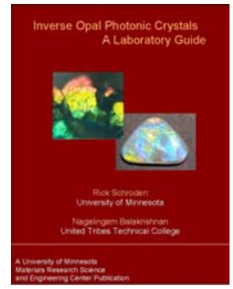
NSF provides about half the total federal support for university-based basic research in materials. The technological and societal significance of the field is far-reaching. DMR supports education, fundamental research and facilities that are critically important to the future advancement of industries and technologies ranging from electronics and communications to information technology, transportation and aerospace, energy, environmental protection, manufacturing, medicine and health care, packaging, and civil infrastructure. More than half of DMR's portfolio consists of support for individual investigators and focused research groups. The balance supports 29 Materials Research Science and Engineering Centers (MRSECs), and experimental facilities for shared use, including the National High Magnetic Field Laboratory (NHMFL), user facilities for x-ray synchrotron radiation and neutron scattering, and a new Science and Technology Center in materials and devices for information technology research.

Researchers and educators supported by DMR made exciting progress this year. For example:

- Max Lagally and colleagues at the University of Wisconsin have shown that nanoscale interfaces between two mismatched crystalline materials induce stresses that may have a surprisingly large effect on the fabrication and performance of ultra-small microelectronic devices.

- Strength and ductility are two important mechanical properties of any material system, but materials are rarely strong and ductile at the same time. En Ma and colleagues at the Johns Hopkins University have developed a new metal-processing technique that produces a strong, ductile material composed of a combination of micrometer- and nanometer-sized grains. This research may point the way to a new generation of super-strong high-ductility alloys.

- The Materials Research Science and Engineering Center at the University of Minnesota supports a comprehensive education program involving the Native American community through partnerships with Tribal Colleges in the upper Midwest. Recently, faculty and students from Tribal Colleges and the Center teamed up to develop a *Photonic Crystals Laboratory Guide* which includes step-by-step procedures for the synthesis of photonic crystals based on metal oxides. Instructors at Tribal Colleges, four-year colleges, and universities can download the guide from the Web at no charge.



The FY 2004 Request includes several enhancements and new activities:

- DMR will increase support for the NSF priority area in nanoscale science and engineering by \$5.30 million to \$76.23 million in FY 2004. The increment will include partial support for up to five new nanoscale science and engineering centers, support for new awards through core programs, and support for the National Nanotechnology Infrastructure Network (NNIN). Overall DMR support for other NSF priority areas (ITR, BE and Mathematics) will increase by \$1.36 million to a total of \$12.09 million.

- Support for research into the fundamental physics and chemistry of materials and investigation of materials phenomena in DMR core programs will be enhanced by up to \$10.0 million, primarily through awards to individual investigators and focused research groups. This will include enhanced support for Quantum Science and Technology (QST), using the coherent control of quantum phenomena toward applications that may include quantum computing, mesoscopic physics, the manipulation of nuclear or electronic spin states, quantum electronics in nanoscale organic and inorganic materials, and the probing and manipulation of materials processes and properties.

- Up to \$2.0 million will be provided to establish four to five additional Partnerships for Research and Education in Materials in FY 2004 (formerly Collaboratives for Materials Research and Education in the FY 2003 Request), enabling minority-serving institutions to strengthen their research and education activities in materials through links to existing materials groups, centers and facilities. Support for international collaboration in materials research and education through centers and disciplinary research programs will be enhanced by up to \$3.0 million, and \$1.80 million will be provided to establish two to three new International Materials Institutes through open competition.

- An additional \$4.50 million will be provided in FY 2004 to enhance operations supporting fundamental research at DMR user facilities, and to plan the development of new mid-scale research resources, including synchrotron and neutron beam lines whose cost and scope is beyond that of the NSF Major Research Instrumentation (MRI) program. This amount includes up to \$2.0 million to support initial planning for beam line instrumentation at the DOE Spallation Neutron Source (SNS).

- DMR support for the National High Magnetic Field Laboratory will be unchanged at \$24.0 million in FY 2004, although an additional \$500,000 will be provided to the NHMFL through the Chemistry Subactivity to support the integration of the National High Field Mass Spectrometry Facility into the NHMFL.

MATHEMATICAL SCIENCES $201,870,000

The FY 2004 Request for the Mathematical Sciences (DMS) Subactivity is $201.87 million, an increase of $20.0 million, or 11.0 percent, over the FY 2003 Request of $181.87 million.

Mathematical Sciences Funding
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Mathematical Sciences	151.53	181.87	201.87	20.00	11.0%
Total, DMS	$151.53	$181.87	$201.87	$20.00	11.0%

Advances in science and engineering, driven in part by increasingly sophisticated and readily available computing environments, have lifted the mathematical sciences to the forefront of science and engineering, reshaping modern discovery through quantitative predictions, instrumentation development, modeling, visualization, computational algorithms, and optimization methods. Science and engineering are becoming more mathematical and statistical, not only in the physical, engineering and informational sciences, but also the biological, geophysical, environmental, social, behavioral, and economic sciences.

NSF has a crucial role in the support of basic academic research in the mathematical sciences, providing more than 58 percent of all federal university-based support. NSF-supported research involves a broader range of infrastructure, fundamental research, and multidisciplinary research topics than that sponsored by other federal agencies that support academic mathematical sciences research. Especially important is the critical function of the mathematical sciences in the education and training of the nation's scientific and engineering workforce.

DMS includes areas such as analysis, geometry, topology, foundations, algebra, number theory, combinatorics, applied mathematics, statistics, probability, biomathematics, and computational mathematics. Awards in these areas support a variety of research projects, multidisciplinary projects, and Focused Research Groups, with some grants including funding for graduate and postdoctoral students as well as for workshops, computing equipment and other research and education needs. In addition, DMS supports infrastructure efforts across the mathematical sciences, including national research institutes, postdoctoral research fellowships, graduate education, broadened career experiences for researchers, increased participation in the nation's research personnel base, research conferences and workshops, shared scientific computing research equipment, and undergraduate investments such as Research Experiences for Undergraduates (sites and supplements).

The pervasive nature of the mathematical sciences in underpinning and enabling much of today's scientific, engineering, and commercial activities is illustrated by the following examples:

- Researchers in a Focused Research Group at Stanford University are developing topological methods in data analysis. This project brings sophisticated ideas from the mathematical sciences, including algebraic topology, probability, and statistics, together with techniques from computational mathematics and computer science, to develop new methods to analyze data that are difficult to investigate using classical linear methods. These new methods will be especially useful when the data is obtained by sampling with noise from highly curved or singular spaces in high-dimensional spaces.

- A researcher at Cornell University applying algebraic techniques to combinatorial problems that arise in discrete and convex geometry has made recent progress in enumerating the faces of complex polytopes by introducing techniques from algebraic geometry. The type of information sought has been of use in the design of geometric algorithms for problems in robotics and motion planning and, more recently, in the analysis of randomization schemes for the management of data.

- Researchers at the University of Minnesota and Cornell University have developed probabilistic models to understand the ability of competing species to co-exist. The model was developed to study the ability of different strains of the barley yellow dwarf virus to co-exist.

- A researcher and his colleagues at the Santa Fe Institute have used ideas from the economic theories of risk aversion to create a general model of yield-risk management that produces strategies to minimize the likelihood of total ruin. The design principle, called "constrained optimization with limited deviations" or COLD, allows the effective elimination of the likelihood of disasters if one accepts a very small loss in average system performance. This method was used to study a problem in which forest managers are faced with maximizing timber yields with acceptable levels of risk.

- The Institute for Pure and Applied Mathematics at UCLA conducted a program on "Large Scale Communication Networks" in March-June 2002 that included discussions of packet-switching protocols and their optimization. A revision of the Internet's basic transmission control protocol (TCP) developed in that research program was successfully implemented and tested in November 2002 by a Caltech/SLAC research team working on fast, large networks for supercomputing.

The FY 2004 Budget Request of $201.87 million will enhance interdisciplinary research groups and other collaborative mechanisms that integrate the mathematical sciences with chemistry, materials research, physics, astronomy and other sciences and engineering.

Of special importance in FY 2004 is the Mathematical Sciences priority area investment of $67.39 million, an increase of $20.0 million over the FY 2003 Request. This investment reflects the importance of mathematical and statistical sciences in the kinds of crosscutting science and engineering research areas described above.

The FY 2004 increase in DMS will support:

- Research in dynamical systems, structure and geometry of the physical world, and other mathematical and statistical fundamental research necessary to support advances in interdisciplinary fields.

- Focused mathematical sciences research teams, interdisciplinary training groups, and other collaborative mechanisms related to advancing science and engineering, including continuation of the GEO-Math partnership for collaborative research in the mathematical sciences and geosciences. The FY 2003 interagency partnerships with the Defense Advanced Research Projects Agency (DARPA) and the National Institutes of Health (NIH) will be continued and it is anticipated that additional new collaborations with engineering and the biological, physical and computer sciences will be initiated.

- Enhancement of the national institutes in the mathematical sciences that address the growing interface between the mathematical sciences and other disciplines and the mathematical and statistical problems whose solutions will contribute to both fundamental knowledge and national needs. In FY 2002, three new national institutes were established.

- Enhancement of research training activities in the mathematical sciences.

PHYSICS $217,500,000

The FY 2004 Request for the Physics Subactivity is $217.50 million, an increase of $24.19 million, or 12.5 percent, over the FY 2003 Request of $193.31 million.

Physics Funding
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Physics Research	195.88	193.31	217.50	24.19	12.5%
Total, PHY	$195.88	$193.31	$217.50	$24.19	12.5%

The Physics Subactivity (PHY) supports fundamental research in a broad range of physical phenomena, including support in: atomic, molecular, optical, and plasma physics; elementary particle physics; gravitational physics; nuclear physics; particle and nuclear astrophysics; and theoretical physics. Physics also supports interdisciplinary research, including: biological physics, complex systems, turbulence, and other developing interface areas associated with the core disciplines, for example the interface with information technology. The impact of physics research extends far beyond physics as a result of the discovery of new phenomena and the development of new techniques and basic tools that advance other fields, e.g., laser technology, biomedical technology, information technology, nanotechnology, energy science, including nuclear science, and many other techniques used in high technology industries.

Typical awards include funding for faculty salary support, graduate students, post-doctoral associates, instrumentation development, and other research needs. PHY supports an increasingly vigorous effort in the integration of research and education, including support of the Research Experience for Undergraduates (REU) program, the Faculty Early Career Development Program (CAREER), and important and innovative new outreach efforts aimed at improving links to K-12 teachers and students. The REU program continues to be very successful at reaching underrepresented minorities and women.

PHY provides support for a large portion of university-based research in the physics sub-disciplines, ranging from nearly 100 percent for gravitational physics to 30-50 percent for the other physics programs. The scope of support ranges from individual-investigator awards for research based at the investigator's home institution, to awards to major user groups with principal responsibility for experiments at national or international user facilities. PHY also supports centers and institutes in many areas and national user facilities for certain subfields. The user facilities represent important elements of the national infrastructure: in elementary particle physics, the Cornell Electron Storage Ring (CESR); in nuclear physics, the Michigan State University National Superconducting Cyclotron Laboratory; and in gravitational physics, the Laser Interferometer Gravitational-Wave Observatory (LIGO). Center activities include: support for Physics Frontiers Centers, including centers in the areas of biological physics, cosmological physics, gravitational physics, coherent ultrafast optical science, and the structure and origin of matter, the latter at an HBCU (Historically Black College or University); and a new Science and Technology Center (STC) in biophotonics.

In a recent development at the Physics Frontiers Center 'Frontiers of Optical, Coherent and Ultrafast Science' (FOCUS) at the University of Michigan, investigators succeeded in laser-cooling, trapping, and imaging individual cadmium ions for use in quantum information experiments. This was the first demonstration of sympathetic cooling of a single atom that can be simultaneously optically addressed. This technique will be extremely important for the future use of a register of Cd^+ ions for quantum computing, where sympathetic cooling would quench possible motional decoherence without destroying internal quantum coherence.

PHY oversees a construction project funded through the Major Research Equipment and Facilities Construction (MREFC) Account – the Large Hadron Collider (LHC) ATLAS and CMS detectors. Construction funding for the LHC detectors began in FY 1999 and concludes in FY 2003 (see the MREFC chapter for additional information). LIGO, which was also funded through the MREFC Account, is fully operational in FY 2004, with all interferometers operating in coincidence (the 2- and 4-km interferometers at Hanford and the 4-km interferometer at the Livingston site; see the Tools chapter for additional information).

Some recent trends and areas of future emphasis are particle and nuclear astrophysics, biological physics, computational and information-intensive physics, and underground science. New programs have been established to emphasize these topics. The particle and nuclear astrophysics program has been reinforced by the recent report "Connecting Quarks to the Cosmos: Eleven Science Questions for the New Century" (National Academies Press, 2002). The FY 2003 Request called for a major NSF-sponsored workshop on neutrino physics and underground science and a National Academy of Sciences assessment of the need for investment in this field. Both the workshop (Neutrino and Subterranean Science, 17-19 September, 2002) and the report ("Neutrinos and Beyond: New Windows on Nature" (National Academies Press, 2002)) have been completed; with an emphasis on research needs in underground science.

In concert with other MPS subactivities, PHY will increase its emphasis of support for mid-scale instrumentation such as, moderate-scale neutrino, cosmic ray and gamma ray detectors, and the development of resources such as grid computing which serve the data requirements of several information-intensive physics and astrophysics experiments. Another area of increased emphasis is Quantum Science and Technology (QST). In the area of QST, PHY will emphasize quantum information science with support of forefront research in the cooling, trapping, and manipulation of atoms using ultrafast and ultracold techniques.

The FY 2004 Request for PHY includes:

- An increase of $10.68 million in research projects to a total of $140.30 million. PHY will continue to support forefront areas of physics, with some emphasis on particle and nuclear astrophysics, computational and information-intensive physics, quantum information science, biological physics and on advanced R&D towards next generation particle accelerators and gravitational wave detectors. Education and outreach activities will receive continued emphasis: enhancing K-12 science teacher training, expanding diversity within the research community, integrating research and education, and broadening the role physics plays in new and emerging areas of research, including the training of young physicists. Part of this increase will provide support for the new STC in biophotonics ($3.96 million).

- An increase of $13.51 million for facilities and research resources to a total of $77.20 million includes: support for full operations of the Michigan State National Superconducting Cyclotron Laboratory's radioactive ion beam facility for a total of $15.20 million; support full operations of LIGO to a total of $29.0 million as the lab focuses on coincidence observations between the lab's two detector sites as well as with foreign gravitational wave detectors; and an increase of $1.51 million for CESR operations to a total of $21.0 million, to enable exploration of critical weak and strong elementary particle interaction phenomena and to sustain the important accelerator physics research activity at Cornell. Early operations of the LHC ATLAS and CMS detectors will be supported for a total of $10.0 million. Development of grid computing capabilities will continue at a total of $2.0 million.

MULTIDISCIPLINARY ACTIVITIES $31,000,000

The FY 2004 Request for the Multidisciplinary Activities Subactivity is $31.0 million, an increase of $5.98 million or 23.9 percent over the FY 2003 Request of $25.02 million.

Multidisciplinary Activities Funding
(Dollars in Millions)

	FY 2002 Actual	FY2003 Request	FY2004 Request	Change Amount	Change Percent
Research Project Support	24.83	25.02	31.00	5.98	23.9%
Total, OMA	$24.83	$25.02	$31.00	$5.98	23.9%

The Multidisciplinary Activities Subactivity (OMA) enables and facilitates MPS support of particularly novel, challenging, or complex projects of varying scale in both research and education that are not readily accommodated by traditional organizational structures and processes. This is done primarily in partnership with the five other MPS Subactivities to encourage multidisciplinary proposals from all segments of the MPS community and especially to encourage initiatives by multi-investigator, multidisciplinary teams pursuing problems on a scale that exceeds the capacity of individual investigators. Most often, these cooperative undertakings involve two or more partners – both from MPS and beyond – that join with OMA to push in new directions of scientific understanding and that broaden and enrich education and research training activities in the MPS disciplines. Examples of such multi-investigator, multidisciplinary and often multi-institutional projects facilitated by OMA include the initial awards in Collaboratives for Research in Chemistry, Environmental Molecular Science Institutes, and Physics Frontier Centers.

OMA facilitates partnerships between MPS and other NSF activities, other agencies, industry, national laboratories, state and local governments, and international organizations. Such partnerships are critically important to the pursuit of the strategic goals of the Foundation and of the MPS community and contribute significantly to the preparation of a diverse workforce that is broadly trained, flexible, and globally competitive. Facilitation by OMA of both disciplinary partnerships and organizational partnerships is vital to the accelerated discovery of new ideas, the development of new tools, and the broadened training necessary to enable the Nation's workforce to meet new and rapidly evolving demands. Examples of the importance of such partnerships are seen in the Grant Opportunities for Academic Liaison with Industry (GOALI) program, the NSF-European Commission cooperation in international research and research training, the MPS, ENG, SBE and DOE cooperative development and support of the Pan American Advanced Study Institutes program, and the NSF-EPA partnership in support of research in technology for a sustainable environment and in environmental statistics.

The Subactivity supports innovative experiments in physical science and mathematics education that could lead to new paradigms in disciplinary and multidisciplinary graduate and undergraduate education. It also is a focal point within MPS for activities to facilitate the development of a diverse and globally competitive workforce. The MPS research infrastructure serves as a resource to enhance the K-12 teaching cohort and broaden the discovery-based learning experiences of K-16 students, and to draw upon MPS-supported research as an effective platform for public science education. Examples of OMA investment in these educational arenas include Research Experiences for Teachers, which provides in-service and pre-service K-12 teachers with discovery-based learning experiences in the MPS disciplines; support, in partnership with the EHR/DUE Subactivity, of a new multi-institutional, multidisciplinary Center for the Integration of Research, Teaching, and Learning at the University of Wisconsin which, in collaboration with Michigan State University and Pennsylvania State University, is creating an interdisciplinary program to prepare graduate students, postdoctoral researchers, and current faculty to meet the challenges of STEM higher education; and support for Internships in Public Science Education (IPSE), a program that brings recent science results from MPS-supported research to the public by promoting partnerships between the MPS research community and specialists in public science education.

In FY 2004, OMA will continue to work with other MPS Subactivities and programs across the Foundation with an emphasis on fundamental research in the area of Quantum Science and Technology (QST), research at the interface between MPS and the Biological Sciences Activity, and an MPS focus on mid-scale instrumentation.

The FY 2004 Request of $31.0 million, an increase of $5.98 million, includes:

- Support for the Research Experiences for Teachers program will be increased by $500,000 to provide enriching discovery-based learning experiences for in-service and pre-service K-12 teachers.

- Increase support for GK-12 program by $430,000 to $2.40 million.

- Support for research partnerships with the other MPS Subactivities, including Research Partnerships for Diversity, that attract and retain individuals from traditionally underrepresented groups into doctoral programs in the MPS disciplines will be increased by $1.50 million.

- An investment of $1.0 million will support a new partnership with the DOE Office of Science will enable undergraduate students and faculty from underserved undergraduate institutions to participate in research activities at infrastructure-rich National Laboratories.

- Support of cooperative international research and training activities will be increased by $500,000 to enhance the global competitiveness of U.S. scientists, engineers, and students. Activities such as the MPS Distinguished International Postdoctoral Research Fellowship program and other such programs enable graduate students, postdoctorals, and faculty in the MPS disciplines to carry out research at the world's leading facilities and laboratories to develop and to enrich essential international dimensions of their individual research and education programs.

- Investment in research by multidisciplinary groups of scientists, mathematicians, and engineers leading to the development of next-generation instrumentation, particularly mid-scale instrumentation, will be increased by $1.0 million. Such instrumentation integrates modeling, computation and measurement to enable fundamental advances and broad training across a wide spectrum of disciplines.

- The Grant Opportunities for Academic Liaison with Industry (GOALI) program, which affords a vital mechanism for broadening graduate and postdoctoral training, will be continued at a level of $3.0 million, unchanged from FY 2003.

- Support for activities that draw upon the extensive MPS research investment for public science education will be increased by $500,000. The MPS Internships in Public Science Education activity supports partnerships between MPS researchers and the public science education communities, with focused emphasis on MPS-supported research centers and facilities.

- Support at the level of $1.92 million will facilitate the launch of the innovative Chemistry Undergraduate Research Centers (URCs) program and the attendant Discovery Corps.

SOCIAL, BEHAVIORAL AND ECONOMIC SCIENCES

SOCIAL, BEHAVIORAL AND ECONOMIC SCIENCES $211,740,000

The FY 2004 Budget Request for the Social, Behavioral and Economic Sciences (SBE) Activity is $211.74 million, an increase of $16.13 million, or 8.2 percent, above the FY 2003 Request of $195.61 million.

SBE Funding
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Social and Economic Sciences	68.29	77.61	83.92	6.31	8.1%
Behavioral and Cognitive Sciences	58.56	65.30	71.12	5.82	8.9%
Science Resources Statistics	16.28	25.70	26.70	1.00	3.9%
Total, SBE without INT	143.13	168.61	181.74	13.13	7.8%
Office of International Science and Engineering (INT)[1]	40.84	27.00	30.00	3.00	11.1%
Total, SBE with INT	$183.97	$195.61	$211.74	$16.13	8.2%

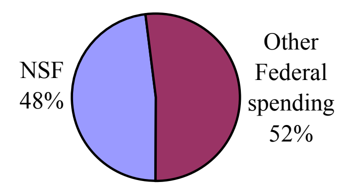
Totals may not add due to rounding.
[1]FY 2002 includes a transfer of $13.66 million from the Department of State for an award to the U.S. Civilian Research and Development Foundation.

The Social, Behavioral and Economics Sciences Activity supports research, infrastructure and education in the social, behavioral, cognitive and economic sciences, primarily through grants to investigators at universities and other institutions. The research it supports has, over the past several decades, resulted in substantial advances in our understanding of human and social development and of how people behave, both as individuals and as parts of groups and other more formal organizations. SBE also supports, through its Science Resources Statistics (SRS) Subactivity, the collection and dissemination of statistics on science resources, and the Office of International Science and Engineering (INT), the focal point for NSF's international science and engineering activities.

RELEVANCE

SBE is a principal source of federal support for fundamental research on human cognition and behavior and social structures and social interaction, as well as for research on the intellectual and social contexts that govern the development and use of science and technology. Overall, SBE accounts for 48 percent of federal support for basic research in the social sciences at U.S. academic institutions. In some fields, including anthropology, archaeology, political science, economics, sociology and the social aspects of psychology, it is the predominant or the exclusive source of federal support for basic research and infrastructure development.

Federal Support for Basic Research in the Social Sciences at Academic Institutions in the U.S. (FY2000)
(excludes the Psychological Sciences)



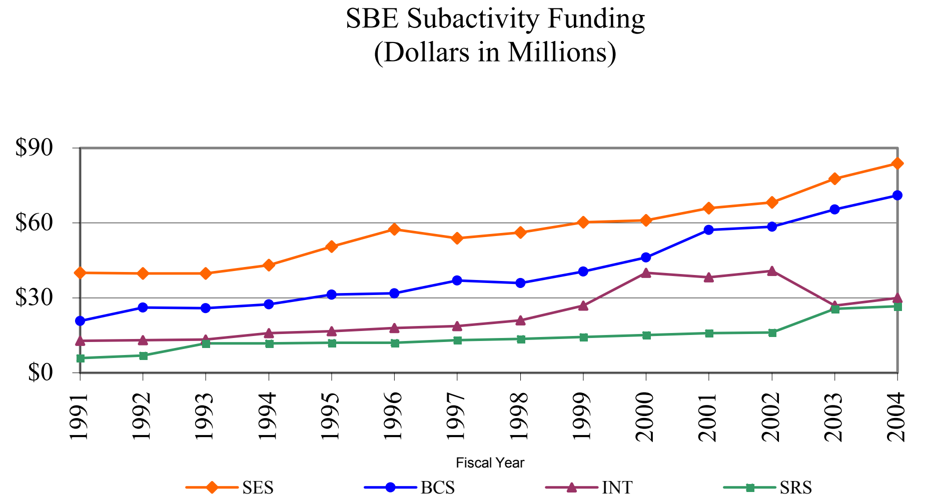
SBE programs advance knowledge about human behavior and society. SBE activities span a wide variety of fields ranging from basic research related to understanding the human mind to studies of the root causes of the nation's most serious social problems such as the determinants of perception, the ways that children learn, how the economy functions, the structure of language, the genesis of crime, and the spread of democracy. Every critical national problem, including terrorism, business failures, and global warming, is rooted in the kinds of behavior the SBE sciences seek to understand.

Because SBE-supported research is often national in scope and because many of the findings derived from SBE-supported research advance basic scientific knowledge or have their most natural applications in the public policy arena, private-sector firms have few incentives to invest in SBE studies. Moreover, the basic nature of most SBE-supported research means that its most likely outputs often appear too far removed from immediate application to interest federal agencies with more focused missions.

NSF maintains the high quality of research it funds by rigorous merit review, including in almost all cases external merit review. Both within and across programs, SBE maintains a mixed portfolio of projects. Some of these involve large investments that will pay off over the long run by supporting not just the work of the investigator but also the work of other researchers who will draw on data the investigator has gathered or on methods the investigator has pioneered. Other SBE-supported work will have more direct short-term benefits or will be high-risk research that may not have obvious benefits at all, but, if it does, has the potential to reshape thinking about a problem or even a field.

The Science Resources Statistics Subactivity within SBE is the Federal statistical agency responsible for the compilation and analysis of data on the science and engineering enterprise. Major components are surveys on the education of the science and engineering workforce and the nation's research and development portfolio. The results of this work are used to assess the state of the nation's domestic workforce in science and engineering, its ability to compete globally and the outlook for the nation's research capacity, over both the near and longer term. Findings from SRS studies have long been important to the development of the nation's educational and science policy agendas.

In January 2002, SBE's Division of International Programs was re-established as the Office of International Science and Engineering in response to the National Science Board's recommendation that international science and engineering be "a high priority for NSF, with a much stronger focus and a much higher level of visibility." The Office serves as a visible focal point, both inside and outside NSF, for international science and engineering activities; promotes the development of an integrated, Foundation-wide, international strategy; and manages international programs that are innovative, catalytic, and responsive to the broad range of NSF interests. INT's enhanced role will support the Foundation's international science and engineering investments in new and vigorous ways.

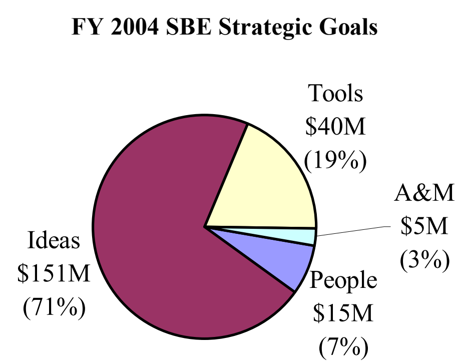


In FY 2000, FY 2001 and FY 2002, INT includes transfers of $15.40 million, $13.75 million, and $13.66 million, respectively, from the U.S. State Department for an award to the U.S. Civilian R&D Foundation.

STRATEGIC GOALS

SBE works to advance the Directorate's programs by linking NSF's three strategic outcome goals of People, Ideas and Tools:

- PEOPLE: SBE seeks to advance its mission by creating research experiences for undergraduates that engage them in the SBE sciences, by providing graduate students with funds to improve their dissertation research, by helping junior faculty become innovative researchers and teachers with the encouragement of CAREER awards and by funding mid-career training of social scientists in emerging, cutting-edge methodologies. Graduate training also is supported through the IGERT program. SBE seeks to enhance diversity through special fellowship competitions; outreach to HBCUs, Hispanic, and other minority serving institutions; and through programs that respond to the need for women in science (e.g., ADVANCE).

  The Office of International Science and Engineering: INT supports the advancement of NSF's strategic outcome goal of People by developing and maintaining a diverse, internationally competitive and globally engaged workforce of scientists and engineers. INT will support international research and training experiences, especially for students and researchers early in their careers, which promote NSF interests and contribute to strengthening the U.S. scientific enterprise.

- IDEAS: SBE supports fundamental, cutting-edge research in the social, behavioral and economic sciences to better understand individual, collective and organizational behavior. The directorate also seeks to facilitate interdisciplinary work across the SBE sciences and with non-SBE sciences in order to clarify complexities of human behavior that cannot be understood from the perspective of only one discipline. SBE's broad range of research is directly aimed at advancing NSF's strategic outcome goal of Ideas. Research in economics, sociology, political science, decision-making, and risk analysis yields theories and information that advance basic science and provide important social benefits in the form of better-informed public policy, more efficient business management, and knowledge that enables wiser individual action. Research findings in the psychological, cognitive, and language sciences yield a sharper picture of human behavior and cognition with diverse implications ranging from advancing general knowledge of how human civilizations spread to laying the groundwork for devices that assist disabled individuals in becoming more independent.

The Office of International Science and Engineering: INT will continue to promote partnerships among U.S. scientists and engineers and their colleagues in foreign nations. The National Science Board has noted that, "Collaborative activities and international partnerships provide increasingly important means of keeping abreast of new insights and discoveries critical to maintaining U.S. leadership position in key fields." Research at the frontier requires partnerships with the world's best scientists and engineers and access to the unique research facilities and opportunities found throughout the world. The investigation of global scale problems and phenomena requires international understanding and collaboration.

- TOOLS: SBE seeks to develop knowledge and resource infrastructures that will allow better measurement and analysis of variables that shape and reflect human and organizational decision-making and behavior. These include large-scale longitudinal surveys, international and organizational databases, laboratories and collaboratories, Internet networks, new methods for modeling behavior, and techniques for incorporating spatial and biological information in models of human activity. The SRS Subactivity of SBE works to meet the statistical demands of a diverse user community interested in the nation's science, engineering, and technology enterprise by providing and disseminating knowledge through survey development, data collection and analysis, information compilation and dissemination, and customer service.

SBE's support for ongoing core and new activities contributes to NSF's efforts to achieve its strategic goals and to the administration and management activities necessary to achieve these goals.

Summary of SBE Funding by Strategic Goal
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	Change Amount	Change Percent
People	11.51	11.02	15.23	4.21	38.2%
Ideas	134.86	143.35	151.15	7.80	5.4%
Tools	33.04	37.99	39.99	2.00	5.3%
Administration and Management	4.56	3.25	5.37	2.12	65.2%
Total, SBE	$183.97	$195.61	$211.74	$16.13	8.2%

People (+$4.21 million, for a total of $15.23 million)

SBE, like other NSF Directorates, regards research and education as mutually reinforcing. The generation of new knowledge and its dissemination so that others may benefit from new scientific understanding go hand in hand. The people supported through SBE-funded projects represent both the focus of our investments and important products of them. Support for programs specifically addressing NSF's Strategic Outcome Goal of People totals $15.23 million in FY 2004, an increase of $4.21 million over FY 2003. Major SBE increases in FY 2004 include IGERT Traineeships, increasing by $1.27 million to $4.88 million, above the FY 2003 Request of $3.61 million; ADVANCE awards, increasing by $460,000 to $1.28 million, above the FY 2003 Request of $820,000; and support for post-doctorates, increasing by $1.50 million, to $2.90 million above the FY 2003 Request of $1.40 million. New initiatives include the selection of up to 100 U.S. graduate students for a new Summer Institute in China for $500,000; and new support for other graduate student and professional participation in international collaborative activities for $200,000. In FY 2004, it is estimated that SBE programs will provide support for about 5,000 people, including students, researchers, post-doctorates, and trainees. People-oriented support includes increased efforts to strengthen the global orientation of the nation's science and engineering workforce by supporting internationally collaborative research as well as research and training abroad.

SBE People Investments
(Dollars in Millions)

	FY 2003 Estimate	FY 2004 Estimate	Change Amount	Change Percent
Undergraduate	2.22	2.72	0.50	22.5%
Graduate and Professional	8.80	12.51	3.71	42.2%
Total, People	$11.02	$15.23	$4.21	38.2%

The Office of International Science and Engineering facilitates the Foundation's strategic outcome goal of People by providing valuable international experiences for U.S. researchers, particularly those in the early stages of their careers. Participation in collaborative international research and education programs prepares U.S. students and researchers for careers in an increasingly interconnected world. In FY 2004, INT will increase its support for the international dimensions of REUs (Research Experiences for Undergraduates), IGERTs (Integrative Graduate Education and Research Traineeships), and postdoctoral research fellowships. Two programs of special note are the Summer Institutes for U.S. graduate students in Japan, Korea, and Taiwan, which will expand to China in FY 2003; and the Advanced Studies Institutes, which bring together graduate students and postdoctoral fellows from the United States and selected developing countries to explore cutting-edge areas of research.

Ideas (+$7.80 million, for a total of $151.15 million)

SBE promotes NSF's strategic outcome goal of Ideas through a broad range of research support encompassing the social and behavioral science disciplines. Research in economics, political science, sociology, decision-making, and risk analysis yields important societal benefits in the form of increased understanding of cooperation and conflict, better informed public policy and more efficient business management. Research findings in psychological, cognitive, and language sciences are yielding a sharper picture of how human language is acquired and how it is used, both for thought and communication, thus laying the foundation for progress in many areas of major national importance, ranging from teaching children how to read to building computers that can talk. Support for discoveries at and across the frontiers of science and engineering, connected to learning, innovation and service to society extends over SBE's entire portfolio. In FY 2004, funding for research in this category is at $151.15 million, an increase of $7.80 million over the FY 2003 Request of $143.35 million.

- SBE will provide support for fundamental research in the social and economic sciences in FY 2004 at $83.92 million, an increase of $6.31 million from the FY 2003 Request of $77.61 million. Fundamental research supported by SBE in the social and economic sciences develops and advances scientific knowledge focusing on economic, legal, political, and social systems as well as on organizations and institutions. Support will be provided for the development of new research methods applicable across social and behavioral science disciplines and for research on the intellectual and social contexts that govern the development and use of science and technology. During FY 2004, areas of emphasis in the social and economic sciences will include understanding the social causes and consequences of social system shocks, such as market collapses, ethnic violence, floods, earthquakes, and terrorist assaults; risk analysis and decision-making with special attention to extreme events and to the problems of climate change; innovation in the development of mathematical models including the coupling of formal and empirical modeling; integrating qualitative and quantitative methods; building and maintaining longitudinal databases and other fundamental research infrastructure; and furthering our understanding of organizations and other social institutions.

- In FY 2004, SBE will provide support for fundamental research in the behavioral and cognitive sciences at a level of $71.12 million, an increase of $5.82 million from the FY 2003 Request of $65.30 million. Fundamental research supported by SBE in the behavioral and cognitive sciences develops and advances scientific knowledge and methods focusing on human cognition, cognitive neuroscience, language, and learning; children's development, learning, and literacy; social behavior and culture; human social, demographic, and cultural variation; human evolution and contemporary human biological variation; geographic patterns and processes and geographic information science; and interactions between humans and the natural environment. Special emphases for FY 2004 include research on human cognition including work in the multidisciplinary field of cognitive neuroscience; computational linguistics; and research that traces human biological and behavioral changes over time.

- As the focal point for international activities, the Office of International Science and Engineering will provide leadership across the Foundation for the development of new and challenging ways to pursue knowledge across the frontier. INT, as well as other parts of SBE, will invest in NSF priority science and engineering areas by providing support for collaborations in Biocomplexity in the Environment, Information Technology Research, Nanoscale Science and Engineering, Mathematical Sciences, and Human and Social Dynamics. INT will also foster mutually beneficial international collaborations among NSF-supported centers and centers of excellence in other countries.

- Across all of its programs, SBE will continue efforts to increase the average size and duration of the awards, thus enabling scientists to devote a greater portion of their time to actual research. This may contribute to increasing the efficiency of NSF's merit review process and achieving greater cost-effectiveness for both NSF and the scientific community.

In support of the Ideas goal, SBE funds the following centers:

SBE Centers
(Dollars in Millions)

	FY 2003 Estimate	FY 2004 Estimate	Change Amount	Change Percent
Long-Term Ecological Research Sites	0.20	0.20	0.00	0.0%
Children's Research Initiative Centers	1.50	4.00	2.50	166.7%
National Consortium on Violence Research	1.00	1.00	0.00	0.0%
Research Centers on the Human Dimensions of Global Change	2.30	0.00	-2.30	N/A
Environmental Social and Behavioral Science Centers	0.00	3.50	3.50	N/A
Climate Change Research Initiative Centers	0.00	4.50	4.50	N/A
Total, Centers Support	$5.00	$13.20	$8.20	164.0%

- In partnership with the Directorate for Biological Sciences, SBE will maintain combined support in FY 2004 at a level of $200,000 for the two Urban Long-Term Ecological Research (LTER) sites. These Urban LTER sites examine the complex interactions of human activity and the natural environment in the Baltimore and Phoenix metropolitan areas.

- The Children's Research Initiative (CRI) supports a variety of research activities, including small research centers, individual investigator awards, collaborative proposals, and workshops. Together, the research centers, each of which receives approximately $500,000 per year for five years, represent a new thrust in the field of integrative developmental science; individually, they support leading-edge research about children and media, developmental science, and the integration and dissemination of developmental science to inform both research and policy. In FY 2003, up to three new centers are proposed, with up to an additional three centers proposed in FY 2004.

- The National Consortium on Violence Research (NCOVR), based at Carnegie Mellon University, is engaged in a program of capacity building in the violence research community. The Consortium's activities focus on training the next generation of researchers in interdisciplinary approaches to understanding interpersonal violence and on increasing the participation of underrepresented groups in research on violence. NCOVR also seeks to facilitate collaborative methodological research and the promotion of intellectual exchanges that cut across disciplines. NSF is providing about $1.0 million in support for the Consortium in FY 2003. Support in FY 2004, contingent on review of a renewal proposal in 2003, will be $1.0 million.

- Following a new competition, NSF intends to continue providing support for centers that advance fundamental knowledge about environmental social and behavioral science; promote education and training at levels ranging from undergraduate to postdoctoral; and foster interdisciplinary and multidisciplinary research collaborations. NSF's FY 2004 support for two or three new Environmental Social and Behavioral Science Centers is expected to total $3.50 million, a $1.20 million increase from the level that supported the Human Dimensions of Global Change Centers in FY 2003 during their final year of funding.

- SES intends to fund three to five centers focusing on Risk Analysis and Decision-making in relation to global climate change as part of the government-wide Climate Change Research Initiative. The FY 2004 investment in these centers is expected to total $4.50 million, with the expectation that continuing support at this level will be available yearly for three additional years. The centers will involve interdisciplinary teams that will push the frontiers of research on risk analysis and decision-making in ways that will enhance our nation's capacity to evaluate the risks associated with climate change and to develop policies and decisions based on realistic appraisals of risks. Centers will be expected not just to engage in basic research on risk analysis and decision-making with implications for climate change, but also to link with stakeholders as they develop their research activities. In addition to advancing the science of risk analysis and our understanding of decision-making, center agendas may include developing and testing ways of communicating risks to stakeholders and cross-culturally, exploring methods for incorporating stakeholders in decision-making processes, and educational components that focus on professionals in training, community risk managers and/or ordinary citizens.

Priority Areas

- In FY 2004, SBE will support research and education efforts related to broad, Foundation-wide priority areas in Biocomplexity in the Environment, Information Technology Research, Nanoscale Science and Engineering, Mathematical Sciences, and Human and Social Dynamics. SBE also will support the formation of collaborative international research teams to address each of these priority areas.

SBE Investments in Priority Areas
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Biocomplexity in the Environment	3.00	1.65	2.50	0.85	51.5%
Information Technology Research	4.36	4.65	5.15	0.50	10.8%
Nanoscale Science and Engineering	0.00	1.11	1.50	0.39	35.1%
Mathematical Sciences	N/A	1.10	1.50	0.40	36.4%
Human and Social Dynamics	N/A	10.00	15.90	5.90	59.0%

- **Biocomplexity in the Environment (BE):** In FY 2004, SBE will increase its level of support for BE by $850,000 to $2.50 million. These funds will contribute to NSF's centralized competition to support research on complex interactions among coupled human and natural systems at diverse spatial, temporal, and organizational scales.

- **Information Technology Research (ITR)**: In FY 2004, SBE will provide $5.15 million for ITR, an increase of $500,000 over the FY 2003 Request. These funds will support fundamental research using a wide array of new information technology research methods in the social and behavioral sciences, including fundamental research on geographic information science. In addition, these funds will support fundamental research of social, economic, and workforce issues associated with computational social science and will assemble international collaborative teams to conduct ITR research.

- **Nanoscale Science and Engineering (NSE):** In FY 2004, SBE will provide $1.50 million for NSE, an increase of $390,000 over the FY 2003 Request. This funding for NSE will support research in the social, behavioral and economic sciences on factors that stimulate nanoscientific discovery, ensure the responsible development of nanotechnology, and enhance human performance.

- **Mathematical Sciences**: In FY 2004, SBE continues its support for Mathematical Sciences at $1.50 million, an increase of $400,000 over the FY 2003 Request. These funds will support development of collaborative teams consisting of social/behavioral and mathematical/statistical scientists to develop new mathematical statistical techniques that will advance research in the social and behavioral sciences. Innovative training activities also will be supported.

- **Human and Social Dynamics**: In FY 2004, SBE will provide $15.90 million, an increase of $5.90 million over the FY 2003 Request, to expand the Human and Social Dynamics priority area. SBE will support basic research that is primed for major advances through the use of new research tools and new data, and by extending prior research of proven utility using new methods or different perspectives. Support will be provided for research that aims at enhancing human performance, understanding the social, economic and behavioral implications of technology and other drivers of societal change, and advancing the scientific study of risk analysis and decision-making in the face of uncertainty. The priority area will also work to build capacity in the social, economic and behavioral sciences by advancing spatial social science, supporting cutting-edge mathematical and statistical modeling, and investing in needed data sets and other fundamental social and behavioral science infrastructure. Priority area funding aimed at these last three goals bridges the Ideas and Tools categories, although some proposals and initiatives will fall more into one area than the other.

Tools (+$2.0 million, for a total of $39.99 million)

SBE promotes the development of Tools by taking advantage of new information technologies as it directs resources into research-enhancing investments such as web-based collaboratories, digital libraries, and databases, including the science resources data and analysis produced by the Science Resources Statistics Subactivity. In FY 2004, SBE will provide $39.99 million to support the development of tools to enhance the conduct of research and education. This is an increase of $2.00 million from the FY 2003 Request level of $37.99 million.

- SBE will provide $26.70 million for support of the Science Resources Statistics Subactivity, an increase of $1.0 million over FY 2003. This enables NSF to fulfill its statutory mandate to produce data and analysis on the scientific and engineering enterprise. In FY 2004, $8.50 million will support the implementation of survey redesign activities for the 2003 National Survey of College Graduates based on the 2000 Decennial Census.

- In FY 2004, SBE will increase by $890,000, to $15.52 million, support for the development of widely accessible research databases, web-based collaboratories, and other projects that provide fundamental infrastructure for large, diverse scientific communities. These tools are essential components of the research agenda of the social and behavioral sciences. Building on new computational and communications technology, new products will collect and integrate economic, cultural, cognitive, psychological, social, political and geographic data and provide more powerful tools for analysis and dissemination. Some efforts will allow new scientific gains to be extracted from existing data, while others will extend new methodologies from the narrow areas where they are being developed to broader application or multiple research sites. Additions to science and technology databases will illuminate research on critical issues like globalization, the development of new industries, and factors that shape the scientific workforce.

Administration and Management

Administration and Management provides for administrative activities necessary to enable NSF to achieve its strategic goals. Requested funding for FY 2004 is $5.37 million, an increase of $2.12 million over the FY 2003 Request of $3.25 million. This includes the increased costs of Intergovernmental Personnel Act appointments and contractors performing administrative functions. The increase in FY 2004 represents new A&M costs associated with the expansion of the Human and Social Dynamics priority area and establishing an international office in Beijing, China.

QUALITY

SBE maximizes the quality of the research and development (R&D) it supports through the use of a competitive, merit-based review process. The percent of basic and applied research funds that were allocated to projects that undergo merit review was 84 percent for SBE in FY 2002, the last year for which complete data exist. Within the BCS and SES subactivities, 97 percent of all projects undergo merit review.

SBE uses various internal and external mechanisms to review the relevance of proposed and existing programs to help identify emerging opportunities and goals for the future. These include the SBE Advisory Committee, which meets semiannually to provide ongoing reviews of the Directorate's activities and to advise on potential future directions. Other internal and external review mechanisms include Committees of Visitors, National Academy of Sciences reports, blue ribbon panels, workshops, and long-range planning documents, among others.

PERFORMANCE

Recent Research Highlights: Examples of significant discoveries or advances resulting from SBE-supported research include:

- With NSF support, Tim White of the University of California at Berkeley and colleagues are studying *Homo erectus*, a fossil hominid that may have originated approximately two million years ago. Studying fossils in Ethiopia, White found *Homo erectus* fossils from about a million years ago that are similar to contemporaries in Asia, Europe and sub-Saharan Africa. The researchers determined that, like other large mammals, *H. erectus* was a species comprising local populations that differed slightly but as a result of gene flow did not branch into independent species. Subsequent climatic changes likely played a critical role in splitting this widespread species into *Homo sapiens* in Africa and Neanderthals, an evolutionary dead end, in Europe. (Award #9910344) http://www.eurekalert.org/pub_releases/2002-03/uoc--efs031802.php

(©2003HGilbert)

- Researchers conducted a study on the costs and benefits of bank bailouts, with a focus on how bailouts affect the economy. The authors established that there is a reciprocal relationship between bank bailouts and aggregate liquidity, and that depending on the characteristics of banks in danger of failing, their failure can either add to or subtract from the aggregate pool of liquidity. The implication is that under some defined conditions, an economic system that would otherwise stabilize with a few bank failures could collapse completely as a result of bank bailouts. (Award #9975209) http://gsb.uchicago.edu/fac/douglas.diamond/ or http://gsb.uchicago.edu /fac/raghuram.rajan/

- The Survey of Undergraduate Programs in the Mathematical and Statistical Sciences in the United States has examined four-year college and university undergraduates and found that fewer mathematics bachelor's degrees have been awarded since 1995 (down 14 percent), part-time faculty has increased substantially since 1990 (up 35 percent) and statistics course enrollments have gone up 45 percent since 1990. The survey also found that since 1995, there has been a 600 percent increase in temporary full-time faculty at the two-year college level and an 8 percent drop in full-time permanent faculty. The report comes out at a time when both the scientific community and the general public are becoming more aware that mathematics is the foundation for the other sciences. (Award #9900736)

- As part of the East Asia Summer Institute Program, Sarah Albano, a graduate student at the University of Washington, spent the summer of 2002 at the University of Tokyo analyzing groundwater data near two active Japanese volcanoes. These data, combined with analogous data that Albano obtained previously on Mt. Pinatubo in the Philippines, will offer insight into how changes in groundwater levels may predict volcanic eruptions. Sean Duffy, a graduate student at the University of Chicago, spent the summer of 2002 at Kyoto University extending and refining his study of differences in the ways that Americans and Japanese perceive objects relative to their environment. The studies that Duffy and his Japanese colleagues conducted will reveal how human cognitive functions are conditioned by cultural factors. Albano and Duffy were among 102 American graduate students who spent the summer of 2002 conducting research in Japan, Korea and Taiwan in NSF's East Asia Summer Institute Program, which will be expanded in 2003 to include China.

Other Performance Indicators

Key SBE performance metrics include the number of people supported by SBE awards and the funding profile for the directorate. The tables below show the growth in the number of people benefiting from SBE's funding and trends in growth of award size, duration and number.

Number of People Supported in SBE Activities

	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate
Senior Researchers	1,751	1,875	2,030
Other Professionals	335	345	375
Postdoctorates	100	130	140
Graduate Students	1,334	1,405	1,520
Undergraduate Students	640	860	930
Total Number of People	4,160	4,615	4,995

Totals may not add due to rounding.

Social, Behavioral and Economic Sciences Funding Profile

	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate
Number of Requests for Funding	4,536	4,430	4,790
Dollars Requested (in millions)	$1,462	$1,500	$1,620
Total Number of Awards	1,869	2,060	2,230
Statistics for Competitive Awards:			
Number	1,265	1,415	1,500
Funding Rate	33%	32%	32%
Statistics for Research Grants:			
Number of Research Grants	814	882	900
Median Annualized Award Size	$50,130	$55,795	$60,000
Average Annualized Award Size	$63,770	$73,394	$80,000
Average Duration (yrs.)	2.3	2.6	2.7

SOCIAL AND ECONOMIC SCIENCES $83,920,000

The FY 2004 Budget request for the Social and Economic Sciences (SES) Subactivity is $83.92 million, an increase of $6.31 million, or 8.1 percent, from the FY 2003 Request of $77.61 million.

Social and Economic Sciences Funding
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Social and Economic Sciences	68.29	77.61	83.92	6.31	8.1%
Total, SES	$68.29	$77.61	$83.92	$6.31	8.1%

The SES Subactivity supports research to develop and advance scientific knowledge, focusing on human activity in the context of economic, legal, political and social systems, and governments, business organizations, and other institutions. SES also supports inquiry into the social aspects of science and technology and participates in NSF-spanning multidisciplinary research and educational activities.

SES includes the fields of economics; decision, risk and management sciences; political science; law and social science; sociology; ethics and values studies; science and technology studies; methodology, measurement and statistics, and cross-disciplinary activities, including a program in Innovation and Organizational Change, co-funded by Engineering. Knowledge arising from SES-supported research is disseminated to, and used by, many branches of the federal government, as well as by state and local governments, private corporations, charitable organizations, and other institutions.

SES sponsored research has fundamentally advanced the methods and theories of the social and economic sciences, while yielding important practical results and societal benefits. For example, SES supported the Nobel Prize winning research of Daniel Kahneman and of Vernon Smith that laid the groundwork for behavioral economics and experimental economics. As importantly, SES fostered research building on Kahneman and Smith's path-breaking contributions. This body of work helped give these approaches to economics the importance they have today. Benefits to society have been immense. For example, implications of auction theory were tested at an NSF-funded experimental economics laboratory building on methods Smith pioneered. This testing supplied scientific support for the design of the Spectrum Auction, which returned more than $10 billion to the United States Treasury.

SES supported research is just as significant in fields without Nobel Prizes. Archbishop Desmond Tutu welcomed James Gibson's study of political tolerance in South Africa, saying, "This groundbreaking study…is timely in looking for solutions to what could so easily subvert what so many laboured so valiantly for and [for which] many others gave their lives." Other important work draws on SES supported shared-use databases and research platforms that deal with cyclical, intergenerational, and life-course measures of economic and social behavior. This infrastructure is central to research that advances fundamental understandings of such socially important phenomena as income dynamics, teenage childbearing, divorce, the social implications of race and gender, consumer spending and saving, political preferences, and education and job choices. Other important SES-sponsored research has pushed the frontiers of risk analysis and decision-making with practical societal benefits as diverse as improved medical diagnostic systems and more effective monitoring of nuclear plant safety.

In FY 2004, the SES Request of $83.92 million will support a range of activities, including:

- Research on decision-making under uncertainty in support of the Climate Change Research Initiative. This research investment, proposed to begin in FY 2003, is aimed at producing new understandings of how to analyze and manage risks associated with climate change as well as tools, perspectives, and information to assist individuals, groups, and organizations in the development of public policies and in private-sector decision-making. ($5.0 million)

- Research on social system shocks and extreme events, including research into their causes and aftermaths and their implications for risk analysis and decision-making. We will add to our store of knowledge on an array of vital topics, such as terrorism; the consequences of economic and social shocks for people, markets and organizations; and the formation and trajectories of beliefs, trust, and cooperation in the face of newly-sensed threats and vulnerabilities and their implications for risk assessments and precautionary decision-making. ($3.0 million)

- Support for key social, economic, and demographic databases and for research on human and social capital. Supported research will collect, organize and disseminate large data sets that allow researchers to explore the effects of beliefs, families, educational institutions, businesses, and communities on the acquisition of skills and education and their deployment in work, family and leisure activities. Knowledge gained from these databases will advance our understanding of social behavior and is likely to inform private, state, and federal approaches to investing in human and social resources. These infrastructure investments also can be expected to form the empirical bases for doctoral dissertation research across the social and economic sciences. ($12.0 million)

- Funding to support the development and use of cutting-edge methodologies in the social and behavioral sciences. One aspect of this investment, already underway, is a major effort to promote the linkage of formal theory and empirical research in understanding specific social, political, and economic issues. This research emphasis has and will continue to involve cross-disciplinary work teams, conferences, educational activities, and training institutes. In addition, SES will foster active collaborations between mathematical scientists and social and behavioral scientists as part of NSF's Mathematical Sciences priority area and will support efforts to advance the science of evaluation research and to make better use of qualitative data. ($8.0 million)

- Funding for inquiries into the social implications of modern technologies (e.g., nanotechnology and the Internet) and other drivers of social change. Supported research will examine sources of scientific discovery and technological innovation, the processes by which innovations diffuse through society, the social impact of new technology, and the ethical and value implications of scientific discoveries in both historical perspective and contemporary life. Other agents of change likely to be the subject of new research include mass migrations, political upheavals, ethnic conflict, legislation, the mass media, economic policies, and terrorist and environmental threats. ($10.0 million)

- Investments in the above areas will occur both through special competitions and existing programs. In addition, SES will maintain the health of its core disciplines through its support of existing disciplinary and cross-disciplinary programs. This support will fund a wide variety of peer-reviewed, investigator-initiated research that promises to expand extant knowledge bases while pushing disciplinary frontiers, as well as smaller high risk/high payoff proposals funded as Small Grants for Exploratory Research (SGER). Program funds will also support workshops designed to set future research priorities, major long-term grants to promote the integration of teaching and research by the nation's most able new investigators, programs to enhance the progress of women and minorities in the academic disciplines, and education at the graduate and undergraduate levels. ($45.92 million)

BEHAVIORAL AND COGNITIVE SCIENCES $71,120,000

The FY 2004 Budget Request for the Behavioral and Cognitive Sciences (BCS) Subactivity is $71.12 million, an increase of $5.82 million, or 8.9 percent, from the FY 2003 Request of $65.30 million.

Behavioral and Cognitive Sciences Funding
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Behavioral and Cognitive Sciences	58.56	65.30	71.12	5.82	8.9%
Total, BCS	$58.56	$65.30	$71.12	$5.82	8.9%

The BCS Subactivity supports research and related activities that develop and advance scientific knowledge and methods focusing on human cognition; cognitive neuroscience; language; children's development, learning and literacy; social behavior and culture; human social, demographic, and cultural variation; human origins and contemporary human biological variation; geographic patterns and processes; geographic information science; and interactions among individuals, societies and the natural and built environment. Programs include archaeology, cultural anthropology, physical anthropology, geography and regional science, cognitive neuroscience, developmental and learning sciences, human cognition and perception, linguistics, and social psychology.

An expanding set of strong core disciplinary programs is balanced by an increased emphasis placed on collaborative, interdisciplinary projects that build capacity across multiple fields. One group of activities will focus on human cognition and computational linguistics and their relationship to improvements in human performance. The understanding of the fundamental processes that support basic and higher level cognitive functions, such as perceiving, reasoning, interacting, learning, and communicating, will be improved by coupling theoretical insights with sophisticated experimentation using modern instrumental techniques, including on-line behavioral and physiological data capture, virtual reality and other simulations of social interactions, and computer-based displays of complex information, such as visual flow fields. These approaches encourage partnerships to contribute to the development of new methods for understanding and enhancing performance in the home, classroom, workplace, and elsewhere.

Human communication and man-machine interaction will be improved through the convergence of new technologies and theoretical advances in the study of human behavior, cognition, and language and their social, cultural, and developmental context. Lines of inquiry related to human language that hold special promise include language processing, corpus linguistics, pragmatics, multi-modal communication, and language documentation and preservation. Another rapidly emerging field is cognitive neuroscience. Because of the scale and complexity of work in these and other areas, BCS will fund larger-scale projects and innovative technical developments that will also help train future generations of behavioral and cognitive scientists. These projects will focus on strengthening our understanding of the basic mechanisms of cognition, perception, action, language structure and use, and social and affective behavior, and will help explain when and how children and adults learn new knowledge and skills.

Research in the developmental and learning sciences will support integrative studies of cognitive, linguistic, social, cultural, and biological processes related to children and adolescents' learning in formal and informal settings. Ongoing support will be provided for the Children's Research Initiative for research that incorporates multidisciplinary, multi-method, microgenetic, and longitudinal approaches. This initiative will help develop new methods and theories; examine the transfer of knowledge from one domain to another and from one situation to another; assess peer relations, family interactions, social identities, and motivation; examine the impact of family, school, and community resources; assess adolescents' preparation for entry into the workforce; and investigate the role of demographic characteristics and cultural influences on children's learning and development.

BCS will continue its support of research on the essential shared characteristics of human beings within a broad chronological and spatial context. The Humans Origins emphasis (HOMINID) will support several large-scale awards. This emphasis will rely heavily on powerful genetic technology and on the details of human and other species' genome sequences, and it will pay increasing attention to comparative genomics.

BCS is helping establish a strong infrastructure for future research by supporting projects such as the establishment of the National Historical Geographic Information System (NHGIS), which will provide free public access to U.S. Census databases from 1790 to the present, including the digitization of all census geography so that place-specific information can be readily used in geographic information systems. Through these activities, the NHGIS will become a resource that can be used more widely for secondary education and training and become a reference resource used by policy makers.

In FY 2004, the BCS Request of $71.12 million will support a range of activities, including:

- Funding for the Cognitive Neuroscience program, maintained at a level of about $7.0 million. In order to enhance understanding of the relationship between human behavior and brain function, emphasis will be on supporting state-of-the-art work that is informed by theoretical advances in cognition, perception, social psychology, linguistics and human development. Support also will be provided for large-scale meta-analysis of data from multiple subjects.

- Funding for the Human Origins emphasis (HOMINID), maintained at a level of $2.0 million. This emphasis area will continue to expand knowledge of the origins and development of the human species, the relationship of humans and the world's environments, and human adaptation processes over the last five million to six million years.

- Disciplinary and interdisciplinary research on human-environmental interactions, which totals about $10.0 million. This area includes support for two or three new environmental social and behavioral science centers, for Long-Term Ecological Research sites, and for research on the Dynamics of Coupled Natural and Human Systems, a major emphasis of the Biocomplexity priority area.

- Support for special emphasis in the areas of enhancing human performance, agents of change, spatial social science, modeling, and infrastructure and data resource development at a level of $6.0 million.

- Support for the Children's Research Initiative, maintained at a level of $5.0 million. Research related to enhancing literacy and improving math and science skills will be emphasized.

- Funding will be maintained for core disciplinary and interdisciplinary research in the geographic, anthropological, archaeological, cognitive, psychological, and linguistic sciences ($40.0 million). These funds will also support workshops designed to set future research priorities, grants to promote the integration of teaching and research by the nation's most able new investigators, programs to enhance the progress of women and minorities in the academic disciplines, and education at the graduate and undergraduate levels.

SCIENCE RESOURCES STATISTICS $26,700,000

The FY 2004 Budget Request for the Science Resources Statistics (SRS) Subactivity is $26.70 million, an increase of $1.0 million, or 3.9 percent, from the FY 2003 Request of $25.70 million.

Science Resources Statistics Funding
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Science Resources Statistics	16.28	25.70	26.70	1.00	3.9%
Total, SRS	$16.28	$25.70	$26.70	$1.00	3.9%

The legislative mandate for the Division of Science Resources Statistics (SRS), as stated in the National Science Foundation Act of 1950, as amended, is "…to provide a central clearinghouse for the collection, interpretation, and analysis of data on scientific and engineering resources and to provide a source of information for policy formulation by other agencies of the Federal Government…." To meet this mandate, SRS provides policymakers, researchers, and other decision makers with high quality data and analysis for making informed decisions about the nation's science, engineering, and technology enterprise. The work of SRS involves survey development, methodological and quality research and analysis, data collection, analysis, information compilation, dissemination, and customer service to meet the statistical demands of a diverse user community, as well as preparation of the *Science and Engineering Indicators* and *Women and Minorities and Persons with Disabilities in Science and Engineering* biennial reports.

SRS continues to make improvements in the relevance and quality of its products. Priorities for FY 2004 build on prior efforts to improve the quality, relevance, timeliness, and accessibility of SRS products, continue the redesign of major components of SRS data collections, and implement such redesigns.

- Every decade a redesign of the samples and surveys used to collect data on the scientific and engineering workforce is necessary to reflect the results of the Decennial Census. Extensive redesign activities were conducted in fiscal years 2000, 2001, and 2002. Implementation of the redesign was undertaken in FY 2002 and FY 2003. SRS will begin data collection of the *National Survey of College Graduates 2003* in October 2003. Data collection will continue through much of FY 2004 and initial data processing will also be undertaken. In FY 2004, data processing will be completed, as will release of the data files, and initial analysis of the data.

- At the end of FY 2002, a major National Academy of Sciences (NAS) review of the SRS R&D portfolio of surveys was initiated which is expected to lead to proposed major revisions of the R&D survey portfolio. This multi-year (2003-2005) review is in compliance with NSF policy requiring a Committee of Visitors review of NSF programs on a rotating basis. The NAS review is also in compliance with Section 25 of Public Law No. 107-368 for a review of discrepancies in the R&D data collection.

- During FY 2003, efforts to improve and redesign the Survey of Research and Development Expenditures at Universities and Colleges and the Survey of Graduate Students and Postdoctorates in Science and Engineering continued. Improvements to both surveys will be implemented on an ongoing basis during FY 2004 concurrent with major multi-year redesign efforts for both surveys.

- In FY 2004, SRS will begin a comprehensive study of the feasibility of developing a new ongoing survey to collect information about individuals in postdoctorate positions.

- SRS will continue in FY 2004 to conduct its other surveys and analytical activities that produce the information for carrying out the NSF statutory mandate, for meeting the Tools strategic outcome goal of providing "broadly accessible, state-of-the-art and shared research and education tools," and for developing *Science and Engineering Indicators* and *Women, Minorities, and Persons with Disabilities in Science and Engineering*.

- In FY 2004, SRS will continue to explore options for the redesign of an ongoing mechanism to obtain current information on public attitudes toward science and engineering for inclusion in the *Science and Engineering Indicators* report.

INTERNATIONAL SCIENCE AND ENGINEERING $30,000,000

The FY 2004 Budget Request for the Office of International Science and Engineering (INT) is $30.0 million, an increase of $3.0 million, or 11.1 percent, from the FY 2003 Request of $27.0 million.

International Science and Engineering Funding
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
International Science and Engineering[1]	40.84	27.00	30.00	3.00	11.1%
Total, INT	$40.84	$27.00	$30.00	$3.00	11.1%

[1]FY 2002 includes a transfer of $13.66 million from the U.S. Department of State for an award to the U.S. Civilian Research and Development Foundation.

The Office of International Science and Engineering (INT) supports the advancement of NSF's strategic outcome goals of Ideas and People. By its nature the scientific enterprise is global. To ensure the generation of new knowledge across the frontiers of science and engineering, it is essential that U.S. scientists have opportunities to be engaged with the best collaborators and access to facilities found throughout the world. INT supports cooperative research activities with developed and developing countries in all fields of science and engineering supported by the Foundation. INT complements and enhances the Foundation priority areas and program approaches by providing the opportunity for international engagement. INT supports activities that provide access to critical research conducted outside the United States and that broaden the base of knowledge about mutually beneficial science and technology opportunities abroad.

INT facilitates the advancement of NSF's strategic outcome goal of People – to develop and maintain a diverse, internationally competitive and globally engaged workforce of scientists and engineers. INT supports research and related activities that promote partnerships between U.S. and foreign researchers. INT supports U.S. participation in both bilateral and multilateral workshops and symposia, the initial phases of collaborative research, key selected multinational scientific bodies, and individual and small group research training.

INT provides valuable international experiences to U.S. researchers, particularly those in the early stages of their careers. Specific INT-supported activities include:

- Summer research experiences for students in selected regions of the world;
- Postdoctoral research opportunities abroad;
- Inclusion of students in international cooperative research projects; and
- Opportunities for U.S. researchers to develop collaborations with their counterparts in other countries.

Together, these activities will promote progress in research and education. These activities will also enable the next generation of U.S. researchers to experience the international nature of research and to maintain U.S. leadership in an increasingly global research environment.

With the continuing growth of scientific expertise and resources worldwide, there are increasing opportunities for international cooperation in areas of mutual interest or concern. For example, to ensure that the U.S. research community stays at the forefront of the fast-changing area of nanoscale science and engineering, INT is supporting several centers as well as interdisciplinary research teams in this field. In the area of information technology research, INT supports U.S. researchers in collaborations on international standards, cross-cultural communication, and comparison of research methods. In the area of biocomplexity in the environment, some of the most challenging scientific questions are best studied in environmental systems outside the United States. INT supports a range of projects in the dynamics of coupled natural and human systems, including a study of people, policies, and pandas in China's Wolong Nature Reserve and a comparative study on how human activities influence forest dynamics in Venezuela and Texas.

Ensuring that the next generation of scientists and engineers understands and experiences the global nature of research and development is an objective of many of INT's investments. In FY 2002, INT supported 37 international postdoctoral fellowships. These fellowships support postdoctoral research in a foreign laboratory and involved researchers from 24 states working in 19 different countries.

The summer institutes in Japan, Korea, and Taiwan provide an opportunity for U.S. graduate students to conduct a summer research project in a host lab. The program is also supported by the National Institutes of Health. In FY 2002, 102 U.S. students participated in these summer institutes, investigating research topics that included: high intensity laser techniques for particle acceleration, the design of a new wheeled omnidirectional robot, and a comparison of the cancer screening services in the United States and Japan. In FY 2003, the summer institute program will be expanded to China, and up to 100 U.S. students may participate in FY 2004.

Cooperation with China has been an area of increasing interest and opportunity for U.S. scientists and engineers. In FY 2004, INT plans to open an office in Beijing to accommodate the expected increase in collaborative activity.

In FY 2004, INT will emphasize:

- Investing in NSF priority science and engineering areas by providing support for international collaborations in Biocomplexity in the Environment, Information Technology Research, Nanoscale Science and Engineering, Mathematical Sciences, and Human and Social Dynamics.

- Developing new types of international research and training experiences that promote NSF interests and contribute to strengthening the U.S. scientific enterprise.

- Fostering mutually beneficial collaborations between NSF-supported research centers and equivalent research institutions in other countries.

- Encouraging opportunities that provide future U.S. scientists and engineers with international research experiences early in their careers.

- Promoting international networking and connectivity in research and education collaboration through the use of advanced information technology.

- Supporting international scientific organizations that are of high priority to the interests of the U.S. scientific community.

- Promoting a Foundation-wide vision of international research and education.

U.S. POLAR PROGRAMS

U.S. POLAR PROGRAMS $329,930,000

The FY 2004 Budget Request for U.S. Polar Programs (OPP) is $329.93 million, an increase of $26.12 million, or 8.6 percent, over the FY 2003 Request of $303.81 million.

OPP Funding
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
U.S. Polar Research Programs	230.52	235.74	261.86	26.12	11.1%
U.S. Antarctic Logistical Support Activities	70.27	68.07	68.07	0.00	0.0%
Total, Polar Programs	$300.79	$303.81	$329.93	$26.12	8.6%

Totals may not add due to rounding.

Polar regions are key elements of the global climate system. They are also premier natural laboratories for the study of a variety of fundamental phenomena that cannot be studied elsewhere. The U.S. Polar Programs Activity supports most of the polar research funded by the National Science Foundation.

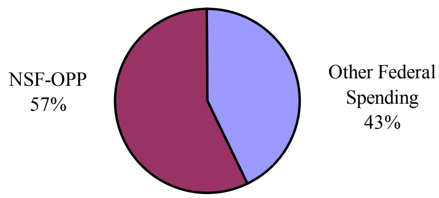
RELEVANCE

NSF is one of twelve federal agencies supporting Arctic research and logistics. As directed by the Arctic Research Policy Act of 1984, NSF is the lead agency responsible for implementing Arctic research policy, and the NSF Director chairs the Interagency Arctic Research Policy Committee (IARPC). IARPC helps coordinate multi-agency Arctic research and developed the interagency plans for Study of Environmental Arctic Change (SEARCH), an FY 2004 priority for NSF's Arctic research. NSF-funded Arctic research is concerned with the entire Arctic region, including Alaska, Canada, Greenland, Svalbard, the Arctic Ocean and adjacent seas, the upper atmosphere, and near space. Research involves a broad spectrum of scientific disciplines, including the atmospheric, ocean, and earth sciences, biology, glaciology, social science, engineering, and science education. NSF-supported research in the Arctic advances disciplinary knowledge and increases our understanding of regional climate and how climate change impacts living systems, including humans. Funding is provided for both research and associated logistics support in this remote region.

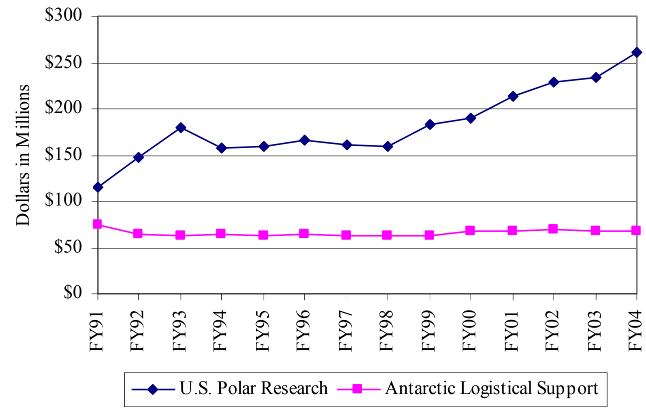
Antarctica, with 10 percent of Earth's land mass, is nearly 1.5 times the size of the United States. Its associated seas represent nearly 6 percent of the world's oceans and its ice, and 70 percent of the Earth's fresh water. NSF is responsible for managing all U.S. activities in the Antarctic as a single, integrated program. The U.S. presence in Antarctica is based on the conduct of scientific research and environmental stewardship. Scientific research ranging from astrophysics to microbiology and climatology is made possible through year-round work at three U.S. stations, two research ships, and a variety of remote field camps. Funding for the United States Antarctic Program (USAP) includes research and the science support directly linked to specific research projects, as well as support for the broader operations and logistics infrastructure that makes it possible for U.S. scientists to conduct science on the remote and uninhabited continent. NSF-supported infrastructure also enables mission agency research. All life support is provided by NSF, including facilities infrastructure, communications, utilities (water and power), logistics to, from, and within Antarctica and all related infrastructure – aircraft, runways, communications, passenger movement, baggage handling.

STRATEGIC GOALS

Federal Funding for Polar Research in FY 2001



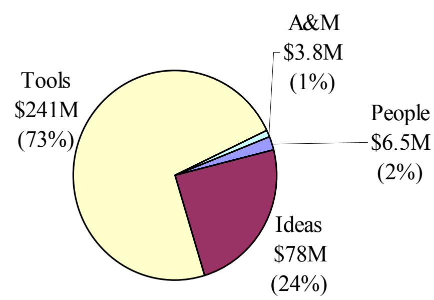
Polar Programs Subactivity Funding



Three strategic focus areas guide OPP's activities: People, Ideas, and Tools. OPP's support for ongoing core and new activities contributes to NSF's efforts to achieve its strategic goals, and to the administration and management activities necessary to achieve these goals.

- PEOPLE: Innovative efforts in Polar Programs contribute to developing a diverse, internationally competitive workforce of scientists, engineers and well-prepared citizens. These efforts have included use of new technologies such as interactive video; efforts to improve scientific literacy and education in Alaska; contributions to developing a geosciences curriculum for undergraduates relating geoscience disciplines to polar and global phenomena; and a new postdoctoral program for polar researchers. Continuing activities include support for the Antarctic Artists and Writers program; Scouting in Antarctica; the Live from Antarctica project linking researchers to classrooms; and Teachers Experiencing the Antarctic and Arctic.

FY 2004 OPP Strategic Goals



- IDEAS: Only fundamental research that either impacts strongly on global phenomena, such as climate change, or that can be uniquely or best undertaken in the polar regions is supported. Polar research addresses the solid earth, glacial and sea ice, terrestrial and marine ecosystems, the oceans, the atmosphere and the universe. Research on the solid earth is integral to understanding plate tectonics, the evolution of life in Earth's distant and recent past, and the interactions of Earth's crust with the overlying ice sheets. Glacial and sea ice studies elucidate aspects of biologic productivity and global climate processes. Marine/terrestrial biota studies reveal how organisms adapted, at the genetic and macroscopic level, to the hostile environments. A major focus of ocean studies is the role of polar regions in generating nutrient-rich, cold currents that influence global ocean circulation. High latitude magnetic field and upper atmospheric studies provide unique views of near-earth space physics. The dry, cold atmosphere at the South Pole, its 9,300 foot elevation and six-month continuous night permit astronomical studies not feasible elsewhere.

  - TOOLS: Research in the polar regions requires provision of research support, special facilities, and logistics. Maintaining Arctic and Antarctic research facilities, stations, and camps requires a substantial portion of Polar Program funds for meeting ongoing, often long-term commitments.

Research support includes costs typically awarded directly to grantees in other areas of NSF – technicians, field safety equipment, laboratory costs, transportation of scientists and their cargo, and instrumentation and equipment – but handled centrally by Polar Programs when it is more cost-effective to do so. In FY 2004, both the physical infrastructure and communications will continue to be upgraded at research stations in Alaska and in Antarctica, including improving security at USAP facilities in Christchurch, New Zealand. Both scientific and operational needs for enhanced computing and communications will be met by equipment upgrades. Remote sensing, data retrieval and handling, and automated observatories will be developed.

Summary of Polar Programs Funding by Strategic Goal
(Dollars in Millions)

	FY 2002	FY 2003	FY 2004	Change	
	Actual	Estimate	Estimate	Amount	Percent
People	4.44	4.78	6.47	1.69	35.4%
Ideas	71.43	73.76	78.35	4.59	6.2%
Tools	221.23	222.77	241.36	18.59	8.3%
Administration and Management	3.69	2.50	3.75	1.25	50.0%
Total, OPP	$300.79	$303.81	$329.93	$26.12	8.6%

Totals may not add due to rounding

Budget Highlights

People (+$1.69 million, for a total of $6.47 million)
The FY 2004 OPP budget will provide enhancement of multidisciplinary education, teaching, and training activities through:

- Initiation of a Postdoctoral Fellowship Program to enable the exploration of emerging areas of polar research and expand the diversity of polar researchers.
- Expanded support for science interns, primarily Alaska Native students.
- Contributing to the Foundation-wide goal of increasing support for GK-12 and IGERT.

OPP People Investments
(Dollars in Millions)

	FY 2003	FY 2004	Change	
	Estimate	Estimate	Amount	Percent
K-12	0.13	0.13	0.00	0.0%
Undergraduate	0.64	0.64	0.00	0.0%
Graduate and Professional	3.57	5.26	1.69	47.3%
Other People	0.44	0.44	0.00	0.0%
Total, People	$4.78	$6.47	$1.69	35.4%

Ideas (+$4.59 million, for a total of $78.35 million)

The FY 2004 OPP budget will provide enhancement of multidisciplinary research activities, inter-agency partnerships, and international activities through:

- Support for emerging frontiers in polar biology.
- Study of Arctic Environment Change (SEARCH), including the dynamics of changes and the fundamental ecosystem properties of the Bering Sea.
- Arctic System Science research on how changes in arctic biogeochemical cycles and biophysical processes would affect both arctic and global systems.
- Two Antarctic initiatives, Antarctic Drilling (ANDRILL) and West Antarctic Ice Sheet (WAIS), which will yield new information on historic climate change in Antarctica.
- Research and development of technology for exploration of Antarctic subglacial lakes.
- Research aimed at enhancing the understanding of Antarctica's dominant role in Southern Hemisphere meteorology and improving weather forecasting/modeling capabilities for operational and safety purposes.
- Ground truthing measurements of global mass balance of the ice sheets.

Priority Areas

In FY 2004, OPP will support research and education efforts related to broad, Foundation-wide priority areas in Biocomplexity in the Environment, Information Technology Research, and Mathematical Sciences.

OPP Investments in Priority Areas
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Biocomplexity in the Environment	1.41	1.41	1.55	0.14	9.9%
Information Technology Research	1.22	1.33	1.55	0.22	16.5%
Mathematical Sciences	N/A	0.18	0.18	0.00	0.0%

- **Biocomplexity in the Environment (BE)**: In FY 2004, OPP will provide $1.55 million for BE, an increase of $140,000, or 9.9 percent, over the FY 2003 Request of $1.41 million. These funds will support the following:

  Arctic/Subarctic Ocean Flux (ASOF) is a component of Study of Environmental Arctic Change (SEARCH), a broad, interdisciplinary, multi-scale program with a core aim of understanding the complex of recent and ongoing intertwined changes. Global oceanic and atmospheric circulation controls climate and is, in turn, strongly influenced by ice cover, ocean temperature, and fresh water input to the Arctic Ocean. Continued warming of the Arctic has the potential to slow or stop the "oceanic conveyor belt" that controls Northern Hemisphere weather patterns. ASOF is an international effort to monitor the valves in the Arctic Ocean circulation system to determine the water, energy, and salt balance among all of the inputs, outputs, and regions of water-mass transformation in the Arctic that drive global circulation patterns.

Lake Vostok in East Antarctica is considered important for understanding the geologic history of Antarctica as well as understanding the processes that may have triggered the evolutionary explosion on Earth and possibly on other planets. Workshops will be supported to address sampling, measurement and contamination control technologies so that the Lake can be realistically and safely sampled.

Address emerging frontiers in polar biology. The National Academy of Sciences/National Research Council is currently undertaking a study that will help set priorities in this area.

- **Information Technology Research (ITR)**: In FY 2004, OPP will provide $1.55 million for ITR, an increase of $220,000, or 16.5 percent, over the FY 2003 Request of $1.33 million. These funds will enable continued support for development of remote operation capabilities and development of accessible information systems for polar data and activities related to the agency's cyberinfrastructure activities.

- **Mathematical Sciences**: In FY 2004, OPP will continue support at the FY 2003 Request level of $180,000 to fund modeling activities in polar research.

Tools (+$18.59 million, for a total of $241.36 million)
The FY 2004 OPP budget will provide enhancement of national and international facilities and laboratories through:

- Beginning the development of a network of strategically placed U.S. Long-Term Observatories in the Arctic linked to similar efforts in Europe and Canada.
- Installation of a modern local area network in Barrow, Alaska with improved access to the Internet.
- Upgrades at Toolik Field Station, University of Alaska, Fairbanks' field station for ecological research on Alaska's North Slope.
- Support for up to 30 additional projects throughout the Arctic including Alaska, Canada, the Arctic Ocean, Greenland, Scandinavia and Russia.
- Continued safety training for field researchers and funding for field safety experts, global satellite telephones for emergency response, and improved logistics coordination in the Arctic.
- Operational and logistical support for Antarctic science activities such as observation of cosmic microwave background radiation at South Pole Station.
- Development of an overland traverse capability in Antarctica.
- Replacing the McMurdo Station power plant and associated switch gear.
- Continued development of a plan, with a timeline of estimated costs, for modernizing infrastructure at McMurdo and Palmer Stations.

OPP Investments in Tools
(Dollars in Millions)

	FY 2003 Estimate	FY 2004 Estimate	Change Amount	Change Percent
Antarctic Facilities and Operations	128.70	144.29	15.59	12.1%
Antarctic Logistics	68.07	68.07	0.00	0.0%
Arctic Logistics	26.00	29.00	3.00	11.5%
Total, Tools	$222.77	$241.36	$18.59	8.3%

Administration and Management

Administration and Management provides for administrative activities necessary to enable NSF to achieve its strategic goals. Requested funding for FY 2004 is $3.75 million, an increase of $1.25 million over the FY 2003 Request of $2.50 million. This includes the cost of Intergovernmental Personnel Act appointments and contractors performing administrative functions.

QUALITY

The U.S. Polar Programs Activity maximizes the quality of the research and development (R&D) it supports through the use of a competitive, merit-based review process. The percent of basic and applied research funds that were allocated to projects that undergo merit review was 93 percent in FY 2002, the last year for which complete data exist.

To ensure the highest quality in processing and recommending proposals for awards, OPP convenes Committees of Visitors, composed of qualified external evaluators, to review each program every three years. These experts assess the integrity and efficiency of the processes for proposal review and provide a retrospective assessment of the quality of results of NSF's investments. OPP contracts – for support organizations, leased vessels, helicopters, and fixed-wing aircraft – are regularly competitively re-competed, and functions are outsourced wherever feasible and economical. OPP also receives advice from the OPP Office Advisory Committee (OAC) on such issues as the mission, programs, and goals that can best serve the scientific community. The OAC meets twice a year and members represent a cross section of polar research with representatives from a broad spectrum of disciplines, as well as a cross-section of institutions, broad geographic representation, and balanced representation of women and under-represented minorities.

PERFORMANCE

Highlights of recent support and areas of continuing interest in polar research include the following:

- Identification of anti-freeze proteins (AFPs) in marine fish, insects, plants, fungi, and bacteria. AFPs enable organisms to metabolize at temperatures below freezing. Understanding how AFPs work and the evolution of these capabilities holds promise for cryopreservation of biomedical materials, foods and agriculture.

- Continuing research on understanding what causes major ice streams, like the Pine Island Glacier, to thin and accelerate the flow of ice into the ocean, and how that process will affect global sea levels.

- Discovery of rapid climate change over the last 110,000 years through the study of ice cores in Greenland.

- Continuing efforts to understand the patterns and mechanisms driving Arctic sea ice and permafrost melting, the impact of such albedo changes on the global climate and potential impacts on indigenous peoples in the Arctic.

- Scientists at the South Pole, using the Degree Angular Scale Interferometer (DASI), made the first-ever measurements of polarization in the cosmic microwave background (CMB), the sky-pervading afterglow of the big bang. The polarization of the CMB was produced by the scattering of cosmic light when it last interacted with matter, nearly 14 billion years ago. The discovery verifies the framework that supports modern cosmological theory and indicates that ordinary matter – humans, stars and galaxies – accounts for less than five percent of the universe's total mass and energy. The vast majority of the universe, therefore, is made of a mysterious force that astronomers call "dark energy" – as-yet undiscovered forms and objects.

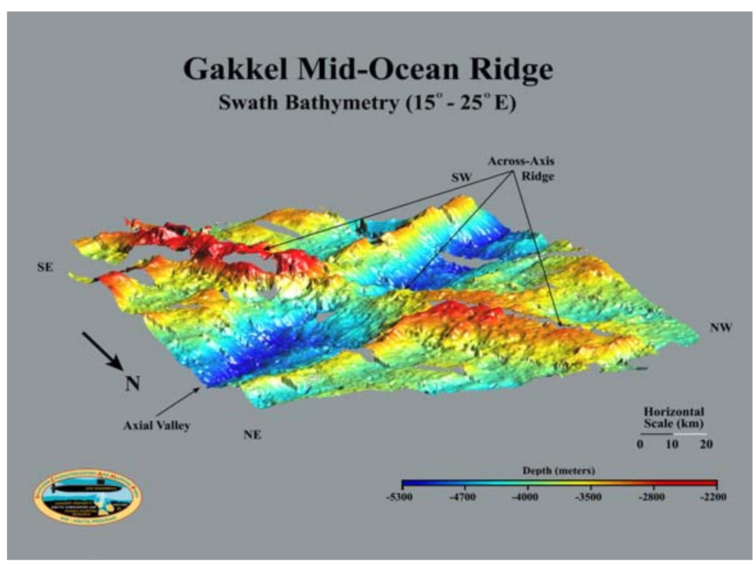
DASI, the Degree Angular Scale Interferometer, is a radio telescope designed to measure temperature and polarization irregularities in cosmic microwave background (CMB) radiation over a large range of scales with high sensitivity. Working at the U.S. station at the South Pole, University of Chicago astrophysicists using DASI in 2001 and 2002 made highly precise measurements to "see" temperature differences in and a minute polarization of CMB. These discoveries not only extend scientific understanding of formation of the Universe but also verify the framework that supports modern cosmological theory. Shown here are DASI (right), the Martin A. Pomerantz Observatory (middle), and a second telescope Viper (left) in the "dark sector" near South Pole Station.

Photo Credit: U.S. Antarctic Program/U.S. Air Force photo by MSgt Thomas Cook.

- Discovery that in addition to providing 420,000 years of climate information, Lake Vostok ice cores revealed that the water frozen from the lake surface contains microorganisms. Studies aimed at improving the sensitivity for detecting organisms and dissolved organic compounds in these cores is continuing.

- Discovery of hydrothermal vents (black smokers) on the Gakkel Ridge in the Arctic Ocean in a multi-national project with the U.S. Coast Guard Cutter *Healy* and the German icebreaker *Polarstern*. The Arctic Ocean and its floor remain the least explored of the world's oceans.

Using the newly developed SCAMP (Seafloor Characterization and Mapping Pods), investigators from Tulane University, University of Hawaii's Hawaii Mapping and Research Group, and Lamont-Doherty Earth Observatory (LDEO) mapped previously uncharted areas of the Arctic Ocean floor. SCAMP, developed at LDEO, provided the first high-resolution bathymetric map of the Gakkel Ridge, gravity-anomaly data, narrow-beam bathymetry, and "chirp" sub-bottom profiler data for inclusion in an arctic bathymetric map.



- A meteorologist wintering over at the South Pole underwent successful knee surgery with the help of a telemedicine link between the South Pole and doctors at Massachusetts General Hospital. The operation was carried out by the physician at the South Pole, who was assisted by an orthopedic surgeon and an anesthesiologist in Boston, Massachusetts. Two-way voice and video links between the U.S. and Antarctica have been used to assist in medical procedures before, but this is the first time that telemedicine has been used for surgery.

Other Performance Indicators

The tables below show the number of people benefiting from OPP's funding, and trends in award size, duration, and number.

Number of People Supported in OPP Activities

	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate
Senior Researchers	779	800	880
Other Professionals	498	515	560
Postdoctorates	116	120	130
Graduate Students	379	390	430
Undergraduate Students	227	230	250
Total Number of People	1,999	2,055	2,250

Polar Programs Funding Profile

	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate
Number of Requests for Funding	936	980	1,020
Dollars Requested (in millions)	$630	$680	$737
Total Number of Awards	621	640	700
Statistics for Competitive Awards:			
Number	264	270	300
Funding Rate	46%	40%	40%
Statistics for Research Grants:			
Number of Research Grants	222	235	250
Median Annualized Award Size	$81,517	$83,900	$86,400
Average Annualized Award Size	$130,353	$134,300	$138,300
Average Award Duration, in years	3.1	3.5	3.5

U.S. POLAR RESEARCH PROGRAMS $261,860,000

The FY 2004 Budget Request for U.S. Polar Research Programs Activity is $261.86 million, an increase of $26.12 million, or 11.1 percent, over the FY 2003 Budget Request of $235.74 million.

Polar Research Programs Funding
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Arctic Research Program	35.89	37.84	40.76	2.92	7.7%
Arctic Research Support and Logistics	27.58	26.00	29.00	3.00	11.5%
Arctic Research Commission	1.02	1.08	1.19	0.11	10.2%
Antarctic Research Grants Program	39.88	40.46	44.21	3.75	9.3%
Antarctic Operations and Science Support	126.15	130.36	146.70	16.34	12.5%
Total, U.S. Polar Research Programs	$230.52	$235.74	$261.86	$26.12	11.1%

Totals may not add due to rounding.

The U.S. Polar Research Programs Activity supports both Arctic and Antarctic research. Arctic support represents part of a larger NSF and federal research effort. Antarctic support includes funding for NSF-supported researchers as well as for meeting NSF responsibilities as manager of the entire federal Antarctic program, including special requirements for operations and science support.

Polar Activities

The following activities planned for FY 2004 cut across all Polar Research Programs:

- Initiation of a Postdoctoral Fellowship Program targeted at emerging scientific frontiers and underrepresented groups. The evolution of research frontiers in polar areas brings with it the opportunity to engage a new generation of scientists, particularly those from underrepresented groups.

- Activities that address emerging frontiers in polar biology. The National Academy of Sciences/National Research Center has undertaken a study that will help set priorities in this area.

Arctic Research Program

The FY 2004 Budget Request for the U.S. Arctic Research Program within Polar Programs is $40.76 million, an increase of $2.92 million, or 7.7 percent, over the FY 2003 Request of $37.84 million. This funding, with the Arctic Research Support and Logistics funding, represents over 70 percent of the NSF support for university-based Arctic research.

The U.S. Arctic Research Program supports research on the Arctic Ocean, atmosphere, and land areas – including their people, and marine and terrestrial ecosystems. In addition to research in individual disciplines, an Arctic System Science component focuses on interdisciplinary approaches to understanding the Arctic region, including its role in global climate.

It has become widely recognized that the Arctic is in the midst of a change over the last decade. Changes have been measured in the ice cover, atmosphere, some terrestrial parameters, and northern ecosystems. Residents of the North are seeing these environmental changes affecting their lives. It is important to determine whether these changes are correlated with a short-term shift in regional atmospheric circulation or whether they signal long-term global change. Priorities in FY 2004 include:

- Support for the Bering Sea Ecosystem Changes Study (BSECS). BSECS is a study of the dynamics of changes and the fundamental ecosystem properties of the Bering Sea – among the most productive of high latitude marine ecosystems, supporting one of the world's richest assemblages of seabirds and marine mammals and large stocks of commercially valuable fish and shellfish. Additionally, the broad eastern shelf and shelf slope are important because they modify the heat, salt, nutrient content and particulate carbon load of water passing from the North Pacific Ocean into the Arctic Ocean. BSECS is a component of the Study of Environmental Arctic Change (SEARCH) that is planned to be a multiyear, multi-million dollar per year effort involving many federal agencies.

- Arctic System Science research on how changes in arctic biogeochemical cycles and biophysical processes would affect both arctic and global systems.

- Expanded support for science interns, primarily Alaska Native students.

- Study of Shelf-Basin Interactions, focusing on the biological, geochemical and physical processes mediating carbon exchange across the shelf in the Chuckchi Sea/Barrow area. This will be the third field season for this research.

- The second field season for the Freshwater Cycle Study. This work involves a wide range of studies of the freshwater cycle including atmospheric processes affecting deposition and transport, hydrological processes on land including watershed studies and river outflows (Arctic Community-wide Hydrological Analysis and Monitoring Program), and freshwater budgeting in the Arctic Ocean basin (Arctic/Subarctic Ocean Flux).

Arctic Research Support and Logistics

The FY 2004 Request for Arctic Research Support and Logistics is $29.0 million, an increase of $3.0 million, or 11.5 percent, above the FY 2003 Request of $26.0 million. Arctic research support and logistics is driven by and responsive to the science supported in U.S. Arctic Research programs. Funding for logistics is provided directly to grantees or to key organizations that provide or manage Arctic research support and logistics. Some of the highlights and improvements are:

- Continued support to approximately 150 projects throughout the Arctic including Alaska, Canada, the Arctic Ocean, Greenland, Scandinavia and Russia. Almost half the projects are located in Alaska. There is increasing support available for work in the Arctic Ocean and Bering Sea with full use of the USCGC *Healy* augmented by either *Polar Sea* or *Polar Star,* and the *R/V Alpha Helix.*

- Continued access to fixed and rotary-wing airlift support to researchers conducting regional studies in the difficult and often fragile Arctic terrain in Alaska, Canada, Greenland, Arctic Scandinavia, and Russia.

- Continued access to U.S. Coast Guard and other icebreakers, University-National Oceanographic Laboratory vessels and coastal boats, and support on the U.S. Coast Guard Cutter *Healy.*

- Modest upgrades at Toolik Field Station, University of Alaska, Fairbanks' field station for ecological research on Alaska's North Slope.

- Continued safety training for field researchers and funding for field safety experts, global satellite telephones for emergency response, and improved logistics coordination.

- Begin integration under SEARCH of a network of U.S. Long-Term Observatories, linking to similar efforts in Europe and Canada.

- Installation of a modern local area network the Barrow Environmental Observatory with improved access to the Internet.

Arctic Research Commission

Funding for the Arctic Research Commission (ARC), an independent federal agency, is transferred through the National Science Foundation to ARC. In FY 2004, ARC is requesting $1.19 million, an increase of $110,000, or 10.2 percent, over the FY 2003 Request of $1.08 million.

Antarctic Research Grants Program

The FY 2004 Budget Request for the Antarctic Research Grants Program is $44.21 million, an increase of $3.75 million, or 9.3 percent over the FY 2003 Budget Request of $40.46 million. The program provides grants to fund scientific research related to Antarctica and to the Southern Ocean. The FY 2004 Request will support research projects in Antarctica and at academic institutions in the U.S. This fundamental research will provide new information on the ozone hole, how extreme environments affect gene expression, the effects of ultraviolet radiation on living organisms, changes in the ice sheet and impacts on global sea level, global weather, climate, and ocean circulation, and on the early evolution of our universe as well as its current composition. Priorities in FY 2004 include:

- Funding support to begin planning for two Antarctic initiatives, Antarctic Drilling (ANDRILL) and West Antarctic Ice Sheet (WAIS), which will yield new information on historic climate change in Antarctica. ANDRILL is a multinational initiative to investigate Antarctica's role in global environmental change over the last 100 million years using stratigraphic drilling to determine Antarctic climatic, volcanic and tectonic history. WAIS is a multidisciplinary study of rapid climate change and future sea level. These initiatives will provide a benchmark for improvements in climate change models.

- Research, science support, and development of technology for exploration of Antarctic subglacial lakes in Antarctica. This is a growing area of interest because in addition to providing 420,000 years of climate information, Lake Vostok ice cores revealed that the water frozen from the lake surface contains microorganisms.

- Continued Ross Island Meteorology Experiment (RIME) development, aimed at enhancing the understanding of Antarctica's dominant role in Southern Hemisphere meteorology and improving weather forecasting/modeling capabilities for operational and safety purposes.

- The newly launched NASA spacecraft measuring global mass balance of the ice sheets will permit collaborative NSF/NASA studies (e.g., ground truthing) to expand from 2003 to 2004 as these data becomes available.

- Ongoing support of measurements of cosmic microwave background radiation, including its polarization, at South Pole Station, permitting unprecedented observations of the early structure/development of the universe and placing new constraints on cosmological theory.

- Southern Ocean GLOBEC (Global Ocean Ecosystems Dynamics), with the goal of understanding and ultimately predicting how populations of marine animal species interact with the physical environment and respond to natural and anthropogenic climate changes. Successful completion of the observational phase will permit migration to the analysis phase in 2004.

- International Trans-Antarctic Science Expedition (ITASE), which investigates the last 200 years of climate in Antarctica in an effort to understand atmospheric composition and anthropogenic effects.

- Continued operation of polar Long-Term Ecological Research sites (LTERs) as part of an international framework for ecosystem research. Preliminary studies will be conducted on establishment of a site in the Ross Sea area as part of the full-scale National Ecological Observatory Network.

- Astrophysics research to address the origin of the universe, galaxies, and stars.

Antarctic Operations and Science Support

The FY 2004 Budget Request for Antarctic Operations and Science Support is $146.70 million, an increase of $16.34 million, or 12.5 percent, over the FY 2003 Request of $130.36 million. Antarctic Operations and Science Support makes research in Antarctica possible by providing the required research and life support facilities, food, fuel, environmental protection, health and safety and all other operational support for all U.S. research conducted on the continent, including research funded through other federal agencies (National Aeronautics and Space Administration, National Oceanographic and Atmospheric Administration, U.S. Geological Survey, Department of Energy, and the Smithsonian Institution).

The Antarctic Operations and Science Support subactivity is also responsible for managing several activities funded out of the Major Research Equipment and Facilities Construction (MREFC) Account, including South Pole Station Modernization. The new station will provide the infrastructure required for imaginative new science on the drawing board. Taking full advantage of the new station will require new efficiencies in delivering scientists and science supplies to remote locations and the South Pole and fuel to the South Pole. Other MREFC projects are IceCube and Polar Support Aircraft Upgrades. See the MREFC section for further information on these projects.

FY 2004 priorities include:

- Providing operational and logistical support for Antarctic science activities such as observation of cosmic microwave background radiation at South Pole Station.

- Improving operational capability and efficiency, including –

  Development of an overland traverse capability. With the completion of the new South Pole Station in 2007, the U.S. will have the premier research station in the Antarctic interior, setting the stage for U.S. leadership for many years to come. The traverse capability is needed in order to reduce dependence on LC-130 aircraft for delivering fuel and outsized scientific equipment to South Pole Station, and to free up LC-130 aircraft missions for science support, where their unique capability is most needed – in the deep field and wherever speed of delivery is essential. The diversification of the

USAP continental transportation system will improve its reliability and enhance its cost-effectiveness. In FY 2004, necessary equipment will be procured to allow the proposed route between McMurdo and South Pole to be tested. Current plans, depending on FY 2003 and FY 2004 appropriations, are for an operational traverse in FY 2006.

Replacing the McMurdo Station power plant and associated switch gear, which are nearing the end of their useful life. The power plant has been identified as the most critical single point failure risk to the USAP.

- Continued development of a plan, with a timeline of estimated costs, for modernizing infrastructure at McMurdo and Palmer Stations.

Longer term priorities for the program include:

- Completing studies for 24x7 broadband access to South Pole.
- At McMurdo Station:
  Replacing and upgrading obsolete dormitories.
  Improving and expanding health care facilities.
  Providing appropriate food storage and adequate warehousing facilities.

Science support and operations are provided primarily through a support contractor, selected through a competitive bidding process. A Polar Class U.S. Coast Guard icebreaker provides access to McMurdo Station for resupply ships. Other agencies and contractors also provide technical support in areas of expertise such as engineering, construction and communications. Significantly increased sea ice coverage as a consequence of the presence of the icebergs B-15 and C-19 has resulted in an increase in Coast Guard costs for ice-breaking.

The estimated costs of these functions are displayed in the following table:

Antarctic Operations and Science Support
(Dollars in Millions)

	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate
Administration	5.50	5.60	5.80
Science Facilities, research ships, field camp operations, science support aircraft	35.61	36.20	40.30
Operations at McMurdo, South Pole and Palmer Stations	31.70	32.30	37.30
Transportation of people and cargo, materials and inventory	19.60	19.80	20.60
Engineering, construction and facilities maintenance	11.80	12.26	17.10
Data handling and communications	16.40	16.50	17.00
Waste management, fire protection, health and safety, quality assurance	3.30	3.40	3.50
U.S. Coast Guard Icebreaker support	2.24	4.30	4.60
Total, Antarctic Operations and Science Support	$126.15	$130.36	$146.20

U.S. ANTARCTIC LOGISTICAL SUPPORT ACTIVITIES $68,070,000

The FY 2004 Budget Request for U.S. Antarctic Logistical Support Activities is $68.07 million, which is unchanged from the FY 2003 Budget Request.

Antarctic Logistical Support Funding
(Dollars in Millions)

	FY 2002	FY 2003	FY 2004	Change	
	Actual	Request	Request	Amount	Percent
U.S. Antarctic Logistical Support	70.27	68.07	68.07	0.00	0.0%
Total, U.S. Antarctic Logistical Support Activities	$70.27	$68.07	$68.07	$0.00	0.0%

U.S. Antarctic Logistical Support is provided by U.S. Department of Defense components. The major elements are:

- Military personnel of the 109th Airlift Wing (AW) of the New York Air National Guard.
- 109th AW LC-130 flight activity and aircraft maintenance.
- Transportation and training of personnel in connection with the U.S. Antarctic Program.
- Support of the logistics facilities of the Air Force Detachment 13 in Christchurch, New Zealand and the 109th Airlift Wing in Scotia, New York.
- Support for air traffic control, weather forecasting, and electronic equipment maintenance.
- The charter of Air Mobility Command Airlift and Military Sealift Command ships for the re-supply of McMurdo Station, as well as surface freight charges.
- Fuel purchased from the Defense Logistics Agency.
- Reimbursement for use of Department of Defense satellites for communications.

INTEGRATIVE ACTIVITIES

INTEGRATIVE ACTIVITIES $132,450,000

The FY 2004 Budget Request for Integrative Activities (IA) is $132.45 million, an increase of $21.84 million, or 19.7 percent, above the FY 2003 Request of $110.61 million.

Integrative Activities Funding
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Integrative Activities	105.76	110.61	132.45	21.84	19.7%
Integrative Activities	$105.76	$110.61	$132.45	$21.84	19.7%

Integrative Activities supports emerging cross-disciplinary research and education efforts, recognizing the importance of these types of integrative efforts to the future of science and engineering. In FY 2004, IA provides funding for Major Research Instrumentation, Science of Learning Centers, Partnerships for Innovation, and the Science and Technology Policy Institute. In addition, funding is requested for the ADVANCE program, Disaster Response Research Teams, and for administration of the Science and Technology Centers.

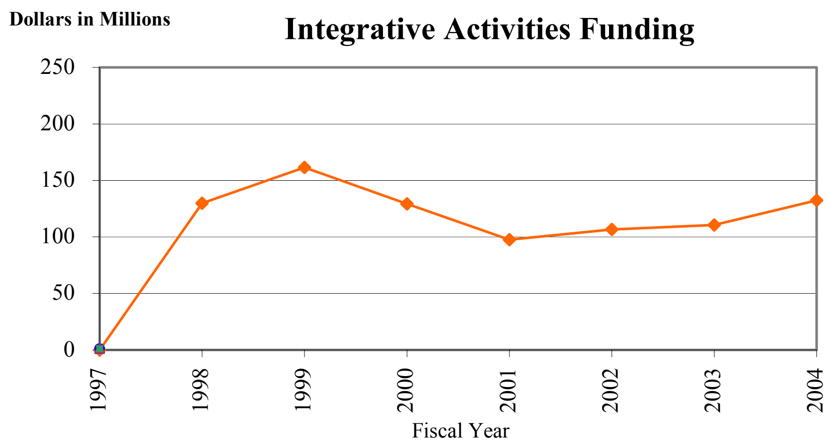
Areas within Integrative Activities
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	Change Amount	Change Percent
Partnerships for Innovation[1]	[10.97]	5.00	10.00	5.00	100.0%
ADVANCE[2]	[16.12]	[17.14]	4.00	4.00	N/A
Science and Technology Centers[3]	25.88	26.61	3.45	-23.16	-87.0%
Science of Learning Centers	0.00	20.00	20.00	0.00	0.0%
Disaster Response Research Teams	0.00	1.00	1.00	0.00	0.0%
Major Research Instrumentation	75.89	54.00	90.00	36.00	66.7%
Science and Technology Policy Institute	3.99	4.00	4.00	0.00	0.0%
Total, Integrative Activities	$105.76	$110.61	$132.45	21.84	19.7%

Totals may not add due to rounding.
[1]The Partnerships for Innovation effort was funded within the Education and Human Resources Account in FY 2002.
[2]ADVANCE is an NSF-wide program. Additional funding is found within the Research and Related Activities Account. The requested increase in IA will bring the NSF total for this program in FY 2004 to $21.16 million.
[3]The decrease for Science and Technology Centers funding reflects new awards made in September 2002. These funds are shown in Integrative Activities in the FY 2003 Request, and are transferred to the appropriate managing R&RA Activity in FY 2004.

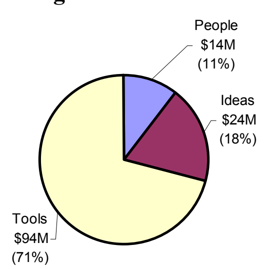
RELEVANCE

IA is a source of federal funding for the acquisition and development of research instrumentation at U.S. academic institutions. IA also funds a number of research centers and programs that support and enhance NSF workforce preparation strategies.



NSF uses various internal and external mechanisms to review the relevance of proposed and existing programs and to help identify emerging opportunities for agency-wide foci and their associated goals for the future. These include Committees of Visitors, advisory committees, academy and other reports, workshops, and long-range planning documents, among others. Three aims (strategic goals) guide NSF's Integrative Activities efforts:

STRATEGIC GOALS



- PEOPLE: Supports promising partnerships among academe, state/local/federal government and the private sector that will explore new approaches to support and sustain innovation.
- IDEAS: Facilitates the advancement of scientific knowledge and learning research through support of Science and Technology Centers, Science of Learning Centers and other disciplinary research.
- TOOLS: Enables enhancement of the infrastructure for the conduct of research. Investments support acquisition of research instrumentation and the development of laboratories and other facilities needed to do world-class research.

Summary of Integrative Activities Funding by Strategic Goal
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	Change Amount	Change Percent
People	0.00	5.00	14.00	9.00	180.0%
Ideas	25.88	47.61	24.45	-23.16	-48.6%
Tools	79.88	58.00	94.00	36.00	62.1%
Administration and Management	0.00	0.00	0.00	0.00	0.0%
Total, IA	$105.76	$110.61	$132.45	$21.84	19.7%

Budget Highlights

People (+$9.0 million, for a total of $14.0 million)
Supports promising partnerships among academe, state/local/federal government and the private sector that will explore new approaches to support and sustain innovation. The FY 2004 IA budget will provide enhancements in multidisciplinary education, teaching, and training activities through:

- *Partnerships for Innovation*. Doubled the funding from $5.0 million proposed in the FY 2003 Request for the Partnerships for Innovation (PFI) program for a program total of $10.0 million. The goals of the PFI program are: to stimulate the transformation of knowledge created by the national research and education enterprise into innovations that create new wealth, build strong local, regional and national economies and improve the national well-being; to broaden the participation of all types of academic institutions; and, to catalyze or enhance infrastructure necessary to foster and sustain innovation in the long-term.

- *ADVANCE*. Increased funding of $4.0 million in IA for the ADVANCE program brings the NSF total to $21.16 million. The goal of ADVANCE is to expand and strengthen the academic science and engineering workforce through increased representation of women, particularly in the senior and leadership ranks. To meet this goal, the ADVANCE program provides award opportunities for both individuals and organizations, including Fellows Awards, Institutional Transformation Awards, and Leadership Awards. Institutional transformation awards link faculty and university leadership in partnerships to examine, analyze and improve policies and practices that enhance the recruitment, retention, and promotion of women faculty. Leadership awards stimulate and sustain outstanding contributions with widespread impact by individuals, small groups and organizations such as professional societies on increasing the participation and advancement of women in academic science and engineering careers. Fellows awards are offered for individuals at particular career junctures that impact progression of women into and through the academic ranks. These awards provide research support to individuals to establish a strong, sustainable independent research and education career in academe. With each of the three types of ADVANCE awards, NSF seeks to support new approaches to improving the climate for women in U.S. academic institutions and to facilitate women's advancement to the highest ranks of academic leadership.

Ideas (-$23.16 million, for a total of $24.45 million)
Facilitates the advancement of scientific knowledge and learning research through support of Science and Technology Centers, Science of Learning Centers and other disciplinary research. The FY 2004 IA budget will provide support of multidisciplinary research activities and interagency partnerships through:

- *Science of Learning Centers*. Continued funding at the FY 2003 Request level for Science of Learning Centers at $20.0 million. NSF's investment in Science of Learning Centers (SLC), proposed to begin in FY 2003, will build on the Foundation's support for learning research in multiple disciplines including biology, psychology, education, neuroscience, cognitive science, linguistics, computer and information science, robotics, mathematics and statistics, engineering, the physical sciences, and the social and behavioral sciences. SLCs will be built around a unifying research focus and will incorporate a diverse, multidisciplinary environment involving appropriate partnerships with academia, industry, international partners, all levels of education, and other public and private entities.

  SLCs must demonstrate an effective implementation strategy that will achieve all three of the SLC principal goals, which are to: (1) advance the frontiers of the science of learning through multidisciplinary research, (2) connect this research to specific educational, scientific, technological, and workforce challenges, and (3) develop research communities that can capitalize on new opportunities and discoveries and respond to new challenges. FY 2004 support for the SLCs totals $20.0 million, providing funds for three to four centers and a number of catalyst projects that could eventually develop into centers. This funding level is designed to support a diverse portfolio of research projects, providing leadership across a broad range of science and engineering approaches to science of learning research.

- *Disaster Response Research Teams*. Continued funding at the FY 2003 Request level of $1.0 million for Disaster Response Teams that will respond to events such as terrorist attacks. These teams will conduct rapid, post-event studies that will provide invaluable data and insights into disaster response. NSF's broad base of support for fundamental science and engineering provides the underlying capability that enables the nation to respond rapidly and aggressively in time of national need.

The FY 2004 Request for IA transfers $23.16 million for six Science and Technology Centers awarded in FY 2002 from within IA to the appropriate managing Subactivities in Research and Related Activities Account (CISE, ENG, GEO, and MPS).

Tools (+$36.0 million, for a total of $94.0 million)
Enables enhancement of the infrastructure for the conduct of research. Investments support acquisition of research instrumentation and the development of laboratories and other facilities needed to do world-class research. The FY 2004 IA budget will provide enhancements in infrastructure and institutional research programs through:

- *Major Research Instrumentation*. Increased funding of $36.0 million above the FY 2003 request of $54.0 million for a total of $90.0 million to support the acquisition and development of research instrumentation in academic institutions. The Major Research Instrumentation (MRI) program is designed to increase access to state-of-the-art scientific and engineering equipment for research and research training in U.S. academic institutions. This program seeks to foster the integration of research and education by providing instrumentation for research-intensive learning environments where more American students will be trained for careers in science and engineering. In FY 2004, the MRI program will focus on ensuring the availability of cutting-edge research instrumentation to a broad set of academic institutions, including undergraduate institutions, minority-serving institutions, and community colleges. To facilitate broader participation in the MRI program, NSF will significantly reduce or eliminate the MRI cost-sharing requirement for small and minority institutions. The cost-sharing requirement was eliminated for non-PhD granting institutions in 2003.

- *Science and Technology Policy Institute*. Continued funding at the FY 2003 Request level of $4.0 million for the Science and Technology Policy Institute (STPI). STPI is a federally-funded research and development center established by Congress in 1992 to support the complex task of devising and implementing science and technology policy. The Institute provides analytical support to the Office of Science and Technology Policy (OSTP), to identify near-term and long-term objectives for research and development and to identify options for achieving those objectives.

EDUCATION AND HUMAN RESOURCES

EDUCATION AND HUMAN RESOURCES $938,040,000

The FY 2004 Request for the Education and Human Resources Activity (EHR) is $938.04 million, an increase of $29.96 million, or 3.3 percent, over the FY 2003 Request of $908.08 million.

EHR Funding
(Dollars in Millions)

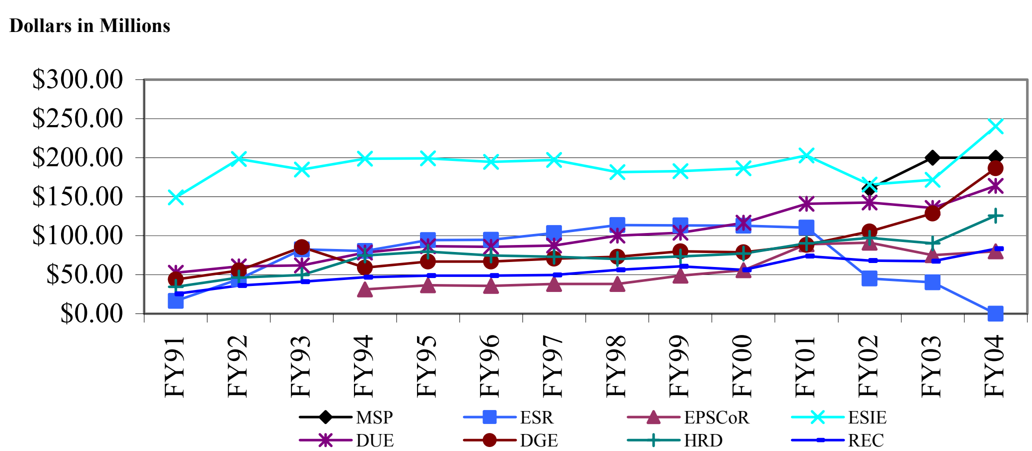
	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Math and Science Partnership	150.08	200.00	200.00	0.00	0.0%
EPSCoR[1]	90.65	75.00	75.00	0.00	0.0%
Elementary, Secondary & Informal Education[2]	210.76	211.69	194.45	-17.24	-8.1%
Undergraduate Education	142.70	135.60	142.10	6.50	4.8%
Graduate Education	105.97	128.38	156.88	28.50	22.2%
Human Resource Development	97.01	90.21	103.41	13.20	14.6%
Research, Evaluation & Communication	68.95	67.20	66.20	-1.00	-1.5%
Total, EHR[3]	$866.11	$908.08	$938.04	$29.96	3.3%

[1]FY 2002 Actual includes $10.97 million for the Partnerships for Innovation program, which is funded in Integrative Activities in the Research and Related Activities Appropriation in the FY 2003 and FY 2004 Requests.
[2]FY 2002 Actual and FY 2003 Request for Elementary, Secondary and Informal Education (ESIE) includes $45.06 million and $40.25 million, respectively, from Education System Reform (ESR). In FY 2004, all remaining ESR projects are moved to ESIE in order to consolidate K-12 programs.
[3]Totals may not add due to rounding. Excludes $57.31 million in FY 2002 and an estimated $65.68 million in FY 2003 from H-1B Nonimmigrant Petitioner Fees. Legislation for this activity expires in FY 2003.

RELEVANCE

The Education and Human Resources (EHR) Activity supports education, research, and infrastructure development in all science, technology, engineering and mathematics (STEM) disciplines. In accordance with the NSF Act of 1950, NSF is the principal federal agency charged with promoting science and engineering (S&E) education at all levels and in all settings. Support for STEM education and related research and human resource development programs for the EHR Subactivities from FY 1991 is shown in the chart below.

EHR Subactivity Funding



Because of its comprehensive research and education portfolio in S&E education, EHR is in a unique position to address the critical problems facing America's STEM educational system and the workforce implications of those problems. Too few K-12 teachers are knowledgeable in science or mathematics. By high school, unacceptably low numbers of students are motivated to enroll in physics or chemistry, and only 20-25 percent of graduating high school seniors have completed enough mathematics to be ready to study science or engineering. Each year, S&E degrees as a percentage of the population of 24 year olds have remained virtually constant at 5-6 percent. Within this group, women and minorities are seriously underrepresented. The U.S. Department of Labor estimates that 60 percent of the new jobs being created in our economy today will require technological literacy while only 22 percent of the young people entering the job market now actually possess the necessary skills.

EHR's portfolio is comprehensive, addresses critical national issues in science and math education, and includes a research and evaluation track in each activity to ensure that EHR-sponsored programs add to our knowledge base about STEM education, that recommended educational improvements are evidence-based and that high standards of accountability are sustained. EHR's education and research programs are aligned with Administration priorities as outlined in the *No Child Left Behind Act* and the Administration's interagency priorities for R&D. These priorities include strengthening science, mathematics, and engineering education by promoting excellent educational programs and best practices; and emphasizing research that enables the successful development and implementation of science-based programs and practices. Research goals include strengthening mathematics and science education and advancing the use of educational technology for improving both student achievement and teacher training. Examples of EHR programs that address national concerns include:

- The President's education initiative, the Math and Science Partnership (MSP), which seeks to improve K-12 education for all by preparing teachers in STEM disciplines, enhancing STEM faculty participation in K-12 schools, offering advanced courses to students, and ensuring that schools offer a challenging curriculum.
- Informal science activities across the nation that help foster the public understanding of science and promote adult learning in STEM.
- Research on education includes a focus on the use of information technology in education and the translation of research results into educational practice.
- Undergraduate programs focus on meeting the needs of two-year colleges, expanding the nation's STEM talent, meeting federal workforce needs for cybersecurity specialists, fostering STEM research and education capacity at Historically Black Colleges and Universities (HBCUs) and other minority-serving institutions, and promoting the advancement of women and racial/ethnic minority students to increase their participation in the STEM enterprise.
- EPSCoR activities develop State-NSF partnerships designed to stimulate sustainable improvement in R&D competitiveness in the 22 states eligible for the EPSCoR program.

STRATEGIC GOALS

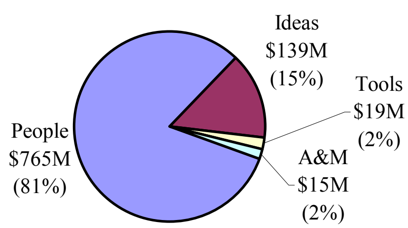
For FY 2004, EHR program activities will be directed at achieving four broad goals:

1. Preparing the **next generation of STEM professionals** and attracting more U.S. citizens to STEM careers.
2. Increasing the **technological and scientific literacy** of the general public so that they can exercise responsible citizenship in an increasingly technological society and acquire knowledge of science, mathematics and technology that is appropriate to the development of workforce skills and life-long career opportunities.

3. Creating the capacity to promote participation (**diversity**) and achievement in STEM consistently and effectively.
4. Attending to **critical workforce needs** requiring significant math and science skills and knowledge, both by attracting new people to these STEM careers and by support for the development and retooling of the current STEM workforce. Current and anticipated workforce needs include: a) STEM talent in the professional and instructional workforces; b) STEM professionals for the growing fields of homeland defense and cybersecurity and for emerging fields (e.g., nanotechnology); and c) replacements for the substantial numbers of STEM workers, teachers and faculty who are expected to retire over the next 10 years.

Three strategic focus areas guide EHR's activities:

FY 2004 EHR Strategic Goals



PEOPLE: EHR contributes two-thirds of all NSF funds intended to achieve the PEOPLE Strategic Goal. EHR's objectives are to improve the quality of STEM education and training at all levels, support promising students, increase the diversity of the STEM community and instructional workforce, and broaden the participation of all U.S. citizens in the STEM enterprise.

IDEAS: EHR promotes research on learning, STEM education and the use of learning technologies for students, teachers and adult learners, and fosters the translation of research successes into educational practice. EHR provides leadership through the Interagency Education Research Initiative (IERI) and other broad research programs to advance knowledge about how individuals learn, explore learning innovations that can serve society, expand participation in cutting-edge research, and build a strong community of education researchers.

TOOLS: EHR invests in the National STEM Education Digital Library (NSDL), which builds a national resource to increase the quality, quantity and comprehensiveness of Internet-based STEM educational materials while creating virtual learning communities that link students, teachers and faculty with each other and with a rich array of learning tools.

EHR's support for ongoing core and new activities contributes to NSF's efforts to achieve its strategic goals, and to the administration and management activities necessary to achieve these goals.

Summary of EHR Funding by Strategic Goal
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	Change Amount	Change Percent
People	679.91	732.69	764.85	32.16	4.4%
Ideas	146.32	137.22	139.22	2.00	1.5%
Tools	24.16	23.60	18.60	-5.00	-21.2%
Administration & Management	15.72	14.57	15.37	0.80	5.5%
Total, EHR	$866.11	$908.08	$938.04	$29.96	3.3%

Budget Highlights

People (+$32.16 million, for a total of $764.85 million)

The EHR portfolio includes programs affecting all STEM fields, every educational level, and both formal and informal educational settings. EHR's past efforts have demonstrated the value of systemic approaches to educational improvement. People activities managed by EHR are informed by research, and based on evidence of successful practices and on recognized educational standards. EHR's activities develop effective curricula and courses, and provide professional development for teachers and faculty.

EHR People Investments
(Dollars in Millions)

	FY 2002	FY 2003	FY 2004	Change	
	Actual	Estimate	Estimate	Amount	Percent
PreK-12 Education	308.70	359.58	346.89	-12.69	-3.5%
Undergraduate Education	166.08	157.35	180.70	23.35	14.8%
Graduate & Professional	114.33	136.87	164.92	28.05	20.5%
Other People Support	90.80	78.89	72.34	-6.55	-8.3%
Total, People	$679.91	$732.69	$764.85	$32.16	4.4%

PreK-12 Education

- Within the $200.0 million total for the Math and Science Partnership (MSP), EHR will fund the *MSP Teacher Institutes for the 21st Century* that will produce teachers at all grade levels, K-12, who are knowledgeable and proficient in mathematics, science, and related technologies and who have the disciplinary expertise and stature needed to motivate students towards continued study of mathematics/science in advanced courses.

Undergraduate Education

- The STEM Talent Expansion Program (STEP) increases by $5.0 million to $7.0 million to build this program as a way to reinvigorate undergraduate experience.
- The Louis Stokes Alliances for Minority Participation (LSAMP) program increases by $6.20 million to $32.73 million to increase award size and improve collaboration through partnerships with the Alliances for Graduate Education and the Professoriate (AGEP) program.
- The Historically Black Colleges and Universities – Undergraduate Program (HBCU-UP) increases by $6.0 million to $19.97 million to increase award size and improve coordination with other institutions that serve minority students.
- The Federal Cyber Service: Scholarship for Service (SfS) program increases by $5.0 million to $16.18 million to increase the numbers of associate and baccalaureate degree recipients in STEM fields in areas of critical national need.

Graduate & Professional

- Increasing the stipend level and the number of students in the three NSF-supported graduate education programs continues to be a high priority of the Foundation. The FY 2004 Request provides an increase of $28.50 million to a total of $156.88 million to increase the number of graduate students and raise the annual stipend level to $30,000 in the Integrative Graduate Education Research Traineeships (IGERT) program, the Graduate Teaching Fellowships in K-12 Education (GK-12) program and the Graduate Research Fellowships (GRF) program. With additional funding from the R&RA Activities, nearly 5,000 U.S. graduate students in the STEM disciplines will be supported.

Workforce for the 21st Century

In FY 2004, EHR will provide $8.50 million in funding to launch NSF's Workforce for the 21st Century priority area. For FY 2004, NSF's Workforce efforts will focus on attracting students, especially those students who have traditionally been underrepresented, to science, technology, engineering and mathematics (STEM) disciplines, and on research activities focused on workforce issues. Examples of possible activities include integrating research and education through hands-on research experiences for high school students and/or undergraduates across disciplines, providing for partnerships with non-academic S&E employers to offer internships and in-service learning, and conducting research on factors determining students' career choices.

Ideas (+$2.0 million, for a total of $139.22 million)

EHR promotes the Foundation's Ideas goal through research tracks in its programs. EHR pursues research questions addressing cognitive science, educational practice, learning technologies, effective methods of instruction, ways to adapt successful practices to a larger scale, etc. EHR seeks to develop a more effective program of research on education and the effective use of learning technologies.

Programs specific to the Ideas goal include: Experimental Program to Stimulate Competitive Research (EPSCoR) which remains level with the FY 2003 Request of $75.0 million; the Research on Learning and Education (ROLE) program, which is funded at the FY 2003 Request level of $39.56 million; and the Interagency Education Research Initiative (IERI), funded at $15.0 million in EHR, with an additional $10.0 million contributed by the R&RA Activity. The $25.0 million total for IERI is the same as in the FY 2003 Request.

EHR's support for the Centers of Research Excellence in Science and Technology totals $10.88 million, an increase of $2.0 million over the FY 2003 Request, primarily to increase award size. These Centers are designed to stimulate the capacity for conducting competitive research at minority institutions. The Centers help to produce well-trained doctoral students and assist faculty to become more competitive in obtaining research funding.

Priority Areas

In FY 2004, EHR will support research and education efforts related to broad, Foundation-wide priority areas in Information Technology Research, Nanoscale Science and Engineering, Mathematical Sciences, and Human and Social Dynamics.

EHR Investments in Priority Areas
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Percent
Information Technology Research	2.00	2.48	9.53	7.05	284.3%
Nanoscale Science and Engineering	0.00	0.22	2.22	2.00	909.1%
Mathematical Sciences	n/a	2.74	2.74	0.00	0.0%
Human and Social Dynamics	n/a	n/a	1.00	1.00	n/a

- **Information Technology Research (ITR)**: EHR's total support for the ITR priority area is $9.53 million in FY 2004, an increase of $7.05 million over the FY 2003 Request of $2.48 million. The increase will allow for study on the impact of IT on educational practice, new approaches to using technology in education, application and adaptation of technologies to promote learning in a variety of fields and settings, and the effects of technology on learning.

- **Nanoscale Science and Engineering (NSE)**: The EHR contribution to NSE increases by $2.0 million to $2.22 million in FY 2004 to support undergraduate education and the new emphasis on K-12 nanoscience education.

- **Mathematical Sciences:** FY 2004 support totals $2.74 million, unchanged from the FY 2003 Request. EHR participation supports mathematical sciences education activities.

- **Human and Social Dynamics**: EHR contributes $1.0 million in FY 2004 to support research in the Enhancing Human Performance research area.

Tools (-$5.0 million, for a total of $18.60 million)

The National STEM Education Digital Library (NSDL) promotes Internet-based STEM educational resources and allows the formation of virtual learning communities linking students and teachers/faculty with a wide array of resources. EHR funding for NSDL decreases by $5.0 million in FY 2004 to $18.60 million. Additional support in the GEO and MPS activities brings the NSDL total to $23.80 million in FY 2004. NSF recently awarded support for the NSDL Core Integration Portal project, which will serve as the central management point for the Library and for collections and services. As a result of this award, funding requirements for NSDL decline in FY 2004.

Administration and Management

Administration and Management provides for administrative activities necessary to make it possible for NSF to achieve its strategic goals. Requested funding for FY 2004 is $15.37 million, an increase of $800,000 over the FY 2003 Request. This includes the cost of Intergovernmental Personnel Act appointments and contractors performing administrative functions.

QUALITY

EHR maximizes the quality of the education awards and R&D it supports through the use of a competitive, merit-based review process. The percent of basic and applied research funds that were allocated to projects that undergo merit review was 95 percent in FY 2002, the last year for which complete data exist.

To ensure the highest quality in processing and recommending proposals for awards, EHR convenes Committees of Visitors, composed of qualified external evaluators, to review each program every three years. These experts assess the integrity and efficiency of the processes for proposal review and provide a retrospective assessment of the quality of results of NSF's investments.

The Directorate also receives advice from the Advisory Committee for Education and Human Resources (EHRAC) on such issues as: the mission, programs, and goals that can best serve the science education community; how the EHR portfolio can be improved; how EHR can promote quality STEM education at all levels; and priority investment areas in education research. The EHRAC meets twice a year. Members are educators and researchers representing a wide cross-section of STEM fields and a cross-section of institutions including industry. The Committee has broad geographic representation and balanced representation of women and underrepresented minorities.

PERFORMANCE

Examples of significant discoveries or advances resulting from EHR-supported research and education awards include:

- For the three-year-old Historically Black Colleges and Universities–Undergraduate Program (HBCU-UP) project at Clark Atlanta University, the number of minority STEM majors involved in faculty-supervised research has increased from 25 in 1999 to 45 in 2001. The university has developed and implemented the Center of Excellence in Teaching and Learning and the Distance Learning Instructional Technology Education Center to provide faculty development opportunities that engage faculty in the institutional reform effort. There are now 145 STEM faculty who are prepared to use innovative pedagogical techniques, and this number is expected to continue to grow. The project's combined pre-calculus course, developed through an HBCU-UP program initiative, emphasizes problem-solving, provides more contact hours between students and instructors, and teaches students relatively new to STEM disciplines how to read and understand scientific and technical materials.

- As part of NSF's Experimental Program to Stimulate Competitive Research (EPSCoR) program, researchers in Kansas are considering critical questions in Homeland Security and attempting to mitigate future bioterrorism and biological hazards through the *Kansas Program for Complex Fluid Flow*. A dozen scientists at Kansas State University, the University of Kansas, and Wichita State University are gaining a better understanding of how air moves through a confined space occupied by people, such as a room or an aircraft cabin, and how particles or contaminants may be transported through the area and around objects. http://www.mne.ksu.edu/cff/.

- In work funded under the Interagency Education Research Initiative (IERI), Robert J. Sternberg at Yale University suggests that classroom instruction can be more effective if it promotes all three aspects of intelligence – analytic, creative, and practical – as all are critical to learning. For classes in grades 3 to 5, Sternberg found that when all three aspects were emphasized, students had higher levels of mathematical achievement, the learning rate for minority students was higher than the rate for non-minority students, and achievement gains were higher in poorer schools than in affluent schools.

- An Integrative Graduate Education Research Traineeships (IGERT) project at Carnegie Mellon University responded rapidly to the events of 9/11 by studying how terrorist networks are likely to evolve, using models to develop strategies for terrorist network destabilization, demonstrating that destabilization strategies that work in hierarchical companies will not work on networks, and addressing various intelligence and planning issues. Currently four counterterrorism projects are underway. http://www.casos.ece.cmu.edu/home_frame.html.

- In the past decade, science has deciphered more secrets of the human brain than in the previous 90 years combined. In 2002, the Public Broadcasting System (PBS) aired the five-part series, *The Secret Life of the Brain,* exploring the startling new map of the brain, contradicting much of what was previously believed, and holding out hope for dramatic advances in the areas of addiction, depression, learning disorders, Alzheimer's Disease, and schizophrenia. With support from the Informal Science Education (***ISE***) program, *The Brain* called on neuroscience's leading researchers to increase public understanding of how research is practiced; the connection between pure and applied research; and how these methods impact their lives. Over 15 million people viewed all or part of the series. Educational outreach products included an award-winning book; a Web site, www.pbs.org/wnet/brain, which has been accessed by more than 600,000 users; and grants to PBS stations nationally for educational outreach.

- The NSF Graduate Research Fellowships program has a well-deserved reputation for supporting some of the most promising researchers and educators in America. Four of the Nobel Laureates for 2001 were former NSF Fellows: Eric Allen Cornell (Physics), Karl B. Sharpless (Chemistry), Leland H. Hartwell (Physiology or Medicine) and Joseph E. Stiglitz (Economics). Two of the 15 National Medal of Science winners for 2002, Mario R. Capecchi and Ernest R. Davids, were former NSF Graduate Fellows.

- Research in detector technology development initially supported under EHR's Centers of Research Excellence in Science and Technology (CREST) program by the Hampton University Nuclear and High Energy Physics Research Center has been expanded this year into the Center for Advanced Medical Instrumentation. This Center has developed patented diagnostic and surgical devices now used clinically and houses a new academic program in Medical Physics (the first such program in Virginia and the first nationally at an HBCU). Hampton University physics doctoral students represented half of the total African Americans graduating in this discipline this year.

- The Louis Stokes Alliances for Minority Participation (LSAMP) program has played a seminal role in increasing the number of minority bachelor's degree recipients in the United States since its inception in 1991. In 2002, student participants in the LSAMP Program reached an all time high of 201,615 enrollees, with 21,707 underrepresented minority graduates at the bachelor's degree level in STEM disciplines. Graduates are being accepted into America's top schools. For example, enrollment of undergraduate students at the Florida/Georgia LSAMP has increased from 454 in 1993 to 1,268 in 2001 while the number of STEM bachelor's graduates at participating institutions more than quadrupled from 416 in 1991 to 2,145 in 2001. Another highly successful LSAMP project is in Houston. The Houston LSAMP has graduated 1,206 STEM minority students during its first two years of operation and currently has 6,414 minority students enrolled in STEM areas. The number of direct participants in the Houston Alliance has increased from 155 students during the first year of the program to 337 students during the second year – an increase of 117 percent.

- The *Pennsylvania State ATE Center in Nanofabrication* builds upon two significant strengths in Pennsylvania: the Nanofabrication Manufacturing Technology Partnership with industry and the NSF-sponsored Penn State Nanofabrication Facility, a research facility that is part of NSF's National

Nanotechnology Users Network. The Center's goal is to develop a workforce with broad skills in micro- and nanofabrication applications through a resource-sharing approach. The Center shares the Penn State Nanofabrication Facility to support educational programs at more than 30 institutions of higher education; relies on private industry to guide every phase of educational program development; has created programs in micro- and nanofabrication at community colleges and other institutions across Pennsylvania; operates a unique capstone semester program at Penn State for college students; conducts workshops and courses for faculty; and develops educator and student awareness of micro- and nanofabrication education and career opportunities. The Center has partnerships with all 14 community colleges and several state universities in Pennsylvania to offer programs in nanofabrication. Students work together in class, labs, or the nanofabrication facility about 8 hours a day during the capstone semester, and graduates are eagerly sought by industry. http://www.nanofab.psu.edu/

- This year, the *Summer Undergraduate Research in Science/Engineering (SURE)* program at the Georgia Tech Alliance for Graduate Education and the Professoriate (AGEP) continued its strong record of success as it entered its eleventh year, with an enrollment of students from 17 different universities in the U.S., Puerto Rico, and the U.S. Virgin Islands. This year's group provides a very promising cohort of potential Georgia Tech graduate students. Nearly 90 percent of SURE's 166 total participants have gone to graduate school (nearly half have enrolled at Georgia Tech). A CyberNetwork that will provide unprecedented connectivity between undergraduate minority development programs (e.g., LSAMP) and graduate development programs (e.g., AGEP) is near completion, and is being co-funded by NSF's Office of Integrative Activities.

- Supported by the National STEM Education Digital Library (NSDL), the Scripps Institute of Oceanography is collaborating with the San Diego Supercomputer Center and the University of California-San Diego Library to develop a prototype digital library collection that includes extensive data, images, and documents from a recent oceanographic cruise in the Pacific. A Floating Digital Library Workshop was held aboard the R/V Melvillein in March 2002 while researchers were collecting geophysical data off the coast of New Zealand. This activity represents an important step in providing real-time data to scientists and educators. On May 8, a "Live on the Web" talk gave an overview of the accomplishments of the expedition. This project represents the potential for expanding the audience able to benefit from oceanographic expeditions.

Other Performance Indicators

The following table shows the growth in the number of people benefiting from EHR's funding.

Number of People Supported in EHR Activities

	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate
Senior Researchers	5,798	5,900	5,900
Other Professionals	3,768	3,800	3,800
Postdoctorates	417	430	450
Graduate Students	4,317	4,600	4,800
Undergraduate Students	20,000	21,000	21,000
K-12 Students	11,000	13,000	14,000
K-12 Teachers	83,500	84,500	85,500
Total Number of People	128,800	133,230	135,450

Change in EHR Budget Structure

The Education and Human Resources Activity is restructured in FY 2004 to promote a coherent approach to the teacher education continuum in which NSF's state, urban, and rural systemic initiatives are integrated from the Education Systemic Reform (ESR) Subactivity into the Elementary, Secondary, and Informal Education (ESIE) Subactivity. This restructuring will consolidate preK-12 programs and capture lessons learned from the urban and rural systemic efforts. Support for existing awardees will continue in FY 2004. A crosswalk for the FY 2003 Request is shown below.

EHR Change in Budget Structure
(Dollars in Millions)

Current Structure	New Structure				Total, Current Structure
	ESR	**ESIE**			
		IMD	*TSD*	*ISE*	
Education System Reform (ESR)			**40.25**		**40.25**
Elementary, Secondary, and Informal Education (ESIE)					**171.44**
Instructional & Assessment Materials Development (IMD)		*28.99*			*28.99*
Teacher and Student Development (TSD)			*87.45*		*87.45*
Informal Science Education (ISE)				*55.00*	*55.00*
Total, New Structure	**$0.00**	*$28.99*	*$127.70*	*$55.00*	**$211.69**

MATH AND SCIENCE PARTNERSHIP $200,000,000

The FY 2004 Request for the Math and Science Partnership Subactivity is $200.0 million, unchanged from the FY 2003 Request.

Math and Science Partnership Funding
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Percent
Total, MSP	$150.08	$200.00	$200.00	$0.00	0.0%

The Math and Science Partnership (MSP) program responds to a growing national concern – the lackluster performance of U.S. children in mathematics and science. *No Child Left Behind*, which enunciates the President's vision for K-12 education, articulates this concern and identifies the main underlying factors for the poor performance of U.S. students: too many teachers teaching out of field, too few students taking advanced coursework, and too few schools offering challenging curricula and textbooks.

MSP builds on the nation's dedication to improve mathematics and science education through support of partnerships that unite the efforts of local school districts with faculties of colleges and universities – especially disciplinary faculties in mathematics, science, and engineering – and with other stakeholders. MSP seeks to improve student outcomes in mathematics and science for all students, at all K-12 levels. As the achievement of students rises, MSP expects to significantly reduce achievement gaps in mathematics and science education among diverse student populations.

To achieve these long-term outcomes, the MSP program supports the development, implementation and sustainability of promising partnerships among: mathematics, science, engineering and education faculty and their institutions of higher education; administrators, teachers and guidance counselors in K-12 schools and school systems; and other important stakeholders to:

- Ensure that all K-12 students have access to, are prepared for and are encouraged to participate and succeed in challenging curricula and advanced mathematics and science courses;
- Enhance the quality, quantity and diversity of the K-12 mathematics and science teacher workforce; and
- Develop evidence-based outcomes that contribute to our understanding of how students effectively learn mathematics and science.

The first competitions for (a) MSP Comprehensive and Targeted projects and (b) MSP Research, Evaluation and Technical Assistance (RETA) projects were held in FY 2002 and resulted in seven Comprehensive awards, seventeen Targeted awards and twelve RETA awards. Collectively, the funded Comprehensive and Targeted projects and RETA projects constitute the MSP Learning Network, a network of researchers and practitioners studying and evaluating promising strategies to improve K-12 student achievement and other student outcomes in mathematics and science. The MSP Learning Network activities are expected to deepen our understanding of how students effectively learn mathematics and science such that successful approaches can be broadly disseminated and emulated in educational practice.

MSP Comprehensive projects implement change in mathematics and science educational practices in both higher education institutions and in schools and school districts to result in improved student achievement across the K-12 continuum. Projects are distinguished by the range and variety of lead institutions and partners involved. The Washington University MSP, for example, partners the University with five school districts, the St. Louis Science Center and the St. Louis Zoo. The El Paso MSP involves not only the University of Texas at El Paso and twelve independent school districts, but also the Office of the Mayor of El Paso and the Hispanic and Black Chambers of Commerce.

Targeted projects focus on improved K-12 student achievement in a narrower grade range or have a disciplinary focus in mathematics and/or science. The partnership housed at the University System of Maryland, for example, targets science in grades 9-12, while the California State University-Fullerton partnership targets mathematics in grades 6-12.

In New York, another targeted project at SUNY-Brockport teams with the Rochester City School District and the Brighton Central School District, with the Shodor Foundation and the Krell Institute as additional partners. A Computational Mathematics, Science and Technology (CMST) approach to learning science will be employed in which students and teachers engage in fieldwork, laboratory experiments, mathematical modeling, computer simulation and visualization. CMST employs mathematical models to describe physical phenomena, therefore bringing a new perspective to the usefulness of mathematics as a tool in real life. A Challenge program incorporating CMST will provide tools and motivation for 200 7th to 12th-grade students under the supervision of participating teachers. In addition to the collaboration and new strategies for problem solving, an important component of the professional development program for mathematics and science teachers is a four-week summer institute each year, serving a total of 240 teachers. In addition, there is a master's degree program for 30 teachers. Preservice education programs at SUNY-Brockport are being revised and new courses are to be introduced with a focus towards improving the quality, quantity and diversity of the new teacher workforce.

Research, Evaluation and Technical Assistance (RETA) projects provide large-scale research and evaluation capacity for the MSP Learning Network, and provide Comprehensive and Targeted awardees with assistance in the implementation and evaluation of their work.

- The Council of Chief State School Officers has established a collaborative research team involving the Wisconsin Center for Education Research and the American Institutes for Research to address the following research questions: (1) To what extent is the quality of the professional development supported by MSP consistent with a research-based definition of quality? (2) What effects do teachers' professional development experiences have on instructional practices and content taught in math and science classes? (3) Are high-quality professional development activities more likely than lower-quality activities to increase the alignment of content with state standards and assessments? (4) How can MSP projects use study findings to improve professional development and the content and instruction of mathematics and science classes?

In FY 2003, MSP continues support for new Comprehensive and Targeted awards and a combination of research, evaluation and technical assistance grants and contracts, informed by assessments of lessons learned from the FY 2002 efforts. In FY 2004, MSP adds a new activity for Teacher Institutes for the 21st Century, with a focus on developing master teachers who have deep content expertise in mathematics, science, and related technologies, who are excited about newer developments in these fields, and who have the disciplinary depth and stature to motivate students towards continued study of mathematics and science in advanced courses.

NSF and the U.S. Department of Education (ED) will continue to collaborate on appropriate program linkages to manage the federal investment in science and mathematics education for the greatest effectiveness. In FY 2002, NSF and ED co-funded one MSP Comprehensive award and one Targeted award.

EXPERIMENTAL PROGRAM TO STIMULATE COMPETITIVE RESEARCH $75,000,000

The FY 2004 Request for the Experimental Program to Stimulate Competitive Research (EPSCoR) is $75.0 million, unchanged from the FY 2003 Request.

Experimental Program to Stimulate Competitive Research Funding
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Innovation Partnership Activities[1]	10.97	0.00	0.00	n/a	n/a
Experimental Program to Stimulate Competitive Research	79.68	75.00	75.00	0.00	0.0%
Total, EPSCoR	$90.65	$75.00	$75.00	$0.00	0.0%

[1] The Partnership for Innovation Program is transferred to Integrative Activities in the Research and Related Activities Appropriation in FY 2003 and FY 2004.

EPSCoR is a State-NSF partnership designed to stimulate sustainable improvements in R&D competitiveness through the development and utilization of science and technology (S&T) resources that reside in a state's major research universities. EPSCoR emphasizes local direction and administration by broad-based statewide governing committees; program accountability at all levels; and non-federal cost-sharing investments. EPSCoR currently operates in twenty-two states, the Commonwealth of Puerto Rico, and the U.S. Virgin Islands. The states are: Alabama, Alaska, Arkansas, Delaware, Hawaii, Idaho, Kansas, Kentucky, Louisiana, Maine, Mississippi, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, South Carolina, South Dakota, Vermont, West Virginia, and Wyoming. EPSCoR attempts to develop nationally competitive R&D infrastructures within participating states by promoting partnerships among state government, universities, and the private sector in strategic research areas with high growth potential. The success of EPSCoR supported projects is demonstrated in the following examples:

- An Idaho research team is building on their own and others' previous EPSCoR-supported research to develop novel nanowire structures in the 10- to 100-nanometer range. The research aims to synthesize nanowires of a variety of semiconducting materials and to selectively grow nanowires in predetermined, ordered arrays. Though the current stage of research has just been started, it has been discovered that nanowires can be formed into nanosprings of about 60 nanometers (400 atoms) in diameter. A subsequent process for forming nanosprings from silicon and carbon has verified a theoretical model predicting that nanosprings could be formed from any amorphous ceramic material. Nanosprings have potential application in nano-electro-mechanical devices such as nanomotors.

- In West Virginia, faculty hires and important equipment purchases made possible by EPSCoR hold the promise for scientific advances in several areas related to the use of biomolecules as diagnostic and therapeutic agents, including the development of human "signatures" for security purposes. The purchase of state-of-the-art research equipment such as a 600MHz Magnetic Resonance Spectrometer and a Quadrupole Time of Flight Mass Spectrometer was vital in recruiting distinguished senior faculty to West Virginia University to develop a broad research program in biomolecular structure and biomarkers.

- In Kentucky, EPSCoR is attempting to close the digital gap in underdeveloped regions. This project involves collaboration among many EPSCoR states and with the National Computational Science Alliance and the National Partnership for Advanced Computational Infrastructure (NPACI). The project has provided a vehicle through which scientists and researchers in EPSCoR states will be able to utilize the Access Grid technology developed by the National Center for Supercomputing Applications (NCSA). To date, Access Grid nodes have been established in 16 of the 22 EPSCoR states. The Access Grid can support large-scale distributed meetings and collaborative work sessions as well as seminars, lectures, tutorials, and training.

- A New Mexico EPSCoR project will catalogue a significant collection of arthropods. Once the cataloguing of this collection has been accomplished, national information links will greatly increase the utility of the collection to researchers and educators across the United States. Follow-up funding already committed from the University of New Mexico, New Mexico State University and Western New Mexico University will allow scientists to integrate biota data across various taxa available from many institutions and to connect to national databases.

- In Alaska, EPSCoR is supporting a project in the Fairbanks North Star Borough School District to implement consistent, standards-based K-6 mathematics curriculum and instruction. *Project PRIME* is a local pilot project that will provide over 200 hours of training in math content and teaching methods to teachers and administrators with the aim of increasing student performance as measured on state-mandated tests in grades 2-9. The project will increase the mathematical content knowledge of K-6 teachers and create a cadre of math teacher leaders. Project PRIME will form active, substantive partnerships with the University of Alaska-Fairbanks Department of Mathematical Sciences and School of Education, the NSF-sponsored Alternative to Rebuilding Curriculum Center, the Alaska Department of Education and Early Development, and businesses in Fairbanks.

The FY 2004 Request of $75.0 million represents no change from FY 2003. Funding in EHR is supplemented in the Request by approximately $30.0 million in the Research and Related Activities Appropriation, bringing total EPSCoR support to approximately $105.0 million. The FY 2004 Request will enable NSF to provide continuing support for the following activities:

<u>Research Infrastructure Improvement (RII)</u> - RII are 36-month awards of up to $9.0 million total for research infrastructure improvements in S&T areas identified as critical to a state's future R&D competitiveness. A 50 percent non-federal state match is required over the term of the award. RII awards were recommended for the states of Hawaii, Kansas, and Vermont during FY 2003.

<u>Co-funding</u> - Co-funding efforts at NSF involve joint support of research and education proposals submitted by researchers from EPSCoR states to the Foundation’s ongoing grant programs as a means of accelerating the movement of EPSCoR researchers and institutions into the mainstream of federal and private sector R&D support. During the period FY 1998-2002, researchers from EPSCoR states received over 900 awards totaling $312.8 million through this mechanism. NSF research programs provided $187.90 million of this total.

<u>Outreach</u> - NSF program officers and staff coordinate a comprehensive outreach program to universities, industry, and state government in EPSCoR states to inform researchers and S&T administrators of NSF policies and programs. Since the program’s inception in FY 1998, NSF staff have made 724 visits to EPSCoR states to foster greater participation by institutions and researchers in other NSF-supported activities.

ELEMENTARY, SECONDARY, AND INFORMAL EDUCATION $194,450,000

The FY 2004 Request for the Elementary, Secondary, and Informal Education (ESIE) Subactivity is $194.45 million, a decrease of $17.24 million, or 8.1 percent, from the FY 2003 Request of $211.69 million.

Elementary, Secondary and Informal Education Funding
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Instructional & Assessment Materials Development	28.86	28.99	28.99	0.00	0.0%
Teacher Development*	126.21	127.70	115.46	-12.24	-9.6%
Informal Science Education	55.68	55.00	50.00	-5.00	-9.1%
Total, ESIE	$210.76	$211.69	$194.45	-$17.24	-8.1%

Totals may not add due to rounding
*FY 2002 Actual and FY 2003 Request for Elementary, Secondary and Informal Education (ESIE) includes $45.06 million and $40.25 million, respectively, from Education System Reform (ESR). For the FY 2004 Request, ESR projects are moved to ESIE in order to consolidate K-12 programs.

ESIE's comprehensive programming develops research-based models and high-quality, innovative resources that strengthen the teaching and learning of science, technology, and mathematics (STM) education, pre-Kindergarten through grade 12 (preK-12). Instructional materials and student assessments that promote active investigation, together with new models for teacher education, contribute to STM classroom environments that serve all students well. Moreover, ESIE media, exhibit, and community-based programs increase scientific and technological literacy and develop life-long skills benefiting learners of all ages. ESIE programs create a solid educational foundation for the future research, instructional, and technological workforce, as well as for students pursuing post-secondary education in other disciplines. All ESIE efforts incorporate high standards in content, pedagogy, and assessment; capitalize on the strengths of formal and informal education communities; and forge partnerships among major stakeholders (e.g., higher education, school districts, state education agencies).

Instructional and Assessment Materials Development (IMD) activities develop instructional materials and assessment tools for improving preK-12 STM education. These materials influence traditional textbooks and are gaining wider national acceptance as a growing body of research demonstrates their impact on student performance. For example, *Contemporary Mathematics in Context (Core-Plus)* — a secondary curriculum emphasizing real-life investigations and modeling — is a four-year research and development effort that has lead to gains in achievement, as well as effective transition to university-level study. At the University of Michigan, entering *Core-Plus* students out-scored a control-group of their peers in their first-year mathematics course. In FY 2004, IMD funding is maintained at the FY 2003 Request of $28.99 million.

Teacher Development supports creation of models and resources requisite to large-scale STM education reform. Newly restructured programming promotes a coherent approach to the teacher education continuum in which NSF's state, urban, and rural systemic initiatives are integrated from the Education Systemic Reform (ESR) Subactivity into ESIE's Teacher Development activities. This restructure will consolidate preK-12 programs and capture lessons learned from the urban and rural systemic efforts. Support for existing awardees will continue in the FY 2004 Request. In the FY 2004 Request, funding for Teacher Development activities decreases by $12.24 million from the FY 2003 Request due mainly to the transfer of and reduced funding commitment to the ESR programs. Teacher Development activities include:

- **Centers for Learning and Teaching (CLTs)** address national priorities for (a) rebuilding and diversifying the human infrastructure for STEM education; (b) increasing the number of K-16 educators with deep knowledge of discipline, pedagogy, and student assessment; and (c) conducting substantive research on learning, teaching, and education policies. Recently funded CLTs are researching the nature of mathematical knowledge required for teaching proficiency; testing models of collaboration in professional development to strengthen qualifications of teachers newly entering the workforce; and studying ways to improve development of science curricula. A notable impact of CLT efforts is the partner alliances forged to strengthen development of STM K-12 specialists. For example, the *Appalachian Collaborative Center for Learning, Assessment, and Instruction in Mathematics (ACCLAIM)* catalyzed an unprecedented agreement among graduate deans at the University of Tennessee, Ohio University, Marshall University, the University of Kentucky, and the University of Louisville. *ACCLAIM* partner institutions now accept each other's graduate credit courses. Each university thus capitalizes on its strengths and graduate fellows are given maximum flexibility in designing programs of study. A summary of the award information may be found at: https://www.fastlane.nsf.gov/servlet/showaward?award=0119679.

- **Teacher Professional Continuum (TPC)** brings together EHR's teacher education efforts, creating a coherent continuum of professional experiences that both prepare teachers and enhance their skills. TPC goals are to produce innovative resources for preparing and supporting STM teachers and administrators; to research and develop models and systems that support the professional continuum; to research teacher learning and its impact on teaching practice; and to disseminate research findings, strategies, and resources to a national audience. The quality of NSF's professional development materials is evidenced by three evaluations conducted by the National Staff Development Council. Evaluation criteria included: a well-defined staff development program; demonstration of improved student achievement; content-specific strategies for improving teachers' content knowledge and pedagogical skills; and use in multiple schools or across a district, state, or region. Fourteen of the 22 projects found to impact student achievement were developed with NSF support. In FY 2004, TPC funding in ESIE is $55.12 million, a decrease of $1.0 million from the FY 2003 Request.

- **Presidential Awards for Excellence in Mathematics and Science Teaching (PAEMST)** provide national career recognition for exemplary elementary and secondary teachers of mathematics and science. In FY 2004, funding is maintained at the FY 2003 Request of $4.33 million.

Informal Science Education (ISE) promotes public interest, understanding, and engagement in science and technology through voluntary, self-directed, and lifelong learning opportunities for both children and adults. ISE-supported activities include development of radio and television series, large-format films, exhibits, Web-based projects, youth programs, and a variety of educational materials and programs. In addition to reaching large audiences, ISE projects often receive national and/or international recognition. For example, the Children's Museum of Indianapolis' traveling exhibit, *Bones,* teaches visitors about the science of bones. Among the rich suite of print, video, and digital educational materials is *Break a Bone* (winner of a 2002 Telly Award for non-broadcast communications) and *Bones Website* (winner of the international Crystal Award of Excellence which recognizes high-quality web production) http://tcm.childrensmuseum.org/bones/entrance.htm. FY 2004 funding decreases to $50.0 million, a reduction of $5.0 million or 9 percent below the FY 2003 Request of $55 million. Efforts to reach audiences in smaller communities are maintained, while those to promote public understanding of research and develop STM instructional materials for after-school programs are scaled back.

UNDERGRADUATE EDUCATION $142,100,000

The FY 2004 Request for the Undergraduate Education (DUE) Subactivity is $142.10 million, an increase of $6.50 million, or 4.8 percent, over the FY 2003 Request of $135.60 million.

Undergraduate Education Funding
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Curriculum, Laboratory, & Instructional Development	85.59	79.74	71.74	-8.00	-10.0%
Workforce Development	57.11	55.86	70.36	14.50	26.0%
Total, DUE	$142.70	$135.60	$142.10	$6.50	4.8%

The Undergraduate Education Subactivity serves as NSF's focal point for the improvement of undergraduate science, technology, engineering, and mathematics (STEM) education. This Subactivity provides leadership and leveraged project support for efforts that promote the engagement in inquiry-based learning by all undergraduate students including disciplinary majors, prospective preK-12 teachers, prospective technicians, and non-majors/citizens in an increasingly technological society. Supported projects are in 2- and 4-year colleges, and universities. The objectives are to improve STEM learning across the undergraduate spectrum through the reform of courses, laboratories, curricula, and instructional materials, and to increase the quality and quantity of the science and engineering workforce. Emphases include integration of learning technologies, faculty development, and preparation of teachers.

Curriculum, Laboratory, and Instructional Development includes:

The STEM Talent Expansion Program (STEP), initiated in FY 2002, to support initial planning and pilot efforts at colleges and universities to increase the number of U.S. citizens and permanent residents pursuing and receiving associates or bachelor's degrees in established or emerging STEM fields. Support for this program is increased in FY 2004 by $5.0 million to $7.0 million.

The Robert Noyce Scholarship Program, offering scholarships for juniors and seniors majoring in mathematics, science or engineering, and stipends for science, mathematics, or engineering professionals seeking to become teachers. Projects help recipients obtain certification and become successful math and science teachers in K-12 schools. FY 2004 funding for this program is $4.0 million, unchanged from the FY 2003 Request.

National STEM Education Digital Library (NSDL), formally opened in summer 2002, establishes a national resource of high quality Internet-based STEM educational content and services to support learners at all levels, in formal and informal settings. In FY 2003, the Core Integration project will be funded, which provides centralized management of the Library and the Library's collections and services. The FY 2004 Request will support: (1) continued development of NSDL by strengthening the core integration of the interoperation of previously-funded collections and services projects; (2) continued incorporation of technological advances and targeted research to improve the functionality and usability of NSDL services; and (3) initiation of new collections of high quality educational products and digital library services that increase the comprehensiveness and usability of the NSDL. The FY 2004 Request decreases from the FY 2003 Request by $5.0 million to a level of $18.60 million, reflecting the fact that funding requirements decline with the award of the Core Integration project. Additional funding of $5.20 million in the R&RA appropriation from the GEO and MPS Activities brings the total funding to $23.80 million.

The NSF Director's Awards for Distinguished Teaching Scholars program seeks to engage faculty who bring the excitement and richness of discovery in STEM fields to all students, whether they currently plan STEM careers or not. The recipients share NSF's "highest honor for excellence in both teaching and research" and receive $300,000 over four years to continue and expand their work beyond their institutions. The FY 2004 Request is held constant at the FY 2003 Request of $1.51 million.

Course, Curriculum, and Laboratory Improvement (CCLI) strengthens NSF's efforts to assure access to a high quality STEM education for all students by focusing on the identification, development, adaptation and implementation of exemplary curricular and laboratory educational materials and instructional models. The FY 2004 Request for CCLI is $40.63 million, an $8.0 million reduction from the FY 2003 Request of $48.63 million. Within CCLI, Assessment of Student Achievement in Undergraduate Education (ASA) is supported at $3.0 million, the same as the FY 2003 Request. ASA promotes the development and dissemination of assessment practices, materials, and tools to improve courses and curricula as a basis for improving undergraduate STEM education. ASA supports assessments of undergraduate student performance, and provides measures for student academic learning outcomes and the quality of educational environments in support of student learning.

Workforce Development includes:

Federal Cyber Service: Scholarship for Service (SfS) seeks to build a cadre of individuals in the Federal sector with the skills needed to protect the nation's critical information infrastructure. Scholarships provide full tuition, academic fees, and student stipends in exchange for service in Federal agencies after graduation. Capacity building grants improve the quality and increase the production of information assurance and computer security professionals. In FY 2002, the U.S. Congress provided an additional $19.30 million in funding to increase the number of students in the program. In response, EHR has funded new scholarship programs at four schools, as well as nine supplements to the existing eleven scholarship-providing institutions, resulting in 130 new scholarships that otherwise would not have been available under this program. FY 2004 funding for SfS is increased by $5.0 million to $16.18 million.

Advanced Technological Education (ATE) supports improvement in technician education, particularly at two-year colleges and secondary schools, by supporting the design and implementation of new curricula, courses, laboratories, educational materials, opportunities for faculty and student development, and collaboration among educational institutions and partners from business, industry, and government. In FY 2004, funding is sustained at the FY 2003 Request of $38.16 million.

Teacher Professional Continuum (TPC) is the Foundation's effort to address critical issues and needs regarding the recruitment, preparation, enhancement, and retention of K-12 science, technology, and mathematics teachers and is a joint activity with ESIE. This effort is supportive of EHR's highest priorities, including the Math and Science Partnership and Centers for Learning and Teaching. The FY 2004 Request is $6.52 million in the DUE Subactivity and will be used to support efforts within TPC that focus on the preparation of future teachers.

The Higher Education Centers for Learning and Teaching (HE CLTs) are an extension of the CLT program in ESIE and support coordinated efforts to reform teaching and learning at the nation's colleges and universities through a blend of research, faculty professional development, and education practice. Requested funding of $1.0 million will create a new Center, co-funded by MPS and ENG in the Research and Related Activities Appropriation.

Workforce for the 21st Century priority area funding of $8.50 million is included in the DUE Subactivity. For FY 2004, NSF's Workforce efforts will focus on attracting students, especially those students who have traditionally been underrepresented, to science, technology, engineering and mathematics (STEM) disciplines.

GRADUATE EDUCATION $156,880,000

The FY 2004 Request for the Graduate Education (DGE) Subactivity $156.88 million, an increase of $28.5 million, or 22.2 percent, over the FY 2003 Request of $128.38 million.

Graduate Education Funding
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Total, DGE	$105.97	$128.38	$156.88	$28.50	22.2%

The Graduate Education Subactivity aims to recognize and support a diverse pool of outstanding individuals in their pursuit of advanced science, technology, engineering, and mathematics (STEM) education; to reform graduate education; and to build stronger links between higher education and K-12 education. These efforts help strengthen U.S. education at all levels and help ensure continued U.S. economic and research preeminence. Individuals are supported through research and teaching fellowships and traineeships at the graduate level. The increase of $28.50 million reflects the Foundation's commitment to increasing graduate stipends to a level that will attract the high quality students necessary for the nation's future and to increasing the number of supported graduate students. In academic year (AY) 2004-2005, the annual stipend will be increased to $30,000, an increase of $5,000 over the FY 2003 Request.

Graduate Research Fellowships (GRF) support the most promising science, mathematics, and engineering students in the U.S. to develop their knowledge and skills so that they perform at the forefront of education and research. In FY 2004, priorities include achieving greater diversity in the applicant and awardee pools, and continuing to increase support levels to strengthen the competitiveness and prestige of the program. Since 1952, nearly 38,000 U.S. students have received GRF awards. In FY 2004, funding for this program increases within DGE by $16.29 million (22.2 percent) over the FY 2003 Request, to a total of $89.74 million. About 2,200 Fellows will be supported in FY 2004 with DGE funds; an estimated 2,550 Fellows are supported throughout the Foundation.

Graduate Research Fellows study a wide variety of fields in many different settings. Fellows have many noteworthy accomplishments while graduate students; for example, Fellows reported work towards 32 patents during the 2001-2002 academic year. The patent ideas come from a wide range of disciplines: engineering (agricultural, biomedical, chemical, electrical, mechanical), materials science, chemistry, and the life sciences. The following examples illustrate accomplishments of Fellows:

- Catherine Linnen, a Ph.D. candidate in Evolutionary Biology at Harvard University, studies the biology and systematics of a sawfly genus found in the northern United States and Canada. In AY 2001-2002, she co-authored two publications, received the Derek Bok Award for Excellence in Teaching, and received three research grants.

- Kathryn Jeanne De Laurentis is a Ph.D. student in mechanical engineering at Rutgers. She is investigating novel design methodologies for lightweight robotic manipulators. In particular, she is developing the design of a 'shape memory' robotic hand with applications in biomedical engineering, prosthetics and situations where a dextrous robotic hand is needed to perform fine tasks. In AY 2001-2002, she was a co-author of one journal publication and four conference presentations and was a recipient of a U.S. patent awarded in April 2002. She also has been involved in two programs at Rutgers that encourage participation of middle and high school girls in engineering and technology, participates in a mentoring program at the County College of Morris, and is mentor for a student enrolled in the Ronald McNair program.

Graduate Teaching Fellowships in K-12 Education (GK-12) supports graduate and advanced undergraduate STEM students as content resources for K-12 teachers. This NSF-wide program links the acknowledged excellence of U.S. graduate education with the critical needs of the K-12 sector. Graduate Teaching Fellows assist K-12 teachers with the science and mathematics content of their teaching, demonstrate key science and mathematics concepts, and gain pedagogical skills necessary at all education levels. Professional development opportunities are provided for the K-12 teachers. The FY 2004 Request for GK-12 in EHR is $42.46 million, an increase of $7.71 million (22.2 percent) over the FY 2003 Request. Including funding from the R&RA Account, the total number of graduate students supported through GK-12 is about 900.

The GK-12 program is building partnerships to improve graduate education and the K-12 learning environment. For example, the GK-12 project at Northeastern University partners with the Hewlett Packard Foundation, the Boston Museum of Science, the Philanthropic Initiative Foundation, the New England Aquarium and the Boston Public Schools to cross-fertilize the experience of Fellows to the urban educational environment. Both the Museum and Aquarium provide professional development activities for Fellows and teachers, pairing scientists with teachers. Retired scientist and engineer volunteers also serve as resources.

A grant to the University of Pennsylvania illustrates the excitement for science and mathematics that can result from connections between graduate and K-12 education. Thurgood Marshall elementary school is an inner city elementary school with a high population of African American students and a broad mix of students from other nations. Few (or sometimes none) of the students score average or above on the state math exam. Fellows are helping implement an innovative and challenging math program. The principal reports: “The Fellows offer a new perspective. Teachers feel less risk when working with the Fellows than working with expert mentor teachers. The Fellows helped by giving the teachers an opportunity to discuss things with people who knew and loved math.”

Integrative Graduate Education and Research Traineeships (lGERT), an NSF-wide program initiated in FY 1998, promotes new paradigms in graduate education. Graduate students engage in a broad array of coursework and research opportunities that transcend disciplinary boundaries, explore career options through internships, develop skills such as communication, computation, and teamwork, and engage in international activities. Support for IGERT within the Graduate Education Subactivity increases by $4.48 million (22.3 percent) to $24.68 million in FY 2004. Approximately 1,500 trainees are supported throughout the Foundation.

Adnan Derti, an IGERT trainee at Boston University, is working on the development of a microarray fabrication facility, involving biology, chemistry, genetics, and manufacturing engineering. Derti produced a working prototype DNA microarray fabricator that will generate arrays expected to have greater specificity and cost less than those commercially available. The next step is to adapt this to proteomics, one of the great challenges of the post-genomic era.

Pedro Irazoqui-Pastor, an IGERT trainee at the University of California – Los Angeles, has combined neuroscience with bioengineering and state-of-the-art circuit design. This education provided skills necessary to develop an inductively powered, wireless neural recording device. This implanted device, which can record both single-unit activity and field potentials, has been successfully designed, fabricated, and tested. This device makes possible a variety of previously impossible-to-perform neuroscientific experiments.

HUMAN RESOURCE DEVELOPMENT $103,410,000

The FY 2004 Request for the Human Resource Development (HRD) Subactivity is $103.41 million, an increase of $13.20 million, or 14.6 percent, above the FY 2003 Request of $90.21 million.

Human Resource Development Funding
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Undergraduate/Graduate Student Support	55.07	50.77	62.97	12.20	24.0%
Research and Education Infrastructure	25.30	23.20	25.20	2.00	8.6%
Opportunities for Women and Persons with Disabilities	16.64	16.24	15.24	-1.00	-6.2%
Total, HRD	$97.01	$90.21	$103.41	$13.20	14.6%

The Human Resource Development Subactivity aims to increase the participation and advancement of underrepresented groups and institutions at every level of science, technology, engineering, and mathematics (STEM) education through the promotion of racial and ethnic diversity, gender equity, and access for persons with disabilities. Programs focus on success factors such as increasing interest and academic performance, degree attainment, and workforce participation. These efforts engage the full range of academic institutions and — through the development, assessment and documentation of model efforts to improve teaching, learning, and research participation — serve to benefit all students.

Within this Subactivity, programs address three priorities: (1) increasing substantially the diversity of the STEM professoriate; (2) strengthening the synergy among key minority-focused programs and the interactions among grantees within these programs and with other NSF programs in research and education; and (3) expanding upon a strong educational research base to develop and foster broad implementation of innovative strategies for increasing participation and achievement of girls, women, and persons with disabilities in STEM education and research activities.

Undergraduate/Graduate Student Support includes:

- Louis Stokes Alliances for Minority Participation (LSAMP) strengthen and encourage STEM baccalaureate degree production of students from underrepresented populations by utilizing the knowledge, resources, and capabilities of a broad range of organizations from the academic, federal, and commercial sectors. The effectiveness of LSAMP is demonstrated by significant increases in the number of minority students in STEM fields earning baccalaureate degrees. Funding is increased by $6.20 million to a level of $32.73 million to increase award size and improve coordination with other programs that aim to increase participation of underrepresented minority students.

- Historically Black Colleges and Universities — Undergraduate Program (HBCU-UP) provides awards to enhance the quality of undergraduate STEM programs through curricular reform and enhancement, faculty development, research experiences for undergraduates, upgrading of scientific instrumentation, and improvement of research infrastructure. FY 2004 funding is increased by $6.0 million to $19.97 million to increase award size and improve coordination with LSAMP and the Alliances for Graduate Education and the Professoriate.

- Tribal Colleges and Universities Program (TCUP) provides awards to these institutions to enhance the quality of STEM instructional and community outreach programs through curricular reform and enhancement, faculty development, research and other out-of-classroom educational experiences for students, upgrading of scientific instrumentation, and improvement of research infrastructure. In FY 2004, support for the program remains constant at the FY 2003 Request of $9.98 million.

- Presidential Awards for Excellence in Science, Mathematics, and Engineering Mentoring (PAESMEM), administered by NSF on behalf of the White House, identify outstanding mentoring efforts/programs designed to enhance the participation of groups underrepresented in science, mathematics, and engineering. In FY 2004, funding is maintained at the FY 2003 Request of $290,000.

Research and Education Infrastructure includes:

- Alliances for Graduate Education and the Professoriate (AGEP) continue implementing strategies for increasing STEM Ph.D. attainment among students drawn from underrepresented minority populations and encouraging those students to enter the professoriate. AGEP activities are projected to double their STEM doctoral degree production within a five-year period. In FY 2004, program support totals $11.80 million, unchanged from the FY 2003 Request.

- Centers of Research Excellence in Science and Technology (CREST) serve as hubs for conducting competitive research at minority institutions, including those that produce well-trained doctoral students in STEM fields. A goal of the program is to assist Center faculty to participate more fully in other NSF research programs. Currently, HRD supports 11 Centers. CREST funding is increased by $2.0 million in FY 2004 to $10.88 million to increase award size.

- Model Institutions for Excellence (MIE) support minority institutions with a strong track record for graduating underrepresented minority students at the baccalaureate level, and encouraging those students to pursue graduate degrees. Jointly funded with the Research and Related Activities Appropriation, EHR funding for this program is sustained at $2.52 million for total NSF support of $9.81 million.

Opportunities for Women and Persons with Disabilities includes:

- Program for Gender Equity (PGE) supports education and research activities that foster the increased participation of women and girls in STEM. PGE funding of $9.96 million is requested in FY 2004, a reduction of $550,000 from the FY 2003 Request of $10.51 million.

- The Research in Disabilities Education (RiDE) program, formerly the Program for Persons with Disabilities (PPD), will be funded at $5.28 million, the same as the FY 2003 Request. RiDE supports efforts to increase the participation and achievement of individuals with disabilities in STEM education and careers. Methods and products of focused research awards are incorporated in program-sponsored regional alliances. The alliances serve to inform educators, government and industry about proven-good practices in the classroom, promote broader awareness and inclusion of disabilities issues, and define specific areas of human learning in need of further attention by the research community.

RESEARCH, EVALUATION AND COMMUNICATION $66,200,000

The FY 2004 Request for the Research, Evaluation and Communication (REC) Subactivity is $66.20 million, a decrease of $1.00 million, or 1.5%, from the FY 2003 Request.

Research, Evaluation and Communication Funding
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Research	55.91	54.56	54.56	0.00	0.0%
Evaluation	13.04	12.64	11.64	-1.00	-7.9%
Total, REC	$68.95	$67.20	$66.20	-$1.00	-1.5%

Research funding remains unchanged at $54.56 million in FY 2004 and includes:

- The Research on Learning and Education (ROLE) program organizes a variety of efforts and seeks to build a stronger interdisciplinary approach to research on learning and education. ROLE helps EHR build the research base for all of EHR's programs. A major focus of ROLE research is to discover how we learn. Cooperatively with other NSF activities in the biological, social, and behavioral science fields, ROLE will continue exploratory efforts in brain research and cognitive neuroscience in order to inform the design of classrooms and other formal and informal learning environments of the future. Additionally, ROLE seeks to advance the nation's ability to change educational systems to improve STEM learning. ROLE and related research funding totals $39.56 million in FY 2004, the same level as in the FY 2003 Request.
- The Interagency Education Research Initiative (IERI) is unique among EHR programs in that its primary purpose is to support research on implementation and scalability of educational methods. The goal of IERI is to improve preK-12 student learning in reading, mathematics, and science by supporting interdisciplinary research on large-scale implementations of educational practices and technologies that have already secured significant and credible evidence of success that can generalize to larger and more varied settings. Research in IERI thus provides a knowledge base of sustainable improvements in education for diverse student populations in a wide range of learning environments. IERI supports research that reflects the context in which educators do their work, to ensure adaptability to classrooms in an array of settings. Research conducted on a scale that allows for a careful examination of how characteristics within a variety of education systems interact to facilitate learning helps accelerate their successful adoption in a wide range of schools. IERI generates knowledge to address directly the challenge of how to bridge the gap between research and practice, to translate knowledge into tangible tools and practical procedures for education, and to improve educational practices and technologies. REC requests $15.0 million in FY 2004 for IERI, unchanged from the FY 2003 Request. This investment is leveraged with annual contributions from the NSF Research and Related Activities Appropriation ($10.0 million) and participation by the Department of Education and the National Institutes of Health.

Research on learning, teaching, and technology generates important discoveries, advancing our understanding of knowledge acquisition, and instructional practice, and strengthening the research base for programs across EHR. It establishes proofs-of-concept for developing and applying learning technologies to STEM learning and teaching at all education levels. A primary goal is to increase the level of science and mathematics knowledge of all students, as well as to develop mechanisms for ensuring effective implementation of learning strategies and tools in classrooms, schools, and large-scale systems. National and international studies, and analyses, such as the Third International Mathematics and Science Study (TIMSS) and the TIMSS-Repeat (TIMSS-R), provide invaluable descriptions of the status and progress made by U.S.

education, as well as insights for meeting its challenges. For example, REC-supported international comparative research highlights the disturbing level of content preparation of U.S. middle school teachers compared to other countries, and suggests that high school teacher induction practices of other countries enable more productive and effective instruction in early teaching careers. This blend of results on research on learning, effective learning technology development, and insights from international comparisons can contribute to policy discourse and decision-making in improving U.S. mathematics and science education practice.

The unique span of REC investment, ranging from the cognitive neuroscientific to the scale of large educational systems, is generating insights into the learning process than can only be approached from a multidisciplinary perspective. A portfolio of nearly 200 projects that covers the span from early childhood through adult learning, including preK-16 education, is helping build a productive and forward-moving research community that is characterized by its multidisciplinary expertise in cognition, learning theory, technology, pedagogy, instructional workforce development, policy, and education system reform.

The research on learning portfolio continues to yield converging results that suggest that different approaches to instruction can produce strong learning gains, especially in disadvantaged settings, such as limited-English urban areas characterized by significant achievement gaps. These studies include a series of separate research projects in different parts of the country. One, for example, has tested an approach based on teaching scientific model-building for fourth and fifth grade students, finding that a sustained program of model-based instruction produced more sophisticated and accurate understanding of scientific concepts and the relationships between them. Another program of instruction, in which presentation of scientific concepts was carefully mediated through the language and cultural symbols of the students, produced significant effect sizes in subsequent standardized science assessments. Projects in REC's educational technology portfolio have continued to build a body of evidence on improving STEM learning. REC supported tools are designed to amplify, highlight, and reveal mathematical or scientific ideas, principles, and processes, and enable the modeling, representation, manipulation and transformation of scientific or mathematical objects and processes. These tools will support significant pedagogical shifts that are appropriate for classrooms today and in the future.

Evaluation funding declines by $1.0 million to $11.64 million in FY 2004. Evaluation efforts that systematically assess the impact and results of all major EHR programs are supported in REC, contributing to improved program performance and accountability. Evaluation will continue to use a continuum of activities such as developing program indicators, producing databases, conducting impact studies, and carrying out program evaluations, to document accountability throughout NSF's portfolio of STEM education, training and human resource development programs. A special emphasis of Evaluation activities is measurement and data collection necessary to meet the reporting requirements of the Government Performance and Results Act. Support for evaluation is also included in the Math and Science Partnership program. The Evaluation Research and Evaluation Capacity Building (EREC) program awarded its first round of grants in FY 2002 and early in FY 2003. It was combined in a single program announcement with ROLE to stress the effort within EHR to build a more integrated research and evaluation effort in support of all of EHR's programs. EREC seeks unique approaches to evaluation practice to generate new knowledge for the education community and to support broad policymaking within the research and education enterprise. FY 2004 funding will continue support for evaluations of multiple education programs or projects with similar objectives.

REC also pursues an active program of Communication to disseminate the results of EHR-sponsored research and evaluations. These efforts broadly inform the STEM research and education community, provide vital information for policy-makers, and advance NSF's efforts to integrate research and practice. The interpretation and dissemination of research results to promote research-based approaches to education practice will be essential as the nation address its most critical educational challenges.

H-1B NONIMMIGRANT PETITIONER FEES $0

The FY 2004 H-1B Nonimmigrant Petitioner Fees are projected to be $0, based on the expiration of current H-1B legislation in FY 2003.

H-1B Nonimmigrant Petitioner Fees Funding
(Dollars in Millions)

FY 2002 Actual	FY 2003 Request[1]	FY 2004 Estimate	Change Amount	Change Percent
57.31	92.50	0.00	-92.50	-100.0%
$57.31	$92.50	$0.00	-92.50	-100.0%

[1] Estimates of the FY 2003 H-1B funds available to NSF have decreased to $65.68 million since the FY 2003 Request.

Beginning in FY 1999, Title IV of the American Competitiveness and Workforce Improvement Act of 1998 (P.L. 105-277) established an H-1B Nonimmigrant Petitioner Account in the general fund of the U.S. Treasury for fees collected for each petition for alien nonimmigrant status. That law required that a prescribed percentage of funds in the Account be made available to NSF for the following activities:

- Computer Science, Engineering, and Mathematics Scholarships (CSEMS). Merit-based scholarships of up to $2,500 for up to two years were provided for new or continued enrollment at institutions of higher education by eligible low-income individuals pursuing associate, undergraduate, or graduate degrees in computer science, computer technology, engineering, engineering technology, or mathematics.

- Grants for Mathematics, Engineering, or Science Enrichment Courses. These funds were intended to provide opportunities to students for enrollment in year-round academic enrichment courses in mathematics, engineering, or science.

- Systemic Reform Activities. These funds supplemented the rural systemic reform efforts administered under the Educational System Reform (ESR) Subactivity.

All funds resulting from P.L. 105-277 have been obligated.

In FY 2001, Public Law 106-311 increased the funds available by increasing the Petitioner fees. Also, the American Competitiveness in the 21st Century Act (P.L. 106-313) amended P.L. 105-277 and changed the way petitioner fees are to be expended.

Computer Science, Engineering, and Mathematics Scholarships (CSEMS). This activity continues under P.L. 106-313 with a prescribed percentage of H-1B receipts. The maximum scholarship duration is four years and the annual stipend is $3,125. It is estimated that funds for the scholarship program, which total 59.5 percent of the total H-1B funding for NSF, will be about $39.41 million in FY 2003. Estimated funds in FY 2003 would provide approximately 9,500 scholarships for students at 80 colleges and universities. Exemplary CSEMS activities include:

- The CSEMS project implemented under the auspices of the New Jersey Center for Advanced Technological Education by Middlesex County College focuses on increasing the enrollment, retention, and graduation rates in associate degree programs in the CSEMS disciplines. It includes significant support for students in the academic programs and targets talented students in underrepresented populations. New initiatives include expanded partnerships with area schools, business and industries; the creation of a student ambassador corps to assist in the recruitment of students; targeted peer tutoring for students in barrier courses; and peer mentoring by senior CSEMS students.

- The CSEMS project implemented at the University of South Carolina at Columbia uses the educational and research infrastructures of eight partner institutions as support systems for financially disadvantaged, underrepresented minorities in the areas of computer science, engineering, and mathematics. The program provides a mentor support system through problem-solving workshops, Drop-in Centers, Computer/Learning Centers and peer mentoring programs. Industrial and government partners provide outstanding cutting-edge research opportunities. Directed research and internships permit students to take part in a variety of research projects, and establish mentoring relations with research faculty and professionals.

- The "CSEMS at Cal III" by a committee of Berkeley faculty and staff from academic support programs project at the University of California, Berkeley, is following a single cohort of freshman and sophomore students over a four-year period, and it awards scholarships to twenty-nine economically disadvantaged students, with a special emphasis on students from underrepresented groups in engineering and science. All students targeted for the scholarships demonstrate financial need. Students are chosen utilizing a comprehensive approach in evaluating each student's academic merit and professionalism. Scholars participate in a variety of retention-related activities tied to the existing student support infrastructure. This includes faculty advising, academic excellence workshops, tutoring, mentoring, internships in industry and/or research experience, and assistance with graduate school applications or job placement. A unifying theme of the "CSEMS at Cal III" program is to increase student retention by helping each student develop into a committed member of the engineering and academic community.

Private-Public Partnerships in K-12. P.L. 106-313 directs the remaining 40.5 percent of receipts from 2001 and out-years toward K-12 activities involving private-public partnerships in a range of areas such as materials development, student externships, and math and science teacher professional development. Funds for this activity are expected to be $26.27 million in FY 2003.

Information Technology Experiences for Students and Teachers (ITEST) has been added as a partnership activity in K-12 that seeks to increase the opportunities for students and teachers to learn about, experience, and use information technologies within the context of STEM, including Information Technology (IT) courses. Supported projects are intended to provide opportunities for both school-age children and teachers to build the skills and knowledge needed to advance their study, and to function and contribute in a technologically rich society. ITEST includes three major components: (a) youth-based projects with strong emphases on career and educational paths; (b) comprehensive projects for students and teachers; and (c) Resource Centers that engage in research related to funded projects, provide technical support and have responsibilities for national dissemination of project models, instructional materials, and best practices.

MAJOR RESEARCH EQUIPMENT AND FACILITIES CONSTRUCTION

MAJOR RESEARCH EQUIPMENT AND FACILITIES CONSTRUCTION $202,330,000

The FY 2004 Budget Request for Major Research Equipment and Facilities Construction (MREFC) is $202.33 million, an increase of $76.05 million, or 60.2 percent, above the FY 2003 Request of $126.28 million.

MREFC Funding
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Major Research Equipment & Facilities Construction	$115.35	$126.28	$202.33	$76.05	60.2%

The MREFC Account supports the implementation of major research facilities and equipment that provide unique capabilities at the frontiers of science and engineering. Implementation projects supported by this account are intended to extend the boundaries of technology and open new avenues for discovery for the science and engineering community. Initial concept and development, and follow on operations and maintenance costs of the facilities are provided through the Research and Related Activities (R&RA) Account.

There can be no doubt that a modern and effective research infrastructure is critical to maintaining U.S. leadership in science and engineering (S&E). The future success of entire fields of research depend upon their access to new generations of powerful research tools. Increasingly, these tools are large and complex, and have a significant information technology component.

Among Federal agencies, NSF plays a major role in providing the academic (non-medical) research community with access to forefront instrumentation and facilities. In recent years, NSF has received an increased number of requests for major research facilities and equipment from the S&E community. Many of these requests have been rated outstanding by research peers, program staff, management and policy officials, and the National Science Board. NSF's request for the MREFC Account fully funds the ongoing projects and the remaining three projects approved for funding by the National Science Board, but not yet funded, and positions the agency to meet the future needs and opportunities of the research community.

Once a project has been submitted for MREFC funding, it must undergo a multi-phase review and approval process. The process begins with a review by the MREFC Panel, which makes recommendations to the NSF Director with attention to criteria such as scientific merit, importance, readiness and cost-benefit. The Director then selects candidates for National Science Board (NSB) consideration. The NSB then approves, or not, projects for inclusion in future budget requests and establishes priorities. The Director selects from the group of NSB-approved projects those appropriate for inclusion in a budget request to OMB, and after discussion with OMB, to the Congress.

In order for a project to be considered for MREFC funding, NSF requires that it represent an exceptional opportunity that enables research and education. In addition, the project should be transformative in nature, in that it should have the potential to shift the paradigm in scientific understanding and/or infrastructure technology. NSF believes that all the projects included in this Budget Request meet these criteria.

As a general framework for priority-setting, NSF assigned priority to projects based on the following criteria:

- First Priority: Ongoing Projects – Projects where outyear funding for the full project has already been included in a Budget Request to Congress, and projects that have received initial funding for startup operations.

- Second Priority: NSB-Approved New Starts – New projects that have received NSB approval for inclusion in a budget request but which have not yet been included in a budget request or received funding.

NSF believes that the highest priority within the MREFC Account must be the current projects. To that end, highest priority in FY 2004 is to continue to request funding for:

- Atacama Large Millimeter Array Construction ($50.84 million);
- EarthScope: USArray, Plate Boundary Observatory and San Andreas Fault Observatory at Depth ($45.0 million);
- The High Performance Instrumented Airborne Platform for Environmental Research ($23.53 million);
- The IceCube Neutrino Observatory ($60.0 million);
- The George E. Brown Network for Earthquake Engineering Simulation ($8.0 million);
- The National Ecological Observatory Network ($12.0 million); and
- South Pole Station ($960,000).

In addition, three new starts are requested in FY 2005 and FY 2006. In priority order, these are: Scientific Ocean Drilling in FY 2005; Rare Symmetry Violating Processes in FY 2006; and Ocean Observatories in FY 2006.

NSF Funding for MREFC Projects, FY 2002 through FY 2008[1]
(Dollars in Millions)

	FY 2002[2] Actual	FY 2003 Request	FY 2004 Request	FY 2005 Request	FY 2006 Request	FY 2007 Request	FY 2008 Request
ONGOING PROJECTS							
ALMA Construction	12.50	30.00	50.84	49.67	48.84	47.89	46.49
EarthScope: USArray, SAFOD, PBO		35.00	45.00	54.26	40.00	23.00	
High-performance Instrumented Airborne Platform for Environmental Research	35.00		25.53				
IceCube Neutrino Observatory	10.12		60.00	33.40	34.30	35.30	36.30
Polar Aircraft Upgrades	0.89						
Large Hadron Collider	16.90	9.72					
Network for Earthquake Engineering Simulation	24.40	13.56	8.00				
National Ecological Observatories Network[3]		12.00	12.00	16.00	20.00	20.00	20.00
South Pole Station	15.55	6.00	0.96				
Terascale Computing Systems		20.00					
NEW STARTS							
Scientific Ocean Drilling				76.85	23.00		
Rare Symmetry Violating Processes					30.00	42.66	44.00
Ocean Observatories					24.76	40.33	72.46
Totals	$115.35	$126.28	$202.33	$230.18	$220.90	$209.18	$219.25

[1]Does not include funding provided for early concept and development or follow-on operations and maintenance. These funds are provided through the R&RA Account and are discussed in the following individual Activity narratives and the Tools section.
[2]FY 2002 Actuals include $16.44 million in carryover from prior year appropriations for the South Pole Station Modernization Project, the South Pole Station Safety and Environment Project, and the Polar Aircraft Upgrades. $39.88 million appropriated in FY 2002 is carried over into FY 2003 for the IceCube Neutrino Observatory and Terascale Computing Systems. This FY 2002 carryover will be reflected in the Current Plan following an FY 2003 appropriation.
[3]FY 2006-08 implementation funding for NEON will be contingent upon the outcome of the feasibility study of the NEON project and the successful review of the prototype NEON sites.
[4]FY 2002 funding for Terascale was carried over into FY 2003 due to the NSB meeting schedule. The award was approved in October, 2002 and the funds have been obligated.

FIRST PRIORITY: ONGOING PROJECTS IN FY 2004

Atacama Large Millimeter Array

Project Description: Originally referred to as the Millimeter Array (MMA), this project was conceived as an aperture-synthesis radio telescope operating in the wavelength range from 3 to 0.4 mm. ALMA will be the world's most sensitive, highest resolution, millimeter-wavelength telescope. It will combine an angular resolution comparable to that of the Hubble Space Telescope with the sensitivity of a single antenna nearly 100 meters in diameter. The array will provide a testing ground for theories of star birth and stellar evolution, galaxy formation and evolution, and the evolution of the universe itself. It will reveal the inner workings of the central black hole "engines" which power quasars, and will make possible a search for planets around hundreds of nearby stars.

The interferometer will be located at 5000m altitude near San Pedro de Atacama, Region II, Chile. The North American side of the project is led by Associated Universities, Inc./National Radio Astronomy Observatory. Europe is an equal partner in ALMA, with funding and execution of the project carried out through the European Southern Observatory (ESO). Japan may join the project at a later date.

Principal Scientific Goals: To be the most capable imaging radio telescope ever built, ALMA will bring to millimeter and submillimeter astronomy the aperture synthesis techniques of radio astronomy, enabling precision imaging to be done routinely on sub-arcsecond angular scales. ALMA will image at 1mm wavelength with the same 0.1" resolution achieved by the Hubble Space Telescope (HST) at visible wavelengths, and will form a critical complement to the leading-edge optical, infrared, ultraviolet and x-ray astronomical instruments of the twenty first century.

Principal Education Goals: ALMA will play a central role in the education and training of U.S. astronomy and engineering students; at least 15% of ALMA's ~1000 users per year are expected to be students. There is already substantial involvement by graduate students in applied physics and engineering at universities participating in the ALMA Design and Development program.

Partnerships and Connections to Industry: Europe is an equal partner in ALMA, and Canada has joined the U.S. in the North American half of the partnership. ALMA instrumentation will push gallium arsenide (GaAs) and indium phosphide (InP) transistor amplifier technology to high frequencies, will challenge production of high-density, high-speed integrated circuits for computational uses, and can be expected to stimulate commercial device and communication technologies development.

Management and Oversight: Programmatic management is the responsibility of the ALMA Staff Associate in the Astronomical Sciences (AST) Subactivity in the Mathematical and Physical Sciences (MPS) Activity. NSF's ALMA advisory group, consisting of representatives from the Office of General Counsel, the Office of Budget, Finance and Award Administration and the Office of Legislative and Public Affairs serves as a standing Project Advisory Team. AST's external MMA Oversight Committee (MMAOC) has been advising NSF on the project since early 1998 and comprises half of the International ALMA Management Advisory Committee. Management of the National Radio Astronomy Observatories effort on ALMA is through a Cooperative Agreement with the Associated Universities Incorporated (AUI).

<u>Current Project Status</u>: The $12.50 million appropriated for the start of ALMA construction in FY 2002 has permitted the Project to make a smooth transition from Design and Development into an efficiently operating, international construction partnership.

Milestones originally set for FY 2002 and their status follows:

Finalize and sign International ALMA Construction and Operations Agreement (3rd quarter) [Cleared by NSF, Department of State and ESO, now awaiting signature ceremony];
Deliver U.S. prototype antenna and radiometric instrumentation to New Mexico test site (3rd quarter) [radiometric instrumentation delivered 3rd quarter; antenna completed 1st quarter FY 2003];
Begin testing prototype antenna at New Mexico test site (4th quarter) [began 1st quarter 2003];
Deliver antenna foundation designs for Chile site (4th quarter) [on time];
Establish precise GPS locations for ALMA antenna stations, and begin advanced engineering and architectural analysis (4th quarter) [on time]; and
Deliver final ALMA site Environmental Impact Survey to Chilean authorities (4th quarter) [on time].

Current FY 2003 milestones are:
Initiate design contracts for site roads, buildings and utilities (3rd quarter);
Complete assessment of antenna prototype performance (4th quarter);
Deliver prototype correlator (4th quarter);
Deliver prototype IF transmission system (4th quarter);
Let contract for fabrication of production quantities of SiS mixers for 211-275 GHz receiver band (4th quarter); and
Release draft RFP for ALMA antenna production units (4th quarter).

Major milestones for FY 2004 include:
Begin integration of backend prototype hardware (2nd quarter)
Begin initial phase of site construction (2nd quarter);
Evaluate proposals for ALMA production antennas (3rd quarter, dependent on procurement strategy).
Award production antenna contract (3rd quarter, dependent on procurement strategy).

Projected Outyear Milestones: The milestones below are based on the current version of the ALMA project plan and represent a general outline of anticipated activities for FY 2005 and beyond.

FY 2005 Milestones:
Complete initial phase of site construction.

FY 2006 Milestones:
First production antenna unit delivered to Chile and installed on site;
First quadrant of correlator (for 32 antennas at full bandwidth) delivered to Chile;
First antenna testing front end delivered to Chile.

FY 2007 Milestones:
Complete infrastructure for engineering and commissioning observations (data pipeline verified, staff fully in place);
First complete production front end delivered to Chile.

FY 2008 Milestones:
- First ALMA interim science observations;
- A total of 19 antennas will have been delivered to Chile.

FY 2009 Milestones:
- Full correlator (for 64 antennas at full bandwidth) completed in Chile;
- A total of 34 antennas will have been delivered to Chile.

FY 2010 Milestones:
- Begin final phase of site work (antenna foundations for 14km configuration; final road work; complete office/lab facilities);
- A total of 49 antennas will have been delivered to Chile.

Funding Profile: The estimated cost to construct ALMA is $702 million. The U.S. share of the joint array construction is estimated to be $344 million; the construction of the array is expected to take 9 years. Joint detailed cost and scope studies of the array by the partners have been carried out, and a high-level agreement, specifying the details of the U.S.-European capital construction partnership, has been drafted. Canada will join the U.S. side of the ALMA partnership and Japan remains interested in the possibility of joining ALMA as a third major partner, possibly as early as 2004.

A $26.0 million, three-year Design and Development Phase was originally planned for the MMA project. However, since the original three-year plan was initiated, the U.S. entered into a partnership with a European consortium to develop ALMA. Because of the expanded managerial and technical complexity of the ALMA concept, an additional year of Design and Development was supported in FY 2001, at a budget level of $5.99 million. Construction was initiated in FY 2002.

MREFC Appropriations for ALMA
(Dollars in Millions)

	FY 98	FY 99	FY 00	FY 01	FY 02	FY 03	FY 04	FY 05	FY 06	FY 07	FY 08 Through FY 10	Total
ALMA R&D	9.00	9.00	8.00	5.99								31.99
ALMA Construction					12.50	30.00	50.84	49.67	48.84	47.89	104.39	344.13
Total, ALMA	$9.00	$9.00	$8.00	$5.99	$12.50	$30.00	$50.84	$49.67	$48.84	$47.89	$104.39	376.12

ALMA Funding Profile
(Dollars in Millions)

	Concept/ Development		Implementation[1]		Operations & Maintenance[2]		Totals		Grand
	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	Total
FY 1994 & Earlier	0.25						$0.25	$0.00	**$0.25**
FY 1995	0.35						$0.35	$0.00	**$0.35**
FY 1996	0.50						$0.50	$0.00	**$0.50**
FY 1997	0.75						$0.75	$0.00	**$0.75**
FY 1998		9.00					$0.00	$9.00	**$9.00**
FY 1999		9.00					$0.00	$9.00	**$9.00**
FY 2000		8.00					$0.00	$8.00	**$8.00**
FY 2001		5.99					$0.00	$5.99	**$5.99**
FY 2002				12.50			$0.00	$12.50	**$12.50**
FY 2003 Req				30.00			$0.00	$30.00	**$30.00**
FY 2004 Req				50.84			$0.00	$50.84	**$50.84**
FY 2005 Est				49.67	1.00		$1.00	$49.67	**$50.67**
FY 2006 Est				48.84	2.00		$2.00	$48.84	**$50.84**
FY 2007 Est				47.89	5.00		$5.00	$47.89	**$52.89**
FY 2008 Est				46.49	10.00		$10.00	$46.49	**$56.49**
FY 2009 Est				37.37	14.00		$14.00	$37.37	**$51.37**
FY 2010 Est				20.53	19.00		$19.00	$20.53	**$39.53**
FY 2011 Est					23.00		$23.00	$0.00	**$23.00**
FY 2012 Est					23.00		$23.00	$0.00	**$23.00**
Subtotal, R&RA	$1.85		$0.00		$97.00		$98.85		
Subtotal, MREFC		$31.99		$344.13		$0.00		$376.12	
Total, Each Phase		**$33.84**		**$344.13**		**$97.00**			**$474.97**

NOTE: A steady state of about $23 million annually is anticipated for operations support beginning in FY 2012. The expected operational lifespan of this project is at least 30 years.
[1]Based on cost review of original MMA and then projected to ALMA.
[2]Estimates for FY 2005 and beyond are placeholders only, and are not intended to reflect actual budget requirements.

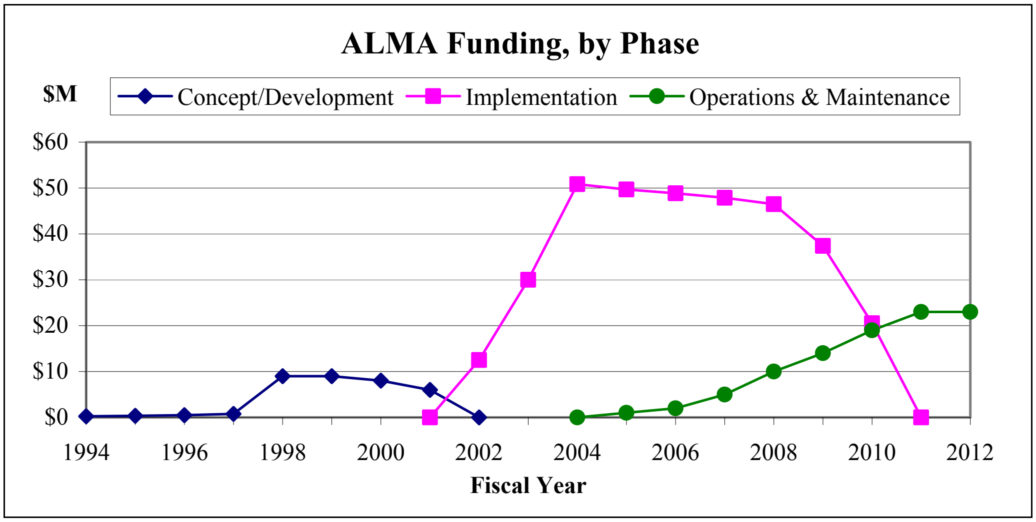
Information pertaining to the data in the table is included below.

- *Concept/Development*: Prior to FY 1998, the National Radio Astronomy Observatory (NRAO) utilized funds provided through the R&RA account to advance the conceptual development of the Millimeter Array, the U.S.-only antecedent to ALMA. Funds were spent on planning workshops, array design and optimization, developing project construction and operations costs, and on site searches and surveys. The planning, design and development supported through the MREFC account achieved the goals set for (i) a refined and audited cost estimate with project milestones, (ii) the selection of a site, (iii) the development of an international partnership with defined shared costs, and (iv) the procurement of prototype antennas.

- *Implementation*: Will fund an array of 64 12-meter antennas having a total collecting area of 7,200 square meters, with 4 receiver bands extending into the submillimeter. The table describes the U.S.

contribution to ALMA and does not address the reduction in costs due to Canada's participation. Outyear costs are adjusted for inflation using the inflators provided by OMB.

- *Operations and Maintenance*: Operations and maintenance funds begin to phase in as initial site construction is completed and antennas begin to be delivered, and are currently only estimates. Funds will be used to manage and support site and instrument maintenance, array operations in Chile, early and eventually full science operations, and in support of ALMA observations by the U.S. science community. The first full year of ALMA science operations is anticipated for FY 2012.



Future Science Support: Along with direct operations and maintenance support for ALMA, NSF will support research performed at the facility, through ongoing research and education programs. The annual support for such activities is estimated to be about $10 million, once the facility reaches full operations.

EarthScope

Project Description: EarthScope is a distributed, multi-purpose geophysical instrument array that will make major advances in our knowledge and understanding of the structure and dynamics of the North American continent. It is planned as a distributed facility – parts of EarthScope are expected to inhabit nearly every county within the U.S. over the project's life span. NSF, the U.S. Geological Survey (USGS), the National Aeronautics and Space Administration (NASA), the Department of Energy (DOE), and the International Continental Scientific Drilling Programme will be funding partners, with USGS and NASA expected as operating partners. Project partners may also include state and local governments, geological and engineering firms, and Canadian and Mexican agencies. Over 3000 earth scientists and students are expected to use the facility annually.

Principal Scientific Goals: Enhanced understanding of earthquakes and seismic hazards, magmatic systems and volcanic hazards, lithospheric dynamics, regional tectonics, continental structure and evolution, fluids in the crust, and associated educational aspects.

Principal Education Goals: To engage science and non-science students in geosciences discovery through the use of technology in real or retrospective time with the aim of integrating research and education.

Partnerships and Connections to Industry: Geotechnical and engineering firms directly use data and models, which will be enabled by EarthScope. Instrumentation firms will collaborate on development for state-of-the-art seismic systems, down-hole instrumentation, and high-precision GPS antenna designs.

Management and Oversight: The NSF coordinator is the Section Head for Special Projects, located in the Earth Sciences (EAR) Subactivity in the Geosciences (GEO) Activity. Other internal oversight is provided by a Project Advisory Team including staff from GEO, the Office of the General Counsel and the Office of Budget, Finance and Award Management. Following the recommendations of a favorable National Academy of Sciences review of EarthScope, an EarthScope Science and Education Committee (ESEC) was formed to provide an advisory structure to ensure coordination of facility construction and operation, science, education and outreach, and information technology efforts.

Current Project Status: FY 2003 highlights include dedicated workshops to refine the EarthScope science plan, organize education and outreach, strengthen coordination with EarthScope partners at NASA and the USGS, and refine communications/information technology capabilities. In partnership with the International Continental Scientific Drilling Programme, work was completed on the pilot hole instrumentation package development. In FY 2003, funds were requested to initiate construction of the EarthScope facility. Major FY 2004 milestones will include the initiation of airborne imaging of potential study sites, beginning of equipment acquisition and installation, awarding of the San Andreas Fault Observatory at Depth drilling contract, and construction of the down-hole monitoring string.

EarthScope's construction schedule is still under review and discussion. The milestones listed below are preliminary and will likely be revised as the project's schedule is finalized.

FY 2003 Milestone:
- Award for EarthScope MREFC construction phase completed (4th quarter);

FY 2004 Milestones:
- Compete and award contracts for broadband and short-period seismic systems (1st quarter);
- Community planning on permanent seismic sites and first array deployment (1st quarter);
- San Andreas Fault Observatory at Depth main hole drilling contract competed and awarded (3rd quarter);
- Drilling begins at end of year (4th quarter);
- Down-hole monitoring equipment constructed (3rd quarter);
- Acquisition begins for GPS and borehole strain systems (2nd quarter);
- Airborne imaging of potential study sites (2nd quarter);
- Delivery of 50 portable GPS systems (4th quarter);
- Delivery and installation of 100 GPS and 20 borehole-strain systems (4th quarter); and
- NSF conducts first annual review of EarthScope (4th quarter).

FY 2005 Milestones:
- Delivery and installation of 50 transportable array sites;
- Delivery and installation of 500 flexible pool short period sites;
- Delivery and installation of 5 Global Seismic Network (GSN) and 10 National Seismic Network (NSN) permanent stations in cooperation with the Advanced National Seismic System (ANSS);
- Main hole completed at San Andreas Fault Observatory;
- Down-hole monitoring instrumentation installed;

Airborne imaging of potential study sites;
Delivery and installation of 175 GPS and 30 borehole-strain systems;
Delivery and deployment of 50 portable GPS systems; and
NSF conducts annual review of project status.

FY 2006 Milestones:
Delivery and installation of 200 transportable array sites;
Delivery and installation of flexible pool sites: 200 broadband and 1000 short period seismic systems;
Delivery and installation of 5 GSN and 10 NSN permanent stations (in cooperation with ANSS);
San Andreas Fault site characterization studies carried out;
Delivery and installation of 200 GPS and 50 borehole-strain systems;
Deployment of 50 portable GPS systems; and
NSF conducts annual review of project status;

FY 2007 Milestones:
Delivery of 150 and installation of 200 transportable array sites;
Delivery of flexible pool sites: 200 broadband and 500 short period;
Installation of flexible pool sites: 200 broadband and 1000 short period;
Delivery and installation of 5 NSN permanent stations (in cooperation with ANSS);
Use site characterization and monitoring data to choose four coring intervals at depth in San Andreas Fault Observatory. Commence coring operations;
Delivery and installation of 200 GPS and 50 borehole-strain systems; and
NSF conducts annual review of project status;

FY 2008 Milestones:
Redeployment of USArray;
Install permanent monitoring instrumentation in four core intervals and main hole of San Andreas Fault Observatory at Depth;
Delivery and installation of 200 GPS and 50 borehole-strain systems; and
NSF conducts annual review of project status.

FY 2009 – FY 2013 Milestones:
Redeployment of USArray on a continual basis;
Complete analysis of San Andreas Fault cores, cuttings and logs. Continue monitoring at depth;
Ongoing operation and maintenance of the PBO; and
NSF conducts biennial reviews of project status.

Funding Profile: Conceptual planning for the EarthScope project has developed over the past decade. NSF has funded planning, design and development since FY 1998, and is ready to implement a five-year period of acquisition, construction and commissioning beginning in FY 2003.

MREFC Appropriations for EarthScope
(Dollars in Millions)

FY 2003 Request	FY 2004 Request	FY 2005	FY 2006	FY 2007	Total
$35.00	$45.00	$54.26	$40.00	$23.00	$197.26

EarthScope Funding Profile
(Dollars in Millions)

	Concept/ Development		Implementation		Operations & Maintenance		Totals		Grand Total
	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	
FY 1994 & Earlier									
FY 1995									
FY 1996									
FY 1997									
FY 1998	1.00						$1.00		**$1.00**
FY 1999	1.00						$1.00		**$1.00**
FY 2000	1.00						$1.00		**$1.00**
FY 2001	2.00						$2.00		**$2.00**
FY 2002	1.00						$1.00		**$1.00**
FY 2003 Req				35.00			$0.00	$35.00	**$35.00**
FY 2004 Req				45.00	1.00		$1.00	$45.00	**$46.00**
FY 2005 Est				54.26	3.00		$3.00	$54.26	**$57.26**
FY 2006 Est				40.00	5.00		$5.00	$40.00	**$45.00**
FY 2007 Est				23.00	11.00		$11.00	$23.00	**$34.00**
FY 2008 Est					13.00		$13.00		**$13.00**
Subtotal, R&RA	$6.00				$33.00		$39.00		
Subtotal, MREFC				$197.26				$197.26	
Total, each phase		**$6.00**		**$197.26**		**$33.00**			**$236.26**

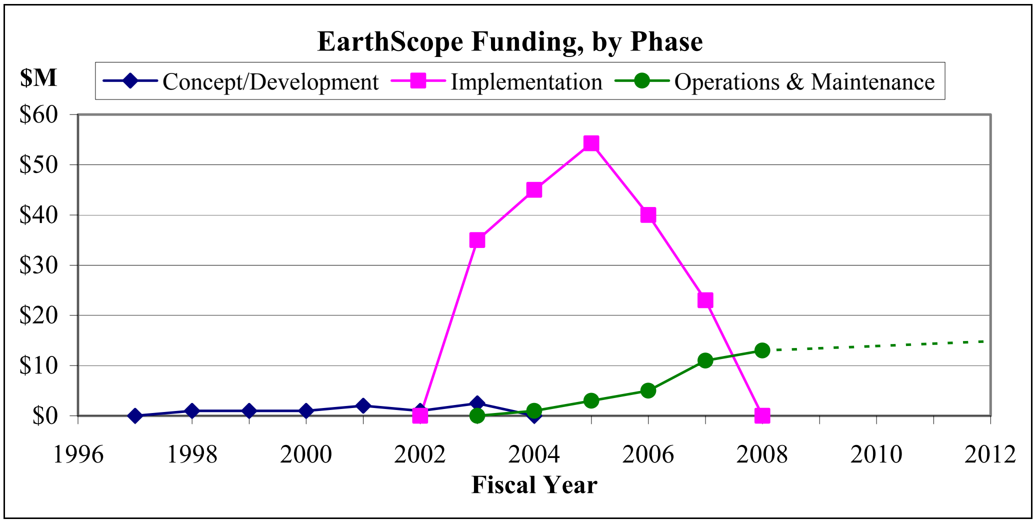
NOTE: A steady state of $13 million in operations support is anticipated by FY 2008. The expected operational lifespan of this project is 15 years after construction is complete in FY 2007.

Information pertaining to the data in the table is provided below.

- *Concept/Development*: FY 1998-FY 2000 funds were used to support workshops, instrument development, and installation technique development appropriate to EarthScope, from existing programs within the Division of Earth Sciences. Dedicated funding was established for FY 2001-03 supporting pre-EarthScope activities that would facilitate the construction and installation. This funding supports meetings, workshops, instrumentation prototype development, installation technique development, and site selection activities.

- *Implementation*: During FY 2003-07, the project will put in place three components of the distributed EarthScope system: (1) the USArray - portable seismometers for deployment across North America; (2) the San Andreas Fault Observatory at Depth - to monitor fault conditions; and (3) the Plate Boundary Observatory – an array of GPS monitors and borehole strain systems to monitor crustal deformation.

- *Operations and Maintenance*: Operations and maintenance will begin to phase-in during the first year of construction. When EarthScope is completed it will be managed, operated and maintained by a consortium including participation from host institutions, affiliate organizations, and the user community.



Future Science Support: Along with direct operations and maintenance support for EarthScope, NSF will support research performed at the facility, through ongoing research and education programs. The annual support for such activities is estimated to be about $15 million, once the facility reaches full operations.

High Performance Instrumented Airborne Platform for Environmental Research (HIAPER)

Project Description: This project is a multidisciplinary high altitude research aircraft capable of conducting science at or near the tropopause with an extensive scientific payload and a range in excess of 6,000 nautical miles. The aircraft will be used approximately 1500 hours a year for research flight hours and integration and testing of instrumentation. It is expected that the research flight hours will be 400-500 per year. The remaining time will be devoted to aircraft maintenance and technology refreshment of the platform infrastructure. Research instrumentation will be developed independently and in partnership with National Center for Atmospheric Research (NCAR) by universities, national laboratories, private companies and international partners. HIAPER will be a national facility, available to the university community as well as to NSF's federal partners such as the National Oceanographic and Atmospheric Administration, the National Aeronautics and Space Administration, the Office of Naval Research and the Department of Energy under existing interagency agreements. HIAPER will be based at NCAR's Research Aviation Facility, Jefferson County Airport, Broomfield, Colorado. Deployments of the aircraft will occur worldwide.

Principal Scientific Goals: HIAPER will be a research aircraft with altitude, range, and endurance capabilities that will enable investigators to perform critical earth system research. With a maximum certified altitude for the aircraft of 51,000 feet, the ability to carry significant payloads to such high altitudes will enable scientists to conduct important atmospheric studies in and near the tropopause. The modified aircraft will be capable of covering a range of 6000 nautical miles in a single flight, which will allow for such missions as a research flight covering the western, southern, and eastern borders of the continental U.S. (from Portland, Oregon to Portland, Maine) and studies of the South Pole environment conducted from South America or New Zealand. The platform will serve the entire geosciences community: atmosphere, cryosphere, biosphere, and hydrosphere.

Principal Education Goals: To engage science and non-science students in geosciences discovery through the use of technology to create a HIAPER "tele-presence" in real or retrospective time with the aim of integrating research and education.

Partnerships and Connections to Industry: The airframe is being acquired from Gulfstream Corporation, with selected airframe modifications by Lockheed-Martin Corporation. Additional support is being received from Aeromet Corporation. Significant participation from smaller private firms in research instrumentation development is also expected.

Management and Oversight: The project is managed and overseen by a project director in the Atmospheric Sciences (ATM) Subactivity in the Geosciences (GEO) Activity. The project director receives advice and oversight support from a NSF Project Advisory Team, which consists of representatives from GEO, the Office of General Counsel, the Office of Budget, Finance and Award Management (BFA), the Mathematical and Physical Sciences (MPS) Activity, and the Office of Polar Programs. A separate HIAPER Advisory Committee, consisting of representatives of the university research community, national laboratories, the University Corporation for Atmospheric Research (UCAR), NCAR and NSF provides advice and recommendations to the Director of NCAR and to the project director at NSF.

Current Project Status: In late December 2001 UCAR and Gulfstream Aircraft Corporation (GAC), a subsidiary of General Dynamics, signed a contract for the acquisition of a Gulfstream V. The green airframe was delivered in June, 2002 and then ferried to Lockheed-Martin for extensive airframe structural modifications to meet science requirements.

Milestones for the project are outlined below:

FY 2002 Milestones:
- Negotiation of final contract between UCAR and GAC (1st quarter);
- Approval of contract by NSF (1st quarter);
- Contract between UCAR and GAC for acquisition of green airframe and structural modifications (1st quarter);
- Production of green airframe (2nd through 4th quarter);
- Staff HIAPER project office at National Center for Atmospheric Research (NCAR) (2nd through 4th quarter).

FY 2003 Milestones:
- NSF Instrumentation Workshop conducted at NCAR
- NCAR Director's Independent Review of Project
- Release of Instrument Development Announcement of Opportunity
- Critical Design Review - Systems
- Structural Modifications Initiated by Lockheed Martin

FY 2004 Milestones:
- Structural Modifications (Continued)
- Award Instrumentation Development Grants
- FAA STC Certificate for Modified Aircraft

FY 2005 Milestones:
- Receipt of Modified Aircraft at UCAR
- Research Infrastructure and Data Systems Installed
- Preparation for Deployments

FY 2006 Milestone:
First Deployment

Funding Profile: In FY 2000, $8.50 million was provided for the project, and an additional $12.47 million was appropriated in FY 2001. In FY 2002 Congress appropriated $35.0 million. The total funding to date, $55.97 million, will allow airframe acquisition and modifications and initiation of core research instrumentation development. The total estimated construction cost for the project is $81.5 million.

MREFC Appropriations for HIAPER
(Dollars in Millions)

FY 2000	FY 2001	FY 2002	FY 2003 Request	FY 2004 Request	Total
$8.50	$12.47	$35.00	$0.00	$25.53	$81.50

HIAPER Funding Profile
(Dollars in Millions)

	Concept/ Development		Implementation		Operations & Maintenance		Totals		**Grand Total**
	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	
FY 1996 & Earlier									
FY 1997									
FY 1998	0.30						$0.30		**$0.30**
FY 1999	0.40						$0.40		**$0.40**
FY 2000		0.50		8.00				$8.50	**$8.50**
FY 2001		0.40		12.07				$12.47	**$12.47**
FY 2002				35.00				$35.00	**$35.00**
FY 2003 Req									
FY 2004 Req				25.53				$25.53	**$25.53**
FY 2005 Est					0.30		$0.30		**$0.30**
FY 2006 Est					3.00		$3.00		**$3.00**
Subtotal, R&RA	$0.70				$3.30		$4.00		
Subtotal, MREFC		$0.90		$80.60				$81.50	
Total, each phase*		**$1.60**		**$80.60**		**$3.30**			**$85.50**

NOTE: The expected operational lifespan is 25 years, pending the full integration of scientific instrumentation. A steady state of about $3.0 million in operations support would occur in or about FY 2006, assuming completion of the project in FY 2004.

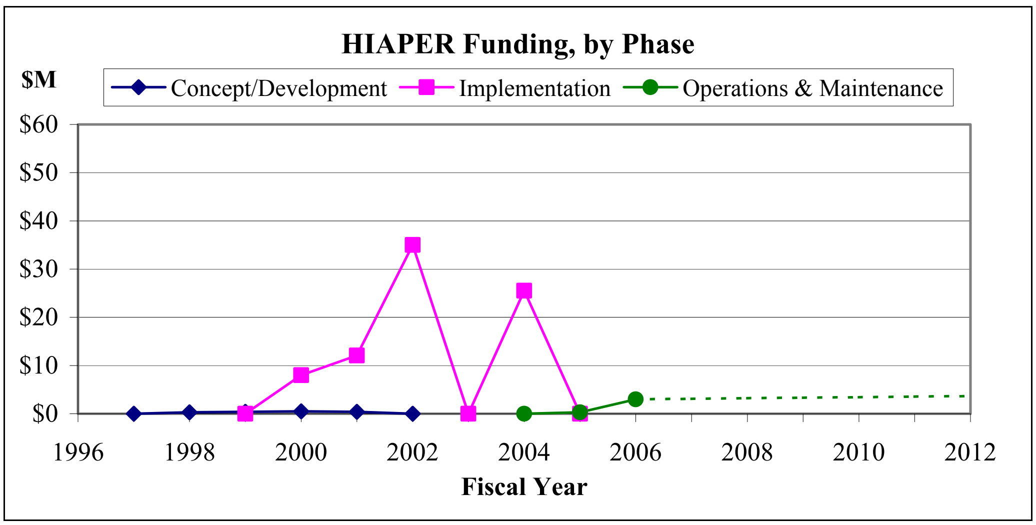
Information pertaining to the data in the table is provided below.

- *Concept/Development*: Initial R&RA funding of approximately $700,000 provided support for workshops to identify the highest priority performance characteristics and platform requirements, and for other workshops, reviews and best practices consultations with federal and nonfederal experts. MREFC funds obligated during this phase of the project include support for the preparation of the

Request for Proposals. After the proposal was received at UCAR, an evaluation and selection team was formed to determine if the proposal met the requirements in the RFP.

- *Implementation*: The full appropriated amounts for FY 2000-02 were required in order to acquire and modify the airframe. Funding was provided to Gulfstream to secure a production slot, and the remainder of the funds were held until the contract was negotiated, approved by NSF and signed by UCAR and GAC. The funding to date allows for green airframe acquisition and the structural modifications required to integrate scientific instrumentation. NSF is requesting $25.53 million in FY 2004 for instrumentation integration and to complete the project. The total construction cost for the project is $81.50 million.

- *Operations and Maintenance*: The aircraft will be maintained and operated by the Research Aviation Facility at NCAR. The intent is to operate the aircraft as a fully certified platform rather than a public use aircraft. Additional follow-on instrumentation will be developed during the operational phase of HIAPER, funded by the R&RA grants program within ATM. HIAPER, in contrast to many research facilities, will accommodate instrumentation from other agencies, international partners as well as new instruments that are developed over the 25-year operational time period through the R&RA Activity. Instruments typically will fly on a variety of platforms, not exclusively HIAPER.



Future Science Support: Along with direct operations and maintenance support for HIAPER, NSF will support research performed at the facility, through ongoing research and education programs. The annual support for such activities is estimated to be about $10.0 to $12.0 million, once the facility reaches full operations.

IceCube Neutrino Observatory

Project Description: IceCube will be the world's first high-energy neutrino observatory and will be located under the ice at the South Pole. It represents a new window on the universe, providing unique data on the engines that power active galactic nuclei, the origin of high energy cosmic rays, the nature of gamma ray bursters, the activities surrounding supermassive black holes, and other violent and energetic astrophysical processes. IceCube will be constructed by the IceCube Consortium, led by the University of Wisconsin (UW). One cubic kilometer of ice will be instrumented with 4800 photomultiplier (PM) tubes (80 strings of 60 PMs each) to detect neutrino-induced, charged reaction products produced when a high energy neutrino interacts in the ice within or near the cubic kilometer fiducial volume. Optical Modules (OMs), each containing a PM and associated electronics, will be distributed uniformly from 1.5 km to 2.5 km beneath the surface of the South Pole ice cap, a depth where the ice is highly transparent and bubble-free. IceCube will record the energy and arrival direction of high-energy neutrinos ranging in energy from 100 GeV (10^{11} electron Volts[eV]) to 10 PeV (10^{16} eV). The principle tasks in the IceCube Project are: production of the needed OMs and associated electronics and cables; production of an enhanced hot water drill and an OM deployment system capable of drilling holes for, and deploying, 16 OM strings per austral season at the Pole; production of a surface array of air shower detectors, one for each OM string to both calibrate and eliminate background events from the IceCube OM array; construction of a data acquisition and analysis system; and associated personnel and logistics support.

Principal Scientific Goals: IceCube will be the world's first observatory capable of studying the universe with high-energy neutrinos. Measurement of the number, direction, timing, and energy spectrum of such neutrinos will provide unique new insights regarding the dynamics of active galactic nuclei, the acceleration mechanisms and locations of the sources of high energy cosmic rays, the properties and dynamics of gamma ray bursters, and the types of processes that take place near the event horizon of supermassive black holes at the centers of galaxies. Many of these phenomena take place at cosmological distances in regions shielded by matter and shrouded by radiation. Since neutrinos carry no charge and interact very weakly with matter, easily passing through the entire earth, they are unique messenger particles for understanding the astrophysics of such extreme phenomena and are capable of bringing us information about previously undiscovered cosmic objects, ones that are invisible to existing observatories that record electromagnetic signals or charged particles. IceCube data on sources will also complement data from existing astrophysical observatories in the optical, x-ray, and gamma ray regions of the electromagnetic spectrum, providing new tests of theories of the underlying dynamics of these objects.

Principal Education Goals: IceCube provides a vehicle for helping to achieve national and Agency education and outreach goals based on the conduct of visionary science in the exciting South Pole environment. These goals include broadening the scientific workforce base in the U.S. and creating a technologically facile work force with strong ties to fundamental research that is the core of a strong economy. Specific outcomes will include: the education and training of next generation leaders in astrophysics, including undergraduate students, graduate students, and postdoctoral research associates; K-12 teacher scientific/professional development, including development of new inquiry-based learning materials; increased diversity in science through partnerships with minority institutions; and enhanced public understanding of science through broadcast media and museum exhibits. Some of these outcomes will result from separate R&RA grants to universities and other organizations for work associated with IceCube, selected following the standard NSF merit review process.

Partnerships and Connections to Industry: The IceCube Collaboration consists of 11 U.S. institutions and institutions in three other countries, Belgium, Germany, and Sweden. Foreign contributions of $40.0 million U.S. are anticipated. The U.S. Department of Energy, through its Lawrence Berkeley Laboratory, is also participating.

Management and Oversight: With strong international participation, IceCube has a management structure that has been developed from plans used in other successful projects. This structure has been agreed to by all participants and provided the framework for the Start-up Project funded in FY 2002. The University of Wisconsin has in place an External Advisory Committee, providing for their oversight of the project, and has appointed both a Project Director and a Project Manager. Internally, NSF has appointed a Project

Coordinator to manage and oversee the NSF award, and has established an internal Project Advisory Team comprised of representatives from the Office of Budget, Finance, and Award Management, the Office of General Counsel, the Mathematical and Physical Sciences (MPS) Activity, and the Office of Polar Programs (OPP), and chaired by the Project Coordinator. Oversight and funding responsibility for IceCube construction and operations are the responsibility of OPP; support for research, education, and outreach using IceCube will be shared by OPP and MPS as well as other organizations and international partners.

Current Project Status: The IceCube project is currently funded through a $15.0 million 'startup funding' award provided by the FY 2002 appropriation. An award was put into place in August of 2002. The primary tasks of that activity are: production and testing of the Enhanced Hot Water Drill (EHWD) system for drilling the required deep-ice holes into which optical modules (the photo-detectors that are the central elements of the IceCube detector) will be placed; production of the optical module deployment system; design of the data acquisition system and software requirements; specification of the requirements, design, and pre-production testing of the IceTop Surface Array; software system architecture and detector simulations; and planning for detector verification. Progress to date has been according to schedule and is within budget. The major task that must be accomplished within startup funding is the construction of the EHWD. EHWD completion during summer 2003 and shipment to the Pole in the fall of 2003 is essential to maintain the schedule of first drilling in the 2004/2005 austral summer. In addition, the Office of Science and Technology Policy (OSTP) requested in FY 2002 that the National Academy of Sciences review the scientific merit of IceCube and other proposed U.S. neutrino collectors in the context of current and planned neutrino research capabilities throughout the world. That report provides strong support for IceCube construction. Management and technical staff are now in place at UW and the participating institutions to proceed with the full IceCube construction project.

Major milestones for the NSF components for IceCube are outlined below:

FY 2003 Milestones:
- Complete development and construction of enhanced hot water drill (EHWD) system; and
- Complete design of the data acquisition system architecture and software requirements.

FY 2004 Milestones:
- Deliver EHWD system and optical module (OM) deployment system to the South Pole; and
- Begin production of optical modules and data acquisition and handling system (DAQ).

FY 2005 Milestones:
- Deliver initial OM strings, IceTop modules, and initial elements of the DAQ to South Pole;
- Assemble the EHWD and OM deployment systems;
- Drill, deploy, and test initial OM strings and corresponding IceTop modules; and
- Establish drill camp and move new counting house building into place.

FY 2006 Milestones:
- Continue OM and IceTop module production;
- Continue to drill, deploy and test OM strings and IceTop modules, including installing and testing the associated DAQ elements; and
- Commission new counting house.

Projected Outyear Milestones (FY 2007-2010) are based on current project planning and represent a general outline of anticipated activities. These activities are also dependant on weather conditions and the Antarctic logistics schedule.

FY 2007-10 Milestones:
- Continue OM and IceTop module production; and
- Continue to drill, deploy and test OM strings and IceTop modules, including installing and testing the associated DAQ elements.

FY 2011 Milestones:
- Complete OM and IceTop module production, string deployment, and the DAQ;
- Complete the calibration, testing, and commissioning of the full IceCube array; and
- Commence full operations.

Funding Profile: $15.0 million was appropriated in FY 2002 for startup activities for the IceCube project. In FY 2004, $60.0 million is requested to initiate construction of the full IceCube project.

MREFC Appropriations for IceCube
(Dollars in Millions)

FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	**Total**
$15.00	$0.00	$60.00	$33.40	$34.30	$35.30	$36.30	$37.30	**$251.60**

IceCube Funding Profile
(Dollars in Millions)

	Concept/ Development		Implementation		Operations & Maintenance		Totals		Grand
	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	Total
FY 1999 & Earlier									
FY 2000									
FY 2001	0.50						$0.50		**$0.50**
FY 2002[1]				10.12				$10.12	**$10.12**
FY 2003 Req[1]				4.88				$4.88	**$4.88**
FY 2004 Req				60.00				$60.00	**$60.00**
FY 2005 Est				33.40				$33.40	**$33.40**
FY 2006 Est				34.30				$34.30	**$34.30**
FY 2007 Est				35.30				$35.30	**$35.30**
FY 2008 Est				36.30				$36.30	**$36.30**
FY 2009 Est				37.30				$37.30	**$37.30**
FY 2010 Est					10.40		$10.40		**$10.40**
FY 2011 Est					10.60		$10.60		**$10.60**
FY 2012 Est					10.90		$10.90		**$10.90**
FY 2013 Est					11.20		$11.20		**$11.20**
Subtotal, R&RA	$0.50				$43.10		$43.60		**$43.60**
Subtotal, MREFC				$251.60				$251.60	**$251.60**
Total, Each Phase		**$0.50**		**$251.60**		**$43.10**			**$295.20**

NOTE: Operations support in FY 2010 is estimated at $10.40 million, and is estimated to remain at that corresponding level of effort in subsequent years. The expected operational lifespan of this project is 25 years beginning in FY 2011.
[1]Funding of $15.0 million in FY 2002 was for start up costs associated with IceCube construction; $10.12 million was obligated in FY 2002, the remaining $4.88 million is carried over from FY 2002 to FY 2003. The FY 2003 amount reflected in the table above is the carry over; no additional funds were requested in FY 2003.

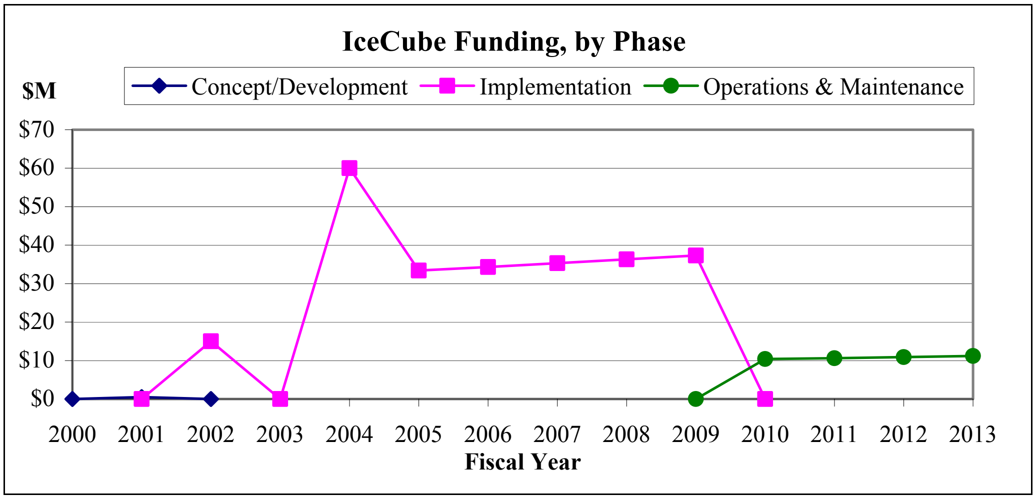
Information pertaining to the data in the table is provided below.

- *Concept/Development:* $500,000 was provided in FY 2001 through the R&RA Account to support drill conceptual development and design, R&D on advanced data acquisition and analysis techniques, and development of interface electronics and associated software for digital detector electronics readout. IceCube builds on the work of the Antarctic Muon and Neutrino Detector (AMANDA), which demonstrated proof-of-principle. NSF's FY 2002 appropriation included $15.0 million for 'start-up' design and development of the IceCube project. That investment focused on state-of-the art drill and electronics development and acquisition.

- *Implementation:* The total cost of the construction project, including the $15.0 million appropriated FY 2002 for start-up activities, is $251.60 million and will extend through FY 2011. $60.0 million is requested in FY 2004 to maintain the schedule. The plan is to drill holes and deploy strings of OMs in each austral summer season (November through mid-February). With good EHWD drill performance, and barring weather-induced complications of logistics support, the full complement of OMs should be in place by about the end of FY 2011.

- *Operations and Maintenance:* Full operation of the IceCube Neutrino Observatory is planned to commence in FY 2011 following completion of drilling and OM deployment and full detector commissioning planned for FY 2011. Transition to full operations will begin in FY 2010. Of this amount, approximately half is for data analysis that will be carried out by the collaborating U.S. IceCube institutions, the other half being for direct operations and maintenance support (IceCube-specific logistics, system engineering, operation and maintenance of the data acquisition and data handling data systems, data quality monitoring, IT upgrades, and calibrations). The general operations of South Pole Station, reported in a separate section, also contribute to supporting IceCube. Costs included for IceCube here include only those that are project specific and incremental to general operations.

Associated Research and Education Activities: Besides the training of next generation astrophysicists, IceCube will encourage the creation of new links to K-12 teachers for purpose of scientific/professional development of secondary school teachers, reaching into the classroom with new inquiry-based IceCube learning materials, as well as using the unique South Pole environment to convey the excitement of astrophysics and science generally to K-12 students. Extra measures will be undertaken to interest underrepresented minorities in science. The plan includes partnership with two largely minority institutions (Clark-Atlanta University, Atlanta GA, and Southern University, Baton Rouge, LA). Public outreach will be carried out through broadcast media and museum exhibits based on the IceCube science and the South Pole environment. Funding for Education and Outreach (E&O) activities will come from the R&RA account. Annual E&O budgets are estimated at $400,000.



Future Science Support: NSF will support activities at institutions working on more refined and specific data analyses, data interpretation (theory support), and instrumentation upgrades, through ongoing research and education programs. The annual support for such activities is estimated at $2.0 million once the facility reaches full operations.

Large Hadron Collider

Project Description: The Large Hadron Collider (LHC) will be the premier facility in the world for research in elementary particle physics. The facility will consist of a superconducting particle accelerator providing two, counter-rotating beams of protons, each beam having an energy up to 7×10^{12} electron volts (7 TeV). The U.S. is involved in the construction of two particle detectors, a Toroidal LHC Apparatus (ATLAS) and the Compact Muon Solenoid (CMS). They will be constructed to characterize the different reaction products produced in the very high-energy proton-proton collisions which will occur in intersection regions where the two beams are brought together.

The LHC is an international project under construction at the CERN laboratory in Geneva, Switzerland. NSF has awarded grants to Northeastern and Columbia Universities under cooperative agreements with subcontracts to over 50 U.S. universities. A total of 34 international funding agencies participate in the ATLAS detector project, and 31 in the CMS detector project. NSF and DOE are providing U.S. support. CERN is responsible for meeting the goals of the international LHC project. The ATLAS and CMS detectors are expected to take data approximately 200 days/year. The remaining time is used for maintenance and testing.

Principal Scientific Goals: The LHC will enable a search for the Higgs particle, the existence and properties of which will provide a deeper understanding of the origin of mass of known elementary particles. The LHC will also enable a search for particles predicted by a powerful theoretical framework known as supersymmetry which will provide clues as to how the four known forces evolved from different aspects of the same 'unified' force in the early universe.

Principal Education Goals: Through the participation of young investigators, graduate students, undergraduates, and minority institutions in this international project, LHC serves the goal of helping to produce a diverse, globally-oriented workforce of scientists and engineers. Further, innovative education and outreach activities, such as the QuarkNet project, allow high school teachers and students to participate in this project (see the URL: http://quarknet.fnal.gov/). Many highly-trained students in high-energy physics move into industrial jobs.

Connections to Industry: Major procurements of components of both warm and superconducting magnets, as well as high-speed electronics, are performed through U.S. industries. Major developments in Grid computing are also valuable outcomes.

Management and Oversight: A program director in the Physics Subactivity of the Mathematical and Physical Sciences (MPS) Activity is responsible for day-to-day project oversight. The NSF program director also convenes an internal Project Advisory Team, including staff from the Office of Budget, Finance and Award Management, the Office of the General Counsel, the Office of Legislative and Public Affairs, and the MPS Executive Officer.

U.S. LHC program management is performed through a Joint Oversight Group (JOG), created by the NSF and DOE membership. The JOG has the responsibility to see that the U.S. LHC Program is effectively managed and executed to meet commitments made under the LHC International Agreement and its Protocols.

Current Project Status: An External Review Committee (ERC), reporting to the CERN Council in June, 2002, identified issues relevant to completion of the LHC project. In the report, the ERC stated that it "believes that the design of the LHC is excellent and that it will reach design specifications". However, the ERC did find that the projected cost increases that became apparent before this report arose from "serious weaknesses in cost awareness and control, as well as in contract management and financial reporting." NSF has been working closely with CERN management on these issues.

In September 2002, CERN management released an Action Plan to address the recommendations of the External Review Committee. A schedule delay was foreseen at that time, largely a result of delays in the delivery of superconducting cable for the LHC magnets. In December, 2002, the CERN council accepted a proposal to revise the 1996 financial framework for the LHC. The revised framework makes LHC completion in 2007 a priority, representing a two year delay from the original plan. The proposal addresses items including accountability, staffing, management, cost awareness, control and reporting, and annual reviews. Most of CERN's resources will now be committed to the project, leaving only a very limited non-LHC experimental program.

Under the new schedule, a period of beam commissioning will be followed by start of the LHC Physics Program in the latter half of 2007. While both experiments will profit from the revised LHC schedule by having additional time to optimize its installation plans, the U.S. collaborators will continue on the original baseline schedule, to avoid any increases in labor and costs.

The NSF-supported components of the ATLAS and CMS detectors are estimated for completion in FY 2005, with the final year of appropriated construction funding in FY 2003. The U.S. ATLAS construction project, as of September 30, 2002, was 75 percent complete, reflecting the most recent update of cost and schedule estimates for completing baseline scope. The U.S. CMS project is 71 percent complete. Milestones for both projects are being completed in the anticipated years. U.S. cost performance has been excellent, with material contracts typically below estimates, and labor costs tracking close to plan. The U.S. strategy aims for the completion of the U.S. deliverables within our baseline cost and with a slightly extended schedule that takes the LHC construction delay into account.

Major milestones for the NSF components of LHC are outlined below:

FY 2002 Milestones:

U.S. ATLAS

Complete Shipment of Liquid Argon Barrel Calorimeter to CERN (Shipment of the Barrel Cryostat on schedule, crates delivered to BNL and will be shipped to CERN when ready for installation.);

Complete Tile Calorimeter Photomultiplier Tube Shipments to CERN (Baseline scope completed. Jan '03 forecast date includes full set of goals approved in BCP 57);

Complete Submodule Production for the Tile Calorimeter (Completed);

Complete Shipment of Transition Radiation Tracker Barrel Modules to CERN (Delay due to radiation damage caused by the baseline gas choice. New baseline gas chosen, schedule slipped to Jan '04);

Complete Final Prototypes of Readout Drivers for Liquid Argon Calorimeter (Not on critical path. U.S. not responsible for deliverables. Final Prototype – Sept '04); and

Complete Production of 45% of the Readout Drivers for the Silicon Tracker (Completed).

U.S. CMS

Begin Mounting and Testing Cathode Strip Chamber Electronics at UCAL and Florida Universities (Completed);

Complete Optical Assemblies for Hadron Calorimeter Barrel #1 (Completed for both Barrels);

Procure Hadron Calorimeter Photodiodes (Completed);

Complete Production of 25% of the Readout Drivers for the Silicon Tracker (Delayed until CMS delivers tested parts for assembly. U.S. CMS has set up two assembly lines to be ready as parts are available.); and

Complete Test of Photomultiplier Tubes for the Forward Hadron Calorimeter (Completed).

FY 2003 Milestones:

U.S. ATLAS

Complete Shipment of Liquid Argon Electronics Crates to CERN (1^{st} quarter);

Complete Delivery of Liquid Argon Forward Calorimeter (Section C) (2^{nd} quarter);

Complete Tile Calorimeter Readout Electronics (4^{th} quarter);

Complete Tile Calorimeter Barrel Shipments to CERN (1^{st} quarter); and

Complete Installation of Liquid Argon Cryogenics Installation (4^{th} quarter);

U.S. CMS

Start Production of the Front End Electronics for the Electromagnetic Calorimeter (1st quarter);

Complete Production of the Front End Electronics for the Hadron Calorimeter (2nd quarter);

Complete 100% Testing of the Hadron Calorimeter Photodiodes (4th quarter); and

Complete Deliveries of all 148 Cathode Strip Chambers for Muon Endcap Layer 23/2 (4th quarter).

FY 2004 Milestones:

US ATLAS
Complete delivery of Liquid Argon Forward Calorimeter (Section A);
Complete delivery of Silicon Strip Modules;
Complete production of Transition Radiation Tracker (Modules and Barrel); and
Complete Muon Chamber production.
US CMS
Complete delivery of Electromagnetic (EM) Calorimeter Photodiodes;
50% of Silicon Tracker Rods completed; and
Start production of the Front End electronics for the EM Barrel Calorimeter.

FY 2005-2006 Milestones:
Start ATLAS and CMS detector installation and testing in underground halls.

FY 2007 Milestone:
First data taking using both ATLAS and CMS detectors.

Funding Profile: Funding for the overall LHC project, including the ATLAS and CMS detectors and the accelerator, is provided through an international partnership involving NSF, the Department of Energy (DOE), and the CERN member states, with CERN member states providing the major portion. Other countries that are not member states are also participating.

The total U.S. contribution to the construction project will be $531 million, with $450 million from the DOE and $80.88 million from NSF. NSF and DOE will jointly provide a total contribution of $331 million for the detector construction, while DOE will provide the entire U.S. contribution ($200 million) for the accelerator construction. There are two other major detectors being constructed, ALICE and LHC-B, in which the U.S. does not play a role.

MREFC Appropriations for LHC
(Millions of Dollars)

FY 1999	FY 2000	FY 2001	FY 2002	FY 2003 Request	Total
$22.00	$15.90	$16.36	$16.90	$9.72	$80.88

Large Hadron Collider Funding Profile
(Dollars in Millions)

	Concept/ Development		Implementation		Operations & Maintenance		Totals		Grand
	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	Total
FY 1994 & Earlier									
FY 1995									
FY 1996	1.20						$1.20		**$1.20**
FY 1997	1.50						$1.50		**$1.50**
FY 1998	1.50						$1.50		**$1.50**
FY 1999	1.50		0.15	22.00	0.16		$1.81	$22.00	**$23.81**
FY 2000				15.90	0.53		$0.53	$15.90	**$16.43**
FY 2001				16.36	2.30		$2.30	$16.36	**$18.66**
FY 2002				16.90	1.60		$1.60	$16.90	**$18.50**
FY 2003 Req				9.72	5.00		$5.00	$9.72	**$14.72**
FY 2004 Req					10.00		$10.00		**$10.00**
FY 2005 Est.[1]					15.00		$15.00		**$15.00**
FY 2006 Est.[1]					20.00		$20.00		**$20.00**
FY 2007 Est.[1]					25.00		$25.00		**$25.00**
Subtotal, R&RA	$5.70		$0.15		$79.59		$85.44		
Subtotal, MREFC				$80.88				$80.88	
Total, each phase		**$5.70**		**$81.03**		**$79.59**			**$166.32**

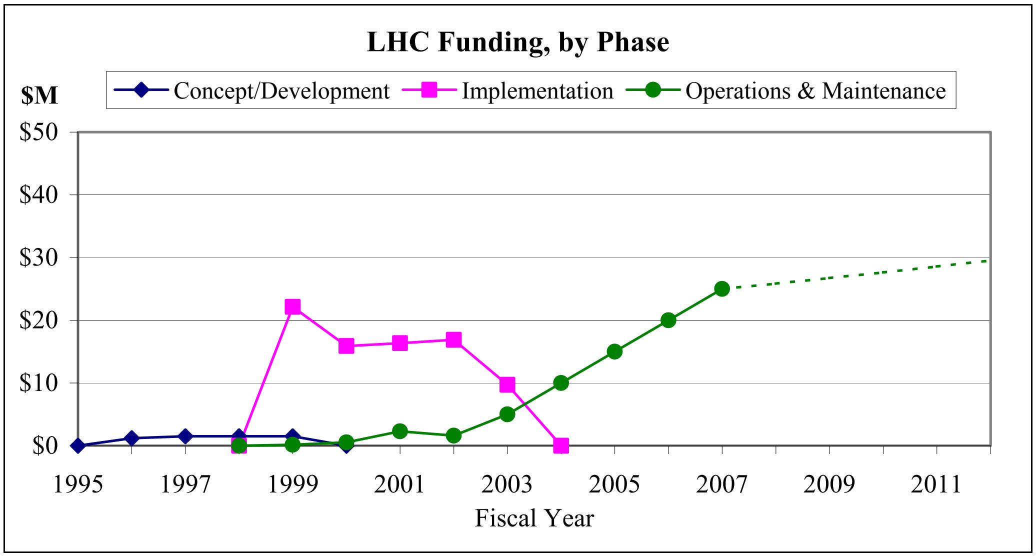
NOTE: NSF's share of operations support is expected to reach a level of effort of about $25.0 million by about FY 2007. The estimated operational lifespan of this project is approximately 20 years.
[1]Operations and Maintenance estimates for FY 2005 and beyond are subject to the availability of funds and appropriate program balance, and are not intended to reflect actual budget requirements..

Information pertaining to the data in the table is provided below.

- *Concept/Development:* The LHC has been under discussion since FY 1989. NSF funding in FY 1996-99 supported technical design studies.

- *Implementation:* NSF components of the ATLAS and CMS detectors, constructed with funds provided FY 1999-FY2003, are anticipated to be completed, tested and ready to install in FY 2005. The overall LHC project is now anticipated for completion at CERN in FY 2007. (In FY 1999, $150,000 in R&RA funds were provided to meet the scheduled award total of $22.15 million. This R&RA action was noted in subsequent NSF MREFC budget justifications to Congress.) Final implementation funding is requested in FY 2003.

- *Management & Operations:* FY 1999-2003 funding primarily represents investments in university computing infrastructure and software development for remote access, to allow university scientists and students to participate in LHC research as well as other projects. Estimated funding for FY 2004 and beyond reflects the NSF share of operations as the ATLAS and CMS detectors approach and initiate operations. Estimated funding during the same period also includes the development of LHC grid software and computing. It is anticipated that over the lifetime of the LHC project, upgrades and new components to address emerging research questions will be considered. Funds for such activities are not included here.



Future Science Support: Along with direct support for operations and maintenance for LHC, NSF will support science and engineering research performed at the facility, through ongoing research and education programs. The annual support for such activities is presently estimated to be about $5.0 million once the facility reaches full operations. Both ATLAS and CMS have well-developed outreach activities (see Education Goals above).

George E. Brown, Jr. Network for Earthquake Engineering Simulation (NEES)

Project Description: NEES will provide a national, networked simulation resource of fifteen geographically-distributed, shared use next-generation experimental research equipment sites with teleobservation and teleoperation capabilities. This facility will transform the environment for earthquake engineering research and education through collaborative and integrated experimentation, computation, theory, databases, and model-based simulation to improve the seismic design and performance of U.S. civil and mechanical infrastructure systems. Research equipment includes shake tables, geotechnical centrifuges, a tsunami wave basin, large-scale laboratory experimentation systems, and field experimentation and monitoring installations. NEES equipment will be located at academic institutions (or at off-campus field sites) throughout the U.S., networked together through a high performance Internet system, and operated during FY 2005-14 by a NEES Consortium. The NEES award for system integration is located at the University of Illinois at Urbana-Champaign. The NEES award for consortium development was made to a non-profit organization, the Consortim of Universities for Research in Earthquake Engineering..

Principal Scientific Goals: Enhanced understanding and more comprehensive, complete, and accurate models of how civil and mechanical infrastructure systems respond to earthquake loading (site response, soil-foundation-structure interaction, tsunami effects, and structural and nonstructural response). This will enable the design of new methods, modeling techniques, and technologies for earthquake hazard mitigation.

Principal Education Goals: To engage engineering, science, and other students in earthquake engineering discovery through on-site use of experimental facilities, telepresence technology, archival experimental and analytical data, and computational resources with the aim of integrating research and education.

Connections to Industry: There are no specific project partnerships at this time. However, through the Congressionally mandated National Earthquake Hazards Reduction Program (NEHRP), Federal Emergency Management Agency (FEMA), the National Institute of Standards and Technology (NIST), NSF, and U.S. Geological Survey (USGS) participate to support research related to earthquake hazard mitigation. Connections to industry include equipment and instrumentation acquisition by awardees from private firms; and private engineering consultants and engineering firms engaging in NEES research or using data and models developed through NEES.

Management and Oversight: The NSF Program Manager for NEES and the NSF Equipment Project Coordinator are located in the Civil and Mechanical Systems (CMS) Subactivity in the Engineering (ENG) Activity. Oversight is supported by the NSF Project Advisory Team consisting of representatives from the Office of General Counsel, the Office of Budget, Finance and Award Management, and the Biosciences, Geosciences, Computer and Information Science and Engineering, and Social and Behavioral Sciences Activities.

Current Project Status: NEES is currently under construction through the end of FY 2004. Under construction are sixteen awards (Phases 1 and 2) to establish equipment sites at fifteen institutions, one award for system integration, and one award for consortium development. All awards are the result of competitive program solicitations. The organizational structure and policies for a NEES Consortium are under development by the earthquake engineering community. Milestones for NEES are outlined below:

FY 2003:
- Continue Phases 1 and 2 equipment construction and begin calibration;
- Establish NEES Consortium entity;
- Initiate system integration test bed operations; and
- Coordinate outreach and training activities for equipment sites as they become operational.

FY 2004:
- Complete equipment construction and calibration of all Phases 1 and 2 equipment;
- All equipment sites networked and operational;
- Coordinate outreach and training activities for equipment sites as they become operational;
- Complete testing of network system;
- Network system operational; and
- NEES Consortium management structure completed for operation in FY 2005.

Funding Profile: NSF received $7.70 million in FY 2000 to initiate construction of NEES. Total MREFC funding for this project will be $81.80 million during FY 2000-04, with an additional $1.10 million provided to the project through the Education and Human Resources (EHR) Account.

MREFC Appropriations for NEES
(Dollars in Millions)

FY 2000	FY 2001	FY 2002	FY 2003 Request	FY 2004 Request	Total
$7.34	$28.11	$24.40	$13.56	$8.00	$81.41

NEES Funding Profile
(Dollars in Millions)

	Concept/ Development		Implementation			Operations & Maintenance		Totals			Grand
	R&RA	MREFC	R&RA	MREFC	EHR	R&RA	MREFC	R&RA	MREFC	EHR	Total
FY 1994 & Earlier											
FY 1995	0.15							$0.15			**$0.15**
FY 1996											
FY 1997											
FY 1998	0.11							$0.11			**$0.11**
FY 1999											
FY 2000		0.36		7.34					$7.70		**$7.70**
FY 2001	0.44	0.03		28.11	1.10			$0.44	$28.14	$1.10	**$29.68**
FY 2002				24.40					$24.40		**$24.40**
FY 2003 Req				13.56					$13.56		**$13.56**
FY 2004 Req				8.00					$8.00		**$8.00**
FY 2005 Est						10.00		$10.00			**$10.00**
Subtotal, R&RA	$0.70					$10.00		$10.70			**$10.70**
Subtotal, MREFC		$0.39		$81.41					$81.80		**$81.80**
Subtotal, EHR					$1.10					$1.10	**$1.10**
Total, Each Phase		**$1.09**			**$82.51**		**$10.00**				**$93.60**

NOTE: A steady state of about $10 million in operations support is expected to occur in or about FY 2005. The expected operational lifespan of this project is 10 years, beginning in FY 2005.

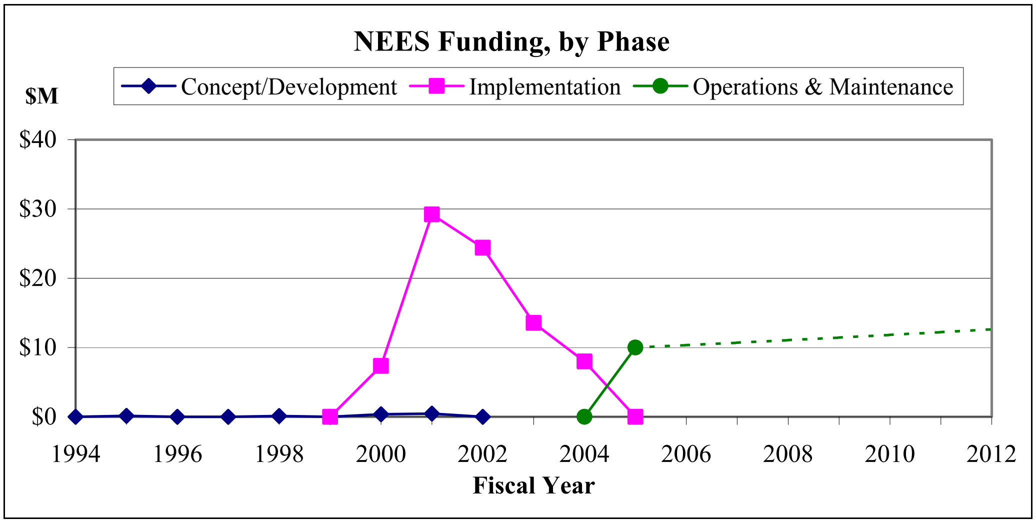
Information pertaining to the data in the table is provided below.

- *Concept/Development:* R&RA support for planning, design and development includes early workshops on experimental needs of the earthquake engineering community and on refinement of ideas for experimental systems in FY 1995 and FY 1998. During this period, the community also developed an action plan at NSF's invitation. Additional R&RA support focused on an international workshop to foster long term working relationships for experimental earthquake engineering research and national workshops and study to develop long-term NEES research concepts and plans (FY 2001). MREFC supported planning design and development specifically for a scoping study of the NEES network system (user and system architecture requirements), including a community workshop for broader input on user requirements prior to the full system integration award being made by NSF.

- *Implementation:* MREFC funds during this phase support a range of equipment acquisition, as well as system integration and consortium development. To encourage the broadest participation for establishment of geographically distributed NEES equipment sites, the FY 2000 competitive program solicitation for NEES research equipment specifically encouraged participation from EPSCoR states. As a result of the merit review process, one award was made to an institution from an EPSCoR state for which the EPSCoR program provided partial funding through the EHR account in FY 2001.

- *Operations and Maintenance:* With completion of the construction period in FY 2004, NEES will enter its 10-year operational period through FY 2014 and will be managed by the NEES Consortium. The NEES Consortium will provide the leadership, management, and coordination for all the NEES resources and will establish a broad and integrated partnership that includes participation of the full membership of the earthquake engineering community, both within the U.S. and abroad.

  As an Internet-based resource, access to the NEES network will be 24/7 to anyone with Internet capabilities. The NEES experimental facilities are expected to be fully utilized annually as shared use research sites coordinated by the NEES Consortium and for research by personnel at the host institution. NEES experimental resources and data are expected to be used annually by approximately 1000 U.S. researchers and students.



Future Science Support: Along with direct operations and maintenance support for NEES, NSF will support research performed at NEES equipment sites through ongoing research and education programs. In addition, NSF plans to initiate grand challenge research projects that will utilize a number of NEES experimental sites, data, and computational resources to comprehensively address major research questions in earthquake engineering and seismic hazard mitigation. The annual support for such activities once the facility reaches full operations is estimated to be about $15 million.

National Ecological Observatory Network (NEON)

Project Description: NEON will be a continental scale research instrument consisting of geographically distributed observatories, networked via state-of-the-art communications. Scientists and engineers will conduct research spanning all levels of biological organization from molecules to whole systems, across scales ranging from seconds to geological time, and from microns to kilometers. Each NEON observatory will include cutting-edge instrumentation, site-based experimental infrastructure, natural history archive facilities and/or computational, analytical and modeling capabilities. In addition, the NEON observatories will be linked via a cutting-edge computational network. The observatories will focus on: deploying field instrumentation; gathering environmental data from field-based arrays; collecting data simultaneously from geographically distributed arrays; integrating data across diverse types of databases; and establishing an informatics infrastructure. The observatories will also be used to optimize the functionality of a networked, multiscale, integrated infrastructure that will comprise a fully realized NEON.

Principal Scientific Goals: Collectively, the network of observatories will allow comprehensive, continental-scale experiments on ecological systems and will represent a virtual laboratory for research to obtain a predictive understanding of the environment. Important ecological questions confronting the U.S. will be addressed using NEON. Examples of research questions that could be addressed by NEON include: Will northern snakehead fish spread across the U.S. and harm sport fish populations? Can the spread of infectious agents like West Nile or Hanta virus be monitored and predicted? Do western wildfires affect water quality in the central or eastern U.S.?

Principal Education Goals: Undergraduates and graduate students will be trained in the conduct of large-scale and long-term ecological research. K-12 students and teachers will also be involved in NEON projects. The research will develop the knowledge to inform policy and to improve the health of U.S. ecosystems.

Partnerships and Connections to Industry: While there are no explicit partnerships planned at this time, potential federal partners have expressed interest in NEON, such as National Parks, National Forests, Marine Sanctuaries and USDA Agricultural Research Sites. Private foundations, such as the Santa Fe Institute, the Turner Foundation, NatureServe, The Nature Conservancy, and other countries have expressed an interest in NEON but no cost-sharing plans have been initiated. NEON-generated information will be employed by natural resource industries, such as forestry and fisheries, to plan programs and design management strategies.

Management and Oversight: Oversight of NEON is provided through the Biological Infrastructure Subactivity in the Biological Sciences Activity. Each observatory will be selected via a merit-review process resulting in a competitively awarded cooperative agreement. One NSF program director will be dedicated to managing the NEON activity. An Integrated Project Advisory Team, including representatives from the Office of General Counsel and the Office of Budget, Finance and Award Management, will be established to assist with management of the project.

Current Project Status: Initial workshops developed the scientific potential, technological needs, and management structure for NEON. Additional workshops focused on computer networking and information technology. In FY 2003, funds were requested to initiate construction of two observatories. Major first-year milestones included competitions for observatories, and starting development of system architecture for the flow, integration and networking of data, communications and materials across NEON.

Major milestones for NEON are listed below.

FY 2003 Milestones:
- Program Announcement for establishment of two (2) observatories; and
- Competition for management – NEON Coordinating Unit (NCU).

FY 2004 Milestones:

Initiate construction of experimental, archival and analytical core facilities for first two NEON observatories;
Procure and install analytical instrumentation and research equipment;
Start development of system architecture for the flow, integration and networking of data, communications and materials across the fully operational NEON;
Establish NEON Coordinating Unit (NCU); and
Complete development and begin testing of system architecture for data, communication, and materials flow across NEON.

FY 2005 Milestones:

Finish construction of core facilities for the first two observatories (2);
Begin testing and begin implementation of networking and integration interfaces;
NCU begins to schedule time and allocates resources to user community;
Evaluation and refinement of NEON model sites;
Finalize Strategic Plan for Entire Network of sites; and
Program Announcement for establishment of additional sites.

FY 2006-08 Milestones:

Begin site preparation for construction of additional sites;
Continue implementation of networking and integration interfaces across the fully operational NEON sites;
Release Program Announcement to solicit proposals for research at NEON sites;
Procure and install analytical instrumentation and research equipment;
Complete construction of core facilities; and
Beta test core facilities.

Funding Profile: In FY 2003, NSF requested $12.0 million to establish two NEON observatories. In FY 2004, NSF is requesting $12.0 million to continue construction of the first two observatories. FY 2006-08 implementation funding will be contingent upon the outcome of the feasibility study of the NEON project and the successful review of the prototype NEON sites.

MREFC Appropriations for NEON
(Dollars in Millions)

FY 2003 Request	FY 2004 Request	FY 2005	FY 2006	FY 2007	FY 2008	Total
$12.00	$12.00	$16.00	$20.00	$20.00	$20.00	$100.00

NEON Funding Profile
(Dollars in Millions)

	Concept/ Development		Implementation		Operations & Maintenance		Totals		**Grand Total**
	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	
FY 1996 & Earlier									
FY 1997									
FY 1998	0.01						$0.01		**$0.01**
FY 1999	0.03						$0.03		**$0.03**
FY 2000	0.17						$0.17		**$0.17**
FY 2001	0.10						$0.10		**$0.10**
FY 2002	1.00						$1.00		**$1.00**
FY 2003 Req				12.00	3.00		$3.00	$12.00	**$15.00**
FY 2004 Req				12.00	6.00		$6.00	$12.00	**$18.00**
FY 2005 Est				16.00	6.00		$6.00	$16.00	**$22.00**
FY 2006 Est[1]				20.00	9.00		$9.00	$20.00	**$29.00**
FY 2007 Est[1]				20.00	12.00		$12.00	$20.00	**$32.00**
FY 2008Est[1]				20.00	15.00		$15.00	$20.00	**$35.00**
Subtotal, R&RA	$1.31				$51.00		$52.31		
Subtotal, MREFC				$100.00				$100.00	
Total, each phase		**$1.31**		**$100.00**		**$51.00**			**$152.31**

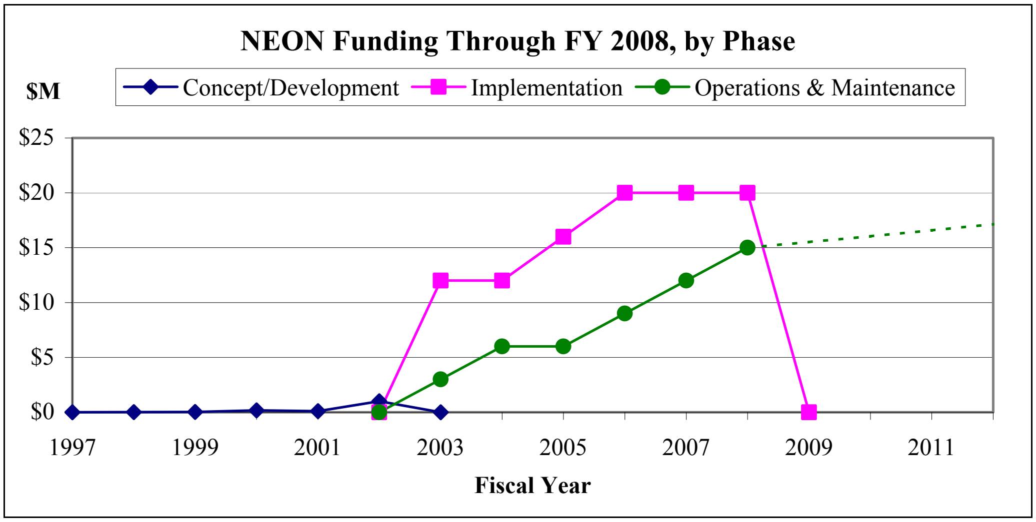
NOTE: A steady state of about $3.0 million per year in operations support per site is expected to occur on or about FY 2025. The expected operational lifespan of this project is 30 years, after construction of each site is completed.
[1]FY 2006-08 implementation funding will be contingent upon the outcome of the feasibility study of the NEON project and the successful review of the prototype NEON sites.

Information pertaining to the data in the table is provided below.

- *Concept/Development*: In FY2002 workshops were funded to specifically address the information technology needs, instrument array design and development, and data and information management architectures. In FY 2003, NSF will issue a call for proposals to establish two prototype NEON observatories. In FY 2004, the first two sites will begin construction.

- *Implementation*: Total construction costs for each site will be $20.0 million. NSF will continually evaluate the success of NEON and together with input from the community develop a strategic plan for the management of the NEON sites.

- *Operations and Maintenance*: NSF is requesting $6.0 million in FY 2004 through the R&RA account to support operation and management of the initial two sites. Initial operations will commence as construction is underway. It is anticipated that NSF will gradually increase funding to support the operations of these sites for the first few years as the network is established.



Future Science Support: Along with direct operations and maintenance support for NEON, NSF will support research performed at the facility through ongoing research and education programs. The annual support for such activities once the facility reaches full operations is estimated to be about $12.0 million.

It is estimated that 1,400 field biologists will use NEON annually. A larger number of scientists, students, resource managers and decision makers will make use of NEON data, both directly and indirectly, through the network capabilities and data distribution and sharing technologies via the network and the internet.

Polar Aircraft Upgrades

Project Description: This project was initiated to modify and upgrade three NSF-owned LC-130's to meet Air Force safety and operability standards that differ from those of the previous U.S. Navy operators. Modifications specified by the Air Force include avionics, airframe, safety, propulsion, and record data; storage and project administration costs are also included. Ski-equipped LC-130 aircraft are the backbone of the U.S. Antarctic Program's air transport system and also support NSF's research in the Arctic. In order to support the Foundation's polar missions, a fleet of ten aircraft is required. In addition to the three aircraft undergoing modification, the Air National Guard has six LC-130's and also flies one NSF-owned aircraft, recently acquired; these seven aircraft already meet the Air Force standards. In parallel with the MREFC project, but funded out of Research and Related Activities, the contract provided for taking care of routine maintenance required on all three aircraft.

Principal Scientific and Education Goals: Support polar research and education by providing necessary air logistics.

Connections to Industry: L3 (formerly Raytheon) and approximately 240 subcontractors for supplies and technical services.

Management and Oversight: The contract for the modifications was awarded and is administered by the Air Force C-130 Systems Program Office at Robins Air Force Base (Warner Robins, GA), which is the government's C-130 engineering authority office. NSF's Office of Polar Programs (OPP) and Division of Acquisition and Cost Support (DACS) provided input during development of the Request for Proposals in an effort to ensure NSF requirements were met. OPP and DACS work as a team with the C-130 Systems Program Office project managers to approve, fund, and track the progress of the work in an effort to ensure the modifications are completed on schedule.

Current Project Status: Completion is defined technically as acceptance by the government. The Defense Contracting Management Agency (DCMA) has this responsibility. This is followed by post-acceptance functional flight checks and subsequent testing by the 109th Air Wing in New York to assume operational readiness.

Aircraft 3301: The modification of aircraft 3301 was scheduled to be completed in FY 2000, but was delayed because the contractor's original schedule for completion apparently did not realistically account for the complexity of the modifications or for the difficulty in obtaining certain critical parts. 3301 was accepted by the government (DCMA) in FY 2001 and flown to New York. One of the tasks identified by the Air Force for this aircraft was re-winging. During post-delivery inspections by the 109th, the new wings were subsequently found to be corroded and therefore the aircraft was flown back to Waco, Texas, so that this defect could be corrected. This aircraft was finally delivered to the government in January, 2002.

Aircraft 3300 and 3302: These two aircraft were originally scheduled to be completed in FY 2001. Both were accepted by DCMA on behalf of the government and have undergone the post-acceptance inspections. The aircraft modifications were completed in June 2002 for 3300 and July 2002 for 3302. Subsequent inspections of 3300 and 3302 revealed the requirement to re-wing both aircraft in the next planned depot maintenance. This re-winging is being undertaken as part of the maintenance tasking, rather than part of the MREFC project.

Following acceptance by the Defense Contracts Management Agency as the agent for the government, the Air National Guard identified deficiencies with all three aircraft that require additional work to be completed before the aircraft can be put into service; that work is ongoing.

Funding Profile: In FY 1998, in order to meet firm Air Force scheduling requirements, $4.30 million was provided for early engineering design. A total of $32.0 million was appropriated for this project in FY 1999 and FY 2000. A cost-to-complete analysis in 2002 indicated an additional $885,000 was required to complete the project. In order to fund the additional project costs and keep the project moving forward, NSF sought and received Congressional approval to reprogram up to $1.0 million from South Pole Station Modernization, another MREFC project, to the Polar Support Aircraft Upgrade project.

Appropriated and Requested Funds for Polar MREFC Projects[1]
(Dollars in Millions)

	FY 97 Approp	FY 98 Approp	FY 99 Approp	FY 00 Approp	FY 01 Approp	FY 02 Approp	FY 03 Request	FY 04 Request	Total
South Pole Safety and Environment	$25.00					$0.50			$25.50
South Pole Station Modernization		$70.00	$39.00	$5.40	$12.59	-$0.50	$6.00	$0.96	$133.44
Polar Support Aircraft Upgrades			$20.00	$12.00	$0.89				$32.89

[1]In FY 2001, SPSM received an appropriation of $13.50 million, of which $20,000 was rescinded. Of the remaining $13.48 million, NSF was authorized to redirect up to $1.0 million to the Polar Support Aircraft Upgrades project in FY 2002. The table reflects that $885,000 of this authorized redirection of funds has been redirected and obligated for Polar Support Aircraft Upgrades. In addition, $500,000 was redirected from the unobligated authority for SPSM in FY 2002 to the South Pole Safety and Environment project to meet the revised cost estimate for that project.

Polar Support Aircraft Upgrades Funding Profile
(Dollars in Millions)

	Concept/ Development		Implementation		Operations & Maintenance		Totals		**Grand Total**
	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	
FY 1994 & Earlier									
FY 1995									
FY 1996									
FY 1997									
FY 1998	4.30						$4.30		**$4.30**
FY 1999		2.90		17.10				$20.00	**$20.00**
FY 2000				12.00				$12.00	**$12.00**
FY 2001									
FY 2002				0.89				$0.89	**$0.89**
Subtotal, R&RA	$4.30						$4.30		
Subtotal, MREFC		$2.90		$29.99				$32.89	
Total, each phase		**$7.20**		**$29.99**					**$37.19**

Information pertaining to the data in the table is provided below.

- _Concept/Development_: This project was given very high priority due to the Air Force requirement to upgrade the aircraft. In order to move the project forward promptly, some non-recurring engineering costs were funded by the Office of Polar Programs through the R&RA Account in FY 1998.

- _Implementation_: Supports upgrade of avionics, airframe, safety, propulsion, data, storage, and project administration. In planning for the MREFC project, the Air Force identified one plane that required rewinging; during subsequent inspections associated with the conversion, it was found that the remaining two aircraft also require re-winging. This is being performed under the maintenance tasking and funded out of the Research and Related Activities Account.

- _Operations and Maintenance_: These aircraft are part of a fleet that undergoes routine maintenance, but there are no known additional operating costs for these three aircraft as a result of this project. Routine upgrades and maintenance, funded out of the Research and Related Activities Account, have been undertaken while the aircraft were being reconfigured, as noted above. The lifetime of the aircraft is virtually unlimited with routine maintenance and periodic upgrades, obsolescence being dictated by avionics rather than airframe limitations.

South Pole Station

Project Description: South Pole Station Modernization (SPSM) will provide a new station to replace the current U.S. station at the South Pole, built 30 years ago and currently inadequate in terms of capacity, efficiency, and safety. The new station will be an elevated complex with two connected buildings, supporting 150 people in the summer, and 50 people in the winter.

Principal Scientific Goals: Support science at the South Pole and maintain U.S. presence at the South Pole in accord with U.S. policy.

Principal Education Goals: Support education associated with the research projects at the South Pole.

Connections to Industry: SPSM's primary connection to industry is through the Raytheon Polar Services Company (RPSC), the U.S. Antarctic Program support contractor. In addition, there are approximately 385 separate subcontractors for supplies and technical services.

Management and Oversight: The Office of Polar Programs (OPP) has the overall management responsibility for SPSM, including development of the basic requirements, design, procurement and construction. OPP has contracted for procurement and construction management for all phases of the project, including design reviews of all drawings and specifications; conformance of the designs and procurements with established standardization criteria; assistance in establishing functional interfaces; transition from the existing to the new facilities; and systems integration. Naval Facilities Engineering Command, Pacific Division (PACDIV) selects, monitors, and manages architectural and engineering firms for design, post-construction services, and construction inspection for the project. The project status, including cost expenditures and cost projections, is monitored on a periodic basis by OPP and the project's Project Advisory Team with members from OPP and the Office of Budget, Finance and Award Management.

Current Project Status: The original estimate for SPSM was $127.90 million. A change in project scope was recently proposed to increase station capacity from 110 people to 150 people, following formal approval by the National Science Board. The current cost estimate for SPSM is $133.44 million, including increased scope (+$2.52 million) and revised cost estimates (+$3.02 million), the latter caused primarily by weather-induced schedule delays. The cost estimate is updated annually. The next cost-to-complete estimate will be completed in August 2003.

The original estimated completion date was FY 2005. With the changes in scope and schedule, the new estimated completion date is FY 2007. The revised milestones for the project, taking into account the revised scope and changes in schedule, are below. The original milestones from FY 1998, when different, are in parentheses.

Activity	**Procurement**	**Transport to Antarctica**	**Airlift to South Pole**	**Start Construction**	**Conditional Acceptance**
Vertical Circular Tower	FY98	FY99	FY99/00 (00)	FY00 (01)	FY02
Quarters/Galley	FY98	FY99	FY00/FY01	FY01 (02)	FY03
Sewer Outfall	FY98	FY99	FY00	FY01	FY02 (01)
Fuel Storage (100K gallons)	FY98	FY98	FY99	FY99	FY99
Medical/Science	FY99 (98)	FY00 (99)	FY01/02 (00)	FY02	FY04
Communications/Administration	FY99 (98/99)	FY01 (00)	FY02/03 (01)	FY03 (02)	FY05 (03)
Dark Sector Lab	FY98	FY99	FY99/00 (00)	FY00 (01)	FY04 (01)
Water Well	FY00 (98)	FY01 (99)	FY01/02 (00)	FY02 (01)	FY02
Remote RF Building	FY99 (98/99)	FY00	FY01	FY01 (02)	FY01 (03)
Emergency Power/Quarters	FY99	FY01	FY02/03 (01/02)	FY03	FY05
Liquid nitrogen and helium facility	FY02 (99)	FY03 (00)	FY04 (01)	FY04 (02)	FY04 (03)
Quarters/Multipurpose	FY99 (00)	FY02 (01)	FY04 (02/03)	FY05	FY06
Electronic Systems and Communications	FY00/03 (99/00)	FY01/04 (00/01)	FY01/05 (01/02)	FY01 (03)	FY06 (04)
Warehousing, SEH and Waste Management	FY99 (01)	FY02/03 (02)	FY04 (03)	FY06 (04)	FY07 (05)
Station Equipment	FY02/03 (01)	FY03/04 (03)	FY04/05 (04)		FY05

Funding Profile: SPSM has received appropriations totaling $127.90 million through FY 2002 (see table and footnote below). The FY 2003 Request includes $6.0 million and the FY 2004 Request includes $955,000 for the change in scope, the revised schedule estimates, and partial reimbursement of redirected funds. The table below indicates the amounts appropriated for projects related to Polar MREFC projects and describes the redirection of funds.

Appropriated and Requested Funds for Polar MREFC Projects[1]
(Dollars in Millions)

	FY 97 Approp	FY 98 Approp	FY 99 Approp	FY 00 Approp	FY 01 Approp	FY 02 Approp	FY 03 Request	FY 04 Request	Total
South Pole Safety and Environment	$25.00					$0.50			$25.50
South Pole Station Modernization		$70.00	$39.00	$5.40	$12.59	-$0.50	$6.00	$0.96	$133.44
Polar Support Aircraft Upgrades			$20.00	$12.00	$0.89				$32.89

[1]In FY 2001, SPSM received an appropriation of $13.50 million, of which $20,000 was rescinded. Of the remaining $13.48 million, NSF was authorized to redirect up to $1.0 million to the Polar Support Aircraft Upgrades project in FY 2002. The table reflects that $885,000 of this authorized redirection of funds has been redirected and obligated for Polar Support Aircraft Upgrades. In addition, $500,000 was redirected from the unobligated authority for SPSM in FY 2002 to the South Pole Safety and Environment project to meet the revised cost estimate for that project.

The advance funding made possible advance bulk buys of materials, which is ultimately more cost-efficient. However, this project’s overall outlay is relatively slow due to the unusual logistics and shortened Antarctic season. As a result, the project has carried over fairly significant amounts each year since FY 1998, resulting in obligations from FY 1998 through FY 2001 that are significantly lower than appropriated amounts.

The following funding profile chart includes actual obligations for past years and anticipated obligations for future years.

South Pole Station Modernization Funding Profile
(Dollars in Millions)

	Concept/ Development		Implementation		Operations & Maintenance		Totals		Grand
	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	**Total**
FY 1994 & Earlier	12.90						$12.90		**$12.90**
FY 1995	1.10						$1.10		**$1.10**
FY 1996	1.60						$1.60		**$1.60**
FY 1997	0.80						$0.80		**$0.80**
FY 1998				24.93				$24.93	**$24.93**
FY 1999				4.28				$4.28	**$4.28**
FY 2000				15.49				$15.49	**$15.49**
FY 2001				10.14				$10.14	**$10.14**
FY 2002				15.55				$15.55	**$15.55**
FY 2003 Req				22.00				$22.00	**$22.00**
FY 2004 Req				20.00				$20.00	**$20.00**
FY 2005 Est				15.00				$15.00	**$15.00**
FY 2006 Est				5.00				$5.00	**$5.00**
FY 2007 Est				1.04	15.00		$15.00	$1.04	**$16.04**
Subtotal, R&RA	$16.40				$15.00		$31.40		
Subtotal, MREFC				$133.44				$133.44	
Total, each phase		**$16.40**		**$133.44**		**$15.00**			**$164.84**

NOTE: A steady state of operational support is anticipated at $15 million by FY 2007, slightly higher than current operational costs. The expected lifetime of the modernized station is 25 years, through FY 2031.

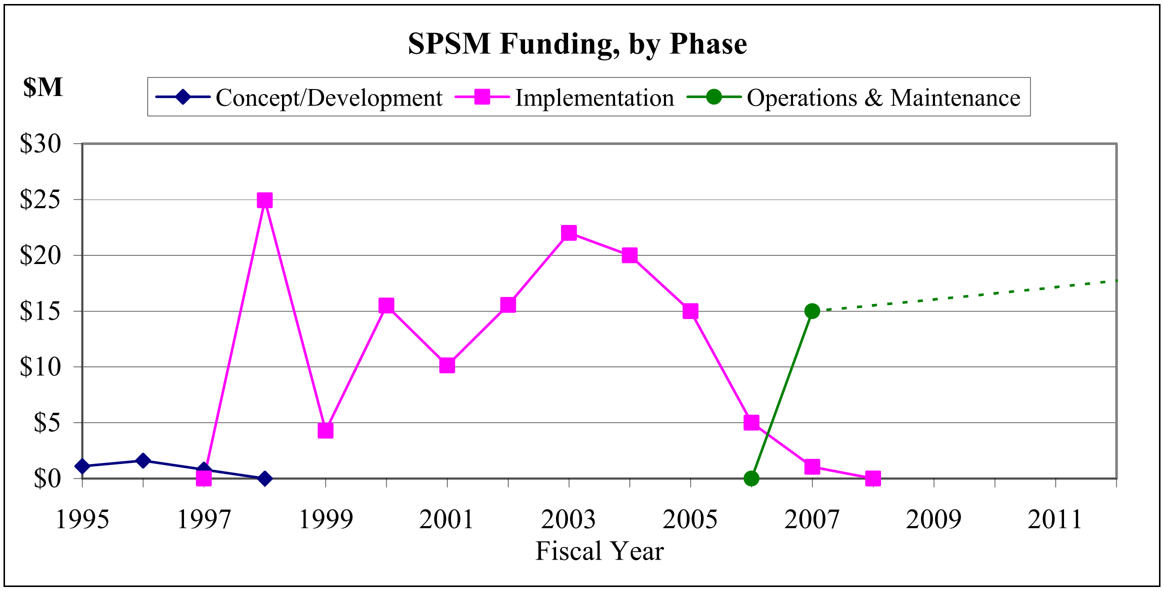
Information on the data in the table is provided below.

- *Concept/Development*: Design, development, planning and closely related activities in support of this project included preparation of more than 40 engineering studies and reports. The documents ranged widely in subject matter including subjects such as snowdrift minimization modeling, detailed analysis of power and heating requirements, preparation of a draft Environmental Impact Statement, energy conservation measures, efficiency and maintainability of diesel generators, fuel storage support system evaluation, design code criteria matrix, concept for signal/communication systems, gray-water system evaluation, minimization of ventilation requirements, control of diesel engine exhaust emissions, and jacking plan and concept.

- *Implementation*: Funding supports construction of an elevated station complex with two connected buildings, supporting 150 science and support personnel in the Austral summer, and 50 science and support personnel in the winter. Costs include materials, labor, logistics for transportation of all material and personnel to the South Pole, construction support, inspection, and equipment, as well as demolition and disposal of the existing station.

- *Operations and Maintenance*: This support represents the continued presence of a U.S. station at South Pole, not new funds. On balance, operation costs of the modernized station are expected to be similar to the former station, with some lower costs due to efficiencies gained, and some possible higher costs due to increased station size and increases in Science Support and Information Systems.

These estimates are currently being reviewed to improve accuracy, taking into account estimated station population and cargo loads.



Future Science Support: Along with direct operations and maintenance support for South Pole Station, NSF will support science and engineering research through ongoing research and education programs. The annual support for such activities is currently estimated to be approximately $8.3 million.

Terascale Computing Systems: Terascale Computing System, Distributed Terascale Facility and Extensible Terascale Facility

Project Description: The NSF Terascale Computing Systems project will provide access to scalable, balanced, terascale computing resources for the broad-based academic science and engineering community served by NSF. A Terascale Computing System (TCS), with peak performance of 6 teraflops, has been built by the Pittsburgh Supercomputer Center (PSC) in partnership with the Compaq Computer Corporation under an award made in FY 2000.

A Distributed Terascale Facility (DTF), initiated in FY 2001, is under construction by The National Center for Supercomputing Applications (NCSA) and the San Diego Supercomputer Center (SDSC), with Argonne National Laboratory (Argonne) and the California Institute of Technology (Caltech), and in partnership with IBM, Intel, Qwest, Oracle and SUN. Based on multiple Linux clusters, DTF will link four sites through high-performance networks to create a very high-performance, distributed facility that allows advanced data handling, remote site interaction, and large-scale storage. Initial operation of the Distributed Terascale Facility will begin in 2003.

In 2002 NSF provided enhancements to the existing Terascale Facilities and initiated the creation of an Extensible Terascale Facility (ETF) by extending the DTF "backbone network" to TCS, and by placing extensible hubs in Chicago and Los Angeles that will permit further expansion of this distributed facility. This ETF "backplane network" will enable science and engineering researchers to conduct analyses at unprecedented scale, to merge multiple data resources seamlessly, and to advance discovery at the frontiers of science and engineering. This Extensible Terascale Facility will provide the national community with at least 10 teraflops of capability in a single system (NCSA) and over 20 teraflops across the ETF including the 6 teraflop TCS system. Users will have access to at least 500 terabyte of storage at a single site (SDSC) and nearly 1 petabyte across the ETF.

Principle Scientific Goals: To provide state-of-the-art capabilities for simulation and modeling of a vast array of scientific, engineering and mathematical problems in traditional disciplines like physics, chemistry, geosciences, and engineering, as well as in disciplines such as biology and the social and economic sciences, where computing is emerging as a critical new tool. A secondary goal made possible by the distributed architecture of ETF is to seamlessly link large, managed scientific data archives and the high-performance computational resources that can be used to mine, analyze, visualize, and perform related simulations on the data.

Principal Education Goals: The primary education goals are twofold: 1) to provide access and training to U.S. students, graduate students, and postdocs in the use and applications of high-performance computing hardware and software; and 2) to insure that there is a highly-trained scientific workforce with experience in applying state-of-the-art supercomputer technology to basic research problems of national importance in all areas of science and engineering.

Partnerships and Connections to Industry: Several industries are partners in the construction of TCS, DTF, and ETF. Primary industrial partners include Hewlett Packard, IBM, Intel, Qwest, SUN, and Oracle.

Management and Oversight: Oversight of this project is provided through a Program Manager in the Advanced Computational Infrastructure and Research Subactivity in the Computer and Information Science and Engineering (CISE) Activity. Oversight is supported by the NSF Project Advisory Team consisting of representatives from the Office of General Counsel, the Office of Budget, Finance and Award Management, CISE, the Education and Human Resources Account and the Biological Sciences, Geosciences, Mathematical and Physical Sciences, and Engineering Activities. An external Technical Advisory Panel makes periodic site visits to the Terascale facility institutions to review construction progress and provide technical advice to the Program Manager. The Technical Advisory Panel participates in resolution of major technical, managerial, or scheduling concerns; provides technical guidance/advice, especially with regard to the integration and coordination with other NSF Partnerships for Advanced Computational Infrastructure (PACI) program activities; and reviews and, where required, approves technical reports and information to be delivered by Awardee.

The DTF and ETF Terascale Activities have a centralized management organization with a single Project Director. An executive committee, comprised of the Principal Investigators who participated in the Terascale awards, advises the Project Director on the construction, management and operation of the Terascale facilities. Also reporting to the Project Director are an External Advisory Committee, an Institutional Oversight Committee, and a User Advisory Committee.

Current Project Status: TCS was dedicated on October 29, 2001. It began allocated usage in April 2002. The first stage of DTF will be completed in June of 2003, and begin allocated usage in October 2003. ETF construction will be completed by the end of FY 2003, and allocated usage will begin in April of 2004.

Milestones for the Terascale Computing Systems are outlined below:

FY 2002 Milestones (Completed except as noted):

Terascale Computing System

Begin full operations of TCS (initial site – 2nd quarter).

Distributed Terascale Facility:

Begin construction of DTF (second site – 1st quarter);

Complete infrastructure preparation at four DTF sites (power, cabinets, air conditioning – 2nd quarter);

Contract for High Performance Network connections between Chicago and Los Angeles (2nd quarter);

Take delivery of backplane networks (3rd quarter); and

Take delivery of initial DTF cluster computers (4th quarter – Completed in 1st quarter FY 2003).

Extensible Terascale Facility:

Review and award supplements to TCS and DTF awardees for hardware and networking upgrades to fully integrate them with DTF backplane, and to create an Extensible Terascale Facility (ETF); (4th quarter) and

Hold workshop for additional sites that are interested in connecting to ETF.

FY 2003 Milestones:

Terascale Computing System:

Install TCS computing, storage and networking upgrades awarded for integration of TCS into ETF (2nd quarter).

Distributed Terascale Facility:

Complete installation and testing of initial clusters and DTF backplane networks (1st quarter);

Installation and testing of High Performance Network connections (1st quarter);

Complete installation and testing of operating software (OS, middleware, Globus) (2nd quarter);

Complete construction and integration of all DTF clusters (3rd quarter); and

Conduct performance testing on DTF (4th quarter).

Extensible Terascale Facility:

Install Hub Routers in Chicago and Los Angeles (1st quarter);

Complete high speed connection between Chicago and the Pittsburgh Supercomputing Center (2nd quarter);

Install computing and storage upgrades at all 5 ETF sites (3rd quarter);

Complete integration of TCS with DTF (4th quarter); and

Competition to extend ETF to additional sites (2nd quarter).

FY 2004 Milestones:

Terascale Computing System:

Continue full operations.

Distributed Terascale Facility:

DTF construction completed; acceptance and friendly user testing starts (1st quarter); and

DTF enters production use (2nd quarter).

Extensible Terascale Facility:

Full integration of all 5 sites into ETF including ETF hardware upgrades (1st quarter);

Begin Allocated usage of ETF (2nd quarter); and

Begin integration of additional sites into ETF (3rd quarter).

Funding Profile: The recommendation to fund ETF in FY 2002 was presented at the National Science Board meeting in August, 2002. In order to make certain that all questions raised during the review had been addressed and responded to in writing, the NSB postponed approval of the award to the next meeting, scheduled for October, 2002, which resulted in a carryover of funds into FY 2003. The NSB approved the award at their October meeting, and the funds have subsequently been obligated. The FY 2003 Request includes $20.0 million to extend ETF to additional resource sites that may include: additional computational resources; large data archives; large instrumentation facilities; or large sensor networks.

MREFC Appropriations for Terascale Computing Systems
(Dollars in Millions)

FY 2000	FY 2001	FY 2002	FY 2003 Request	Total
$36.00	$44.90	$35.00	$20.00	$135.90

Terascale Computing Systems Funding Profile
(Dollars in Millions)

	Concept/ Development		Implementation		Operations & Maintenance		Totals		Grand
	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	Total
FY 1997 & Earlier									
FY 1998	0.06						$0.06		0.06
FY 1999									
FY 2000				36.00				$36.00	36.00
FY 2001				44.90	2.37		$2.37	$44.90	47.27
FY 2002[1]					7.06		$7.06		7.06
FY 2003				55.00	7.00		$7.00	$55.00	62.00
FY 2004 Req					7.00		$7.00		7.00
FY 2005 Est					11.00		$11.00		11.00
FY 2006 Est									
FY 2007 Est									
Subtotal, R&RA	$0.06				$34.43		$34.49		$34.49
Subtotal, MREFC				$135.90				$135.90	$135.90
Total, Each Phase		**$0.06**		**$135.90**		**$34.43**			**$170.39**

NOTE: A strategic plan for the long-term support of NSF's Terascale Facilities for FY 2005 and beyond is currently under development, and will be presented to the National Science Board for consideration.
[1]FY 2002 funding for Terascale was carried over into FY 2003 due to the NSB meeting schedule. The award was approved in October, 2002 and the funds have been obligated.

Information pertaining to the data in the table is provided below.

- *Concept/Development*: Planning for Terascale Computing Systems began in 1998, with a series of 3 workshops held at NSF to assess the need within the academic research community for computational resources with multi-teraflop capability. Because it was anticipated that Terascale Computing Systems would be constructed by partnerships involving academic institutions and commodity hardware vendors, NSF employed a peer-reviewed, competitive solicitation process in FY 2000 and 2001 to select the best designed systems for funding. In FY 2002 the original systems have been upgraded, and funding for the extension of DTF to form the ETF was provided. In FY 2003 ETF will be extended by integrating additional sites into it.

- *Implementation*: TCS was funded at Pittsburgh Supercomputer Center in FY 2000. It was fully operational in first quarter of 2002. DTF was funded at UCSD and NCSA in FY 2001. Construction will continue through FY 2003. Funds in FY 2002 will enhance and augment TCS and DTF, fully integrate TCS and DTF into a single grid-enabled facility, and enable the DTF to extend beyond the five initial sites. Funds in FY 2003 will support connections of new nodes, and upgrades as called for by rapid advances in computing technologies and systems.

- *Management and Operations*: The Terascale facilities incurred operations costs of approximately $7 million in FY 2002. Estimated operations costs are $7.0 million in FY 2003, $7.0 million in FY 2004, and thereafter $11.0 million annually, excluding inflation. The increase does not include funding for equipment upgrades. A long-term strategic plan for the maintenance and operations of the Terascale facilities beyond FY 2004, as a component of the NSF's cyberinfrastructure focus, is currently in preparation and will be submitted for National Science Board approval in 2003.

Future Science Support: Along with the direct operations and maintenance support for Terascale Computing Systems facilities, NSF will support science and engineering research performed at the facilities, through ongoing research and education programs. Terascale Facilities provide support for scientists and engineers funded through all programs supported by the NSF. The annual support for research and education using the Terascale facilities is estimated to be about $160.0 million.

SECOND PRIORITY: NEW STARTS IN FY 2005 AND FY 2006

Scientific Ocean Drilling

Project Description: Requested in FY 2005, this project is to support the conversion, outfitting and acceptance trials of a deep-sea drilling vessel for use in a new international scientific ocean drilling program. The Integrated Ocean Drilling Program (IODP), starting in FY 2004, builds on the long track record of success of the Ocean Drilling Program which, as planned, is being phased out at the end of 2003. Commercial drillships are not configured or routinely equipped to meet the requirements for scientific research. To support the IODP, a new vessel is needed; it is planned as a year-around operations platform that will be capable of operating in all ocean environments and that will accommodate a scientific and technical staff of approximately 50. A competitive procurement will be used to select the organization to contract, convert and operate the vessel. Further information on IODP can be found in the Tools section.

Principal Scientific Goals: The converted drillship will provide the United States facility contribution to the Integrated Ocean Drilling Program. The IODP is co-led by the NSF and the Ministry of Education, Culture, Sport, Science and Technology (MEXT) of Japan. European and Asian nations are also participating in the program. The IODP will recover sediment and crustal rock from the seafloor using scientific ocean drilling techniques, and emplace observatories in drillholes to study the deep biosphere, the flow of fluids in sediments and the crust, the processes and effects of environmental change, and solid earth cycles and geodynamics. MEXT will provide a heavy drillship for deep drilling objectives of the programs. NSF will provide a light drillship and science support services for high-resolution studies of environmental and climate change, observatory and biosphere objectives.

Principal Education Goals: To engage students and the public in geoscience discovery through distance learning initiatives, preparation of classroom modules on IODP research initiatives, and outreach displays at museums and educational/teaching institutions.

Management and Oversight: The project is managed and overseen by a project manager in the Division of Ocean Sciences in the Directorate for Geosciences (GEO). The project manager receives advice and oversight support from a NSF Project Advisory Team, which consists of representatives from GEO, the Office of Polar Programs (OPP), the Office of Budget, Finance and Award Management, and the Office of General Counsel. A scientific-user-community advisory committee has been established to provide recommendations and advice to the contractor and NSF on vessel conversion planning.

Current Project Status: Planning has been completed for the science program, operations and international organizational arrangements for the IODP. Japan has launched and is now outfitting its drilling vessel. The U.S. scientific community has identified the vessel, drilling and laboratory requirements for the NSF drillship. NSF expects to release an RFP for the drillship and operator in FY 2003, with vessel conversion/trials in FY 2005/2006 and scientific drilling operations commencing in FY 2006.

The construction schedule for this project is still under review and discussion. The milestones listed below are preliminary and will likely be revised as the project's schedule is finalized.

FY 2003 Milestones:
- Complete RFP documentation (completed-1st quarter);
- NSB approval for RFP release (completed-1st quarter);
- Issue RFP (2nd quarter);
- Proposals submitted (2nd quarter);
- Proposal evaluation-selection (2nd-3rd quarters);
- Award contract for support of U.S. efforts associated with operational aspects of U.S. participation in the IODP (4th quarter); and
- Initiate development of Project Execution plan (4th quarter).

FY 2004 Milestones:
- Contractor planning/vessel design (1st-2nd quarter);
- MREFC Project Execution plan approved (2nd quarter); and
- Vessel selection (2nd-4th quarters).

FY 2005 Milestones:
- Vessel conversion/outfitting (1st-4th quarters).

FY 2006 Milestones:
- Vessel acceptance trials (1st quarter); and
- Vessel scientific operations begin (2nd quarter).

Funding Profile: Planning through FY 2002 has cost approximately $600,000. In 2003 and 2004, approximately $4.20 million will be provided to initiate contract activity, planning and design. In FY 2005 and FY 2006, $99.85 million of funds from the MREFC account will be required for conversion/equipping/testing of the drillship.

Scientific Ocean Drilling Funding Profile
(Dollars in Millions)

	Concept/ Development		Implementation		Operations & Maintenance		Totals		Grand Total
	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	
FY 1999 & Earlier									
FY 2000	0.10						$0.10		**$0.10**
FY 2001	0.20						$0.20		**$0.20**
FY 2002	0.30						$0.30		**$0.30**
FY 2003 Req	2.10						$2.10		**$2.10**
FY 2004 Req	2.10				4.90		$7.00		**$7.00**
FY 2005 Est	0.50	4.00		72.85	6.50		$7.00	$76.85	**$83.85**
FY 2006 Est		1.00		22.00	32.70		$32.70	$23.00	**$55.70**
FY 2007 Est					53.00		$53.00		**$53.00**
FY 2008 Est					54.80		$54.80		**$54.80**
FY 2009 Est					56.67		$56.67		**$56.67**
FY 2010 Est					58.59		$58.59		**$58.59**
FY 2011 Est					60.58		$60.58		**$60.58**
FY 2012 Est					62.64		$62.64		**$62.64**
Subtotal, R&RA	$5.30				$390.39		$395.69		**$395.69**
Subtotal, MREFC		$5.00		$94.85				$99.85	**$99.85**
Total, each phase		**$10.30**		**$94.85**		**$390.39**			**$495.54**

NOTE: A steady state of about $53 million in operations support is expected to occur in or about FY 2007. The expected operational lifespan of this project is 15 years, beginning in FY 2006.

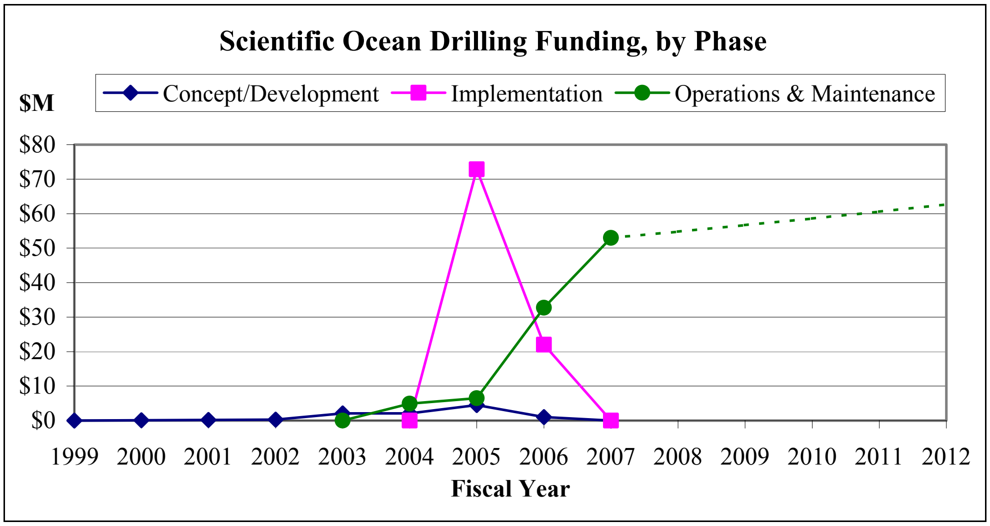
Information pertaining to the data in the table is provided below.

- *Concept/Development*: Activities supported by the R&RA Account will commence immediately upon contract award. This will include: efforts necessary to begin IODP planning in FY 2003 with Japanese partners and the scientific user community; development of the Project Execution Plan by the contractor; development of the Environmental Impact Statement for the non-riser drilling vessel; and initiation of planning for shorebased support of the program, including core storage, data management systems, and logistics.

  Several ship-specific planning activities will be undertaken utilizing MREFC support as soon as the ship to be converted is identified. These include: modification of the ship to provide laboratories for geochemical, geologic and biologic analysis of samples and data; improvements to ship habitability (accommodations, storage, etc.) for cruises of up to 2 months duration, since industry vessels generally operate in a mode where personnel are rotated on a 2 to 3 week cycle; and upgrade of the drilling-coring capability of the vessel.

- *Implementation*: The MREFC funds in FY 2005-06 will be required for the vessel conversion, including construction of laboratory and other scientific spaces, equipping of laboratories with instrumentation, computers and support equipment, and modifications to the drilling equipment of the contracted vessel. Funding is also required for vessel lease during modification and for sea-trial operations of approximately four months duration in FY 2006.

- *Operations and Maintenance:* Following conversion, the drillship will be managed, operated and maintained by the selected contractor (and subcontractors) with funding from the R&RA account, for use in the Integrated Ocean Drilling Program. Operations cost estimates are based on NSF experience in management of the IODP precursor, the Ocean Drilling Program. Specific missions will be reviewed and prioritized by a science advisory committee composed of representatives from IODP member nations. Significant coordination and integration of planning, procedures and operations will be required with Japanese operators of their drillship in the IODP.



Future Science Support: Along with direct operations and maintenance support for IODP, NSF will support research performed at the facility, through ongoing research and education programs. The annual support for such activities is estimated to be about $31 million.

Rare Symmetry Violating Processes (RSVP)

Project Description: A collaboration representing almost 30 institutions from the U.S., Canada, Switzerland, Italy, Japan and Russia submitted a proposal through New York University for RSVP in FY 2000. This project will address new physics at the cutting edge of the sensitivity frontier and represents an extraordinary opportunity to empower a large and growing community to make major discoveries. Two major experiments are to be pursued through this proposal: MECO (Muon to Electron Conversion) and KOPIO ($K^o_L \rightarrow \pi^o\ \nu\ \nu$-bar). These experiments will be performed at the DOE's Brookhaven National Laboratory (BNL) Alternating Gradient Synchrotron (AGS), which has the highest intensity in the world at the energies required for these experiments. The AGS is currently being used as an injector for the Relativistic Heavy Ion Collider (RHIC), for which it is needed only a few hours per day. MECO and KOPIO will extend the sensitivity of probes of rare symmetry violating processes by many orders of magnitude. At this level, the experiments have the opportunity to uncover fundamental new physics relating to the unexplained absence of anti-matter in the universe, and to the postulated existence of "supersymmetric particles" that existed in the early universe. The scale, both in cost and technical complexity, is set by the extraordinary sensitivity required to do this science. RSVP will, through an NSF/DOE memorandum of understanding, be an NSF-supported activity, running concurrently with

RHIC, and with the NSF funding only incremental operating costs. AGS "landlord responsibilities" rest with the DOE Nuclear Physics program.

Principal Scientific Goals: RSVP consists of two complementary experiments:

- MECO is a search for the conversion of muons to electrons and would be able to detect this process even if it is as rare as 1 event for 10^{17} detected muons. The goal is to understand better the family structure of leptons: why do there exist two extra, unstable heavy copies of the electron?
- KOPIO is a search for the decay of a neutral kaon (K^o_L) to a neutral pion, a neutrino and an anti-neutrino. The goal is to understand better a process called CP violation that is required to produce a Universe containing matter rather than a mixture of matter and anti-matter.

Principal Education Goals: RSVP is planning the PRINCIPLES Project, a mathematics, science and technology educational enrichment program for fourth grade teachers and students. BNL, SUNY/Stony Brook and other partners will establish an Elementary Teachers Academy at BNL. The keystone of the Academy will be an in-service seminar course at BNL for elementary school teachers that will address the teaching of MST through investigations or projects by elementary students - focusing on the fourth grade level. Objectives are to show teachers first-hand (1) how and what general principles underlie specific inquiry-based learning activities, and (2) how recourse to such principles can support use of observation and reasoning by their students as they learn. The ultimate goal is to improve student performance in assessments requiring use of these skills. In addition, the strong university makeup of the RSVP collaborations lends itself well to graduate student and postdoctoral educational opportunities. Each of the institutions will train graduate students and postdocs. They will receive a broad education in detector construction and operation and in data analysis and the interpretation of results. This opportunity is increasingly rare in particle physics, as most experiments are carried out by much larger collaborations.

Partnerships and Connections to Industry: RSVP will have strong connections to industry through instrument development and construction, but the specifics are not known at this time.

Management and Oversight: RSVP will be managed through the Physics (PHY) Subactivity in the Mathematics and Physical Sciences (MPS) Activity. One Program Officer within PHY will maintain primary oversight responsibility, with assistance from a Project Advisory Team composed of staff from MPS, the Office of Budget, Finance and Award Management, the Office of General Counsel and the Office of Legislative and Public Affairs. Additional staff may be required during construction, particularly staff trained in large project management principles. From 2000-02, NSF conducted cost, management, and scientific and technical reviews of RSVP. Each panel consisted of external reviewers, and each rated the project very highly. The management review indicated areas for improvement, which have since been implemented by the collaborators.

A comprehensive project management plan is in development and has been reviewed favorably, with minor improvements suggested. The collaboration has benefited from the rigorous and well-tested BNL methodology for the development, management, and oversight of large projects. The final version will include a Work Breakdown Structure detailing costs, schedule, milestones, oversight responsibilities, change control, and tracking. The plan includes experienced university-based project managers, a host laboratory role for BNL that involves environment, health and safety responsibilities for the entire project, and internal review procedures by the experimenters, by BNL, and by the NSF. A direct reporting path from the project manager to the NSF Physics Division is part of this plan, and NSF management and oversight includes periodic cost, schedule, and technical reviews of the project.

Current Project Status: R&D is continuing on critical project components and is expected to continue through FY 2006. RSVP's construction schedule is still under review and discussion. The milestones listed below are preliminary and will likely be revised as the project's schedule is finalized.

FY 2005 Milestone:
Complete magnet design

FY 2006 Milestones (Construction Start):
Complete AGS design modifications.
Deliver and integrate magnet coils

FY 2007 Milestones:
Complete detector component prototypes.
Complete construction of AGS beam

FY 2008 Milestones:
Start detector component production
Complete initial modules

FY 2009 Milestones:
Complete data acquisition system and trigger design
Deliver detector components
Complete magnet tests with installed detector elements

FY 2010 Milestones:
Perform engineering run
Complete construction

Funding Profile: Including FY 2003, $3.3 million has been spent for concept and development of RSVP through the R&RA Account. The total construction cost of the project is estimated at $144.91 million.

RSVP Funding Profile
(Dollars in Millions)

	Concept/ Development		Implementation		Operations & Maintenance		Totals		Grand Total
	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	
FY 2000 & Earlier									
FY 2001	0.90						$0.90		**$0.90**
FY 2002	1.20						$1.20		**$1.20**
FY 2003 Req	1.20						$1.20		**$1.20**
FY 2004 Req	1.50						$1.50		**$1.50**
FY 2005 Est	2.00						$2.00		**$2.00**
FY 2006 Est	2.00			30.00	5.30		$7.30	$30.00	**$37.30**
FY 2007 Est				42.66	8.50		$8.50	$42.66	**$51.16**
FY 2008 Est				44.00	8.50		$8.50	$44.00	**$52.50**
FY 2009 Est				20.25	13.50		$13.50	$20.25	**$33.75**
FY 2010 Est				8.00	14.30		$14.30	$8.00	**$22.30**
FY 2011 Est					14.80		$14.80		**$14.80**
Subtotal, R&RA	$8.80				$64.90		$73.70		**$73.70**
Subtotal, MREFC				$144.91				$144.91	**$144.91**
Total, Each Phase		**$8.80**		**$144.91**		**$64.90**			**$218.61**

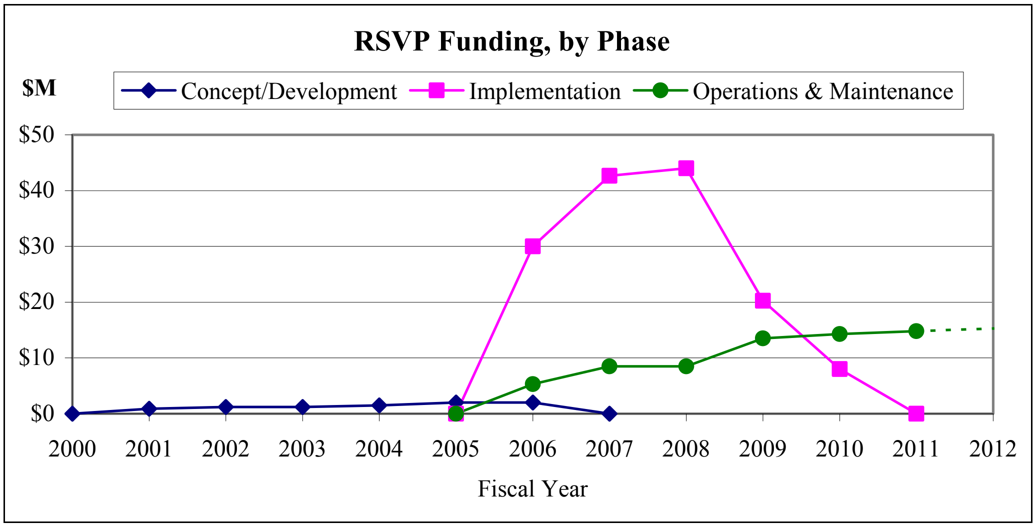
NOTE: NSF's share of operations support is expected to reach a level of effort of about $15.0 million by about FY 2011. The estimated operational lifespan of this project is approximately 20 years.

Information on the data in the table is provided below.

- *Concept/Development*: The technical needs of RSVP require a strong R&D program that is now in progress. In addition to R&D on all KOPIO and MECO components, a major component of MECO is a sequence of high-field, superconducting solenoids appropriately instrumented for particle detection and readout. These solenoids have very tight and challenging field requirements, and the MECO collaboration, with a group at the MIT Plasma Science & Fusion Center, has completed a detailed conceptual design of the magnet system that proves its feasibility and lays the groundwork for industrial production. KOPIO requires a low-energy, time-structured K^o beam, which allows a precise determination of the incident kaon momentum on an event-by-event basis using time-of-flight techniques. R&D is underway on the KOPIO Alternating Gradient Synchrotron (AGS) modifications that match the proposed Canadian contribution.

- *Implementation*: Funding during this phase of the project will provide support for the construction of two beamlines at the AGS and associated Beam instrumentation at the site. This work will be performed by BNL personnel. For the KOPIO detector, universities will construct the critical beam, catcher, radiator and veto counter assemblies. The MECO superconducting magnets will be constructed by industry after a conceptual design is complete, but MECO collimators, targets, beam stops, and calorimeters will be constructed at universities.

- *Operations and Maintenance*: Support for operations and management will phase in as the project is under construction. Initial funds provided through R&RA will support project managers for MECO and KOPIO and a project management office. Test beam operations can begin in FY 2007 and will ramp up as detector elements are completed. Full operations costs are expected to be approximately $15 million beginning in about FY 2010.



Future Science Support: Along with direct support for operations and maintenance, NSF will also support research performed at this facility, through ongoing research and education grants. Support for such activities is presently estimated to be about $4.0 million per year from NSF, once the facility reaches full operations.

Ocean Observatories Initiative (OOI)

Project Description: This project will construct an integrated observatory network that will provide the oceanographic research and education communities with continuous access to the ocean. The OOI will have three elements: 1) a regional cabled network consisting of interconnected sites on the seafloor spanning several geological and oceanographic features and processes, 2) several relocatable deep-sea buoys, and 3) an expanded network of coastal observatories, developed through new construction or enhancements to existing facilities. The primary infrastructure for all components of the OOI consists of an array of seafloor junction boxes connected to cables running along the seafloor to individual instruments or instrument clusters. Depending upon proximity to the coast and other engineering requirements, the junction box is either terminated by a long dedicated fiber-optic cable to shore, or by a shorter cable to a surface buoy that is capable of two-way communications with a shore station. The observatory infrastructure of the OOI will be operated as a shared-use facility with open community access to data.

Principal Scientific Goals: Scientific problems requiring OOI infrastructure are broad in scope and encompass nearly every area of ocean science. Once established, seafloor observatories will provide earth and ocean scientists with unique opportunities to study multiple, interrelated processes over timescales ranging from seconds to decades; to conduct comparative studies of regional processes and spatial characteristics; and to map whole-earth and basin scale structures. This project will establish facilities to meet the following goals: continuous observation at frequencies from seconds to decades; spatial scales of measurement from millimeters to kilometers; high power and bandwidth capabilities as well as two-way data transmission; an ability to operate during storms; an ability to accommodate plug and play sensors, instruments, and imaging systems; bottom-mounted winches for cycling instruments up and down the water column, either autonomously or on command; docking stations enabling autonomous underwater vehicles to download data and recharge batteries; ability to assimilate data into models and make three-dimensional forecasts of the oceanic environment; means for making data available in real time to researchers, schools, and the public over the Internet; and low cost relative to the cost of building and maintaining ships and manned submersible systems.

Principal Education Goals: Scientific discoveries arising from the OOI will provide new opportunities for ocean education and outreach through the capabilities for real-time data transmission and, particularly, real-time display of visual images from the seafloor. Educational links will be made with GEO's Digital Library for Earth Science Education (DLESE), and OCE's Centers for Ocean Science Education Excellence (COSEE). In addition, with the planned establishment of the National Integrated Ocean Observing System, there will be an unprecedented need for oceanographers skilled in the use and manipulation of large, oceanographic, time-series datasets. The facilities comprising the OOI will provide the ideal platforms to train this new generation of oceanographers.

Partnerships and Connections to Industry: Some of the component technologies that are part of the OOI are currently in use or in development as part of the telecommunication and exploration industries. These groups have been involved in conceptual design reviews of proposed OOI components and systems and will be important participants in the construction and implementation phase of the OOI.

Management and Oversight: The project will be managed and overseen by a program manager in the Ocean Sciences Subactivity in the Geosciences Activity. The program manager will receive advice and oversight support from an NSF Project Advisory Team that includes representatives from GEO, the Office of Budget, Finance and Award Management, the Office of International Science and Engineering, the Office of General Counsel, and the Office of Legislative and Public Affairs. The management structure proposed for the acquisition and implementation phase of the OOI is based on a structure that has been successfully used by the Ocean Drilling Program. In this structure, management, coordination, and oversight of the OOI will be the responsibility of the Executive Director of the OOI Program Office, to be established through a cooperative agreement with NSF. This Director will be accountable to an Executive Committee under which will be established Scientific and Technical Advisory Committees. The Executive and Advisory Committees will draw their membership from individuals with expertise in ocean observing science and engineering. Experiments utilizing OOI infrastructure will be selected on a peer-reviewed basis. This project will be coordinated with the National Integrated Ocean Observing System (IOOS) that will support operational mission objectives of agencies such as the National Oceanic and Atmospheric Administration (NOAA), Navy, the National Aeronautics and Space Administration (NASA), and the Coast Guard.

Current Project Status: Current activities are concentrating on the development of implementation plans for the three components of the OOI to facilitate the high priority science developed through community input. The first of these activities was a workshop organized through the Coastal Ocean Processes Program (May 2002) to provide advice on the use of observing infrastructure for advancing coastal science. The report was published in December 2002. Another community activity provided advice on the implementation of a network of regional cabled observatories as a result of a workshop held in August 2002. The report from this workshop will be published in January 2003. There is a third community activity underway to develop a plan for the deployment of a global network of moored buoy systems to facilitate multi-disciplinary science. The report of this group will be completed in Spring 2003. In addition to these activities, OCE has sponsored a National Research Council study to provide recommendations for an overall implementation plan for the OOI. The Dynamics of Earth and Ocean

Systems (DEOS) committee, made up of members of the academic research community, provides a focus for coordinated scientific planning and oversight of these activities.

The construction schedule for this project is still under review and discussion. The milestones listed below are preliminary and will likely be revised as the project's schedule is finalized.

FY 2002 Milestone:
- Establish NSF Program Management Team (3rd quarter 2002)

FY 2003 Milestones:
- Project Management
  - Complete Program Solicitation for the OOI Program Office (3rd quarter 2003)
  - Issue Program Solicitation (4th quarter 2003)

FY 2004 Milestones:
- Project Management
  - Proposals submitted (2nd quarter 2004)
  - Proposal evaluation and selection (3rd and 4th quarters 2004)

FY 2005 Milestones:
- Project Management
  - Issue award for Program Office (1st quarter 2005)

FY 2006 Milestones:
- Project Management
  - Design and implementation of data management and archiving system
- Coastal Observatories
  - Design of relocatable coastal observing infrastructure
  - Issue of a Program Solicitation for enhancements to current coastal observing infrastructure (1st quarter 2006)
- Deep-Sea Buoys
  - Design and testing of moored buoyed systems
- Regional Cabled Network
  - Cable-route surveys and planning
  - Final design, inspection and testing of cables, connectors, nodes, and shore equipment.

FY 2007 Milestones:
- Coastal Observatories
  - Construction and Testing of relocatable coastal observing infrastructure
  - Issue of a Program Solicitation for enhancements to current coastal observing infrastructure (1st quarter 2007)
- Deep-Sea Buoys
  - Design and testing of capabilities needed for buoy installation
- Regional Cabled Network
  - Physical (hardware and software) system integration and testing prior to deployment
  - Preparation of shore facilities and installation of equipment.

FY 2008 Milestones:
- Coastal Observatories
  - Construction and deployment of relocatable coastal observing infrastructure to be integrated into the OOI coastal observing system
  - Issue of a Program Solicitation for enhancements to current coastal observing infrastructure (1st quarter 2008)
- Deep-Sea Buoys
  - Construction and deployment of three moored buoyed systems
- Regional Cabled Network
  - Installation and subsequent inspection of first cable backbone section
  - Installation of science nodes on first backbone section

FY 2009 Milestones:
- Coastal Observatories
  - Construction and deployment of relocatable coastal observing infrastructure to be integrated into the OOI coastal observing system
  - Installation of a new coastal observational system
  - Issue of a Program Solicitation for enhancements to current coastal observing infrastructure (1st quarter 2009)
- Deep-Sea Buoys
  - Construction and deployment of six moored buoyed systems
- Regional Cabled Network
  - Testing and commissioning of first backbone section
  - Installation and subsequent inspection of second cable backbone section
  - Installation of science nodes on second backbone section
  - Installation of initial science experiments on first backbone section

FY 2010 Milestones:
- Coastal Observatories
  - Installation of two new coastal observational systems
  - Issue of a Program Solicitation for enhancements to current coastal observing infrastructure (1st quarter 2010)
- Deep-Sea Buoys
  - Construction and deployment of six moored buoyed systems
- Regional Cabled Network
  - System testing and commissioning
  - Installation of initial science experiments on second backbone section

Funding Profile: NSF expects to spend approximately $14.2 million in concept and development activities through FY 2003. An additional $1.3 million will be spent on such activities through FY 2005. The total construction cost for OOI is $208.81 million beginning in FY 2006. Management, operations and maintenance will be funded through the R&RA Account.

Ocean Observatories Initiative Funding Profile
(Dollars in Millions)

	Concept/ Development		Implementation		Operations & Maintenance		Totals		**Grand**
	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	R&RA	MREFC	**Total**
FY 2000 & Earlier							$0.00	$0.00	**$0.00**
FY 2001	1.60						$1.60	$0.00	**$1.60**
FY 2002	11.00						$11.00	$0.00	**$11.00**
FY 2003 Req	1.60						$1.60	$0.00	**$1.60**
FY 2004 Req	0.70						$0.70	$0.00	**$0.70**
FY 2005 Est	0.60						$0.60	$0.00	**$0.60**
FY 2006 Est				24.76	2.00		$2.00	$24.76	**$26.76**
FY 2007 Est				40.33	4.00		$4.00	$40.33	**$44.33**
FY 2008 Est				72.46	7.00		$7.00	$72.46	**$79.46**
FY 2009 Est				35.89	7.00		$7.00	$35.89	**$42.89**
FY 2010 Est				35.37	9.00		$9.00	$35.37	**$44.37**
FY 2011 Est					10.00		$10.00	$0.00	**$10.00**
FY 2012 Est					10.38		$10.38	$0.00	**$10.38**
Subtotal, R&RA	$15.50		$0.00		$49.38		$64.88		
Subtotal, MREFC		$0.00		$208.81		$0.00		$208.81	
Total, each phase		**$15.50**		**$208.81**		**$49.38**			**$273.69**

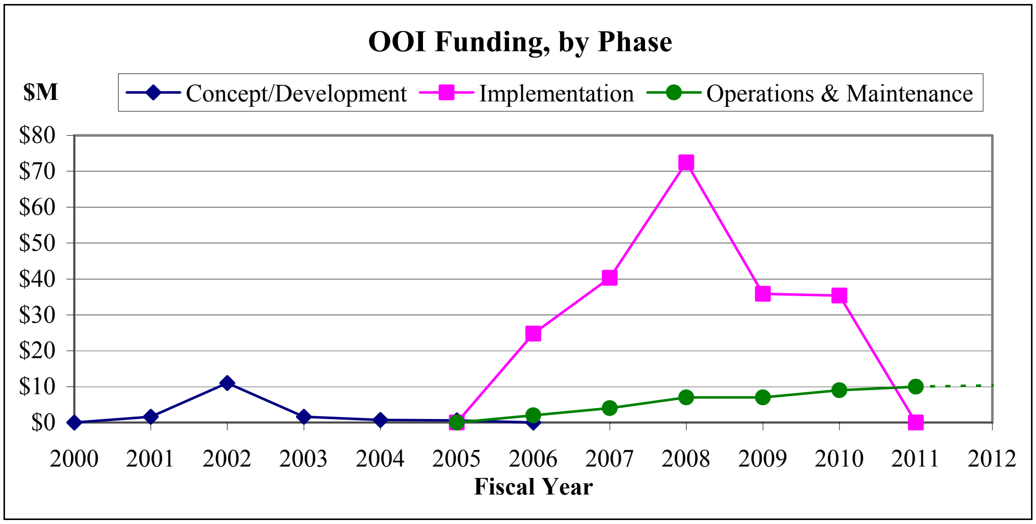
NOTE: A steady state of about $10 million in operations support is expected to occur in or about FY 2011. The expected operational lifespan of this project is 30 years, beginning in FY 2011.

Information pertaining to the data in the table is provided below.

- *Concept/Development:* R&RA funding has supported workshops to identify the observatory infrastructure needed to address the high priority science requiring time-series measurements. Specific design characteristics and platform requirements were developed through conceptual design reviews and best practices consultations with industry and academic experts. In FY 2002 an unsolicited proposal from the Monterey Bay Aquarium Research Institute resulted in a $6.9 million award to establish an advanced cabled observatory in Monterey Bay to both advance scientific goals as well as create a valuable systems and instrumentation testbed for potential future cabled ocean observing systems.

- *Implementation*: Funds requested for this phase will construct: a regional cabled network consisting of interconnected sites on the seafloor spanning several geological and oceanographic features and processes; several relocatable deep-sea buoys; and new construction or enhancements to existing facilities leading to an expanded network of coastal observatories.

- *Operations and Maintenance*: Access to OOI Infrastructure will be determined by peer review and all data will be openly accessible. OOI Infrastructure will be maintained and operated by the OOI Program Office. Future development of more complex sensor packages for the OOI infrastructure will be funded using R&RA funds within OCE. Observing platforms of the OOI will accommodate instrumentation from other agencies, international partners, as well as new instruments that are developed.



Future Science Support: Along with direct operations and maintenance support for the OOI, NSF will support research performed using this infrastructure through ongoing research and education programs. The annual support for such activities is estimated to be about $10.0 million, once the network is fully implemented.

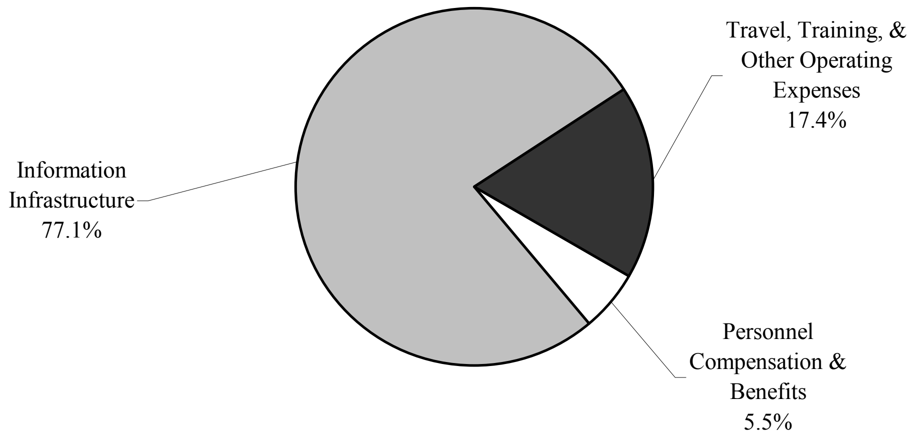
SALARIES AND EXPENSES

SALARIES AND EXPENSES $225,700,000

The FY 2004 Request for Salaries and Expenses (S&E) is $225.70 million, an increase of $22.75 million, or 11.2 percent, over the FY 2003 Request of $202.95 million. Adequate funding for Salaries and Expenses, particularly for Information Technology, is critical to the efficient operations of the agency. While NSF's overall budget has grown, and significant advances have been made through the use of innovative information technology, funding for infrastructure operating expenses has, until the FY 2003 Request, remained essentially flat. From FY 2000 to FY 2002, additional functional capability and applications were deployed, including the Financial Accounting System, the Integrated Payroll System, the Award System, and FastLane enhancements, with no commensurate investment in supporting infrastructure.

For information technology, the NSF FY 2004 Request includes funds to continue implementation of critical investments needed in government-wide initiatives, innovative next-generation electronic capabilities and tools, and supporting hardware, software, and tools necessary to manage and operate an infrastructure that can support NSF electronic business processes. The strategic framework for this investment is discussed in greater detail in the chapter on NSF's Administration and Management (A&M) portfolio. *Note that the Office of Inspector General is described in a separate section of the justification.*

Percent Distribution of S&E Increase Totaling $22.75 Million



This increase will support a focused set of overdue investments that foster NSF's continuing commitment to outstanding customer service:

- $17.54 million will support investments in the development, implementation, operation, and upgrade of NSF's information infrastructure, enable next generation eGovernment capabilities and improvements to information security and physical security through the use of "smart" technologies. IT investments account for 77.1 percent of the S&E increase.

- $3.96 million will support investments in staff development and training, as well as planning activities related to the President's Management Agenda, increasing rental costs for NSF's workspace, increases for travel and general operating expenses associated with NSF's programmatic responsibilities, and contractual costs for the Business Analysis and the

National Academy of Public Administration review. *Note that this is discussed in greater detail in the Administration and Management which is described in a separate section of the justification.* Travel, training and other general operating expenses account for 17.4 percent of the total S&E increase.

- $1.25 million will provide for 1,200 full-time equivalent (FTE). These salary-related items account for the remaining 5.5 percent of the total increase in S&E funding. This increase is for comparability and locality pay and costs related to employee benefits.

Salaries and Expenses Funding
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Personnel Compensation & Benefits	121.28	132.43	133.68	1.25	0.9%
General Operating Expenses:					
Information Infrastructure	16.39	25.19	42.73	17.54	69.6%
Travel, Training and Other	32.26	45.33	49.29	3.96	8.7%
Total, S&E	$169.93	$202.95	$225.70	$22.75	11.2%

Totals may not add due to rounding.

The S&E appropriation includes funds for staff salaries, benefits, travel, training, rent, advisory and assistance services, communications and utilities expenses, supplies, equipment, and other operating expenses necessary for management of the agency's research and education activities. The FY 2004 S&E Budget Request provides support for the following activities:

- Personnel Compensation and Benefits (PC&B): Resources in this category provide funding for salaries and benefits of federal employees. The FY 2004 PC&B request is $133.68 million, an increase of $1.25 million over the FY 2003 Request of $132.43 million. The FY 2003 Request includes funding for 17 FTE from programs proposed to transfer to NSF in FY 2003 that are not requested in FY 2004.

- General Operating Expenses (GOE): Resources in this category constitute the remainder of the S&E appropriation. GOE funds the entire range of operating expenses and travel that are necessary for the agency to administer its programs and safeguard its assets. GOE costs will increase from $70.52 million in FY 2003 by $21.50 million, or 30.5 percent, totaling $92.02 million in FY 2004. Within the total increase are: $17.54 million for Information Infrastructure, $1.16 million for Space Rental, $380,000 for Travel; and $2.42 million for Training and Other General Operating Expenses.

  Within the proposed GOE level, $42.73 million will provide the resources to improve the agency's information systems technology – enhance the information infrastructure, promote eGovernment, enhance customer service, improve security of information and information technology assets, improve physical security with new smart technology, and provide for increasing IT contractor costs.

Personnel Compensation and Benefits

The PC&B increase is $1.25 million in FY 2004. This relatively small increase is due to 17 fewer FTE in FY 2004 and to the pay raise assumptions used in FY 2003 and FY 2004. The FY 2004 Request for

PC&B includes a pay raise assumption of 2.0 percent, which is lower than the pay raise estimate included in the FY 2003 Request.

Personnel Compensation and Benefits Funding
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Personnel Compensation	99.77	109.35	110.40	1.05	1.0%
Personnel Benefits	21.51	23.08	23.28	0.20	0.9%
Total, PC&B	$121.28	$132.43	$133.68	$1.25	0.9%
Full-time Equivalent	1,188	1,217	1,200	-17	-1.4%

Totals may not add due to rounding.

Workforce

The NSF FY 2004 total workforce is shown on the following table. The small reduction in the NSF staff from 1,217 in FY 2003 to 1,200 in FY 2004 is due to the employees associated with the programs that were proposed for transfer to NSF in the FY 2003 Request. The base NSF staffing level will remain constant between FY 2003 and FY 2004.

About 41 percent of the NSF workforce consists of scientists and engineers directly involved in the processing and management of awards; business operations support personnel account for about 36 percent of the workforce; and program support personnel account for most of the remaining 23 percent of the base NSF workforce. In the past ten years, the workforce composition has changed to a higher proportion of scientists and engineers and business operations personnel due to efficiencies gained through automation.

Workforce categories are show in the following tables. Intergovernmental Personnel Act (IPAs) are justified in the A&M section and the OIG workforce is justified in the OIG section of this document. They are included in the following tables to provide a complete view of the NSF workforce.

NSF Workforce Detail by FTE

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount
Staff -- NSF [1]	1,188	1,217	1,200	-17
Staff -- OIG	51	53	60	7
Arctic Research Commission	4	4	4	0
IPA	129	140	170	30
Detailees to NSF	6	5	5	0
Contractors Performing Admn. Functions	175	210	210	0
Total, Workforce FTE	1,553	1,629	1,649	20

[1] The 17 FTE reduction in NSF staff in FY 2004 is due to employees from programs proposed for transfer to NSF from other agencies in the FY 2003 Request, which are not proposed for transfer in FY 2004.

FTE and IPA Distribution by NSF Organization for FY 2002

	Federal Employees	Intergovernmental Personnel Act Appointments
Biological Sciences	100	17
Office of Budget, Finance, & Award Management	129	0
Computer & Information Science & Engineering	56	23
Cooperative Education Program (Student Aides)	30	0
Education & Human Resources	129	28
Engineering	110	20
Geosciences	92	13
Mathematical & Physical Sciences	110	18
Office of Information & Resource Management	165	0
Office of the Director	88	2
Office of Polar Programs	43	2
Social, Behavioral and Economic Sciences	136	6
Subtotal, Actual FTE Usage	1,188	129
Office of Inspector General	51	0
Total, Actual FTE Usage	1,239	129

Totals may not add due to rounding

General Operating Expenses

General Operating Expenses (GOE) fund a broad range of operations necessary for the Foundation to administer its programs. The FY 2004 Request for GOE is $92.02 million, an increase of $21.50 million from the FY 2003 level of $70.52 million.

The Request funds Information Technology initiatives to enhance staff productivity, improve proposal and award processing, promote next generation eGovernment capabilities, and enhance physical and cyber security. The Request also provides for the management and maintenance of the operational components of NSF's administrative and programmatic applications, including FastLane.

Space rental will increase to $18.65 million based on GSA's negotiated leasing cost for FY 2004. In addition, one floor of space in an adjoining building will be leased to relieve crowding in Stafford Place.

The increase in Travel funds will foster a more comprehensive approach to program oversight, monitoring and outreach – especially for large facility projects and other large NSF awards.

The increase in Training and Other General Operating Expenses will promote next-generation video-conferencing, renovate office space, and fund analyses of NSF business processes. Additionally, the funding will maintain the NSF Academy to facilitate employee development and training.

General Operating Expenses Funding
(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Information Infrastructure	16.39	25.19	42.73	17.54	69.6%
Space Rental	16.31	17.49	18.65	1.16	6.6%
Travel	4.59	5.73	6.11	0.38	6.6%
Training and Other General Operating Expenses	11.36	22.11	24.53	2.42	10.9%
Total, GOE	$48.65	$70.52	$92.02	$21.50	30.5%

Totals may not add due to rounding.

Information Infrastructure

Information infrastructure costs are budgeted at $42.73 million in FY 2004, increasing by $17.54 million from the FY 2003 Request of $25.19 million. This Request continues the Foundation's major investment in new technology to support improved business operations and to keep pace with an increasingly complex workload. Reengineering activities throughout NSF are focused on changing business practices to streamline operations and improve efficiency. This investment has produced significant results, including successful efforts to automate proposal and award processes and the development of improved financial systems.

The increase of $17.54 million consists of the following:

- $1.0 million for Enabling Human Capital Management. Accurate, timely human capital information is essential for effective planning and management of NSF’s workforce. A fully integrated system will provide simple, easy to use, cost effective, standardized, and integrated eHuman resources and payroll services to support NSF’s mission and to help plan for future needs. This solution will transform the current human resources and payroll service delivery environment into one that achieves management agenda initiatives and supports government-wide eGov initiatives in human capital. During FY 2004, NSF plans to complete requirements analysis, evaluate alternatives, including government-wide service providers/solution sets, and begin implementation of high-priority capabilities.

- $4.40 million for the next-generation eGrants and support for other government-wide eGov initiatives. NSF is a partner of four eGovernment initiatives: eGrants (led by the Department of Health and Human Services), ePayroll, the Enterprise Human Resources Integration initiative (both led by the Office of Personnel Management), and eTravel (led by the General Services Administration) and continues to support all other endorsed initiatives to achieve government-wide efficiencies. As part of the government-wide eGrants initiative, NSF will continue to support implementation of a common solution set, and make changes to FastLane and other systems to assure seamless integration. Additional investments in FastLane and the Electronic Jacket systems will respond to high-priority customer requests and complement efforts planned for eGrants and eTravel. As part of our next-generation eGrants focus and resulting from the Business Analysis work planned for the Merit Review and Awards Management and Oversight processes, NSF will re-engineer its business process and define new system requirements. This will better enable the range of grant monitoring activities, improve the processing of large and complex awards and include a pre-award review functionality. The next-generation (internal) eGrants system (referred to as the Proposal, Review, and Awards Management Information

System or PRAMIS) will implement a redesigned business process aimed at transforming the current mix of electronic and paper-based sequential award processing to enable dynamic, simultaneous processing of NSF announcements, proposals, and awards. PRAMIS will also provide capability for electronic solicitation, proposal receipt, award and contract administration functions that interface with other government-wide eGov initiatives such as eGrants and eTravel as well as other internal information systems.

- $3.0 million for enhancements and initiatives to improve operational efficiency. NSF has developed a multi-year approach to improving the infrastructure and deploying the hardware, software, and tools necessary to manage and operate applications that process approximately $5.0 billion annually. Our multi-year approach to replace aging hardware, software, and enterprise servers, with priority on equipment three years old and older, allows for incremental improvements in the performance, reliability, and security of the operational infrastructure and is consistent with overall government-wide budget constraints. The Request includes funds to continue implementation of critical investments needed in supporting hardware, software, and tools necessary to manage and operate an infrastructure that can support NSF electronic business processes.

- $1.64 million for continued improvements to NSF's Security Program. NSF's comprehensive, agency-wide IT security program encompasses all aspects of information security, including policy and procedures, risk assessments and security plans, managed intrusion detection services, vulnerability assessments, and technical and management security controls. The FY 2004 Request includes key investments needed to sustain and improve NSF's information security program and posture. This includes continued investments to implement a balanced, technology-enabled security program that includes physical and IT security requirements. Included in this investment is the continued deployment of "smart technology" to meet physical and cyber security needs, and expanded penetration testing and vulnerability scanning for defensive measures. This also includes establishing a common, "corporate directory service" that will store and manage user profiles, access privileges, and application and network resource information. This service will help ensure appropriate access policies are followed across NSF applications, facilities, and services.

- $7.50 million for other information infrastructure costs. This includes operation of a central computing facility; maintenance of hardware and software; management of the NSF intranet and local area network; software development services to enhance and maintain current applications; and electronic mail. Adequate funding in these areas is critical to the efficient operation of the agency, as NSF has become increasingly dependent on a wide array of innovative technologies to handle an increasingly complex workload. As more and more business processes have been improved and automated, the Foundation's staff and its customers around the world depend on efficient and reliable electronic systems in order to conduct business, and a robust information technology infrastructure is critical to NSF's success. While NSF's overall budget has grown, funding for infrastructure operating expenses has until recently remained essentially flat. The Request includes increases to meet expenses for improvements in the basic infrastructure and day-to-day services such as:

  - Increased costs for new integrated contracts to improve the management and efficiency of the NSF data center, help desks, and network management;
  - Increased costs for corporate software licenses and maintenance fees which have increased dramatically over FY 2002;

- Implementation and support for tools initially deployed in FY 2002 to improve and manage software lifecycle activities, addressing software engineering standards, program management, quality assurance, testing, and configuration management;
- Increased costs to support redundancy and backup for critical services such as major systems production environments, electronic mail, and Internet access;
- Increased maintenance costs for FastLane, which is a suite of over 40 Web-based applications, used by more than 230,000 scientists, educators, and administrators;
- Increased maintenance costs for legacy information technology applications and the additional costs to maintain new capabilities for the National Science Board, the Office of Equal Opportunity, and other administrative functions;
- Increased costs to maintain a balanced security program for all central computing capabilities, including 24/7 intrusion detection services, internal and external penetration tests, disaster recovery tests, and additional operational security controls; and
- Increased costs to support an average of 8,000 customer services calls per month for FastLane and other IT services requests.

Space Rental

Budgeted at \$17.49 million in FY 2003, physical infrastructure costs increase by \$1.16 million in FY 2004 to a total of \$18.65 million. These costs include charges by GSA for the Foundation's headquarters location in Arlington, Virginia, and additional space in an adjacent building. The total includes funds for one additional floor of space in the adjacent building.

Travel

The Foundation's science and engineering education and research programs continue to emphasize more complex, interrelated sets of activities. These activities require NSF staff to interact and engage a broader and often new range of participants. These communities and constituencies often require assistance from and coordination with NSF staff in order to ensure compliance with the Foundation's administrative and programmatic requirements in proposing and carrying out their awards. This interaction and coordination takes many forms. It includes increasing pre-award outreach to inform new communities of the NSF role in supporting research and education; providing pre-proposal advice; completing complex pre-award negotiations; and participating in relevant society meetings, site visits, and workshops.

Budgeted at \$5.73 million in FY 2003, Travel increases by \$380,000 in FY 2004 to a level of \$6.11 million. This includes funding to continue to support the merit review process and for increased oversight activities, especially for new grantees and large facilities, and for enhanced outreach activities associated with FastLane. Good management is critical to the success of the research and education activities that we support, and proper and sufficient oversight is vital to the process. This requested amount also would assist in assuring both a reliable merit review process and the oversight recommended by the agency's Office of Inspector General.

Training and Other General Operating Expenses

Budgeted at \$22.11 million in FY 2003, training and other GOE increases by \$2.42 million to the FY 2004 level of \$24.53 million.

Funds in this category cover charges for telephone services and postage, employee learning and development activities, equipment repair and maintenance, mail handling, printing and reproduction, office supplies, and other administrative expenses. The increase will cover anticipated contractual increases and other expenses for administrative equipment, the NSF Business Analysis, and the National Academy of Public Administration review.

The table below shows the planned distribution of general operating expenses by object class and is followed by brief detailed explanations of each category.

General Operating Expenses by Object Class
(Dollars in Thousands)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount
Travel and Transportation of persons	4,591	5,727	6,110	383
Transportation of Things	205	205	211	6
Rental Payments to GSA	16,305	17,491	18,652	1,161
Communications, Utilities and Misc. Charges	2,229	3,420	2,799	-621
Printing and Reproduction	297	455	310	-145
Advisory and Assistance Services	2,585	5,510	10,271	4,761
Other Services	3,500	6,634	8,380	1,746
Purchases of Goods & Services from Gov't. Accounts	1,040	1,200	1,566	366
Medical Care	467	467	499	32
Operations and Maintenance of Equipment	6,254	13,044	13,629	585
Supplies and Materials	2,143	2,794	2,510	-284
Equipment	9,024	13,564	27,074	13,510
Reception and Representation	8	9	9	0
Total	$48,648	$70,520	$92,020	$21,500

Totals may not add due to rounding.

Description of categories:

- **Travel and Transportation of Persons** is discussed at the beginning of the GOE section.
- **Transportation of Things** consists of household moves associated with bringing new scientists and engineers to NSF.
- **Rental Payments to GSA** includes the rent charged by GSA for NSF's facility in Arlington, Virginia, and two floors in an adjacent building. The FY 2004 increase is required to fund GSA's estimate for currently occupied space, plus one additional floor in the adjacent building.
- **Communications, Utilities, and Miscellaneous Charges** include all costs for telephone lines and services, both local and long distance, postage, and rental charges for leased copiers. Operational efficiencies account for the proposed decrease; through the increased use of information technologies to conduct core business practices and a commensurate reduction in paper-based transactions, NSF reduced postage costs by 44 percent in 2002.
- **Printing and Reproduction** include contract costs of composition and printing of NSF's publications, announcements and forms; and printing of stationary and specialty items. The proposed decrease is made possible by the use of information technologies to conduct business and the

elimination of paper-based transactions, resulting in a drop in paper and supply costs of 26 percent in FY 2002.

- **Advisory and Assistance Services** include development, learning and career enhancement opportunities for all Foundation staff offered through the Academy, contracts for position classifications, security investigations, worklife initiatives, outreach and contractual costs for the Business Analysis and the National Academy of Public Administration review and related services. The FY 2004 increase is needed to fund the aforementioned two studies, and implement Human Capital recommendations stemming from the Business Analysis. The costs increase by $4.76 million to $10.27 million from a level of $5.51 in the FY 2003 Request.

- **Other Services** include warehousing and supply services, mail handling, equipment repair and maintenance, renovation costs, furniture repair, contract support for conference room services, and miscellaneous administrative contracts. These costs increase by $1.75 million in FY 2004 to fund renovation of office space, enhancements to physical and mailroom security, and the development of a robust intranet site.

- **Purchases of Goods and Services from Government Accounts** include reimbursable services purchased from GSA. These costs primarily include guard services and off-hours heating and air conditioning support. The increase of $366,000 will be used to increase the level of security.

- **Medical Care** includes costs associated with the health services contract, providing limited on-site medical services to the agency's staff. This includes performing physical examinations for the NSF staff on assignment at the South Pole. The increase reflects the cost to continue the current medical contract.

- **Operations and Maintenance of Equipment** includes management and operation of the central computer facility 24 hours/day, 365 days/year; operation of the customer service center and FastLane help desk; maintenance of database server hardware and related peripherals; software licensing fees; data communications infrastructure and network systems support; electronic mail support; and remote access (e.g., Internet and World Wide Web). The increase of $585,000 is needed for an increase in software licensing fees, and for enhancement of computer security.

- **Supplies and Materials** include office supplies, library supplies, paper and supplies for the NSF central computer facility, and miscellaneous supplies. Supply and paper costs were reduced 26 percent in FY 2002 due to the increased use of information technology to improve operations.

- **Equipment** costs include new and replacement computing equipment, desktop computers, data communications equipment, video-teleconferencing equipment, office furniture, file cabinets, and support equipment such as copiers and audio-visual equipment. Also included are software development costs associated with developing and maintaining central application systems that support proposal, award, financial, and administrative activities. These costs increase in FY 2004 by approximately $13.51 million to support the following activities: investments for the next generation eGrants, support for government-wide eGrants, increased maintenance costs for FastLane, increased maintenance costs for legacy information technology applications, acquiring hardware and software to improve operational efficiency, costs for a robust enterprise architecture to support next generation capability, increased costs to maintain a balanced security program, increased costs for new integrated contracts, and increased costs to support a large increase in customer service calls for FastLane and other IT services requests.

- **Reception and Representation** expenses are funds that may be used for official consultation, representation, or other extraordinary expenses at the discretion of the NSF Director or his/her designee. These expenses do not increase over the FY 2003 Request.

OFFICE OF INSPECTOR GENERAL

OFFICE OF INSPECTOR GENERAL $8,770,000

The Appropriations Act that funds the National Science Foundation provides for a separate Appropriation heading for NSF's Office of Inspector General (OIG). Accordingly, the FY 2004 Request identifies the resources needed to support OIG, including amounts for personnel compensation and benefits, contract services, training, travel, supplies, materials, and equipment.

The FY 2004 Request for OIG is $8.77 million, an increase of $1.07 million, or 13.9 percent, over the FY 2003 Request of $7.70 million.

(Dollars in Millions)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request	Change Amount	Change Percent
Personnel Compensation & Benefits	5.49	5.88	7.18	1.30	22.1%
Other Operating Expenses	1.21	1.82	1.59	-0.23	-12.6%
Total OIG	**$6.70**	**$7.70**	**$8.77**	**$1.07**	**13.9%**
Full-Time Equivalent Employment	51	53	60	7	13.2%

In February 1989 the National Science Board established OIG pursuant to the Inspector General Act Amendments of 1988. The statute confers on OIG the responsibility and authority to:

- Conduct and supervise audits of NSF programs and operations, including organizations that receive NSF funding.
- Conduct investigations concerning NSF programs and operations, including organizations that receive NSF funding.
- Evaluate allegations of research misconduct, such as fabrication, falsification, or plagiarism involving individuals who participate in NSF-funded activities.
- Provide leadership, coordination, and policy recommendations for:
  - Promoting economy, efficiency, and effectiveness in the administration of NSF programs and operations, and
  - Preventing and detecting fraud and abuse in NSF programs and operations.
- Issue semiannual reports to the National Science Board and Congress to inform them about problems, recommended corrective actions, and progress being made in improving the management and conduct of NSF programs.

As set forth in the OIG Strategic Plan, the primary functions of the Office are audits, reviews, and investigations. Reflecting the diverse skills, training, and experience necessary to oversee NSF's varied programs, OIG staff includes scientists, attorneys, certified public accountants, investigators, evaluators, and information technology specialists. The focus of an investigation, audit, or other review may be on a single entity or individual, an organization, a project involving multiple disciplines, or a broad program or functional area.

OIG audits grants, contracts, and cooperative agreements funded by the Foundation's programs. OIG performs audits and reviews of the operations of both internal agency programs and external organizations that receive NSF funding to ensure that financial, administrative, and programmatic activities are conducted economically and efficiently. The Office is also responsible for auditing the Foundation's annual financial statements, which are required for all NSF accounts and activities by the Government Management Reform Act of 1994. OIG contracts with a public accounting firm to conduct the financial statements audit, and the cost is allocated proportionately to the accounts audited. In addition to overseeing the audit, OIG performs systemic audits of financial, budgetary, and data processing systems used by NSF to develop the financial statements. The Office also performs multi-disciplinary reviews of financial, management, and program operations that identify broader problems and highlight best practices.

OIG investigates possible wrongdoing by organizations and individuals who submit proposals to, receive awards from, conduct business with, or work for the Foundation. Allegations of research misconduct are also investigated. OIG assesses the validity and seriousness of the allegations and recommends proportionate action. When appropriate, the Office refers the results of these investigations to the Department of Justice or other authorities for criminal prosecution or civil litigation. Other cases are referred to the Foundation for administrative resolution. OIG works closely with institutions on the conduct of their internal investigations and performs outreach activities aimed at raising the awareness of funded researchers, institutional administrators and agency employees about the OIG's role and NSF's rules and expectations.

The National Science Board, to which OIG reports, has approved measured growth, over a period of years, in the number of audits conducted at organizations that receive NSF funding. The budget increase requested for FY 2004 is needed to improve OIG coverage of NSF programs that have not been adequately addressed in the past due to resource constraints. Over 80 percent of the request is dedicated to OIG personnel costs, and the balance would permit continuing contract support for audits and modest growth in OIG technological capability, staff training, and outreach activities.

Personnel Compensation and Benefits and General Operating Expenses

(Dollars in Thousands)

	FY 2002 Actual	FY 2003 Request	FY 2004 Request
Personnel Compensation & Benefits	5,494	5,880	7,180
Travel and Transportation of Persons	119	190	225
Advisory and Assistance Services	831	1,475	925
Other Services	170	35	60
Communications, Supplies & Equipment	86	120	380
	$6,700	$7,700	$8,770

The proposed increase would allow OIG to expand its efforts in several priority areas, consistent with the OIG Strategic Plan. To support NSF program goals, our audit objectives focus on seven areas that pose the greatest risk to the agency: financial management, acquisition, information technology, human capital, award administration, awardee financial accountability and compliance, and the management of agency programs and projects. To have an impact, OIG needs additional resources to build its staff and increase its skills in conducting performance audits and evaluations of NSF's business operations. In particular, the additional auditors would enable OIG to expand its assessments of (1) NSF's management of large programs, such as the Polar Program operations, and infrastructure projects funded from the Major Research Equipment and Facilities Construction appropriation, (2) the agency's administration of the grant awards process, and (3) NSF's planning and management of its workforce. These efforts are consistent with the President's Management Agenda, which requires federal agencies to restructure their operations to improve the performance and accountability of their programs. NSF has a number of initiatives under way to address these management and performance challenges, and by FY 2004 they should be sufficiently seasoned to allow productive OIG review.

The additional staff is also needed to oversee audits by outside CPA firms, on which OIG relies for its review of NSF awardees' compliance with the financial terms of award agreements. The increasing size and complexity of the agency's awards pose a higher risk for improper and erroneous payments by awardee institutions. Like other federal agencies, NSF makes substantial use of CPA audits performed under the Single Audit Act to provide assurance that awardees are properly accounting for and managing federal grant funds. Recent reviews by other OIGs have raised concerns regarding the quality of these audits, and we need to strengthen the quality control reviews necessary for assessing the reliability of Single Audits of NSF awardees.

The additional auditing capability is also essential for meeting the increasing requirements and workload of the financial statement and information security audits performed in accordance with the Government Management Reform Act and the Federal Information Security Management Act. Accelerated financial statement reporting deadlines, increased focus on reconciling interagency account balances, and heightened attention to information security controls will require more audit resources to ensure timely completion.

Current investigation staffing levels allow us to react to allegations of fraudulent practices, but they do not provide for proactive prevention and detection efforts to determine if violations identified during individual investigations are widespread or whether they undermine the integrity of the data upon which NSF relies. Existing investigative resources also do not enable OIG to evaluate adequately the indicators of grant fraud that may be found during audits and other reviews. Additional investigators would allow OIG to focus proactively on complex audit findings that may indicate fraud and other activities with potential violations that currently go undetected. They would also be able to initiate cases resulting from grant fraud and compliance review programs, as well as from proactive SBIR fraud reviews, and concentrate Office resources on major cases to ensure their timely resolution. The additional audit and investigative staff would also enable OIG to take advantage of missed outreach and education opportunities to awardees' institutions and other government agencies, leverage our specialized experience on behalf of other IG offices by providing guidance on grant-related audits and investigations, and coordinate grant fraud and research misconduct work more effectively with other agencies.

QUANTITATIVE DATA TABLES

NATIONAL SCIENCE FOUNDATION
Research and Development Special Analysis

	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate
Support of R&D		(Dollars in Thousands)	
Conduct of Research and Development			
Basic Research..	$3,074,546	$3,204,940	$3,485,884
Applied Research..	185,462	198,674	203,992
Development...	0	0	0
Subtotal, Conduct of R&D..	3,260,008	3,403,614	3,689,876
R&D Facilities			
Land, Building and Fixed Equipment...	13,145	17,336	13,390
Major Equipment..	227,686	230,079	332,010
Subtotal, R&D Facilities & Major Equipment........................	240,831	247,415	345,400
Total, Support of R&D...	3,500,839	3,651,029	4,035,276
R&D Performed by Colleges and Universities			
(Direct Costs of R&D Performed by Colleges and Universi	(1,993,109)	(2,282,999)	(2,466,115)
(Indirect Costs Related to R&D Performed by Colleges and Universities)...	(687,317)	(562,285)	(593,650)
(Merit-Reviewed Research with Limited Competitive Selection - 1453)...	(164,684)	(164,709)	(165,755)
(Merit-Reviewed Research with Competitive Selection and Internal (Program) Evaluation - 1454)............................	(213,380)	(190,057)	(209,320)
(Merit-Reviewed Research with Competitive Selection and External (Peer) Evaluation - 1455)..................................	(2,881,944)	(3,048,848)	(3,314,801)
Non-Investment Activities..	469,232	505,590	531,607
Education and Training..	803,987	871,591	914,317
TOTAL..	$4,774,058	$5,028,210	$5,481,200

Totals may not add due to rounding.

RESEARCH AND RELATED ACTIVITIES
Research and Development Special Analysis

	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate
Support of R&D	(Dollars in Thousands)		
Basic Research	$2,952,420	$3,074,750	$3,355,694
Applied Research	169,095	191,674	196,992
Development	0	0	0
Subtotal, Conduct of R&D	3,121,515	3,266,424	3,552,686
R&D Facilities			
Land, Building and Fixed Equipment	13,145	17,336	13,390
Major Equipment	110,258	103,799	129,680
Subtotal, R&D Facilities & Major Equipment	123,403	121,135	143,070
Total, Support of R&D	3,244,918	3,387,559	3,695,756
R&D Performed by Colleges and Universities			
(Direct Costs of R&D Performed by Colleges and Universi	(1,894,101)	(2,200,685)	(2,381,690)
(Indirect Costs Related to R&D Performed by Colleges and Universities)	(667,244)	(541,707)	(574,890)
(Merit-Reviewed Research with Limited Competitive Selection - 1453)	(162,717)	(163,227)	(164,255)
(Merit-Reviewed Research with Competitive Selection and Internal (Program) Evaluation - 1454)	(207,743)	(186,078)	(205,320)
(Merit-Reviewed Research with Competitive Selection and External (Peer) Evaluation - 1455)	(2,751,055)	(2,917,119)	(3,183,111)
Non-Investment Activities	259,425	276,100	279,297
Education and Training	111,628	119,541	131,307
TOTAL	$3,615,971	$3,783,200	$4,106,360

Totals may not add due to rounding.

EDUCATION AND HUMAN RESOURCES
Research and Development Special Analysis

	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate
Support of R&D	(Dollars in Thousands)		
Conduct of Research and Development			
Basic Research	$122,126	$130,190	$130,190
Applied Research	16,367	7,000	7,000
Development	0	0	0
Subtotal, Conduct of R&D	138,493	137,190	137,190
R&D Facilities			
Land, Building and Fixed Equipment	0	0	0
Major Equipment	2,076	0	0
Subtotal, R&D Facilities & Major Equipment	2,076	0	0
Total, Support of R&D	140,569	137,190	137,190
R&D Performed by Colleges and Universities			
(Directs Costs of R&D Performed by Colleges and Universi	(99,008)	(82,314)	(84,425)
(Indirect Costs Related to R&D Performed by Colleges and Universities)	(20,073)	(20,578)	(18,760)
(Merit-Reviewed Research with Limited Competitive Selection - 1453)	(1,967)	(1,482)	(1,500)
(Merit-Reviewed Research with Competitive Selection and Internal (Program) Evaluation - 1454)	(5,637)	(3,979)	(4,000)
(Merit-Reviewed Research with Competitive Selection and External (Peer) Evaluation - 1455)	(130,889)	(131,729)	(131,690)
Non-Investment Activities	33,180	18,840	17,840
Education and Training	692,359	752,050	783,010
TOTAL	$866,108	$908,080	$938,040

Totals may not add due to rounding.

MAJOR RESEARCH EQUIPMENT FACILITIES CONSTRUCTION
Research and Development Special Analysis

	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate
Support of R&D	(Dollars in Thousands)		
Conduct of Research and Development			
Basic Research	$0	$0	$0
Applied Research	0	0	0
Development	0	0	0
Subtotal, Conduct of R&D	0	0	0
R&D Facilities			
Land, Building and Fixed Equipment	0	0	0
Major Equipment	115,352	126,280	202,330
Subtotal, R&D Facilities & Major Equipment	115,352	126,280	202,330
Total, Support of R&D	115,352	126,280	202,330
R&D Performed by Colleges and Universities			
(Directs Costs of R&D Performed by Colleges and Universi	(0)	(0)	(0)
(Indirect Costs Related to R&D Performed by Colleges and Universities)	(0)	(0)	(0)
(Merit-Reviewed Research with Limited Competitive Selection - 1453)	(0)	(0)	(0)
(Merit-Reviewed Research with Competitive Selection and Internal (Program) Evaluation - 1454)	(0)	(0)	(0)
(Merit-Reviewed Research with Competitive Selection and External (Peer) Evaluation - 1455)	(0)	(0)	(0)
Non-Investment Activities	0	0	0
Education and Training	0	0	0
TOTAL	$115,352	$126,280	$202,330

Totals may not add due to rounding.

SALARIES AND EXPENSES
Research and Development Special Analysis

	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate
Support of R&D		(Dollars in Thousands)	
Conduct of Research and Development			
Basic Research	$0	$0	$0
Applied Research	0	0	0
Development	0	0	0
Subtotal, Conduct of R&D	0	0	0
R&D Facilities			
Land, Building and Fixed Equipment	0	0	0
Major Equipment	0	0	0
Subtotal, R&D Facilities & Major Equipment	0	0	0
Total, Support of R&D	0	0	0
R&D Performed by Colleges and Universities			
(Directs Costs of R&D Performed by Colleges and Universi	(0)	(0)	(0)
(Indirect Costs Related to R&D Performed by Colleges and Universities)	(0)	(0)	(0)
(Merit-Reviewed Research with Limited Competitive Selection - 1453)	(0)	(0)	(0)
(Merit-Reviewed Research with Competitive Selection and Internal (Program) Evaluation - 1454)	(0)	(0)	(0)
(Merit-Reviewed Research with Competitive Selection and External (Peer) Evaluation - 1455)	(0)	(0)	(0)
Non-Investment Activities	169,927	202,950	225,700
Education and Training	0	0	0
TOTAL	$169,927	$202,950	$225,700

Totals may not add due to rounding.

OFFICE OF INSPECTOR GENERAL
Research and Development Special Analysis

	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate
Support of R&D		(Dollars in Thousands)	
Conduct of Research and Development			
Basic Research	$0	$0	$0
Applied Research	0	0	0
Development	0	0	0
Subtotal, Conduct of R&D	0	0	0
R&D Facilities			
Land, Building and Fixed Equipment	0	0	0
Major Equipment	0	0	0
Subtotal, R&D Facilities & Major Equipment	0	0	0
Total, Support of R&D	0	0	0
R&D Performed by Colleges and Universities			
(Directs Costs of R&D Performed by Colleges and Universi	(0)	(0)	(0)
(Indirect Costs Related to R&D Performed by Colleges and Universities)	(0)	(0)	(0)
(Merit-Reviewed Research with Limited Competitive Selection - 1453)	(0)	(0)	(0)
(Merit-Reviewed Research with Competitive Selection and Internal (Program) Evaluation - 1454)	(0)	(0)	(0)
(Merit-Reviewed Research with Competitive Selection and External (Peer) Evaluation - 1455)	(0)	(0)	(0)
Non-Investment Activities	6,700	7,700	8,770
Education and Training	0	0	0
TOTAL	$6,700	$7,700	$8,770

Totals may not add due to rounding.

FY 2004 PERFORMANCE PLAN

National Science Foundation

FY 2004 GPRA
Performance Plan

February 3, 2003

Note: This GPRA performance plan was developed solely by NSF staff. It reflects discussions of general principles with elements of the research and education communities, the administration, and congressional staff.

ABOUT NSF

Created in 1950, NSF is an independent U.S. government agency responsible for advancing science and engineering in the United States across a broad and expanding frontier. NSF operates no laboratories itself, but rather carries out its mission primarily by making merit-based grants and cooperative agreements to individual researchers and groups, in partnership with colleges, universities, and other institutions – public, private, state, local, and federal – throughout the U.S.

NSF invests in the best ideas from the most capable people, as determined by competitive merit review. NSF evaluates proposals for research and education projects using two criteria: the intellectual merit of the proposed activity and its broader impacts. NSF uses merit review to select about 10,000 new awards each year from about 35,000 competitive proposals submitted by the science and engineering research and education communities.

NSF provides funding to sustain the advance of many research fields and thus, to expand the boundaries of knowledge. NSF supports a portfolio of investments that reflects the interdependence among fields and between research and education. It promotes disciplinary strength while embracing interdisciplinary research and education activities. Agency investments promote the emergence of new disciplines, fields, and technologies, along with the development of scientists and engineers able to embrace them and create the next generation of results. By providing these resources, NSF contributes to the health and vitality of the U.S. research and education enterprise. NSF resources enable and enhance the nation's capacity for sustained growth and prosperity.

EXECUTIVE SUMMARY

The National Science Foundation's (NSF) continuing mission, as set out in the preamble to the National Science Foundation Act of 1950, reads, "To promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense; and for other purposes."

With this mission and within the framework established by the FY 2001 - FY 2006 NSF Government Performance and Results Act (GPRA) Strategic Plan, the National Science Foundation presents its FY 2004 GPRA Performance Plan.

NSF's activities align with its three strategic outcome goals:
- PEOPLE – Developing "a diverse, internationally competitive and globally engaged workforce of scientists, engineers, and well-prepared citizens";
- IDEAS – Enabling "discovery across the frontier of science and engineering, connected to learning, innovation and service to society"; and
- TOOLS – Providing "broadly accessible, state-of-the-art and shared research and education tools."

NSF's management goals are agency-wide goals that enable the Foundation to make progress toward attaining its strategic outcome goals. They are organized into three performance areas:
- Proposal and Award Management, including merit review;
- Business Practices, including cost efficiency, E-government and information technology security; and
- Human Capital, including staff diversity and education.

In FY 2004, approximately 95 percent of NSF's budget request ($5,481 million) is designated for investments the agency makes in support of its strategic outcome goals – PEOPLE ($1,153 million), IDEAS ($2,696 million), and TOOLS ($1,341 million). The remaining 5 percent of the budget request ($291 million) is for Administration and Management, which provides operating support for activities such as reviewing proposals, issuing awards and overseeing projects.

GPRA GOALS FOR STRATEGIC OUTCOMES

NSF is the only agency of the federal government exclusively devoted to promoting basic research and education at all levels and across all fields of science and engineering. NSF does not conduct research and education activities directly, but supports others who do so. External factors related to institutional partners, the private sector, and government affect how individuals and groups respond in proposing and conducting research, which in turn impacts NSF's progress toward attaining its GPRA strategic outcome goals.

As with all basic research, the outcomes associated with NSF research and education investments in FY 2004 are likely to be unpredictable in content and timing. Many of these activities require years to develop and the outcomes can only be judged retrospectively. For these activities, it is difficult to link long-term outcomes directly to annual budgets. In the short-term, investment in diverse portfolios can be described and identified, and it is these investments that will determine whether short-term outputs and long-term outcomes resulting from the portfolio of current awards will be as significant as past outputs and outcomes.

In addition to investing in core research and education activities, NSF annually identifies and invests in emerging opportunities that hold exceptional promise to advance knowledge. For example, the

President's Math and Science Partnership, Workforce for the 21st Century, and increasing graduate student stipends for the Graduate Research Fellows in K-12 Education, Graduate Research Fellowships and Integrative Graduate Education and Research Traineeships programs are FY 2004 priorities for investment related to the PEOPLE strategic outcome goal.

FY 2004 priority areas for investment related to NSF's IDEAS goal include Biocomplexity in the Environment (BE); Information Technology Research (ITR); Nanoscale Science and Engineering (NSE); Mathematical Sciences; and Human and Social Dynamics (HSD). The ITR and NSE activities are highly coordinated, cross-agency programs where NSF chairs the working group or is designated lead agency.

FY 2004 investment priorities related to the TOOLS strategic outcome goal focus on investments in Major Research Equipment and Facilities Construction, SRS Survey redesign, and Cyberinfrastructure.

NSF also supports basic research in conjunction with the Foundation's participation in a wide range of cross-cutting activities, including the FY 2004 interagency research and development priorities identified jointly by the Office of Science and Technology Policy and the Office of Management and Budget. These include Networking and Information Technology Research & Development (NITRD), National Nanotechnology Initiative, Climate Change Science and Technology, Homeland Security and Antiterrorism R&D, Molecular-level Understanding of Life Processes, and Education Research.

GPRA GOALS FOR MANAGEMENT

NSF has developed a set of management goals that support attainment of its strategic outcome goals. Development of annual management goals is informed by the NSF Strategic Plan, previous agency Performance Plans, internal deliberations, past performance, and reasonable projections for future levels of performance.

Embedded within the FY 2004 portfolio of goals are a number that respond to initiatives highlighted in the FY 2002 President's Management Agenda or that have otherwise been identified by the Office of Management and Budget, or the General Accounting Office, in NSF's annual review of financial and administrative systems as required by the Federal Managers' Financial Integrity Act, or by the NSF Office of Inspector General. Other remaining challenges are handled with internal management controls and processes under the purview of the internal NSF Management Controls Committee (MCC), chaired by the Chief Financial Officer. That committee provides continuing and long-term senior executive attention to NSF's management challenges and reforms (detailed in Appendix B).

PRESIDENT'S MANAGEMENT AGENDA

The President's Management Agenda includes five government-wide initiatives: Strategic Management of Human Capital; Competitive Sourcing; Improved Financial Performance; Expanded E-Government; and Budget and Performance Integration. For each initiative, OMB tracks agency progress with a scorecard consisting of "green, yellow and red lights" that reflects agency status. The most recent NSF scorecard gives a "green light" to NSF for the Improved Financial Performance and Expanded E-Government initiatives.

NSF's Performance Plan contains FY 2004 performance goals related to human capital, budget-performance integration and to E-government. Aspects of the other two initiatives are being addressed with internal controls and processes, within the framework outlined in the agency's Administration and Management Strategic Plan.

TABLE OF CONTENTS

I. INTRODUCTION

In response to the Government Performance and Results Act of 1993, the National Science Foundation presents this sixth GPRA Performance Plan. It is based on NSF's GPRA Strategic Plan FY 2001 - 2006[1], finalized in September 2000.

A. NSF MISSION

NSF's continuing mission is set out in the preamble to the National Science Foundation Act of 1950 (Public Law 810507):

To promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense; and for other purposes.

The Foundation's organic legislation authorizes it to engage in the following activities, among others:

- Initiate and support scientific and engineering research, and programs to strengthen scientific and engineering research potential, and education programs at all levels, and appraise the impact of research upon industrial development and the general welfare;
- Award graduate fellowships in the sciences and engineering;
- Foster the interchange of scientific information among scientists and engineers in the United States and foreign countries;
- Foster and support the development and use of computers and other scientific methods and technologies, primarily for research and education in the sciences;
- Evaluate the status and needs of the various sciences and engineering and take into consideration the results in correlating research and educational programs with other federal and non-federal programs;
- Maintain a current register of scientific and technical personnel, and in other ways provide a central clearinghouse for the collection, interpretation, and analysis of the data on scientific and technical resources of the United States, and provide a source of information for policy formulation by other federal agencies;
- Initiate and support specific scientific and engineering activities in connection with matters relating to international cooperation, national security, and the effects of scientific and technological applications upon society;
- Initiate and support scientific and engineering research, including applied research, at academic and other nonprofit institutions;
- Strengthen research and education innovation in the sciences and engineering, including independent research by individuals, throughout the United States; and
- Support activities designed to increase the participation of women and minorities and others underrepresented in science and technology.

The NSF Act confers on the Presidentially-appointed National Science Board the responsibility for establishing policies of the Foundation. The Act also directs the Board to advise the President and Congress to assure the productivity and excellence of the nation's science and engineering enterprise.

[1] For convenience, we will refer to the NSF GPRA Strategic Plan FY 2001 - 2006 as the Strategic Plan in the remainder of this document.

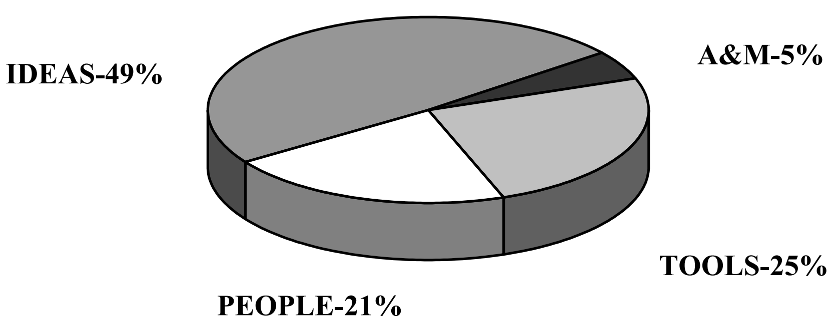
B. NSF GPRA GOALS

NSF's GPRA performance goals are organized in two categories – Strategic Outcomes and Management (see Section II). Goals associated with the strategic outcomes anticipate long-term results derived from NSF awards. The management goals focus on means and strategies that enable the Foundation to successfully work toward attainment of its strategic outcomes.

Approximately 95 percent of NSF's budget goes directly to investments the agency makes in support of its PEOPLE, IDEAS, and TOOLS strategic outcome goals. The remaining 5 percent goes toward Administration and Management (A&M), which provides operating support for activities such as reviewing proposals, issuing awards, and overseeing projects.

The NSF budget justification contains information on the full range of activities covered by support for PEOPLE, IDEAS, and TOOLS. For the FY 2004 budget request, resources allocated to the PEOPLE outcome goal total $1,153 million (cf. $1,087 million for FY 2003 and $995 million in FY 2002); those related to the IDEAS outcome goal total $2,696 million (cf. $2,559 million for FY 2003 and $2,436 million in FY 2002); and those that support the TOOLS outcome goal total $1,341 million (cf. $1,122 million for FY 2003 and $1,112 million in FY 2002). The diagram below shows the distribution of FY 2004 funding among NSF's three strategic areas.

FY 2004 BUDGET REQUEST OF $5.48 BILLION



GPRA GOALS FOR STRATEGIC OUTCOMES

To accomplish the NSF mission to promote the progress of science, NSF invests in the most capable people, supporting their creative ideas, and providing them with cutting-edge research and education tools. Outcomes from the grants and cooperative agreements NSF awards provide evidence of the success of the agency's investments in PEOPLE, IDEAS, and TOOLS. In developing the FY 2004 NSF award portfolio, NSF staff will be guided by the Strategic Plan and this GPRA Performance Plan, which include strategic outcome goals related to:

- **PEOPLE** – *Developing "a diverse, internationally competitive and globally engaged workforce of scientists, engineers, and well-prepared citizens."*

  NSF invests in the best and brightest students, researchers, and educators to ensure a well-prepared workforce and citizenry. In addition, the agency strives to create the capacity to serve all students well. The agency provides support for formal and informal science, technology, engineering and mathematics (STEM) education at all levels – preK-12, undergraduate, and graduate – and for professional development and public science-literacy projects. Investments aimed at the PEOPLE strategic outcome goal relate to the parts of NSF's mission directed at strengthening scientific and engineering research potential and science and engineering education programs at all levels.

- **IDEAS** – *Enabling "discovery across the frontier of science and engineering, connected to learning, innovation, and service to society."*

  NSF invests in ideas to provide a deep and broad fundamental science and engineering knowledge base. The Foundation provides support for creative, cutting-edge research that yields new and important discoveries and promotes the development of new knowledge and techniques within and across traditional boundaries. This strategic outcome goal derives from the part of NSF's mission directed at initiation and support of scientific and engineering research.

- **TOOLS** – *Providing "broadly accessible, state-of-the-art and shared research and education tools*."

  NSF invests in tools to provide widely accessible, up-to-date science and engineering infrastructure. It provides support for a wide range of instrumentation, multi-user facilities, digital libraries and computational infrastructure. This strategic outcome goal derives from the parts of NSF's mission directed at programs to strengthen scientific and engineering research potential, to support the development and use of computers and other scientific methods and technologies, and to provide an information base on science and engineering appropriate for development of national and international policy.

GPRA Goals for Management

Management excellence underpins all of the agency's activities. NSF has developed a set of agency-wide management goals that support attainment of the strategic outcome goals and address initiatives presented in the President's Management Agenda (PMA). The framework for developing management goals is guided by the Strategic Plan, previous agency Performance Plans, internal deliberations, past performance, and reasonable projections for future levels of performance.

The FY 2004 portfolio of management goals contains a number that address the President's Management Agenda or focus on management challenges and reforms identified by the Office of Management and Budget (OMB), or the General Accounting Office (GAO), in NSF's annual review of financial and administrative systems as required by the Federal Managers' Financial Integrity Act, or by the NSF Office of Inspector General. For each challenge and reform identified, the actions the Foundation is taking to address it are discussed throughout the text of this document and are summarized in Appendix B. The complete set of management goals is presented in Section II.

The President's Management Agenda

The President's Management Agenda includes five government-wide initiatives: Strategic Management of Human Capital; Competitive Sourcing; Improved Financial Performance; Expanded E-Government; and Budget and Performance Integration. For each initiative, OMB prepares a scorecard consisting of "green, yellow, and red lights" that reflects agency status and progress in achieving the standards for success ("getting to green"). The most recent scorecard gives "green light" status to NSF for the

Improved Financial Performance and Expanded E-Government initiatives. That same scorecard gives NSF a red in Human Capital, Competitive Sourcing and Budget-Performance Integration.

The following discussion focuses on five OMB criteria needed for success in budget-performance integration. The discussion illustrates the planning and development activities associated with getting to green for a PMA initiative.

- **BUDGET-PERFORMANCE INTEGRATION**

  Integrating Budget and Performance is one of five government-wide initiatives in the President's Management Agenda. Its purpose is straightforward – to link funding to results. Since enactment of GPRA in 1993 and the Chief Financial Officers Act in 1990, NSF has integrated performance information into its budget requests and planning framework. The PMA has helped NSF focus on how best to further elevate its efforts to integrate budget and performance.

  There are two criteria for budget-performance integration for which NSF is successful:
  - Collaboration: Agency has an integrated approach to budgeting and planning.
  - Validation/Effectiveness: Agency documents its effectiveness through Committee of Visitor (COV) reports and other external independent program evaluations.

  There are currently three criteria for budget-performance integration for which NSF is not successful:
  - Goals, objectives, and targets: Agency budget does not tie resources to results and provides limited focus on outcomes.
  - Alignment: NSF has a centralized account (Salaries and Expenses) that funds program resources.
  - Full cost: Agency budget does not charge the full budgetary cost to individual activities.

  The paragraphs and tables below summarize NSF's current approach to implementing this initiative and the agency's strategy for "getting to green." Central to achieving this aim is development of a Budget and Performance Integration Plan that will guide the agency's activities for achieving green status. The draft Plan has been discussed with OMB, with the NSF Advisory Committee for Business and Operations, and it has been shared with the NSF OIG.

  NSF has a *collaborative/integrated* approach to long-range planning and budgeting. These activities are distributed throughout the agency's program directorates and offices, with coordination activities centralized within the Office of Budget, Finance, and Award Management (BFA) and the Office of Information and Resource Management (OIRM). Responsibility for development, coordination and innovation in GPRA activities resides with a team of senior managers – the agency's GPRA Infrastructure Implementation Council (GIIC) – who report directly to the agency's Chief Operating Officer. GIIC is assisted by an integrated planning/budget working group composed of key staff from the program directorates and offices, BFA and OIRM. In addition, the Budget Planning Liaison Group, comprised of program and budget staff, participates in the budget formulation process.

  NSF's *effectiveness* is documented by its COVs and other independent evaluations (e.g., the AC/GPA) and with the analytic Program Assessment Rating Tool (PART) developed by OMB. The PART assesses program performance in four areas: purpose, strategic planning, program management and program results. The PART complements and reinforces GPRA, emphasizing the link between budget and performance. Resulting PART ratings inform the budget process and highlight areas in need of improvement. During formulation of the FY 2004 Budget, OMB completed PARTs on select programs for each agency. For NSF this included PARTs for the TOOLS strategic area and the Geosciences Directorate. OMB's PART review for NSF programs under the TOOLS strategic outcome goal documented clear purpose, quantifiable annual goals, and optimally designed programs.

Per GPRA legislation, NSF is in the process of updating its GPRA Strategic Plan. A draft of the revised plan is due to OMB on March 1, 2003, with the final plan due by September 30, 2003. It is anticipated that the plan will contain a performance structure that links *outcome goals, output targets, and resources*. It will also resolve the definition of a "program", which will enable NSF to complete its Budget and Performance Integration Plan. To date, NSF has developed a draft outline of the plan and has engaged the National Science Board in discussions related to its development.

The *alignment* criterion addresses whether NSF's budget is aligned with program goals in such a way that the impact of different funding levels on the agency's ability to achieve its goals is readily known. At present, NSF has identified strategic outcome goals and has determined which program areas contribute to each.

The crosswalk below links NSF's five budget accounts to its PEOPLE, IDEAS, and TOOLS strategic outcome areas. The funds within the Research and Related Activities and Education and Human Resources accounts are distributed among the three NSF outcome areas. The allocation of funds in these two accounts to the conceptual PEOPLE, IDEAS, or TOOLS area is made on a program-by-program basis.

FY 2004 BUDGET & PERFORMANCE INTEGRATION

(Estimated Millions of Dollars)

	STRATEGIC OUTCOME			
Account	PEOPLE	IDEAS	TOOLS	A&M
Research and Related Activities	388	2,557	1,120	42
Education and Human Resources	765	139	19	15
Major Research Equipment and Facilities Construction	0	0	202	0
Salaries & Expenses	0	0	0	226
Office of the Inspector General	0	0	0	9
Total[a]	$1,153	$2,696	$1,341	$291

[a] Numbers may not add due to rounding.

An additional crosswalk (below) provides further information on deployment of PEOPLE-IDEAS-TOOLS resources among individual budget activities associated with NSF's nine directorates and offices. It also provides an estimate of the Administration & Management (A&M) operating support required for each directorate. The FY 2004 A&M request of $291 million provides support for salaries and benefits of NSF employees; general operating expenses, including key activities related to human capital and information management systems; and audit and Inspector General activities.

PROGRAMMATIC CROSSWALK FOR FY 2004 STRATEGIC OUTCOMES

(Estimated Millions of Dollars)

	STRATEGIC OUTCOME				
	PEOPLE	IDEAS	TOOLS	Administration & Management	Total[b]
Biological Sciences	51	448	59	4	562
Computer and Information Science and Engineering	57	354	166	7	584
Engineering	83	435	11	7	537
Geosciences	37	395	248	8	688
Mathematical and Physical Sciences	125	670	260	6	1,061
Social, Behavioral and Economic Sciences	15	151	40	5	212
Office of Polar Programs	6	78	241	4	330
Integrative Activities	14	24	94	0	132
Education and Human Resources	765	139	19	15	938
Other[a]	0	0	202	234	437
Total[b]	$1,153	$2,696	$1,341	$291	$5,481

[a] Other budget items include Major Research Equipment and Facilities Construction ($202 million, Tools); Salaries and Expenses ($226 million, Administration and Management); and Office of Inspector General ($9 million, Administration and Management).

[b] Numbers may not add due to rounding.

Among NSF's strategies to further enhance *alignment* of budget and program goals is reexamination of its existing account structures – in the context of updating the NSF GPRA Strategic Plan. NSF recognizes that this effort requires attention to the Foundation's Strategic Plan and consideration of organizational alignment, distribution of budgetary resources, and the allocation of costs both to organizations and to outcomes. The expected added value to NSF managers is central in identifying areas to examine and in deciding whether to add or change existing structures.

The *full budgetary cost* criterion focuses on integrating the cost of program outputs and outcomes with performance. NSF is continuing to develop and refine methodology for allocating full budgetary cost to "programs" (see the section entitled "Full Budgetary Costing" in NSF's FY 2004 Budget Request to Congress). In addition, it is directly addressing cost efficiencies related to individual administrative functions and changing aspects of the functions as appropriate in order to generate cost savings. The FY 2004 GPRA goal – to calculate cost savings from utilizing videoconferencing in place of certain travel – is the first step in quantifying potential cost efficiencies associated with one such function. In addition, the resource sections associated with selected agency management goals provide an initial attempt to address the cost issue more broadly.

NSF recently engaged the services of an external management-consulting firm, PricewaterhouseCoopers Consulting, to conduct an integrated performance, cost, and budget strategy assessment, with the intent of obtaining different scenarios to meet our growing requirements in this arena. This study included a best practices survey of public and private enterprises, and input from NSF senior staff on financial and performance information needed for management and budgetary decisions. NSF senior management are evaluating the results of the study to determine the most appropriate and useful cost and performance information to develop and monitor.

GAO's analysis of FY 2002 agency progress in linking plans and budgets (GAO 02-236, January 2002) concluded that NSF was among the group of agencies that "linked program activities to performance goals, showed funding levels needed to achieve goals, and allocated funding from program activities to performance goals . . . the first step in defining the performance consequences of a budget decision." That report also noted that "agencies' initial efforts to link performance plans to their statements of net costs are encouraging and improving." NSF's FY 2001 Accountability Report was its first where the Statement of Net Costs aligned administrative costs with the strategic outcome goals.

C. MEANS AND STRATEGIES

The means and strategies NSF uses to accomplish its mission of promoting the progress of science and engineering research and education have both process-based and programmatic components. The Strategic Plan identifies three *process-based strategies* – developing intellectual capital (i.e., investing in projects that enhance individual and collective capacity to perform), integrating research and education (i.e., investing in projects that infuse learning with the excitement of discovery), and promoting partnerships (i.e., investing in projects that optimize the impact of PEOPLE, IDEAS, and TOOLS on the economy and on society) – that span all NSF activities. They guide the agency in establishing priorities, identifying opportunities, and designing new programs and activities.

Programmatic strategies focus on specific NSF programs and activities, and on the funding needed to support them. These activities reflect the Foundation's funding priorities. They show how the agency balances its highly targeted investments with its broad-based, disciplinary support in order to address workforce issues, maintain the nation's capacity to produce new discoveries, and identify areas of unmet opportunities in which future investments will be productive.

The Strategic Plan gives priority to: (1) support for competitive investigator-initiated research and education along a broad, expanding frontier of science and engineering; (2) identification of and support for "unmet opportunities" that will strengthen and cross-fertilize the science and engineering disciplines and that promise significant future payoffs for the nation; and (3) emphasis on several "transcendent" areas of emerging opportunity that enable research and education across a broad frontier of science and engineering. The transcendent areas identified in the Strategic Plan are Information Technology, Biocomplexity in the Environment, Nanoscale Science and Engineering, and 21st Century Workforce.

D. CROSS-CUTTING ACTIVITIES

Collaboration and partnerships between disciplines and institutions and among academe, industry, and government encourage the transfer of people, ideas, and tools throughout the public and private sectors. NSF's Strategic Plan (Appendix 4) emphasizes the importance of partnerships as a core strategy for enabling Foundation activities. While NSF participates in a wide range of cross-cutting activities, the agency has chosen to highlight its contributions only in areas related to FY 2004 interagency research and development priorities identified by the Office of Science and Technology Policy and the Office of Management and Budget. These include:

- **Networking and Information Technology Research & Development (NITRD):** Networking and computing technologies are increasingly important technologies for the American economy, national and homeland security, and progress across science and engineering. The most recent government-wide plan for research in this area is available at http://www.ccic.gov. In FY 2004, NSF will emphasize investments that support improving the security of computer, network and information systems; begin to develop a new cyberinfrastructure to enable science and engineering disciplines to work more efficiently through shared instruments and data; advance computational, simulation, and data interpretation methods for more detailed analysis; and that advance computational methods for speech and language technologies.

- **National Nanotechnology Initiative (NNI):** This initiative holds great promise broadly across many scientific fields and most sectors of the economy. NSF emphasizes long-term fundamental research aimed at discovering novel materials, phenomena, processes and tools; addressing NNI Grand Challenges; supporting new interdisciplinary centers and networks of excellence, including shared user facilities; supporting research infrastructure; and addressing research and educational activities on the societal implications of advances in nanoscience and nanotechnology. Priority in funding will be given to: (1) research to enable the nanoscale as the most efficient manufacturing domain; (2) nanobiotechnology, and nanobiology for improving human performance; (3) innovative nanotechnology solutions to biological-chemical-radiological-explosive detection and protection; (4) the discovery, understanding and potential application of phenomena specific to the nanoscale; (5) development of new instrumentation and standards; (6) the education and training of the new generation or workers for the future industries; and (7) establishing of the National Nanotechnology Infrastructure Network (NNIN) for user facilities, development of new instrumentation, and training. The most recent information on NNI is available at http://www.nano.gov

- **Climate Change Science and Technology:** A key aspect of the Administration's science-based climate change policy is investment in research and development (R&D) that will address major climate policy decisions and provide a framework for understanding and addressing long-term climate change. NSF's areas of emphasis include understanding the Earth's carbon cycle, research on climate change risk management, and advancing our ability to model dynamic multivariate systems. Additional information on this initiative is available at http://www.usgcrp.gov/usgcrp/ccst.htm

- **Homeland Security and Antiterrorism R&D:** Data mining to support antiterrorism analysis requires the ability to construct patterns from multiple, heterogeneous, data sources, some of which occur as massive streaming data sources in multiple languages. NSF will support research on ways to identify portions of these data that should be saved for analysis, or that contain new information on a developing knowledge structure. Of equal importance, NSF will support research on sharing data across agencies and from data sets that are separated by policy and by law. In these circumstances, research will explore methods to share data that either preserve privacy or include "probable cause" as a part of the data representation to be enriched by mining. Additional efforts are being funded in management of knowledge-intensive, high technology organizations, bioterrorism countermeasures, biometrics, geospatial information fusion (particularly in epidemiology), and biological sensors and sensor networks.

- **Molecular-level Understanding of Life Processes:** The past few years have seen major advances in our ability to sequence, analyze, and utilize complex genomic information from plants, animals, and microorganisms. Coupling such sequence and structural data to modern computational power and new experimental approaches that permit molecular manipulation of biological systems has the potential to unravel the complexity of life at all structural levels. Sequence data has already proven itself to be critical for homeland security forensic purposes.

  Efforts such as the Interagency Microbe Project, a microbe sequencing and physiology effort (http://www.reeusda.gov/1700/funding/rfamgsp.htm); the Interagency Working Group on Metabolic Engineering (http://www.epa.gov/opptintr/metabolic/index.htm); the National Plant Genome Initiative (http://www.reeusda.gov/nri/pubs/plntgen.htm); and The Ecology of Infectious Diseases Program (http://www.nsf.gov/pubs/2003/nsf03507/nsf03507.html) all address fundamental patterns of molecular interactions which are reflected in function and behavior at the cellular, tissue, organismal, and population levels. NSF will focus on many of these areas; for instance, the 'Living Networks' area of emphasis will foster a molecular understanding of life at all levels of biological organization from genes to ecosystems. Other interdisciplinary programs such as the 'Frontiers in Integrative Biological Research' specifically seek the most innovative approaches to understanding the complexity and integration of life processes across all levels of organization.

- **Education Research:** Continuing as a high priority of the Administration, the No Child Left Behind (NCLB) Act of 2002 calls for research that enables the successful development and implementation of science-based programs and practices. Information on the government-wide Interagency Education Research Initiative is available at http://www.ed.gov/offices/OERI/IERI.

  NSF will emphasize research on science and math education, the development and evaluation of science and math materials and research on the assessment of science, mathematics and technology learning. NSF will also support innovations in the preparation and professional development of math and science teachers and, through the Centers for Learning and Teaching, will explore new ways to engage scientists, engineers and mathematicians in K-12 education as well as how to prepare the next generation of teacher educators. In addition, in cooperation with other federal agencies such as the Departments of Education and Commerce and the National Aeronautics and Space Administration, NSF will continue to support research on the effect of technology on learning and the development and evaluation of new approaches to the use of educational technology to support learning. Research on the science of learning and development of strategies to enhance the research community that can address learning and education questions will also be supported. NSF also manages the Math and Science Partnership. This program offers activities in teacher preparation and professional development, the development of linkages between K-12 and the professional science, technology, engineering and mathematics (STEM) communities and supports research on the impact of partnerships on educational outcomes. All MSP-funded projects contribute to the MSP Learning Network, a network of researchers and practitioners studying and evaluating promising strategies to improve K-12 student achievement and other student outcomes in mathematics and science. The MSP effort is itself a partnership between two federal agencies, the NSF and the U.S. Department of Education (ED), who have defined the program linkages necessary to manage this joint investment in mathematics and science education for the greatest effectiveness.

E. EXTERNAL FACTORS AFFECTING SUCCESS

External factors bearing on NSF's ability to achieve its strategic outcome goals are discussed in the Strategic Plan (Appendix 2). These factors stem largely from the fact that NSF does not conduct research and education activities directly (e.g., NSF does not manage its own laboratories) but supports awardees that do so. Circumstances of institutional partners in academe, the private sector, and the government affect how individuals and groups respond in both proposing and conducting research and education.

Additionally, NSF cannot regulate the current condition and quality of research and education facilities and platforms throughout the country, even though it may support the infrastructure. Other factors beyond NSF's control include appropriations, indirect cost rates, government-wide policies, inflation, the budget and plans of other R&D agencies, the uncertainty and risk inherent in research, the availability of technology and the pace of technological innovation.
NSF's influence and leadership extends well beyond its budget. Given its unique role, NSF brings together diverse elements of the larger science and engineering community to achieve its mission. This positions the agency to: (1) establish partnerships that leverage funds and (2) provide leadership that catalyzes new directions for research and education.

II. SUMMARY TABLE

FY 2004 GPRA PERFORMANCE GOALS

NSF's performance goals for FY 2004 are organized in two categories:

- Strategic Outcome Goals (rationale, measurement approach, and baseline information provided in Section III); and
- Management Goals (rationale, measurement approach, and baseline information provided in Section IV).

FY 2004 GPRA PERFORMANCE GOALS

STRATEGIC OUTCOME GOALS	NO.	ANNUAL PERFORMANCE GOALS[A]	FY 2004 AREAS OF EMPHASIS — PROSPECTIVE REPORTING: INVESTMENTS IN EMERGING OPPORTUNITIES	RETROSPECTIVE REPORTING, AS RELEVANT
PEOPLE **Developing "a diverse, internationally competitive and globally engaged workforce of scientists, engineers, and well-prepared citizens."**	**III-1**	***NSF's performance for the PEOPLE Strategic Outcome is successful when, in the aggregate, results reported in the period demonstrate significant achievement in the majority of the following indicators:*** • Development of well-prepared researchers, educators or students whose participation in NSF activities provides experiences that enable them to explore frontiers or challenges of the future; • Contributions to development of a diverse workforce through participation of underrepresented groups[B] in NSF activities; • Development or implementation of other notable approaches or new paradigms[C] that promote progress toward the PEOPLE outcome goal.	❑ Math and Science Partnership ❑ Priority Area: - Workforce for the 21st Century ❑ Graduate Student Support	❑ PreK-12 Education, e.g., - Systemic Reform ❑ Undergraduate Education, e.g., - REU ❑ Graduate and Professional Development, e.g., - IGERT - GK-12 - CAREER ❑ Centers for Learning and Teaching (CLT) ❑ Broadening Participation, e.g., - Partnerships for Innovation - Historically Black Colleges and Universities – Undergraduate Program - Louis Stokes Alliances for Minority Participation

A These performance goals are stated in the alternative form provided for in GPRA legislation.
B For example, women, underrepresented minorities, persons with disabilities or underserved institutions.
C For example, broad-based, program-wide results that demonstrate success related to improved math and science performance for preK-12 students, or professional development of the STEM instructional workforce, or enhancement of undergraduate curricular/laboratory/instructional infrastructure, or highly synergistic education and research activities, or international collaborations, or communication with the public regarding science and engineering.

FY 2004 GPRA PERFORMANCE GOALS (CONTINUED)

STRATEGIC OUTCOME GOALS	NO.	ANNUAL PERFORMANCE GOALS[A] (CONTINUED)	FY 2004 AREAS OF EMPHASIS — PROSPECTIVE REPORTING: INVESTMENTS IN EMERGING OPPORTUNITIES	FY 2004 AREAS OF EMPHASIS — RETROSPECTIVE REPORTING, AS RELEVANT
IDEAS **Enabling "discovery across the frontier of science and engineering, connected to learning, innovation, and service to society."**	**III-2**	***NSF's performance for the IDEAS Strategic Outcome is successful when, in the aggregate, results reported in the period demonstrate significant achievement in the majority of the following indicators:*** • Discoveries that expand the frontiers of science, engineering, or technology; • Connections between discoveries and their use in service to society; • Partnerships that enable the flow of ideas among the academic, public or private sectors; • Leadership in fostering newly developing or emerging areas.	❑ Priority Areas: - Biocomplexity in the Environment - Information Technology Research - Nanoscale Science and Engineering - Mathematical Sciences - Human and Social Dynamics ❑ Core research and education activities ❑ Science of Learning Centers	❑ Balance of portfolio, including projects that are innovative, high-risk, or multidisciplinary ❑ Priority Areas: e.g., Current - Biocomplexity in the Environment - Information Technology Research - Nanoscale Science & Engineering Former - Life & Earth's Environment - Information Technology for the 21st Century - Knowledge & Distributed Intelligence ❑ Core research and education activities ❑ Centers, e.g., - STCs, ERCs, MRSECs. ❑ EPSCoR

A These performance goals are stated in the alternative form provided for in GPRA legislation.

FY 2004 GPRA PERFORMANCE GOALS (CONTINUED)

STRATEGIC OUTCOME GOALS	NO.	ANNUAL PERFORMANCE GOALS[A] (CONTINUED)	FY 2004 AREAS OF EMPHASIS PROSPECTIVE REPORTING: INVESTMENTS IN EMERGING OPPORTUNITIES	RETROSPECTIVE REPORTING, AS RELEVANT
TOOLS **Providing "broadly accessible, state-of-the-art and shared research and education tools."**	***III-3***	***NSF's performance for the TOOLS Strategic Outcome is successful when, in the aggregate, results reported in the period demonstrate significant achievement in the majority of the following indicators:*** • Development or provision of tools[D] that enables discoveries or enhances productivity of NSF research or education communities; • Partnerships with local, state or federal agencies, national laboratories, industry or other nations to support and enable development of large facilities or other infrastructure; • Development or implementation of other notable approaches or new paradigms[E] that promote progress toward the TOOLS outcome goal.	❑ Major Research Equipment and Facilities Construction (MREFC) ❑ Cyberinfrastructure ❑ Science Resources Statistics (SRS) Survey Redesign	❑ Major Research Equipment and Facilities Construction ❑ Major Research Instrumentation (MRI) Program ❑ Science and Engineering policy analyses, information, reports and databases ❑ Scientific databases and tools for using them, including the National STEM Education Digital Library

A These performance goals are stated in the alternative form provided for in GPRA legislation.

D For example, includes research and education infrastructure such as large centralized facilities, or integrated systems of leading-edge instruments, or databases, or widely utilized, innovative computational models or algorithms, or information that provides the basis for a shared-use networked facility.

E For example, broad-based, program-wide results that demonstrate success related to management/utilization of large data sets/information bases, or development of information and policy analyses, or use of the Internet to make STEM information available to NSF research or education communities, or exceptional examples of broadly accessible tools shared by NSF research and education communities.

FY 2004 GPRA PERFORMANCE GOALS (CONTINUED)

PERFORMANCE AREA	NO.	ANNUAL PERFORMANCE GOALS FOR MANAGEMENT
Proposal and Award Management		
Use of Merit Review	IV-1	At least 85 percent of basic and applied research funds will be allocated to projects that undergo merit review.
Implementation of Merit Review Criteria – Reviewers	IV-2	At least 70 percent of reviews with written comments will address aspects of both review criteria.
Implementation of Merit Review Criteria – Program Officers	IV-3	For at least 90 percent of decisions to fund or decline proposals, Program Officers will comment on aspects of both review criteria.
Customer Service – Time to Prepare Proposals	IV-4	Ninety-five percent of program announcements will be publicly available at least three months prior to the proposal deadline or target date.
Customer Service – Time to Decision	IV-5	For 70 percent of proposals, be able to inform applicants whether their proposals have been declined or recommended for funding within six months of deadline or target date, or receipt date, whichever is later.
Efficiency – Award Size	IV-6	NSF will increase the average annualized award size for research grants to $128,000.
Efficiency – Award Duration	IV-7	The average duration of awards for research grants will be 3.0 years.
Facilities – Construction and Upgrade	IV-8	For ninety percent of construction, acquisition and upgrade projects, keep any negative cost and schedule variances to less than 10 percent of the approved project plan.
Facilities – Operations & Management	IV-9	For ninety percent of operational facilities, keep scheduled operating time lost to less than 10 percent.
Business Practices		
Cost Efficiency – Videoconferencing	IV-10	NSF will assess the cost efficiencies associated with administrative processes. Performance Indicator: - Calculation of the agency-wide cost savings realized by the use of videoconferencing.
Electronic Business	IV-11	NSF will continue to integrate its internal electronic grants process with the E-government initiative. Performance Indicators: - 90 percent of program announcements will be posted to Fed Grants. - 75 percent of declined proposals will be processed using E-decline signatures.
Security Program – Information Technology & Physical Security	IV-12	NSF will maintain and enhance the agency-wide security program to ensure adequate protection of NSF's infrastructure and critical assets. Performance Indicators: - 95 percent of NSF's major systems will achieve Level 3 compliance in accordance with the NIST Security Self-Assessment Framework. - Implementation of a "Smart ID" pilot to provide staff with a standard identification card for authentication and access control.

FY 2004 GPRA Performance Goals (continued)

Performance Area	No.	Annual Performance Goals for Management (Continued)
Human Capital		
NSF Staff – Diversity	IV-13	NSF will ensure that diversity considerations are embedded in activities related to agency staffing of scientists and engineers. Performance Indicator: - NSF will complete development of the NSF S&E diversity plan initiated in FY 2003 and begin implementation of its recommendations.
NSF Staff – Diversity	IV-14	NSF will show an increase over FY 2000 in the total number of appointments to NSF science and engineering staff and management from underrepresented groups.
Workforce Learning	IV-15	The NSF Academy will develop a broad array of competency-based learning opportunities that will enable all staff to perform critical functions supporting NSF's vision and goals. Performance Indicators: - Identification of staff requiring Facilities / Center Project Management training. - Initiation of development of a curriculum that leads to certification in Facilities / Center Project Management.
Workforce Planning	IV-16	NSF will develop competency-based occupation classification alternatives that support the agency's strategic business processes and capitalize on its technology enabled business systems. Performance Indicators: - Identification of workforce competencies needed to support the majority of NSF's strategic business processes. - Development of new positions or revision of position descriptions in order to address emerging business process requirements.

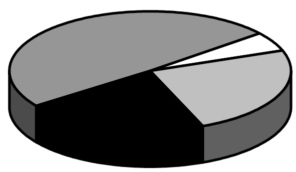
III. GOALS FOR STRATEGIC OUTCOMES

NSF has developed performance goals with descriptive standards to evaluate the results of its investments in research and education, per the GPRA option to set performance goals in an alternative form.

A. PEOPLE STRATEGIC OUTCOME GOAL

STRATEGIC OUTCOME GOAL III-1: Developing "a diverse, internationally competitive and globally engaged workforce of scientists, engineers, and well-prepared citizens."

21%



PEOPLE = $1,153 M

NSF's investments in PEOPLE enable the Foundation to meet its mission of promoting the progress of science, while facilitating the creation of a diverse, internationally competitive and globally engaged workforce of scientists, engineers and well-prepared citizens. In order to achieve the PEOPLE strategic outcome, NSF supports formal and informal science, technology, engineering and mathematics (STEM) education at all levels – preK-12, undergraduate, and graduate – as well as professional development of faculty and teachers and public science-literacy projects that engage people of all ages in life-long learning. The Foundation also supports programs specifically designed to promote the integration of research and education, such as the Integrative Graduate Education and Research Traineeship Program (IGERT), Research Experiences for Undergraduates (REU) and the Faculty Early Career Development Program (CAREER). In partnership with the research and education community, state and local education agencies, civic groups, industry, and parents, NSF fosters the continued development of research-informed, standards-based STEM education at all levels.

FY 2004 Performance Goal III-1: NSF's performance is successful when, *in the aggregate*, results reported in the period demonstrate significant achievement in the majority of the following indicators:

- Development of well-prepared researchers, educators or students whose participation in NSF activities provides experiences that enable them to explore frontiers or challenges of the future;
- Contributions to development of a diverse workforce through participation of underrepresented groups[2] in NSF activities;
- Development or implementation of other notable approaches or new paradigms[3] that promote progress toward the PEOPLE outcome goal.

Comparison to FY 2003 Goal: This goal is identical to the FY 2003 performance goal.

Baseline: Goal III-1 was a new performance goal for FY 2001. NSF was successful in achieving this goal in FY 2001 and in FY 2002.

[2] For example, women, underrepresented minorities, persons with disabilities or underserved institutions.

[3] For example, broad-based, program-wide results that demonstrate success related to improved math and science performance for preK-12 students, or professional development of the STEM instructional workforce, or enhancement of undergraduate curricular/laboratory/instructional infrastructure, or highly synergistic education and research activities, or international collaborations, or communication with the public regarding science and engineering.

Means and Strategies for Success:

Related to process – continue to:

- Support, through merit-based grants and cooperative agreements, the most promising and capable individuals and groups throughout the U.S.;
- Pay particular attention to development of people beginning careers in science and engineering;
- Use all aspects of NSF activity to embed diversity in the science and engineering workforce;
- Maintain existing partnerships and explore opportunities for developing new partnerships that focus on broadening participation. These include making presentations at national and regional meetings involving minority-serving organizations and at formal campus meetings of NSF programs (e.g., EPSCoR and LSAMP);
- Focus on (a) preparation and professional development of teachers of mathematics and science; and (b) alignment of standards, rigorous curricula and assessments;
- Support production of well-trained researchers and educators by providing a variety of NSF activities (e.g., programs with industry; NSF centers) to afford interactive research and education opportunities for students, post-doctoral scientists and faculty at all career stages;
- Support approaches that integrate research and learning activities, encourage the partnering of the K-12 and higher education communities and develop intellectual capital;
- Encourage attendance at international meetings, faculty/student exchange opportunities, and research utilizing international facilities and field/logistics centers in order to further the engagement of the NSF community in international activities; and
- Promote increased linkages between formal programs and informal activities such as those involving museum and science center exhibits, public fora, or the Internet in order to communicate with the public.

Related to programs:

- Provide grants of sufficient size and duration to improve the efficiency of the research process.
- Provide financial support for activities specifically addressing the PEOPLE strategic outcome. For FY 2004 the budget request is about $1,153 million, an increase of $66 million over the FY 2003 request of $1,087 million. Major components of the Foundation's investments in PEOPLE focus on investments in programmatic activities related to (1) K-12 education, (2) undergraduate education, and (3) graduate and professional development. EHR provides a major focus for much of NSF's education and workforce investments; however, these efforts are integrated with complementary activities across the Foundation.
- Support programmatic themes highlighted in the section labeled FY 2004 Areas of Emphasis (discussed in the NSF Budget Request, detailed below and listed in the table in Section II.)

FY 2004 Areas of Emphasis:

Math and Science Partnership (MSP): The Math and Science Partnership, a program for which the first awards were made in FY 2002, is a national effort to unite higher education with schools and school districts to raise student achievement in mathematics and science. MSP plays an important role in the Presidential education initiative, *No Child Left Behind*. The program supports promising partnerships of institutions of higher education (especially faculty members in mathematics, science and/or engineering), schools and school districts, and other key stakeholders to engage in evidence-based activities designed to increase student participation and success in advanced mathematics and science, and to improve quality, quantity and diversity in the teacher workforce. Successful MSP projects will serve as models for educational partnerships. The program also supports research, evaluation and technical assistance of all aspects of the MSP program in order to build the knowledge base of what works, where it works and why it works. The requested FY 2003 funding level is $200 million and the FY 2004 request level is $200 million. The MSP effort is itself a partnership between two federal agencies, the NSF and the U.S. Department of Education (ED), who have defined the program linkages necessary to manage this joint investment in mathematics and science education for the greatest effectiveness.

- *Workforce for the 21st Century:* For the next five years, NSF will develop an integrated research and education effort to address science and engineering workforce needs. The primary goals of this effort are to prepare scientists, mathematicians, engineers, technologists and educators capable of meeting the challenges of the 21st century; to attract more U.S. students to science and engineering fields; and to broaden participation in science and engineering fields. To achieve these goals, three integrative investments will be pursued. Beginning in FY 2004, Integrative Institutional Collaborations will enable institutions to develop complementary activities that weave together, vertically integrate, and augment support from existing programs, creating a seamless route of advancement for students from the K-12 through post-doctoral levels. Workforce Research will promote study of the factors that influence career choices; analyze the quality and productivity of the pathways that students use to prepare for science and engineering careers or advance in their careers; and evaluate programs designed to increase and broaden participation in science, mathematics, and engineering areas at all levels. In future years, support will be added for Faculty for the Future, which will support development of innovative approaches to the education of new K-12 and higher education faculty, particularly those aimed at attracting and retaining members of underrepresented groups, and will provide early and mid-career faculty at Minority-Serving Institutions with research-based faculty development opportunities in laboratories at research-intensive universities. (Request = $9 million)

- Increasing *Graduate Student Stipends* is one strategy to attract more U.S. citizens, nationals, and permanent residents into graduate education in science and engineering. The stipend for NSF fellows and trainees for the 2003-2004 academic year is $25,000. In the 2004-2005 academic year, NSF will increase stipends for its Graduate Research Fellowships (GRF), NSF Graduate Teaching Fellows in K-12 Education (GK-12), and Integrative Graduate Education and Research Traineeships (IGERT) fellows to $30,000. The number of students supported will increase to about 5,000.

- *Other*, for Retrospective reporting:
  - PreK-12 Education: This area of emphasis includes educational systemic reform initiatives such as Rural Systemic Initiatives (RSI) and the Urban Systemic Program (USP).
  - Undergraduate Education: This area includes the Research Experiences for Undergraduates (REU) Program as well as programs enhancing undergraduate curricular, laboratory, and instructional infrastructure, and those supporting the undergraduate instruction of students traditionally underrepresented in the science, engineering, and technological workforce.
  - Graduate and Professional Development: Examples include IGERT and GK-12. IGERT meets the need for a cadre of broadly prepared Ph.D.s by sponsoring development of innovative, interdisciplinary, research-based graduate education and training programs in Ph.D.-granting institutions. GK-12 places graduate and advanced undergraduate students in K-12 schools to serve as science and mathematics content resources for teachers and as role models for young students.
  - The Faculty Early Career Development (CAREER) program supports early-career faculty within the context of their overall career development. It combines research support and education of the highest quality in a single program. (Request = $128 million.)
  - The Partnerships for Innovation (PFI) program focuses on connections between new knowledge created in the discovery process and learning and innovation. The goals of the program are: (1) to stimulate the transformation of knowledge created by the national research and education enterprise into innovations; (2) to broaden the participation of all types of academic institutions

and all citizens in NSF activities to more fully meet the workforce needs of the national innovation enterprise; and (3) to create the associated enabling infrastructure. (Request = $10 million.)

> The Historically Black Colleges and Universities Undergraduate Program provides awards to enhance the quality of undergraduate STEM programs through curricular reform and enhancement, faculty development, research experiences for undergraduates, upgrading of scientific instrumentation, and improvement of research infrastructure. (Request = $20 million.)

> The Louis Stokes Alliances for Minority Participation (LSAMP) program strengthens and encourages STEM baccalaureate degree production of students from underrepresented populations by utilizing the knowledge, resources, and capabilities of a broad range of organizations from the academic, federal, and commercial sectors. The effectiveness of LSAMP is demonstrated by significant increases in the number of minority students in STEM fields earning baccalaureate degrees. (Request = $33 million.)

Data Sources Used in External Assessment Process: Examples of relevant information include student, teacher and faculty participants in NSF activities; demographics of participants; descriptions of student involvement; education and outreach activities under grants; demographics of science and engineering students and the S&E workforce; number and quality of educational models, products and practices; number and quality of teachers trained; student outcomes including enrollments in mathematics and science courses, retention, achievement, and science and mathematics degrees received; press releases, and scientific publications.

This information may be included in PI project reports (annual and final), program / division / directorate annual reports, agency internal collections, formal external evaluations or special studies, or internal / external information systems.

These sources of information may be utilized in Committees of Visitors reports and in the report of the Advisory Committee for GPRA Performance Assessment (AC/GPA).

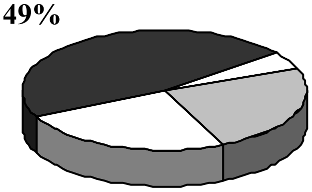
Data Sources for Determining Results: Independent assessments and external third-party evaluations, including the AC/GPA report that assesses performance using the GPRA alternative form; external reports from awardees; internal and external information systems and external studies; and independently maintained databases.

Criteria for success are presented in the performance goal statement.

Data Limitations: Qualitative information requires the judgment of experts; the substance and timing of outcomes from research and education activities are unpredictable; some external databases are not under agency control; long-term data is needed to assess the ultimate impact of outcomes; there is a potential for self-reporting bias.

B. IDEAS STRATEGIC OUTCOME GOAL

STRATEGIC OUTCOME GOAL III-2: Enabling "discovery across the frontier of science and engineering, connected to learning, innovation, and service to society."



IDEAS = $2,696 M

Investments in IDEAS support cutting-edge research that yields new and important discoveries and promotes the development of new knowledge and techniques within and across traditional boundaries. These investments enable the Foundation to meet its mission of promoting the progress of science – while at the same time helping to maintain the nation's capacity to excel in science and engineering, particularly in academic institutions. The results of NSF-funded research projects provide a rich foundation for broad and useful applications of knowledge and the development of new technologies. Support in this area also promotes the education and training of the next generation of scientists and engineers by providing them with an opportunity to participate in discovery-oriented projects.

FY 2004 Performance Goal III-2: NSF's performance is successful when, *in the aggregate*, results reported in the period demonstrate significant achievement in the majority of the following indicators:

- Discoveries that expand the frontiers of science, engineering, or technology;
- Connections between discoveries and their use in service to society;
- Partnerships that enable the flow of ideas among the academic, public or private sectors;
- Leadership in fostering newly developing or emerging areas.

Comparison to FY 2003 Goal: This goal is identical to the FY 2003 performance goal.

Baseline: Goal III-2 was a new performance goal for FY 2001. NSF was successful in achieving this goal in FY 2001 and in FY 2002.

Means and Strategies for Success:

Related to process – continue to:

- Support the most promising ideas through merit-based grants and cooperative agreements to individual researchers and groups, in partnership with colleges, universities, and other institutions – public, private, state, local, and federal – throughout the U.S.;
- Make awards focused on discoveries that create or have potential for use in service to society;
- Encourage partnerships and cooperative research efforts – among disciplines, in different sectors, and across international boundaries;
- Take informed risks in emerging research areas where consensus on appropriate directions (e.g., theory, methodology, or knowledge) is just beginning to form;
- Partner with a diverse range of investigators (e.g., new, minority) and institutions (e.g., research universities, community colleges, EPSCoR states, minority-serving institutions);
- Identify and support major cross-disciplinary priority areas where U.S. and NSF leadership are important;
- Identify and provide support for new and emerging opportunities;

- Develop and support a high-quality, balanced award portfolio that considers disciplines and fields, interdisciplinary research areas, and emerging opportunities; and
- Utilize the NSF core strategies of integrating research and education, promoting partnerships, and developing intellectual capital.

Related to programs:

- Provide grants of sufficient size and duration to improve the efficiency of the research process.
- Provide financial support for programs specifically addressing the IDEAS strategic outcome. For FY 2004, this investment totals about $2,696 million, an increase of $137 million over the FY 2003 request of $2,559 million. Investments in research grants and centers are the principal components of NSF's investments in IDEAS. The FY 2004 request continues to support core disciplinary research and education across the NSF.
- Support programmatic themes highlighted in the section labeled FY 2004 Areas of Emphasis (discussed in the NSF Budget Request, highlighted below and listed in the table in Section II). These themes focus on aspects of the entire NSF portfolio and on priority areas that hold exceptional promise to advance knowledge.

FY 2004 Areas of Emphasis:

- *Priority Areas:*
  - > *Biocomplexity in the Environment* (BE) became a priority area in FY 2000. Study of complex environmental systems is a key element of local, national and global security and is critical to the development of new scientific and technological capabilities that will significantly advance our ability to anticipate environmental conditions and thus improve environmental decision-making. The BE priority area is designed to give NSF the capability to respond to the demand for new approaches to investigating the interactivity of biota and the environment. Activities in this area for FY 2004 will emphasize microbial genome sequencing, ecology of infectious disease, dynamics of coupled natural and human systems, coupled biogeochemical cycles, genome-enabled environmental sciences and engineering, instrumentation development for environmental activities, and materials use: science, engineering and society. (Request = $100 million).
  - > *Information Technology Research* (ITR) is an NSF priority area whose aim is to extend the frontiers of IT, improve our understanding of IT and its impacts on our society, and help prepare Americans for the Information Age. ITR is a collaboration across NSF's activities and is coordinated as part of NSF's participation in the multi-agency NITRD effort. In FY 2004, ITR will exploit and deepen the research initiated to this point and will continue to expand research in multidisciplinary areas, focusing on fundamental research that will lead to profound insights about our physical, biological and social world; it will continue to support research to enable the wide and secure deployment of pervasive IT through new classes of ubiquitous applications, the creation of new paradigms to achieve high-levels of trust in cyberspace and the development of new tools and methods to enhance our national security and critical infrastructure protection. (Request = $303 million).
  - > *Nanoscale Science and Engineering (NSE)* is supported in conjunction with the multi-agency National Nanotechnology Initiative (NNI). NSF is emphasizing long-term, fundamental research aimed at discovering novel phenomena, processes, and tools; addressing NNI Grand Challenges; supporting new interdisciplinary centers and networks of excellence including shared user facilities; supporting research infrastructure; and addressing research and educational activities on the societal implications of advances in nanoscience and nanotechnology. This investment will be expanded in FY 2004 to develop and strengthen critical fields (including nanobiotechnology, manufacturing at the nanoscale, and education) to

establish the science and engineering infrastructure and workforce needed to exploit the opportunities presented by these new capabilities. (Request = $249 million.)

> *Mathematical Sciences.* For FY 2004 NSF is continuing this priority area in order to strengthen the mathematical foundations of science and society. The fundamental mathematical sciences – embracing mathematics and statistics – are essential not only for the progress of research across disciplines, they are also critical to training a mathematically literate workforce for the future. FY 2004 areas of emphasis for this priority area include: fundamental mathematical and statistical sciences, advancing interdisciplinary science and engineering, mathematical and statistical challenges posed by large data sets, managing and modeling uncertainty, modeling complex nonlinear systems, and advancing mathematical sciences education. (Request = $89 million.)

> *Human and Social Dynamics.* This priority area seeks to better understand the causes and ramifications of change, to increase our collective ability to anticipate the complex consequences of change (cultural, scientific and technological, economic, individual, political, and social), to better understand the dynamics of the human mind, to better understand the cognitive and social structures that create and define change, and to help people and organizations better manage profound or rapid change. For FY 2004 NSF will focus research on enhancing human performance through integration of nanotechnology, biotechnology, infotechnology and cognitive science, decision-making under uncertainty, agents of change, modeling human and social dynamics, spatial social science and instrumentation and data resource development (Request = $24 million.)

- *Core Research and Education Activities*: NSF will continue to invest in core research activities and education opportunities evolving from prior investments in disciplinary and interdisciplinary research. These ongoing activities build strength in the science and engineering (S&E) disciplines, enable the development of new and emerging fields, and provide leadership to improve the health and continued vitality of the nation's STEM education. Examples of specific core activities for FY 2004 include 21st Century Biology, sensor technology, fundamental research on environmental issues, CyberTrust Security research, microbial genome sequencing, renewed support for research and infrastructure in the physical sciences and continued funding for EPSCoR.

- *Science of Learning Centers.* The SLC program creates multidisciplinary, multi-institutional Centers to expand our understanding of learning through research on the learning process, the context of learning and learning technologies, leading to enhanced understanding of how people think and learn. SLCs will serve as national "learning" resources, and will play a critical role in developing a broad base of research that will inform our approach to national educational and workforce challenges. The SLC investment will support a diverse portfolio of projects, providing leadership across a broad range of science and engineering approaches, including research that will speak to and learn from educational reform, workforce development, and the linkage of educational strategies to economic development, and add generally to the knowledge base in cognition. (Request = $20 million.)

- *Other*, for Retrospective reporting:

> Balance of portfolio: Focuses on development of an award portfolio that is balanced with respect to support for: emerging opportunities; involvement of new investigators and members of underrepresented groups; and projects characterized as high-risk, multidisciplinary, or innovative. High-risk research is exploratory in nature – there is often a lack of experimental data or methodologies, little consensus on theory, information and/or approach, and a significant probability of failure associated with the research. If successful, such high-risk research could result in significant scientific or technological advances.

> Life and Earth's Environment (LEE) is a former area of emphasis that encompassed a wide range of activities designed to foster research on the complex interdependencies among living organisms and the environments which affect, sustain and are modified by them.
> The Information Technology for the 21st Century (IT^2) initiative addressed issues and concerns raised by the President's Information Technology Advisory Committee (PITAC) in its 1999 report. Past investments focused on software systems, high-end computing, the impacts of information technologies and terascale computing systems.
> Knowledge and Distributed Intelligence (KDI) is a former area of emphasis that aimed to improve our ability to discover, collect, represent, transmit and apply information. It included activities such as research on knowledge networking, learning and intelligent systems, new challenges to computation, and next generation Internet.
> Centers (e.g., STCs, ERCs, MRSECs). Science and Technology Centers (STCs) are university-based research efforts that foster a new collaborative culture among researchers and educators at all levels in academia, industry, government laboratories and other public and private organizations. They provide an opportunity to explore challenging and complex research problems that often require interdisciplinary expertise and high-risk approaches, access to state-of-the-art instrumentation and facilities, and a commitment of high levels of support for sustained periods of time.
> Experimental Program to Stimulate Competitive Research (EPSCoR). Through its EPSCoR program NSF works with state governments, higher education institutions and businesses to improve the academic research infrastructure and national R&D competitiveness in states that have historically received lesser amounts of federal academic R&D funding.

Data Sources used in External Assessment Processes: Examples of relevant information include published and disseminated results, including journal publications, books, software, and audio or video products created; contributions within and across disciplines; organizations of participants and collaborators (including collaborations with industry); contributions to other disciplines, infrastructure, and beyond science and engineering; use beyond the research group of specific products, instruments, and equipment resulting from NSF awards; and the role of NSF-sponsored activities in stimulating innovation and policy development.

This information may be included in PI project reports (annual and final), program / division / directorate annual reports, agency internal collections, formal external evaluations or special studies, press releases, scientific publications, or internal / external information systems.

These sources of information may be utilized in Committees of Visitors reports and in the report of the Advisory Committee for GPRA Performance Assessment (AC/GPA).

Data Sources for Determining Results: Primary sources include formal external third-party evaluations, such as the AC/GPA report that assesses performance using the GPRA alternative form, external databases and reports from awardees, and independent assessments.

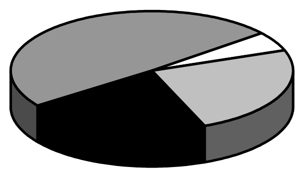
Criteria for success are presented in the performance goal statement.

Data Limitations: Qualitative information requires the judgment of experts; the substance and timing of outcomes from research and education activities are unpredictable; external databases are not under agency control; long-term data is needed to assess the ultimate impact of outcomes; there is a potential for self-reporting bias.

C. TOOLS STRATEGIC OUTCOME GOAL

STRATEGIC OUTCOME GOAL III-3: Providing "broadly accessible, state-of-the-art and shared research and education tools."

25%



TOOLS = $1,341 M

As the issues researchers face increasingly involve phenomena at or beyond the limits of our measurement capabilities, their study requires the use of new generations of powerful tools. Examples of such tools include instrumentation and equipment needed by individual investigators in the conduct of their research, multi-user facilities, digital libraries, accelerators, telescopes, research vessels and aircraft and earthquake simulators. In addition, funding devoted to the TOOLS strategic outcome area provides resources needed to support large surveys and databases as well as computational and computing infrastructures for all fields of science, engineering, and education.

NSF provides support for large multi-user facilities that meet the need for state-of-the-art, world-class research platforms vital to new discoveries and the progress of research. NSF support may include construction, upgrades, operations, maintenance, and personnel needed to assist scientists and engineers in the conduct of research at such facilities. NSF consults with other agencies and international partners to avoid duplication and optimize capabilities for American researchers.

All of these investments enable the Foundation to meet its mission of promoting the progress of science, while responding specifically to direction in the NSF Act of 1950 to foster and support the development and use of computer and other scientific and engineering methods and technologies, primarily for research and education in the sciences and engineering.

FY 2004 Performance Goal III-3: NSF's performance is successful when, *in the aggregate*, results reported in the period demonstrate significant achievement in the majority of the following indicators:

- Development or provision of tools[4] that enables discoveries or enhances productivity of NSF research or education communities;
- Partnerships with local, state or federal agencies, national laboratories, industry or other nations to support and enable development of large facilities or other infrastructure;
- Development or implementation of other notable approaches or new paradigms[5] that promote progress toward the TOOLS outcome goal.

Comparison to FY 2003 Goal: This goal is identical to the FY 2003 goal.

[4] For example, includes research and education infrastructure such as large centralized facilities, or integrated systems of leading-edge instruments, or databases, or widely utilized, innovative computational models or algorithms, or information that provides the basis for a shared-use networked facility.

[5] For example, broad-based, program-wide results that demonstrate success related to management/utilization of large data sets/information bases, or development of information and policy analyses, or use of the Internet to make STEM information available to NSF research or education communities, or exceptional examples of broadly accessible tools shared by NSF research and education communities.

Baseline: Goal III-3 was a new performance goal for FY 2001. NSF was successful in achieving this goal in FY 2001 and in FY 2002.

Means and Strategies for Success:

Related to process – continue to:

- Support, through merit-based grants and cooperative agreements of sufficient size and duration, the most promising projects proposed by individual researchers and groups throughout the U.S.;
- Partner with other federal agencies, states, private organizations, national laboratories, or other nations to develop infrastructure by capitalizing on and leveraging the human and financial resources of each group;
- Operate an internal NSF capital planning process that encourages the development of innovative capabilities and meets the infrastructure needs of the U.S. community served by NSF;
- Develop and implement improvements for selecting, managing and overseeing large facility projects (cf. NSF Large Facility Projects Management and Oversight Plan, September 2001);
- Ensure that the breadth of infrastructure needs of the scientific community are examined regularly through workshops, panels, advisory groups, or other mechanisms;
- Provide broad support to the information technology community and others involved in innovative applications of cutting-edge IT tools for science and engineering;
- Upgrade the computation and computing infrastructure for all fields of science and engineering;
- Provide information on the status of the domestic / foreign science and engineering enterprise to inform science policy and priority setting;
- Develop and support a high-quality, balanced portfolio that invests in disciplines and fields, interdisciplinary research areas, and emerging opportunities; and
- Utilize the NSF core strategies of integrating research and education, promoting partnerships, and developing intellectual capital.

Related to programs:

- Provide financial support for activities specifically addressing the TOOLS strategic outcome. For the FY 2004 budget request, this investment totals about $1,341 million, an increase of $219 million over the FY 2003 request of $1,122 million. The principal components of this TOOLS portfolio are investments in research instrumentation and research facilities (capital and otherwise).
- Support programmatic themes highlighted in the section labeled FY 2004 Areas of Emphasis (discussed in the NSF Budget Request, detailed below and in Section II).

FY 2004 Areas of Emphasis:

- *Investments in Major Research Equipment and Facilities Construction (MREFC)*: This account provides funding for capital expenditures for the construction and acquisition of major research facilities that provide the U.S. scientific community with unique capabilities at the cutting-edge of science and engineering. In FY 2004, $202 million is requested to support seven ongoing projects. MREFC support requested for FY 2003 was $126 million.

- *Cyberinfrastructure.* In FY 2004 NSF will take the first step in an initiative to create cyberinfrastructure that will advance the existing S&E infrastructure of high-performance computers and networks to a new level by integrating these resources with sensors, data resources and new analysis and visualization capabilities. These resources will enable new types and depths of research by using massive data resources, supporting deeper detail for computational analysis and opening new frontiers for analysis and understanding. The aim of this initiative is to create cyberinfrastructure that is resilient, highly capable, adaptable and extensible. It would support networks, storage systems, high-end computing engines, middleware, basic sensing mechanisms, and all the associated services and bring next-generation computer and networking capabilities to researchers and educators nationwide.

- *S&E Data Collection, Analysis and Reporting; Databases and SRS Survey Redesign:* The work of NSF's Division of Science Resources Statistics (SRS) involves survey development, data collection, analysis, information compilation, dissemination, and customer service to meet the statistical demands of a diverse user community interested in the nation's science, engineering, and technology enterprise. In FY 2004, NSF will provide approximately $24 million for this program in order to maintain the core surveys and analytical activities that produce the information necessary for fulfilling its statutory mandate to produce data and analysis on the scientific and engineering enterprise. Survey redesign activities for the National Survey of College Graduates based on the 2000 Decennial Census will continue, and a redesigned survey will be conducted. The National Academy of Sciences will conduct a review of the SRS R&D collection systems in light of the changing nature of research and development. A comprehensive study of the feasibility of developing a new survey to collect information about individuals in postdoctoral positions will be undertaken.

- *Other*, for Retrospective reporting:
  - The Major Research Instrumentation (MRI) Program was established to improve the condition of scientific and engineering equipment for research and research training in our nation's academic institutions. In FY 2004, NSF will provide $90 million for this program.
  - Scientific databases and tools for using them are a critical component of NSF activity. They are a main focus within Information Technology Research, a NSF priority area since FY 2000. The K-16 National STEM Education Digital Library, which totals about $24 million in FY 2004, is another important component in this area.

Data Sources used in External Assessment Processes: Examples of relevant information include descriptions of new tools and technologies, shared-use of facilities, multidisciplinary databases, software, newly-developed instrumentation, and other inventions; data, samples, specimens, germ lines, and related products of awards placed in shared repositories; facilities construction and upgrade costs and schedules; and operating efficiency of shared-use facilities.

This information may be included in PI project reports (annual and final), program / division / directorate annual reports, agency internal collections, formal external evaluations or special studies, press releases, scientific publications, or internal / external information systems.

These sources of information may be utilized in Committees of Visitors reports and in the report of the Advisory Committee for GPRA Performance Assessment (AC/GPA).

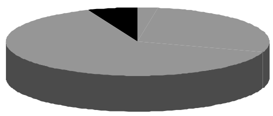
Data Sources for Determining Results: Primary sources include formal external third-party evaluations, such as the AC/GPA report that assesses performance using the GPRA alternative form, and external databases and reports from awardees and independent assessments.

Criteria for success are presented in the performance goal statement.

Data Limitations: Qualitative information requires the judgment of experts; the substance and timing of outcomes from research and education activities are unpredictable; external databases are not under agency control; long-term data is needed to assess the ultimate impact of outcomes; there is a potential for self-reporting bias.

External Factors: In most cases, NSF does not directly operate the facilities that it supports. Typically, the Foundation makes awards to external entities to undertake construction, management and operation of facility projects. NSF's relationship with these organizations is often collaborative in nature and is defined in cooperative agreements between NSF and those organizations.

IV. GOALS FOR MANAGEMENT



Excellence in managing NSF's activities is critical to achievement of the Foundation's mission-oriented outcome goals. Development of management goals included in this FY 2004 Performance Plan was guided by the Strategic Plan, previous Performance Plans, internal deliberations, agency past performance, and reasonable projections for future levels of performance. In developing the FY 2004 portfolio of management goals, NSF limited the number of goals while focusing on those of fundamental importance to the Foundation. The FY 2004 goals emphasize Foundation-level activities. In general, the management goals that largely impact one organizational unit are addressed through internal controls and processes.

As in FY 2003, this year's Goals for Management section contains paragraphs entitled *Resources Required*. Where information is available, these paragraphs identify the additional human and financial resources necessary to achieve the annual performance target. Where the additional resources are unknown or cannot be determined at this time, acknowledgment is made that staff and/or financial resources will be needed. Once determined, this information will be incorporated into future Performance Plans. Successful progress toward goal achievement, as the goals are currently developed, may be contingent upon receipt of the additional resources as stipulated.

The FY 2004 portfolio of goals contains a number that address the President's Management Agenda and focus on management challenges and reforms identified by the Office of Management and Budget, or the General Accounting Office, in NSF's annual review of financial and administrative systems as required by the Federal Managers' Financial Integrity Act, or by the NSF Office of Inspector General. NSF recognizes the importance of the issues identified and has addressed a significant number through the GPRA goals included in this document. The remainder is addressed by other means. The actions the Foundation is taking to address each challenge or reform are discussed in Appendix B.

The President's Management Agenda is comprised of five major government-wide initiatives: Strategic Management of Human Capital; Competitive Sourcing; Improved Financial Performance; Expanded E-Government; and Budget and Performance Integration. For each initiative, OMB prepares a scorecard consisting of "green, yellow and red lights" that reflects agency status and progress in achieving the standards for success ("getting to green").

For FY 2004, NSF is addressing the human capital, budget-performance integration and E-government initiatives with GPRA goals. The remaining two initiatives are being addressed with internal management controls and processes within the framework outlined in NSF's Administration and Management Strategic Plan.

The performance goals included in this management section are largely accomplished through the A&M function. The FY 2004 budget request for A&M totals $291 million compared to $261 million for FY 2003 and $231 million for FY 2002.

A. PERFORMANCE AREA: PROPOSAL AND AWARD MANAGEMENT

This section on proposal and award management focuses on merit review, customer service, efficiency – award size and duration, and facilities management. Success in achieving these goals is dependent upon such factors as high quality external review, sufficient staff resources and operating expenses, administrative requirements, and electronic information systems that support the various processes.

MERIT REVIEW

NSF's merit review process is the keystone for award selection. NSF invests in the best ideas from the most capable people, as determined by competitive merit review. NSF evaluates proposals for research and education projects using the two criteria established by the National Science Board in 1997 – the intellectual merit of the proposed activity and its broader impacts. Both support NSF's mission, "To promote the progress of science; to advance the national health, prosperity, and welfare; and to secure the national defense."

NSF relies on expert evaluation by selected peers when evaluating proposals and making funding decisions. Each year, more than 250,000 merit reviews assist NSF Program Officers in evaluating proposals submitted for consideration. NSF's merit review process is critical to fostering the highest standards of quality, excellence and accountability – standards for which NSF is internationally recognized.

Use of Merit Review

FY 2004 Performance Goal IV-1: At least 85 percent of basic and applied research funds will be allocated to projects that undergo merit review.

Guidelines associated with OMB's R&D Investment Criteria (published in FY 2002) state, "A customary method for promoting R&D quality is the use of a competitive, merit-based process."

The definition of "*Merit-reviewed scientific research with competitive selection and external (peer) evaluation"* as specified by OMB in FY 2000, is "Intramural and extramural research programs where funded activities are competitively awarded from a pool of qualified applicants following review by a set of external scientific or technical reviewers (often called peers) for merit. The review is conducted by appropriately qualified scientists, engineers, or other technically-qualified individuals who are apart from the people or groups making the award decisions, and serves to inform the program manager or other qualified individual who makes the award."

In FY 2000 NSF reduced its 90 percent target for this performance goal in response to a revision of the government-wide definition of merit-reviewed scientific research as specified by OMB in FY 2000 (see above). Based on this revised definition, and OMB's recommended target level of 70 to 90 percent, NSF established an 85 percent target.

Indicator:	**Percent of basic and applied research funds allocated to projects that undergo merit review.**							
	FY 1997	**FY 1998**	**FY 1999**	**FY 2000**	**FY 2001**	**FY 2002**	**FY 2003**	**FY 2004**
Baseline	85%							
Goal			N/A*	80%*	85%	85%	85%	85%
Result		86%	86%	87%	88%	88%	&	&

* The FY 1999 goal was based on the pre-FY 2000 definition of merit-reviewed scientific research and is therefore, not comparable to the goals in FY 2000 and beyond. The 80% estimated goal, recalculated from NSF's original goal of 90%, is based on the OMB definition of merit reviewed scientific research disseminated in FY 2000.
& = Data not yet available.
N/A = Not Applicable

Means and Strategies for Success:
> Utilize external merit review wherever feasible for proposals received by NSF.
> Make exceptions to the external merit review requirement in situations where external reviewers may be difficult to find or where timeliness is crucial (such as for studies of volcanic eruptions or earthquakes).

Resources Required: This goal can be achieved with NSF's requested FY 2003 staff and budgetary resources.

Data / Data Source: The information used to calculate the percentage of basic and applied research funds allocated to merit-reviewed scientific research with competitive selection and external (peer) evaluation is maintained in the NSF Proposal, PI and Reviewer System (PARS), the Award System and the Financial Accounting System (FAS). Data is reported in the Enterprise Information System (EIS).

Data Limitations: There is a possibility of funds not being properly assigned to basic/applied categories.

Implementation of Merit Review Criteria – Reviewers

FY 2004 Performance Goal IV-2: At least 70 percent of reviews with written comments will address aspects of both review criteria.

Comparison to FY 2003 Goal: The FY 2004 goal is identical to the FY 2003 goal.

Baseline: Results from FY 2003 will serve as the baseline for this goal. NSF had similar goals in FY 2001 and FY 2002. NSF was judged not successful in achieving a similar goal in FY 2001 because reviewers did not consistently address the broader impacts criterion. In FY 2002, 84 percent of reviews received by NSF contained information in both the intellectual merit and broader impacts text boxes.

Means and Strategies for Success:
> In FY 2004, NSF will continue to develop and apply recommendations that focus on strategies to stress the importance of both reviewers and proposers using both criteria. For example, NSF now provides a web-based link to examples of broader impacts in the instructions for proposal preparation.
> The Grant Proposal Guide (GPG) now specifies that Principal Investigators (PIs) must address both merit review criteria in separate statements within the one page Project Summary. The GPG also

reiterates that broader impacts resulting from the proposed project must be addressed in the Project Description and described as an integral part of the narrative.

> The FastLane system has been enhanced to remind/inform PIs of the new proposal preparation requirements.

Resources Required: This goal can be achieved with NSF's requested FY 2003 staff and budgetary resources.

Data / Data Source: In FY 2004, the Foundation expects almost all reviews to be submitted to NSF electronically via FastLane. There are separate text boxes in FastLane for reviewers to provide assessments relative to each merit review criterion. Therefore, NSF will be able to determine the number and percentage of reviews that contain comments in both text boxes.

Data Limitations: Proposals may not contain adequate information on the broader impacts of the proposed activity. Information may not be placed in the relevant text box when the review is completed. FastLane statistics do not provide qualitative information on the content of reviewer responses to each criterion.

Comment: Potential considerations a reviewer can employ to evaluate the "broader impacts" criterion include the extent to which proposed activities will: advance discovery and understanding while promoting teaching, training, and learning and vice versa; broaden participation of underrepresented groups; enhance the infrastructure for research and education; enhance scientific and technological understanding; and benefit society.

Implementation of Merit Review Criteria – Program Officers

FY 2004 Performance Goal IV-3: For at least 90 percent of decisions to fund or decline proposals, Program Officers will comment on aspects of both review criteria.

Comparison with FY 2003 Goal: In FY 2003 NSF expects Program Officers to comment on aspects of both review criteria in at least 80 percent of decisions to fund or decline proposals. This target level is increased to 90 percent for FY 2004.

Baseline: NSF had similar goals in FY 2001 and FY 2002. In FY 2001 NSF was successful in achieving a similar goal. In FY 2002 approximately 78% of review analyses commented on aspects of both merit review criteria.

Means and Strategies for Success:

> Encourage management to monitor the percent of review analyses (Form 7s) that address both criteria.

> Explore implementation of an electronic review analysis form that contains separate text boxes for Program Officers to provide assessments relative to each merit review criterion.

> In FY 2002, NSF issued Important Notice 127, dated July 8, 2002, entitled *Implementation of new Grant Proposal Guide Requirements Related to the Broader Impacts Criterion*. This Important Notice reinforces the importance of addressing both criteria in the preparation and review of proposals submitted to NSF and specifies that, effective October 1, 2002, NSF will return without review proposals that do not separately address both merit review criteria within the Project Summary.

Resources Required: Additional staff to develop an electronic review analysis form or other automated approaches to provide information on Program Officer usage (on Form 7s) of both criteria. Successful progress on this goal, as currently developed, may be contingent upon receipt of additional financial resources and/or staffing.

Data / Data Sources: NSF staff currently sample the review analyses (Form 7s) to determine the percent that comment on aspects of both criteria. In the future there is the possibility of developing an enhanced electronic Form 7 (the Review Record that contains the Program Officer's recommendation to fund or decline the proposal) with text boxes delineated for each review criterion. The implementation of such a strategy would allow information on the percent of review analyses that address both merit review criteria to be captured electronically.

Data Limitations: Proposals may not contain adequate information on the broader impacts of the proposed activity.

CUSTOMER SERVICE

Customer service has the potential to impact the number and quality of proposals received and thus NSF's ability to meet its strategic outcome goals. In 1995, NSF adopted a set of customer service standards, primarily related to proposal submission and review processes, focusing on grantees and potential grantees (*applicants*) as the primary *customers* for NSF's administrative processes. In a survey, applicants valued three standards most highly: (1) clear guidelines for proposal content and preparation, (2) a minimum of three months between release of program announcements and proposal deadlines and (3) notification of the proposal funding recommendation within six months of proposal submission. The survey measured baseline levels of customer satisfaction with reference to FY 1995 experiences. Subsequent surveys conducted in FYs 1999 and 2000 produced similar results.

FY 2004 performance goals focus on customer service related to 1) the time between release of program announcements and proposal deadlines and 2) notification of proposal funding recommendation within six months of proposal submission. The third standard valued by applicants – providing clear guidelines – is addressed in internal NSF clearance processes.

Time to Prepare Proposals

FY 2004 Performance Goal IV-4: Ninety-five percent of program announcements will be publicly available at least three months prior to the proposal deadline or target date.

Indicator:	**Percent of program announcements publicly available at least three months prior to the proposal deadline or target date.**						
	FY 1998	**FY 1999**	**FY 2000**	**FY 2001**	**FY 2002**	**FY 2003**	**FY 2004**
Baseline	66%						
Goal		95%	95%	95%	95%	95%	95%
Result		75%	89%	100%	94%	&	&

& = Data not yet available.

Means and Strategies for Success:

- > Each directorate has designated a clearance liaison to coordinate and plan funding activities. This has improved understanding and awareness of this goal throughout the Foundation.
- > NSF will provide clearance for announcements and solicitations that do not meet this customer service standard only in unusual cases where there is a clear need to have a deadline or target date less than three months from the date of release.

Resources Required: This goal can be achieved with NSF's requested FY 2003 staff and budgetary resources.

Data / Data Source: A record of the date of release of each announcement is maintained in NSF's Online Document System (ODS). The deadline date and information on whether the announcement / solicitation is subject to this goal and whether it met the goal is maintained in the Program Information Management System (PIMS). It is expected that as of FY 2003 data will be reported in the Enterprise Information System.

Data Limitations: None identified.

Comments:

- > A number of continuing programs have standing or previously established deadline dates. Some of these programs reissue announcements within 90 days of a proposal due date. As long as that deadline date was previously announced, thereby providing the community with at least 90 days to prepare a proposal, the announcement is considered to be in compliance with this GPRA goal.
- > Program Announcements and Program Solicitations that inform the community of an opportunity to seek NSF funds (other than supplements to an existing award) and have a deadline or target date are considered "Program Announcements" for the purposes of this GPRA goal. Interagency program announcements where NSF is not the lead agency and announcements regarding awards provided by the NSB (e.g. The National Medal of Science) are not considered "Program Announcements".

Time to Decision

FY 2004 Performance Goal IV-5: For 70 percent of proposals, be able to inform applicants whether their proposals have been declined or recommended for funding within six months of deadline or target date, or receipt date, whichever is later.

Indicator:	**Percent of proposals processed within 6 months of deadline or target date, or receipt date, whichever is later.**							
	FY 1997	**FY 1998**	**FY 1999**	**FY 2000**	**FY 2001**	**FY 2002**	**FY 2003**	**FY 2004**
Baseline	61%							
Goal			70%	70%	70%	70%	70%	70%
Result		59%	58%	54%	62%	74%	&	&

& = Data not yet available.

Means and Strategies for Success:

- > During FY 2001, NSF initiated a series of staff brainstorming sessions on "time to decision" in order to identify effective practices related to timely processing of proposals. The results of these sessions have been widely disseminated throughout NSF.

> “Real-time” management reports to help staff pinpoint pending proposals in danger of exceeding the six-month processing goal were developed and are distributed monthly to NSF senior management.
> Some divisions have added “performance on prompt handling of proposals” to their performance evaluation criteria for Program Officers.
> Managers and staff throughout the Foundation are being recognized for efforts to improve timely processing of proposals and thereby reduce the time to decision.
> NSF staff continue to work towards shortening the award process time by making more effective use of electronic mechanisms in conducting reviews, working cooperatively to eliminate overloads and bottlenecks, and carefully tracking the stage of processing and age of all proposals.

Resources Required: This goal can be achieved with NSF's requested FY 2003 staff and budgetary resources.

Data / Data Source: Deadline and target dates are maintained in NSF’s FastLane system. The proposal receipt date and date of Division Director concurrence with a Program Officer’s recommendation on a proposal are maintained in NSF’s Proposal, PI and Reviewer System (PARS). Data is reported in the Enterprise Information System.

Data Limitations: None identified.

Comment: The “time to decision” is the length of time between the closing date (deadline or target date) of an announcement or the date of receipt of a proposal (whichever is later) and the date a Division Director concurs (electronically) with the Program Officer’s recommendation on the proposal.

BROADENING PARTICIPATION

NSF is strongly committed to increasing the participation of science and engineering researchers, educators and students from groups currently underrepresented in the science and engineering enterprise in all NSF activities. One of NSF’s two merit review criteria applied to every competitively evaluated proposal considers, among other factors, “How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc.)?” Congress has enacted legislation giving NSF explicit responsibility for addressing issues of equal opportunity in science and engineering. This assignment reflected the serious underrepresentation of women, minorities, and persons with disabilities in the science and engineering workforce. Through the authorization and appropriation processes, the Congress has made clear, as well, its concern that participation in NSF activities be open to a diverse set of academic institutions.

Recognizing that meeting NSF’s mission and making progress toward all of its outcome goals requires maximum diversity of intellectual thought, over the next decade NSF seeks to:

– Increase the participation of scientists and engineers from underrepresented groups in NSF's merit review process (mail and panel review);
– Increase the participation of scientists and engineers from underrepresented groups in NSF's workshops and conferences;
– Increase the number of proposals submitted by and awards made to scientists and engineers from underrepresented groups; and
– Increase the number of scientists and engineers from underrepresented groups appointed by NSF to its staff.

In FY 2004 NSF will continue to focus on the first and fourth of these efforts. The first is discussed in the following paragraphs. The fourth is discussed in the section entitled NSF Staff - Diversity.

Diversity – Reviewer Pool

In FY 2001 NSF developed and implemented an electronic system to request demographic data, on a *voluntary* basis, from all reviewers. In FY 2002, the agency's GPRA goal for reviewer pool diversity focused on establishing a baseline for participation of members of underrepresented groups in NSF proposal review activities. NSF was not successful in achieving this goal. NSF requested and collected demographic data from reviewers but given the low response rate there is not enough information to establish a baseline. A total of 37,943 distinct reviewers returned their reviews on proposals decided upon in FY 2002. Demographic information is available for 3,507 of these reviewers and 1,168 (33%) of these 3,507 reviewers are members of an underrepresented group.

In FY 2003, NSF will continue to request demographic information from reviewers and to focus on increasing the number of reviewers that voluntarily provide data via efforts to educate reviewers on the purpose of the data collection.

No performance goal related to reviewer diversity is included in this plan. However, development of a future performance goal will again be considered once NSF determines whether it is feasible to set quantitative targets for participation levels of underrepresented groups based on additional data provided in response to FY 2003 NSF requests. Since current information on race, gender and ethnicity is available for less than 10 percent of those who participated in NSF proposal review activities in FY 2002, it is not possible to reliably characterize the reviewer pool at this time.

Means and Strategies for Success:

- Continue efforts to identify additional reviewers from underrepresented groups (including women, underrepresented minorities, persons with disabilities, and individuals in underserved universities) through:
  - Participation of NSF staff in conferences involving underrepresented groups or minority-serving institutions.
  - Collection and sharing of potential reviewer data made available by associations and institutions serving groups that are underrepresented in science and engineering.
- Encourage participation of members of underrepresented groups in activities such as NSF workshops or conferences so NSF is made aware of the review expertise of each.

EFFICIENCY – AWARD SIZE AND DURATION

In FY 2004, NSF will continue to address Foundation-wide concerns about research grant size and duration. Award size and duration are important factors in obtaining high quality proposals and ensuring that there are adequate resources to complete the proposed work. NSF has noted that its current award size and duration might result in inefficiency at U.S. academic institutions if scientists and engineers devote a greater proportion of their time to preparing proposals rather than to conducting research.

Increasing award size and duration is a priority highlighted in NSF's Strategic Plan. Determining the "right" grant size was one of OMB's FY 2002 management reform activities highlighted for NSF. Specifically, OMB asked the agency to develop metrics to measure the efficiency of the research process and determine the "right" grant size for the types of proposals that the Foundation funds. (See

Appendix B.) In response to this request, NSF contracted with Mathematica Policy Research, Inc. to assist in the development and administration of two surveys – one for Principal Investigators and one for institutions. Final results became available in May 2002. The analysis provided by Mathematica offered several alternative methods of determining the right grant size. The Foundation's long-term goal is to reach an average annualized award size of $250,000 and average award duration of 5.0 years.

<u>FY 2004 Performance Goal IV-6:</u> NSF will increase the average annualized award size for research grants to $128,000.

Indicator:	**Average annualized award size for research grants.**						
	FY 1998	**FY 1999**	**FY 2000**	**FY 2001**	**FY 2002**	**FY 2003**	**FY 2004**
Baseline	$90,000						
Goal				$110,000	$113,000	$125,000	$128,000
Result		$94,000	$105,800	$113,601	$115,666	&	&

& = Data not yet available.

<u>FY 2004 Performance Goal IV-7:</u> The average duration of awards for research grants will be 3.0 years.

Indicator:	**Average duration of awards for research grants (in years).**						
	FY 1998	**FY 1999**	**FY 2000**	**FY 2001**	**FY 2002**	**FY 2003**	**FY 2004**
Baseline	2.7						
Goal		2.8	N/A	3.0	3.0	3.0	3.0
Result		2.8	2.8	2.9	2.9	&	&

& = Data not yet available.
N/A = Not Applicable.

<u>Means and Strategies for Success:</u>

> Use electronic monitoring systems to keep track of average award size and duration and to modify funding strategies as needed.

> Increase award size for priority areas, focused competitions, and other programs.

<u>Resources Required:</u> Approximately $60 million is needed to increase average annualized award size from the FY 2003 goal of $125,000 to $128,000 in FY 2004, assuming that there is no increase in the FY 2003 number of awards and that the FY 2004 average award duration is 3.0 years, identical to the FY 2003 goal.

<u>Data / Data Source</u>: Data on award size and duration are maintained in NSF's Proposal, PI and Reviewer System (PARS) and Award system. Data is reported in the Enterprise Information System.

<u>Data Limitations:</u> None identified.

<u>External Factor:</u> Because the increases are budget dependent, award size and/or duration targets may fluctuate.

<u>Comment:</u> These two performance goals (IV-6 and IV-7) are applicable only to competitive research grants, a subset of awards that focuses on awards to individual investigators and small groups.

FACILITIES MANAGEMENT

Throughout its history, NSF has enjoyed a successful track record of providing state-of-the-art facilities for science and engineering research and for the education and training of next-generation researchers. Over time, NSF's portfolio of facilities has grown and diversified to include shared-use infrastructure, instrumentation, equipment, and distributed platforms. NSF's responsibility is to ensure that the research and education communities continue to have access to these state-of-the-art facilities, to provide the support needed to utilize them effectively, and to provide timely upgrades when needed to maintain U.S. leadership in research and education.

NSF's FY 2004 investment in tools for the research and education communities is approximately $1.3 billion. In view of the magnitude of its current and planned investments and the increasing complexity of facilities, NSF recognizes the importance of proper management and oversight of this portfolio – from assuring that new projects are delivered on schedule, within budget and according to specifications to seeing that facilities are operated in the most efficient, cost-effective manner possible.

After several years of GPRA reporting for facilities, NSF conducted a comprehensive internal review of its facilities goals in FY 2002. As a result of that review, NSF introduced revised goals for facility construction and operation in FY 2003. The revised goals more accurately capture NSF's performance and in addition are in alignment with OMB guidance in Circular A-11 related to management of capital assets. For example, the revised goal on construction activities incorporates the Earned Value technique, a widely accepted project management tool for measuring progress.

NSF is developing a Facilities Management and Oversight Guide to convey its expectations for sound project management by NSF staff and awardees. The Guide collects the best practices of NSF, its partners in other federal agencies, and its awardees for planning, managing and overseeing all aspects of facilities. The Guide stresses the need for comprehensive planning, cost estimating and scheduling, and provides users with recommended tools and resources for performing these tasks.

The **construction and upgrade** goal applies to all ongoing projects and those completed within FY 2004 that have a total project cost of at least $5 million.

FY 2004 Performance Goal IV-8: For ninety percent of construction, acquisition and upgrade projects, keep any negative cost and schedule variances to less than 10 percent of the approved project plan.

Comparison to FY 2003 Goal: This is identical to the FY 2003 goal.

Once constructed, NSF expects its **operational facilities** to enable researchers to perform cutting-edge research that expands the frontiers of discovery. NSF's goal in this area focuses on measuring a facility's ability to provide the required operating time.

This operations goal applies to all NSF-supported facilities that received greater than $1 million in annual operations and maintenance support.

FY 2004 Performance Goal IV-9: For ninety percent of operational facilities, keep scheduled operating time lost to less than 10 percent.

Indicator:	Comparison with scheduled operating time.					
	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004
Goal	Keep operating time lost due to unscheduled downtime to less than 10 percent of the total scheduled operating time.	Keep operating time lost due to unscheduled downtime to less than 10 percent of the total scheduled operating time.	For 90 percent of facilities, keep operating time lost due to unscheduled downtime to less than 10 percent of the total scheduled operating time.	For 90 percent of facilities, keep operating time lost due to unscheduled downtime to less than 10 percent of the total scheduled operating time.	For 90 percent of operational facilities, keep scheduled operating time lost to less than 10 percent.	For 90 percent of operational facilities, keep scheduled operating time lost to less than 10 percent.
Result	Majority of facilities successful.	22 of 26 (85%) facilities successful.	25 of 29 (86%) facilities successful.	26 of 31 (84%) facilities successful.	&	&

& = Data not yet available.

Facilities: Success Strategies, Resources and Data:

The following sections apply to both facilities goals (IV-8 and IV-9) presented above.

Baseline: Results from FY 2003 will provide the baseline for goal IV-8. For goal IV-9, FY 2001 data provides the baseline.

Means and Strategies for Success:

> Ensure that cost and schedule plans are realistic and that they contain appropriate contingency.
> Ensure that operational plans are reasonable and realistic.
> Ensure that NSF Program Officers work closely with awardee project managers.
> Ensure that all possible appropriate actions are taken to:
  – keep construction projects within cost and on schedule.
  – maintain operating schedules to the extent possible.
> Provide learning opportunities in large facility project management via the NSF Academy and other venues.

Resources Required: A variety of resources are required to support technical, project management, and business operations staff, and for travel and training requirements. Staff assure a sufficient-sized workforce for the labor-intensive effort of efficient and effective management and oversight of the construction and operation of facilities. Travel resources allow NSF personnel managing and overseeing NSF-supported facilities to interact more closely with project partners. Training funds enable staff to remain current with respect to cutting-edge and best practices in managing and overseeing facilities. Successful progress in meeting the goals of completing projects on time, on budget and within performance specifications, and operating NSF-supported facilities efficiently and effectively, may be contingent upon receipt of the staffing and/or financial resources identified.

Data / Data Source: In order to improve reporting on performance goals related to facilities, NSF initiated development in FY 1999 of a Facilities Reporting System. This system, a FastLane module, receives information on operations and construction from facility managers external to NSF. The system is reviewed annually and revised as needed in order to reflect changes to goals, and incorporate recommendations provided by internal and external customers to improve clarity and ease of use. It is undergoing extensive revision in FY 2003. Data is compiled and reported in the Enterprise Information System.

Data Limitations: NSF expects the quality and consistency of the information provided to continue to improve as facility managers and NSF staff gain experience with responding to newly developed reporting requirements. NSF addresses the accuracy and completeness of the information through internal review and interactions between NSF staff and the managers of the facilities.

External Factors: Factors such as adverse weather, natural disasters, or failure of partners to act as planned can have a significant impact on meeting deadlines for construction projects and operating plans.

B. PERFORMANCE AREA: BUSINESS PRACTICES

A state-of-the-art communications and technology infrastructure is essential to NSF's success in managing an increasing workload. The Foundation is aggressively moving towards an integrated paperless processing environment while providing customer-responsive, high-quality mission support. The following have been implemented or are in progress:

- Successful full implementation of electronic proposal submission and grantee reporting functions;
- Internal electronic grants processing leveraging NSF's success in web-based interactions with the external community;
- Active leadership and cooperation among federal agencies in conducting business electronically;
- Active leadership in government/university forums for addressing business practices; and
- Learning opportunities for staff.

In order to obtain broad-based external support and guidance for the business and operations aspects of the agency the Foundation established a Business and Operations Advisory Committee in FY 2001. This NSF Advisory Committee provides recommendations to the Office of Budget, Finance and Award Management and the Office of Information and Resource Management.

NSF's approach to its business practices is also aligned with the E-Government initiative included in the President's Management Agenda. In the most recent scorecard, NSF received a "green light" for both the *status* and *progress* in implementing the E-Government initiative. The GPRA goals related to electronic travel, electronic government and information technology and physical security discussed below support this initiative.

COST EFFICIENCY – VIDEOCONFERENCING

Over the past several years the use of videoconferencing at the National Science Foundation has evolved from a demonstration project to a part of normal business operations. Videoconferencing is now viewed throughout the business world as a possible alternative to travel in some situations. In addition to eliminating the security and safety concerns associated with travel, videoconferencing also offers cost-efficiencies such as minimizing staff time spent on travel and reducing travel costs.

Videoconferencing is not a direct replacement for travel, but an appropriate, balanced combination of travel and videoconferencing will maximize efficiencies while allowing NSF staff to "visit", virtually and physically, more sites.

Increasing the usage of videoconferences at NSF was a GPRA goal in FY 2001. NSF met its goal of increasing usage of video-conferencing by 100% over the FY 1999 level. The number of videoconferences in the Foundation continues to grow, though the percentage of growth has slowed.

Until recently, the cost savings realized by the use of videoconferencing have not been quantified. In FY 2002, one NSF office, the Office of Polar Programs (OPP), estimated its travel savings from the use of videoconferencing at $140,000. In FY 2003, NSF will establish methods of calculating agency-wide savings resulting from use of videoconferencing, where appropriate, in place of travel. In FY 2004, NSF will capture information required to calculate the cost savings from the use of videoconferencing throughout the Foundation.

Quantifying cost efficiencies associated with innovative business processes and administrative systems such as videoconferencing will illustrate that the changes NSF is making to various administrative functions lead to cost savings.

FY 2004 Performance Goal IV-10: NSF will assess the cost efficiencies associated with administrative processes.
Performance Indicator:
> Calculation of the agency-wide cost savings realized by the use of videoconferencing.

Comparison to FY 2003 Goal: This is a new goal for FY 2004.

Baseline: None. Cost savings associated with videoconferencing are not currently calculated.

Means and Strategies for Success:
- Investigate the Office of Polar Program's methodology for capturing costs and determine its adaptability to the Foundation as a whole.
- Define the assumptions about travel and about videoconferencing that will be used to quantify cost savings.
- Develop a questionnaire to capture the required information.
- Ensure all directorates with videoconferencing programs are included in the results.
- Identify intangible, non-quantifiable benefits associated with videoconferencing (e.g., improved management of projects)

Resources Required: This goal can be achieved with NSF's requested FY 2003 staff and budgetary resources.

Data / Data Sources: Completed questionnaires and information on airfares and per diem rates.

Data Limitations: There is the possibility of incomplete capture of information across the Foundation.

ELECTRONIC GOVERNMENT

NSF is expanding electronic government capabilities consistent with the goals of the President's Management Agenda. As a leader in electronic systems development and implementation, NSF is committed to leveraging technology to minimize the burden on our customers and increase efficiencies agency-wide. NSF, as an official partner agency in the E-grants effort, has contributed approximately $1.8 million, as well as staff resources, to this interagency effort. NSF will continue to use its expertise, experience and substantial accomplishments to promote intergovernmental electronic grants efforts.

On October 1, 2000, NSF became the first agency to perform all of its mission-critical interactions with its proposal applicants through the web. This represented a milestone, and was the first step in creating a completely electronic business process for proposal and award management. NSF's ultimate goal is to create an electronic environment capable of performing all internal and external functions from proposal submission through final project closeout.

NSF's FastLane system makes use of the Internet to allow NSF customers to exchange information with the agency. FastLane functions permit users to prepare and submit proposals, proposal reviews and project reports, determine the status of proposal and funding actions, submit post-award requests and notifications, interactively cooperate in drafting panel evaluations of proposals, initiate cash requests, manage organization information, view reviews and award letters, and perform other basic interactions. Internal electronic grants processing is performed through NSF's Electronic Jacket. NSF is the only federal agency currently receiving proposals electronically as a standard operating procedure. Its web-based interface with grantee organizations was built through collaborations involving both NSF staff and the research and education communities.

The agency's Business Analysis, started in FY 2002, will serve as the driver for implementing NSF's next generation E-government capability. This multi-year effort will guide future technology investments and provide the overarching framework for assuring that technology optimizes business value and mission performance. As part of this effort, NSF will (1) develop an Enterprise Architecture that will provide a blueprint for defining current business processes, applications, information resources, and technical infrastructure; (2) determine the knowledge bases, applications, and supporting technology that are needed to support evolving NSF mission needs; and (3) define a transition strategy and plan for achieving an integrated Enterprise Architecture that is consistent with NSF's business goals and operational priorities.

The Program Information Management System (PIMS), which went into production on October 1, 2002, provides a comprehensive database of NSF funding opportunity information. It will allow NSF staff to update information about funding opportunities, route them through electronic review and approval, and generate new program announcements and solicitations. PIMS will also serve as a data source for the NSF web site, FastLane and other NSF automated systems. NSF will use PIMS to generate synopses of NSF funding opportunities for the Fed Grants portal. Fed Grants, a portal to program announcements from a variety of government agencies, is administered by the General Services Administration and is part of the overall E-grants initiative.

As part of the Foundation's progress toward an electronic environment, NSF now electronically captures signatures. This allows the agency to produce electronically signed declination letters and therefore to utilize email to notify PIs whose proposals have not been awarded for funding. It is no longer necessary to produce a paper declination letter to be signed and sent via U.S. mail.

FY 2004 Performance Goal IV-11: NSF will continue to integrate its internal electronic grants process with the E-government initiative.
Performance Indicators:
> 90 percent of program announcements will be posted to Fed Grants.
> 75 percent of declined proposals will be processed using E-decline signatures.

Comparison to FY 2003 Goal: NSF's FY 2003 goals related to "E-business" focused on receipt and electronic processing of Principal Investigator award transfers and on implementation of Phase III of the web-based Electronic Jacket. The FY 2004 goal retains the emphasis on E-business while continuing progress on new tasks in this area.

Baseline: The percentage of program announcements posted to Fed Grants during the first year it is in production, expected to be FY 2003, will serve as the baseline for this goal.

FY 2001 data will serve as the baseline for the percent of proposals processed using E-decline signatures. In FY 2001 there were 20,953 declines, with 11,479 (~ 55%) processed using E-decline signatures.

Means and Strategies for Success:
> Work cooperatively in the interagency E-grants efforts;
> Continue consolidation of back-end systems into the web-based Electronic Jacket;
> Add E-decline signatures to the paperless workflow in the Electronic Jacket;
> Continue information flow and outreach to NSF customers and users;
> Develop and test the system-to-system interface between PIMS and Fed Grants; and
> Continue to participate in the E-grants pilot.

Resources Required: This goal can be achieved with NSF's requested FY 2003 staff and budgetary resources.

Data / Data Sources: The PIMS will track the percent of announcements posted to Fed Grants. Data to assess the percent of declines that are processed using E-decline signatures is maintained in FastLane and other NSF databases (ProdSql7-Jacket data).

Data Limitations: None identified.

Comments:
> The Expanded Electronic Government initiative is one component of the President's Management Agenda.
> NSF is one of only a few agencies with a database management system for providing information on funding opportunities sophisticated enough to take advantage of the system-to-system interface to E-grants.
> Program Announcements and Program Solicitations that inform the community of an opportunity to seek NSF funds (other than supplements to an existing award) and have a deadline or target date are considered "Program Announcements" for the purposes of this GPRA goal. Interagency program announcements where NSF is not the lead agency and announcements regarding awards provided by the NSB (e.g., the National Medal of Science) are not considered "Program Announcements".

External Factors:
> Successful implementation of GSA's Fed Grants portal will be required.

SECURITY PROGRAM: INFORMATION TECHNOLOGY & PHYSICAL SECURITY

NSF's FY 2004 security initiative includes the creation of an integrated security platform and implementation of current and emerging security tools and technologies. Currently the Foundation uses a number of independent information systems and databases to manage physical and logical access to its facilities and computer networks. The current systems need to link data in order to propagate global changes to access rights across NSF's numerous IT platforms. NSF will create an integrated security platform and exploit "smart technology" to enforce security rules and to ensure consistent security over the entire enterprise. The new system will permit security-relevant data to be synchronized across all entities and platforms.

The NSF information technology and physical security program is designed to protect NSF infrastructure and critical assets while maintaining an open and collaborative environment. Our approach to security includes implementation of appropriate protective measures to ensure the privacy, integrity, and security of information and information technology resources needed by NSF and the broad research community while allowing appropriate access and availability to users, and ensuring the physical safety of our staff and visitors.

NSF is committed to maintaining a safe and secure environment for its 1,600 employees and contractors. This presents a unique and ongoing challenge because of public access to the facility and the estimated 50,000 visitors who participate in panels and meetings annually.

Significant advances in "smart technology" have occurred during the past several years. Given the heightened security awareness resulting from the events of September 11, 2001, NSF is seeking ways to improve the agency's security posture without diminishing the sense of an open environment for employees and visitors.

NSF's information technology security program encompasses all aspects of information security, including policies and procedures, risk assessments and security plans, managed intrusion detection services, vulnerability assessments, disaster recovery, and technical and management security controls. NSF's IT security program continues to focus on security as an integral component of the Foundation's business operations. The agency is adhering to the NIST Security Self-Assessment Guide for Information Technology Systems to assure compliance as required by law. This guidance identifies five levels of security. Level 1 requires development of security policies. Level 2 requires development of procedures to implement the policies. Level 3 is achieved when the policies and procedures are implemented. Level 4 requires testing of the procedures. Level 5 is an integrated, comprehensive program with decision-making based on cost, risk, and mission impact.

In FY 2002, the Foundation implemented an agency-wide security program in response to the Government Information Security Reform Act (GISRA). Policies were reviewed, developed and published. A security-training program for all NSF staff and contractors was developed and implemented.

As part of this FY 2002 program, an inventory of all NSF systems was conducted and risk assessment questionnaires were completed on all systems. This risk assessment approach includes a consideration of major factors in risk management: the value of the system or application, threats, vulnerabilities, and the effectiveness of current or proposed safeguards. NSF is reviewing its systems in accordance with the NIST framework and with the guidelines in OMB Circular A-130. To date, nineteen major systems have been identified. NSF's security posture is at Level 2 as of the end of 2002.

In FY 2003, the IT and physical security program will be enhanced. Agency-wide security procedures and control techniques will be developed. Ninety-five percent of major systems will have approved security plans on file and have documented certification and accreditation. Contingency plans will be developed for all general support systems.

"Major system" is a generic term used here to include both general support systems (GSS) and major applications, as defined in OMB Circular A-130. A general support system is an interconnected set of centrally provided information resources under the same direct management control that share common functionality. A GSS normally includes hardware, software, information, data, applications, communications, and people. The NSF Local Area Network (LAN) is an example of a GSS. A major application is an application that requires special attention to security due to the risk and magnitude of the harm resulting from the loss, misuse, or unauthorized access to or modification of the information it contains. Examples of NSF's major systems are the Financial Accounting System (FAS) and the Proposal, PI and Reviewer System (PARS).

To achieve NIST Level 3 compliance in major systems will require implementation of system security plans and procedures and periodic review of security controls.

FY 2004 Performance Goal IV-12: NSF will maintain and enhance the agency-wide security program to ensure adequate protection of NSF's infrastructure and critical assets.
Performance Indicators:
> 95 percent of NSF's major systems will achieve Level 3 compliance in accordance with the NIST Security Self-Assessment Framework.
> Implementation of a "Smart ID" pilot to provide staff with a standard identification card for authentication and access control.

Comparison to FY 2003 Goal: In FY 2003 the performance indicators for this goal are:
- 95 percent of major systems will have approved security plans on file.
- 95 percent of major systems will have documented certification and accreditation.

For FY 2004 the performance indicators retain the emphasis on information technology security while continuing progress on new tasks in this area. The "Smart ID" pilot indicator has been added.

Baseline: In FY 2002 none of the major systems have achieved Level 3 compliance. The "Smart ID" pilot is a new performance indicator in FY 2004.

Means and Strategies for Success:
> Develop and implement, as required, appropriate IT and physical security polices and procedures.
> Provide and document security training for NSF staff and on-site contractors, with more in-depth training for those with significant IT security responsibilities.
> Contract for and implement a routine penetration-testing program to identify security vulnerabilities.
> Perform requirements study for an integrated security platform.
> Field-test a Commercial-Off-The-Shelf Secure Access system with a limited group of users.
> Establish a collaborative team of IT and physical security staff.

Resources Required: Funding has been requested in the FY 2003 budget to procure a "smart technology" secure access system. Cost estimates for this system are $3 million. Additional resources will be necessary to maintain and upgrade all aspects of NSF's enhanced security program.

<u>Data Sources/Data Limitations:</u> Completed NIST self-assessments for all major systems. In FY 2003 a project plan for the smart technology implementation will be developed that will outline the components of the pilot program. Indicator achievement will be measured relative to that plan.

C. PERFORMANCE AREA: HUMAN CAPITAL

The NSF Strategic Plan states that "a diverse, capable, motivated staff that operates with efficiency and integrity" is a critical factor for NSF success. For more than 50 years, the agency has promoted the progress of science, drawing upon its talented, diverse workforce to catalyze science and engineering discovery, learning and innovation. NSF has a long history of being at the forefront in providing a work environment conducive to supporting and motivating its staff.

The nature of science and engineering research and education at an ever-changing frontier demands unique knowledge agility in the NSF workforce. The agency maintains this characteristic by encouraging development of its permanent workforce and complementing it by capitalizing upon current staffing flexibilities such as the Intergovernmental Personnel Act and the Visiting Scientist Program. These flexibilities provide a cohort of rotating scientists and engineers who typically spend 1-3 years with the agency. Together with permanent staff, these rotators bring their research and professional experience to inform NSF's science, engineering, and education investments. Following their NSF assignments, these researchers and educators return to their home or other organizations with an informed perspective on federal science and engineering research and education priorities.

Throughout the federal government there is increasing recognition that human capital is a valuable asset that needs to be managed strategically. Within NSF, approximately 44 percent of the science and engineering excepted service employees, 63 percent of the executive service employees and 24 percent of the general schedule employees will be eligible to retire in 5 years. In addition, NSF experiences approximately a 25 percent turnover of science and engineering professional staff every two years because of its extensive use of visiting scientists and engineers. These factors, coupled with the increased complexity in proposal review and award, the implementation of electronic proposal processing and E-business practices, and new internal and external requirements for accountability, performance measurement and oversight, make succession planning, recruitment, retention, and adapting the skill mix of employees critical human capital issues for the Foundation.

The five-year A&M plan guides NSF's efforts to approach these human capital issues strategically. The implementation of this plan has been aided by the ongoing Business Analysis in which NSF, in partnership with Booz Allen Hamilton, is systematically examining all facets of human capital planning – organizational alignment and optimum workforce size and composition, identification and provision of needed competencies and skills, and recruitment and retention of staff to meet current requirements and ensure effective succession.

NSF's efforts to approach human capital issues strategically are in alignment with the government-wide initiative on human capital included in the President's Management Agenda. The most recent scorecard gives a "red light" to NSF's *status* for the human capital initiative. On that same scorecard, NSF has a "green light" for *progress* for implementing actions to achieve green status. The GPRA goals on workforce learning and workforce planning discussed below directly support this initiative.

NSF STAFF – DIVERSITY

NSF has an ongoing interest in ensuring that diversity considerations are embedded in activities related to agency staffing of scientists and engineers. In concert with the human capital goals of the President's Management Agenda, NSF's approach to strategic workforce planning ensures that the agency has the *right people with the right competencies in the right jobs at the right time*. NSF's approach to succession planning encompasses both the development of critical talent and core competencies from within, and the identification and recruitment of strategic talent from the outside. This two-pronged approach allows the agency to anticipate and meet its staffing needs in the challenging, dynamic environment that constitutes work at the science and engineering frontier and ensures that employees are well prepared to meet agency challenges in the near- and longer-terms.

An ongoing, key component of this strategy is the recruitment and retention of highly qualified staff that reflects the diversity of America. The NSF Strategic Plan encourages a policy that recognizes that a diverse workforce – i.e., one that includes members of underrepresented groups and reflects institutional and geographic differences – broadens the agency outlook and talent base and enables it to better serve both its research and education communities and ultimately all citizens. Science and engineering (S&E) staff are one of three employment categories for which NSF maintains demographic data (the other two are business and operations staff and program support staff). S&E staff and management include all staff normally categorized as "scientists and engineers". This group includes Program Officers as well as senior executives and management staff with science and engineering backgrounds who are involved in program planning and agency management.

There is underrepresentation (relative to the general U.S. population) of women, certain minority groups, and persons with disabilities within the NSF S&E staff. Realistic goals for closing this representation gap vary across the different research and education areas; however, NSF intends to continue its efforts to develop effective strategies designed to attract and retain a diverse corps of science, engineering, and education professionals. Agency recruitment practices will continue to involve proactive searches for qualified candidates, in combination with earnestly practiced inclusivity and review by NSF management.

For this FY 2004 Performance Plan, NSF continues an existing goal on S&E appointments from underrepresented groups and maintains a focus on ensuring that diversity considerations are embedded in activities related to agency staffing of scientists and engineers. The agency's goal related to total number of hires to S&E staff and management will be continued, at least through FY 2004, until both the workforce analysis and diversity plans are finalized. Results will serve to inform the agency's development of future performance goals for its human capital.

In FY 2003, an internal task force comprised of representatives across the directorates and program offices will initiate development of a S&E diversity plan to help ensure that diversity considerations are embedded in staffing decisions throughout the Foundation. The task force will examine relevant statistical information regarding NSF staff, the geographic and institutional diversity of our IPAs and VSEEs, and identify issues requiring special attention during the recruitment and retention of a diverse workforce. The FY 2004 goal focuses on completion of the task force's report and initiation of implementation of its recommendations.

Performance Goal IV-13: NSF will ensure that diversity considerations are embedded in activities related to agency staffing of scientists and engineers.
Performance Indicator:
> NSF will complete development of the NSF S&E diversity plan initiated in FY 2003 and begin implementation of its recommendations.

Baseline: No baseline exists. This is a continuation of a goal developed in FY 2003.

Means and Strategies for Success:

- Present NSF S&E diversity plan to NSF senior management for discussion;
- Conduct inreach activities with key NSF staff (e.g., division director and working group meetings) to discuss recommendations within and implementation of the diversity plan.
- Examine and consider the data and recommendations developed by organizations such as the Committee on Equal Opportunities in Science and Engineering (CEOSE) in its 2002 report; and
- Identify best practices and areas for investment within the NSF portfolio related to diversity issues.

Resources Required: To be determined. May include additional business/operations staff or contractors with IT expertise to maintain information bases that capture institutional and geographic data for the NSF IPAs and Visiting Scientists, Engineers and Educators (VSEEs). Successful progress on this goal, as currently developed, may be contingent upon receipt of the staffing and/or financial resources identified.

FY 2004 Performance Goal IV-14: NSF will show an increase over FY 2000 in the total number of appointments to NSF science and engineering staff and management from underrepresented groups.

Indicator:	**Total number of appointments to S&E staff and management from underrepresented groups.**				
	FY 2000	**FY 2001**	**FY 2002**	**FY 2003**	**FY 2004**
Baseline / Result: **Women**	46	59	63	&	&
Members of under-represented minority groups	25	32	33	&	&
Goal				Increase over FY 2000.	Increase over FY 2000.

& = Data not yet available.

Means and Strategies for Success:

- Continue to encourage members of underrepresented groups to apply for NSF science and engineering staff and management positions through increased outreach efforts – including targeted advertising, participation by NSF staff in selected professional engineering, scientific and education conferences, invitations to members of underrepresented groups to participate as proposal reviewers, attendance at employment fairs, and site visits to minority institutions and organizations;
- Make presentations on the full breadth of NSF opportunities at regularly scheduled meetings (e.g., Experimental Program to Stimulate Competitive Research, Louis Stokes Alliances for Minority Participation, etc.); and

> Encourage Program Officers to develop and maintain contacts with individuals, professional societies, and other groups that focus on broadening the participation of underrepresented groups and on eliminating barriers associated with their participation.

Resources Required: Financial resources to travel and conduct outreach activities; staff to develop and maintain internal databases. Successful progress on this goal, as currently developed, may be contingent upon receipt of resources identified.

Data / Data Sources: Demographic data on the actual number of appointments to S&E staff and management in the NSF workforce is maintained in Division of Human Resources Management databases.

Data Limitations: Provision of diversity-related information is voluntary and therefore may be incomplete.

External Factor: NSF can collect information only by categories agreed upon within the current federal data collection standards.

Comment: Prior to FY 2003, the agency focused on Program Officers and equivalent in this goal. For FY 2003, the goal and associated baseline were expanded to include all staff normally categorized as "scientists and engineers". This group includes those staff counted in previous GPRA reports as well as senior executives and management staff with science and engineering backgrounds who are involved in program planning and agency management.

WORKFORCE DEVELOPMENT

NSF is engaged in a Business Analysis, in partnership with Booz Allen Hamilton. This effort is examining the five elements of the President's Management Agenda in a coherent, comprehensive manner, with iterative reviews of human capital during the process to facilitate integration of NSF's human capital strategies with strategic and programmatic planning. This analysis is providing information needed to identify future workforce competencies within the context of how the agency plans to perform its work in the future in a constantly-expanding science and engineering frontier, and to ensure that staff receive the education and development necessary to provide for effective succession in key positions.

NSF believes that workforce challenges can be met with the continued professional development of its personnel. The NSF Academy, a contemporary organizational and professional development program that creates and integrates innovative learning opportunities, embodies the Foundation's dedication to advanced technologies and continuous learning. As such, the Academy is the linchpin for individual and workforce development. In FY 2003 NSF intends to initiate a national search to recruit and hire a Dean and to establish an Advisory Group to inform the Academy on progress and recommend approaches for evaluation.

The NSF Academy integrates existing workforce development programs and associated learning opportunities into a strategically aligned learning system. Informed by the recommendations of the Business Analysis, leadership and succession planning will be built into the competency-based curriculum, thereby providing all employees with the opportunity to gain the skills and knowledge necessary to compete for leadership and management roles.

Through this activity, the agency has placed a greater emphasis on providing opportunities for personnel to update and expand project management and business-related skills, as well as on ensuring that these skills are sought out and valued in the recruitment and hiring of additional permanent personnel. In addition, the Academy addresses the impact of technology innovation on NSF's workforce. These changes demand new and increasing IT skills in almost all career fields, as well as the development of new IT-related staff positions.

Workforce Learning

Performance Goal IV-15: The NSF Academy will develop a broad array of competency-based learning opportunities that will enable all staff to perform critical functions supporting NSF's vision and goals.

Performance Indicators:

- Identification of staff requiring Facilities / Center Project Management training.
- Initiation of development of a curriculum that leads to certification in Facilities / Center Project Management.

Comparison to FY 2003 Goal: NSF's FY 2003 goal related to workforce learning focused on development of new courses or revision of existing courses to address program management, leadership development, and technology and business process training. The FY 2004 goal retains the emphasis on workforce learning while addressing the specific need of NSF staff to manage increasingly large and complex facility projects.

Baseline: These are new indicators and no baseline exists.

Means and Strategies for Success:

- Analyze results from the Business Analysis to help identify job duties and competencies required for Facilities / Center Project Management
- Obtain Directorate, Staff Office and policy input to identify NSF positions requiring Facilities / Center Project Management training; courses relevant to specific positions; and requirements for certification.
- Work with vendor(s) to determine / develop curriculum for certification program(s) in Facilities / Center Project Management;
- Based on input from NSF staff, select the most appropriate and effective methods of learning, i.e., instructor-led classes, E-learning, distance learning, and other learning delivery methods available through technology;
- Obtain contractor support to develop curriculum and/or classes, as needed;

Resources Required: This goal can be achieved with NSF's requested FY 2003 staff and budgetary resources.

Comments:

- The NSF Academy provides a comprehensive suite of courses tied to competency requirements. A Basic Course for Project Management was piloted in FY 2002 and offered again in FY 2003. A total of 43 employees received the training. Two additional courses have subsequently been added to the curriculum. In addition, the Basic Course will be revised to incorporate the NSF Facilities Guidelines currently under development.
- Deputy, Large Facilities Projects may approve external courses as part of the curriculum.

Workforce Planning

The second of NSF's workforce goals for FY 2004 addresses future workforce needs through implementation of the preliminary findings and recommendations of the Business Analysis. The FY 2004 effort includes initial development of human resource standards that link employee competencies with critical business processes and emerging technology.

Foreseeing the workforce challenges before it, NSF has taken some preliminary steps to identify emerging workforce needs. For example, the agency has been exploring the potential of increasing the number of entry-level science and engineering positions, providing opportunities for science and engineering internships, and funding academic advancement and career development programs. A strategic facet of this workforce investment is its impact on new entrants to the science and engineering workforce where there are a greater number of individuals from groups presently underrepresented in science and engineering.

Performance Goal IV-16: NSF will develop competency-based, occupation classification alternatives that support the agency's strategic business processes and capitalize on its technology-enabled business systems.

Performance Indicators:

> Identification of workforce competencies needed to support the majority of NSF's strategic business processes.

> Development of new positions or revision of position descriptions in order to address emerging business process requirements.

Comparison to FY 2003 Goal: NSF's FY 2003 goal related to workforce planning focused on identification of workforce competencies for all current NSF job families and on identification of competency-based, classification alternatives. The FY 2004 goal focuses on association of workforce competencies with NSF's business processes and adds the addition or revision of positions in accordance with the identified competencies as an indicator. The emphasis on workforce planning is retained while continuing progress on new tasks in this area.

Baseline: NSF has currently identified five core strategic business processes. These are resource allocation, merit review, award management and oversight, knowledge management and performance assessment and accountability. The number may be revised as a result of the Business Analysis. Position descriptions currently exist for all NSF positions.

Means and Strategies for Success:

> Identify current workforce skill mix and skill gaps;

> Analyze emerging and future workforce needs;

> Identify optimal occupational groupings in support of mission and business practices; and

> Work collaboratively with the business analysis contractor to identify new types / classes of positions.

Resources Required: Current staff and business analysis contractor to provide needed functional expertise to conduct the activity and additional FTE and contractors to support position development. Successful progress on this goal, as currently developed, may be contingent upon receipt of the staffing and/or financial resources identified.

Data / Data Source: Findings of the Business Analysis, including workforce competencies and future business requirements, and current position documentation. The newly established or revised positions will be reviewed externally for relevance to emerging business process requirements.

Data Limitations: Undefined.

V. Verification and Validation (V&V)

OMB's FY 2002 Circular A-11 guidance pertaining to GPRA indicates that performance plans should:

- Identify the means the agency will use to verify and validate the measured performance values;
- Provide information on data sources; and
- Provide information on actions to improve completeness and reliability of performance data.

A. Types and Sources of Performance Data and Information

Most of the data that underlie achievement assessments for strategic outcome goals originate outside the agency and are submitted to NSF through the Project Reporting System, which includes annual and final project reports for all awards. Through this system, performance information / data such as the following are available to program staff, and are compiled by NSF staff for third party evaluators and other external committees:

- Information on People – student, teacher and faculty participants in NSF activities; demographics of participants; descriptions of student involvement; education and outreach activities under grants; demographics of science and engineering students and workforce; numbers and quality of educational models, products and practices used/developed; number and quality of teachers trained; and student outcomes including enrollments in mathematics and science courses, retention, achievement, and science and mathematics degrees received;
- Information on Ideas – published and disseminated results, including journal publications, books, software, and audio or video products created; contributions within and across disciplines; organizations of participants and collaborators (including collaborations with industry); contributions to other disciplines, infrastructure, and beyond science and engineering; use beyond the research group of specific products, instruments, and equipment resulting from NSF awards; and role of NSF-sponsored activities in stimulating innovation and policy development; and
- Information on Tools – published and disseminated results; new tools and technologies, multidisciplinary databases; software, newly-developed instrumentation, and other inventions; data, samples, specimens, germ lines, and related products of awards placed in shared repositories; facilities construction and upgrade costs and schedules; and operating efficiency of shared-use facilities.

Most of the data supporting management goals can be found in NSF central systems, as noted in the description accompanying each goal. These NSF central systems include the Enterprise Information System (EIS); FastLane, with its Performance Reporting System and its Facilities Reporting System; the Online Document System (ODS); the Proposal, PI, and Reviewer System (PARS); the Awards System; the Electronic Jacket; and the Financial Accounting System (FAS). These systems are subject to regular checks for accuracy and reliability.

The Division of Human Resources Management (HRM/OIRM) maintains information related to staff recruitment and staff training. OEOP databases are also available for reporting purposes.

B. Completeness and Reliability of Performance Data

NSF's FY 2002 Performance and Accountability Report noted that the agency's results draw upon data that are complete and reliable. Standards for complete and reliable data, as presented in OMB Circular A-11, focus on the following issues (selected for relevance to NSF):

- Performance data are considered complete if actual performance is reported for every performance goal and indicator in the annual plan; and
- Performance data are considered reliable if there is neither refusal nor a marked reluctance by agency managers or decision-makers to use the data in carrying out their responsibilities, and data are further defined as reliable when the agency managers use the data contained in the annual report on an ongoing basis in the normal course of their duties.

C. Data Verification &Validation Activities

In order to verify and validate the measured values of actual FY 2004 performance, NSF intends to use a process similar to the one used in FY 2000, FY 2001, and FY 2002. NSF engaged an external third party, International Business Machines Corporation (IBM) Business Consulting Services (formerly PricewaterhouseCoopers LLP), to verify and validate selected GPRA performance results as well as the process through which supporting data was compiled. IBM documented the processes NSF follows to collect, process, maintain, and report selected performance data. They identified relevant controls and commented on their effectiveness. Based on GAO guidance, they provided an assessment of the validity and verifiability of the data, policies, and procedures NSF used to report results for the FY 2002 management goals.

APPENDICES

A. ACRONYMS

B. MANAGEMENT CHALLENGES AND REFORMS

C. COMPARISON OF NSF GOALS – FY 2003 AND FY 2004

D. INTERIM ADJUSTMENTS TO NSF GPRA STRATEGIC PLAN FY 2001 – FY 2006 AND DEVELOPMENT OF AN UPDATED STRATEGIC PLAN

APPENDIX A: ACRONYMS

A&M	Administration and Management
AC/GPA	Advisory Committee for GPRA Performance Assessment
BE	Biocomplexity in the Environment
BFA	Office of Budget, Finance and Award Management
CAREER	Faculty Early Career Development Program
CEOSE	Committee on Equal Opportunities in Science and Engineering
CLT	Center for Learning and Teaching
COV	Committee of Visitors
DOE	Department of Energy
ED	Department of Education
EHR	Directorate for Education and Human Resources
EIS	Enterprise Information System
EPSCoR	Experimental Program to Stimulate Competitive Research
FAIR	Federal Activities Inventory Reform
FAS	Financial Accounting System
FTE	Full-Time Equivalent
FY	Fiscal Year
GAO	General Accounting Office
GIIC	GPRA Infrastructure Implementation Council
GISRA	Government Information Security Reform Act
GK-12	Graduate Teaching Fellowships in K-12 Education
GPG	Grant Proposal Guide
GPRA	Government Performance and Results Act
GRF	Graduate Research Fellowship
GSS	General Support System
HR	Human Resources
HRM	Division of Human Resource Management
IERI	Interagency Education Research Initiative
IGERT	Integrative Graduate Education and Research Traineeship
IT	Information Technology
IT^2	Information Technology for the 21^{st} Century
ITR	Information Technology Research
ITS	Information Technology Security
K-12	Kindergarten through twelfth grade
K-16	Kindergarten through college
KDI	Knowledge and Distributed Intelligence
LEE	Life and Earth's Environment
LSAMP	Louis Stokes Alliances for Minority Participation
MCC	Management Controls Committee
MREFC	Major Research Equipment and Facilities Construction (Account)
MRI	Major Research Instrumentation
MRSEC	Materials Research Science and Engineering Center
MSP	Math and Science Partnership
NAPA	National Academy of Public Administration
NASA	National Aeronautics and Space Administration
NCLB	No Child Left Behind
NIST	National Institute of Standards and Technology
NITRD	Networking and Information Technology Research and Development
NNI	National Nanotechnology Initiative
NRC	National Research Council
NSB	National Science Board
NSE	Nanoscale Science and Engineering
NSF	National Science Foundation
NVO	National Virtual Observatory
ODS	Online Document System
OEOP	Office of Equal Opportunity Programs
OIG	Office of Inspector General
OIRM	Office of Information and Resource Management
OMB	Office of Management and Budget
OPP	Office of Polar Programs
PARS	Proposal, PI and Reviewer System
PFI	Partnerships for Innovation
PI	Principal Investigator
PIMS	Program Information Management System
PITAC	President's Information Technology Advisory Council
PMA	President's Management Agenda
PwC	PricewaterhouseCoopers LLP
R&D	Research and Development
REU	Research Experiences for Undergraduates
RSI	Rural Systemic Initiatives
S&E	Science and Engineering
SLC	Science of Learning Center

SRS	Division of Science Resources Statistics
STC	Science and Technology Center
STEM	Science, Technology, Engineering and Math
USAP	United States Antarctic Program
USGS	United States Geological Survey
USP	Urban Systemic Program
V&V	Verification and Validation
VSEE	Visiting Scientists, Engineers and Educators

APPENDIX B: MANAGEMENT CHALLENGES AND REFORMS

This appendix contains a discussion of management issues presented in the President's Management Agenda or identified for NSF and other federal agencies by OMB or GAO, in NSF's annual review of financial and administrative systems as required by the Federal Managers' Financial Integrity Act, or by the NSF Office of Inspector General. The OIG issues addressed are those included in a December 23, 2002 memorandum on NSF's management and performance challenges.

Many of the issues discussed also fall within the purview of the internal NSF Management Controls Committee (MCC), chaired by the Chief Financial Officer. That committee provides continuing and long-term senior executive attention to NSF's management challenges and reforms.

MAJOR MANAGEMENT CHALLENGE	STEPS TO ADDRESS CHALLENGE
Merit Review and its Role in Fostering Diversity (OIG)	
NSF's OIG (December 2002*) noted "Increasing the participation of minority scientists as proposers, reviewers, and investigators, while maintaining the integrity of the award process, remains an important priority and challenge for NSF." The OIG notes that the NAPA study on the Foundation's criteria for project selection, which focused on the impact of the "broader impacts" criterion recommended "broader-based review panels with participants drawn from a wider range of institutions, disciplines and underrepresented minorities" but also noted that low participation in voluntary data disclosure has hampered accurate data tracking .	NSF considers its merit review process the keystone for award selection. The agency evaluates proposals using two criteria – the intellectual merit of the proposed activity and its broader impacts. NSF staff rely on expert evaluation by selected peers when evaluating proposals and making funding decisions. Each year, more than 250,000 merit reviews are provided to assist NSF with the evaluation of proposals. NSF focuses its management activities on a wide variety of issues related to merit review – including use of both merit review criteria by reviewers and program officers, broadening participation, and enhancing customer service. For example, NSF revised its guidance to proposers in the *Grant Proposal Guide* (GPG) to reflect the importance of the broader impacts criterion. In FY 2001 NSF developed and implemented an electronic system to request demographic data, on a *voluntary* basis, from all reviewers. Participation was disappointingly low. As a result the agency was unsuccessful in achieving its FY 2002 GPRA goal for establishing a reviewer pool diversity baseline. In FY 2003, NSF will continue to request demographic information from reviewers and to focus on increasing voluntary participation via efforts to educate reviewers on the purpose of the data collection. Development of a related future performance goal will be considered once the feasibility of setting quantitative targets for participation levels of underrepresented groups based on the limited data available is assessed. <u>Summary:</u> Issue addressed with internal management controls and processes. Related issues addressed with FY 2004 GPRA Goals IV-1, 2, 3, and 5

*The December 2002 OIG reference that appears throughout this section refers to the NSF Inspector General's statement concerning NSF's Management and Performance Challenges. See the NSF FY 2002 Performance and Accountability Report to view a copy.

MAJOR MANAGEMENT CHALLENGE	STEPS TO ADDRESS CHALLENGE
Management of Large Infrastructure Projects (OMB;OIG)	
In response to OMB concerns related to NSF's capability to manage proposed multi-year, large facility projects given their magnitude and costs NSF was asked to develop and submit a plan to OMB that documents its costing, approval, and oversight of major facility projects. The NSF OIG (December 2002) has noted that "NSF has made progress toward correcting the types of problems identified" in audits. The OIG also recognized that NSF will "continue to make needed improvements to the guide over time."	NSF continues its efforts to improve management and oversight of its large facility projects in accordance with the plans laid out in the *Large Facility Projects Management & Oversight Plan,* available at http://www.nsf.gov/bfa/lfp/document/finalplan.pdf. This facilities plan has four major foci: • Enhance organizational and staff capabilities and improve coordination, collaboration, and shared learning among NSF staff and external partners; • Implement comprehensive guidelines and procedures for all aspects of facilities planning, management and oversight; • Improve the process for reviewing and approving Large Facility Projects; and • Practice coordinated and proactive oversight of all facility projects. In August 2002, NSF launched a new search for a Deputy Director for Large Facility Projects and named an interim Deputy Director. Selection is anticipated in February 2003. Implementation of the elements of the plan is underway, including training, guidance and establishment of Project Advisory teams. Summary: Issue addressed with FY 2004 GPRA Performance Goals IV-8 and IV-9 and internal management controls and processes.

MAJOR MANAGEMENT CHALLENGE	STEPS TO ADDRESS CHALLENGE
Award Administration (OIG)	
Award administration is a broad term used to describe the award and program monitoring directed toward scientific progress and the oversight exercised by BFA (Office of Budget, Finance, and Award Management) over grantees' financial management of NSF awards. The NSF OIG (December 2002) noted that " [T]he Guide is generally responsive to the recommendations outlined in the FY 2001 Management Letter Report and represents an important first step to improving NSF's post-award administration practices" but encouraged more detail and more emphasis on lower risk awardees.	To address the need for increased oversight of the agency's complex and diverse portfolios, the NSF A&M Strategic Plan includes a framework for Award Management and Oversight that focuses on a collaborative, multi-functional award management and oversight process that is informed by risk management strategies and verifies that projects are in compliance. NSF has drafted a strategic plan and a *Risk Assessment and Award Monitoring Guide* for assessing and managing awardee risks and assets focusing on financial and administrative monitoring to insure proper stewardship of federal funds at awardee institutions. This plan is risk-based and is being piloted at a number of institutions and will be refined based on our assessment of these reviews. Summary: Issue addressed with internal management controls and processes.

MAJOR MANAGEMENT CHALLENGE	STEPS TO ADDRESS CHALLENGE
GPRA Data Quality (OIG)	
The NSF OIG (December 2002) noted "[W]e continue to have concerns about the validity and quality of NSF's Government Performance and Results Act (GPRA) data and outcome measures." Particular concerns were expressed about the perception of too many GPRA goals, the need for more agency level data capture to support programs, and the need for clarity in the priority setting process.	Since the FY 2000 GPRA reporting cycle, NSF has engaged an external party, IBM Consulting (IBM), [formerly Pricewaterhouse Coopers LLP (PwC)], to provide an independent verification and validation (V&V) of selected GPRA goals. The V&V focused on reliability of data, on processes to collect, process, maintain, and report the data, and on program reports prepared by external experts. IBM mapped NSF procedures against GAO guidance for polices and procedures that underlie GPRA performance reporting. IBM's FY 2000, FY 2001 and FY 2002 assessments were positive and constructive and have helped NSF be in compliance with standards set forth in OMB Circular A-11. NSF will reassess its GPRA outcome measures during preparation of the updated and revised Strategic Plan, due to OMB on March 1, 2003. The agency also engaged the services of an external management-consulting firm, PricewaterhouseCoopers Consulting, to conduct an integrated performance, cost, and budget strategy assessment, with the intent of obtaining different scenarios to meet our growing requirements in this arena. This assessment was completed in August 2002. Information derived from this assessment was used to develop an action plan for integrating budget, cost and performance activities. The plan was submitted to OMB to formalize NSF actions for implementing the PMA. Copies of the action plan have also been provided to the OIG and NSF's Business and Operations Advisory Committee. <u>Summary:</u> Issue addressed with external V&V and internal management controls and processes.

MAJOR MANAGEMENT CHALLENGE	STEPS TO ADDRESS CHALLENGE
Management of U.S. Antarctic Program (OIG)	
The NSF OIG (December 2002) has stated that "The successful operation of the USAP requires unique management and administrative skills combined with knowledge of the special needs of Antarctic researchers." They also note that "[O]ne issue that has been raised in Committee of Visitors (COV) reports, as well as our audit work, is the need to improve long-range capital planning and budgeting for repairing and maintaining the Antarctic infrastructure, including facilities, transportation, and communications.	NSF agrees with the OIG that the safety of scientists and workers, environmental concerns, and the national interests of the U.S. Government require unique management and administrative skills that are responsive to the special needs of Antarctic scientific research. In order to meet these challenges, NSF staff utilize their special expertise to: • Implement next steps in long range plan for renovating/updating McMurdo Station infrastructure. • Coordinate Department of Defense, NASA, USGS and DOE activities; • Oversee environmental, health, safety, and medical activities; • Oversee construction and maintenance of all infrastructure at three U.S. stations in Antarctica (roads, fire stations, clinics, power stations, heating, communications, ground stations, air traffic control, ground vehicles, food services, sewage treatment, water supplies, etc.); • Coordinate support of scientists in Antarctica, construction of specialized science instrumentation, etc.; • Plan and budget for the above activities; and • Select science projects for deployment on the basis of merit review and ability to meet logistics requirements. <u>Summary:</u> Issue addressed with internal controls and processes.

MAJOR MANAGEMENT CHALLENGE	STEPS TO ADDRESS CHALLENGE
The Math and Science Partnership Program (OIG)	
NSF's OIG notes in December 2002 that "[T]he sustained involvement of NSF remains essential. NSF program officers now need to provide extensive coaching of the new projects …[and] will also need to assist project partners in building a shared sense of purpose and in coordinating efforts. Also, those projects involving awardees with limited experience in handling federal funds will require close monitoring of all aspects of their projects, including financial and administrative matters. Therefore, NSF staff will need to help coordinate the efforts of the various parties, monitor the progress of the projects, and ensure that federal funds are handled properly, while at the same time administering the subsequent program solicitation of approximately $200 million.	NSF has developed a comprehensive award oversight and management plan for all Math and Science Partnership awards. NSF made 24 MSP awards in FY 2002. Larger, more complex awards were made as cooperative agreements. These cooperative agreements will describe the post-award management and oversight that will support the work of MSP partnerships in realization of their goals; management and oversight activities will draw upon NSF's strong, community-based site visit processes. The lead partners responsible for both fiscal and project management of MSP-supported projects will, for the most part, be institutions with significant experience handling federal funds. For lead partners with no prior experience working with NSF or other federal funds, NSF staff will work closely with these organizations in the monitoring of all aspects of the project, including financial and administrative matters. NSF has also set up workshops and provided technical assistance resources for grantees and prospective grantees. <u>Summary:</u> Issue addressed with internal controls and processes.

MAJOR MANAGEMENT CHALLENGE	STEPS TO ADDRESS CHALLENGE
Electronic Government (PMA, OMB, GAO)	
Expanded electronic government is one of the government-wide initiatives presented in the *President's Management Agenda for 2002*. That document states that "the administration's goal is to champion citizen-centered electronic government." Specifics were delineated in the February 27, 2002 E-government Strategy Document, http://www.whitehouse.gov/omb/inforeg/egovstrategy.pdf, which includes E-grants, E-travel and E-payroll/HR projects of relevance to NSF.	The NSF Administration and Management Strategic Plan provides the framework for agency activities that address the President's Management Agenda E-government initiative. The results of NSF's E-government initiatives are significant and earned NSF the only E-government "green light," as of the July 2002 scorecard from OMB. The OMB mid-session review reports that NSF is a "model for successful E-Government." In FY 2002, NSF received 99.99% of proposals through electronic systems. NSF's FastLane system, which handles virtually all business transactions with proposers and awardees, exemplifies what can be achieved in E-government information system design, development, and implementation. NSF continues to be an active leader in interagency E-government efforts through the government-wide E-grants initiative as well as actively participating in E-travel and E-payroll/HR activities. Summary: Issue addressed with FY 2004 GPRA Performance Goal IV-11 and internal management controls and processes.

MAJOR MANAGEMENT CHALLENGE	STEPS TO ADDRESS CHALLENGE
Data/Information (IT) Security (GAO, OMB, OIG)	
The NSF OIG (December 2002) stated "The agency is to be commended for the improvements in its security program made in the past year, including implementation of a mandatory security awareness training program, formal assignment of security responsibilities and authorities, restructuring of key security positions, appointment of an agency-wide security officer, and establishment of updated security policies and procedures. These accomplishments help build a foundation for a comprehensive security program and demonstrate the agency's commitment to information security." Nevertheless, concern was expressed that "more improvements are needed." GAO (01-758) noted that recent audits continue to show that federal computer systems are riddled with weaknesses that make them highly vulnerable to computer-based attacks and place a broad range of critical operations and assets at risk of fraud, misuse and disruption.	The NSF Information Technology Security (ITS) Program remains focused on ensuring that NSF infrastructure and critical assets are appropriately protected while maintaining an open and collaborative environment for science and engineering research and education. An agency-wide ITS program has been implemented encompassing all aspects of information security. Documentation in accordance with OMB Circular A-130, "Management of Federal Information Resources" of risk assessments and commensurate security plans for major systems is prepared and independently reviewed. NSF has comprehensive disaster recovery plans and capabilities, which are tested on an annual basis at a hot-site location. Additional resources have been requested to enhance the agency's overall security posture through the use of emerging "smart technology." NSF has implemented policies and processes to monitor and protect against intrusion attempts. Routine penetration testing is planned to start in FY 2003. In accordance with Government Information Security Reform Act (GISRA) and the Computer Security Act, NSF has implemented a program of IT security training to all NSF staff and contractors who use NSF computer systems. Summary: Issue addressed with FY 2004 GPRA Performance Goal IV-12 and internal management controls and processes.

MAJOR MANAGEMENT CHALLENGE	STEPS TO ADDRESS CHALLENGE

Erroneous Payments to Recipients of Government Funds (PMA, OMB)

OMB guidance and the *President's Management Agenda for 2002* addresses improved financial performance for federal agencies, including erroneous payments. In addition, the General Accounting Office (GAO) recently issued an executive guidance, which outlines strategies for agencies to effectively manage improper payments.	NSF has always understood its fiduciary responsibility to ensure taxpayer funds entrusted to it are properly controlled and disbursed. Consequently, NSF has a culture of high operating efficiencies and sophisticated systems, which results in few improper payments. NSF has already adopted many of the strategies suggested by GAO in its internal controls as part of daily business functions. Since all NSF payment functions are centrally located, the agency has the ability to do pre-payment review of all payments, which keeps the amount of improper payments low. A formal post payment risk assessment reinforced that assertion. Also, NSF is in compliance with OMB reporting requirements in this area. Summary: Issue addressed with internal NSF management controls and processes.

MAJOR MANAGEMENT CHALLENGE	STEPS TO ADDRESS CHALLENGE

Cost-Sharing (OIG)

The NSF OIG (December 2002) noted that "… audit work indicates that NSF grantees continue to experience significant problems in accounting for cost sharing, raising questions about whether required contributions are actually being made. The issues cited in our reports are primarily related to the commingling of reimbursable and cost-shared expenses, time and effort reporting, and cost-sharing certification."	During FY 2002, BFA began development of the Risk Assessment and Award Monitoring Guide. This document establishes the strategic framework for assessing and managing awardee risks and assets. Cost sharing is identified as a high-risk factor and was focused on in development of the risk assessment protocol, currently being pilot tested with a sample set of organizations. NSF envisions increased on-site review to provide important business and managerial assistance to awardees in this area. In addition, BFA has been assessing issues that have surfaced since implementation of Important Notice 124, *Implementation of the New Cost Sharing Policy.* At the August 2002 meeting of the National Science Board (NSB), the Audit and Oversight Committee affirmed the importance of this issue and requested that NSF develop more explicit policies and procedures related to implementation of the "tangible benefit" criterion of the cost sharing policy. These activities are under way. In addition, at its November 2002 meeting, the NSB approved clarifications to its 1999 cost sharing policy that will are expected to improve cost sharing negotiations. Summary: Issue addressed with internal management controls and processes.

MAJOR MANAGEMENT CHALLENGE	STEPS TO ADDRESS CHALLENGE
Competitive Sourcing [A-76 Competitions and FAIR Act Inventories] (PMA, OMB)	
The *President's Management Agenda* proposes to increase competition for commercial activities performed by the government as listed on agency Federal Activities Inventory Reform (FAIR) Act inventories. The FY 2003 guidance for agencies is to complete competitions on a total of 15% of the FTE listed on their FAIR Act inventories. The Administration's long-term goal is to open at least one-half of the Federal positions listed on the FAIR Act inventory of commercial functions to competition with the private sector. Agency plans should outline how the agency intends to meet these goals. OMB has recently released a draft revision to its Circular A-76 and NSF will monitor the impact of these changes.	NSF has entered into a multi-year contract to conduct a Strategic Business Analysis. The agency intends to use the findings and recommendations from the workforce study part of this effort to redefine its FAIR Act inventory. This will underpin the development of a strategic competitive sourcing plan that optimally supports future business needs and is responsive to the *President's Management Agenda* requirements. Development of this plan will begin in FY 2003. A high level of competitively sourced commercial activities over the years has enabled NSF to focus its small workforce on its core business needs and mission-essential functions. Although NSF's budget has increased by more than 80 percent in the past ten years, the number of NSF federal employees has increased by only one percent, due in part to the agency's effective use of competitive sourcing. In addition, NSF annually relies upon more than 50,000 volunteer, non-federal reviewers for proposal review and award oversight. <u>Summary:</u> Issue addressed with internal management controls and processes and through development of a Business Analysis.

MAJOR MANAGEMENT CHALLENGE	STEPS TO ADDRESS CHALLENGE
Cost Accounting Systems (OIG, PMA)	
NSF's OIG noted in December 2002 that "[m]managerial (cost) accounting information is used to assess operational effectiveness and efficiency. Cost information not only adds significant value to activities such as budgeting, cost control, and performance measurement, but also is useful in informing capital investment decisions such as prioritizing the funding of large infrastructure projects…. NSF should use its accounting systems to capture total project or outcome costs and supply information useful to the Congress, OMB, the National Science Board and NSF management." In addition, NSF is rated "red" on the Budget-Performance Integration initiative of the President's Management Agenda in part because the NSF Budget does not charge the full budgetary cost to individual activities.	The Foundation has engaged the services of an external management-consulting firm to conduct an integrated performance, cost, and budget strategy assessment, with the intent of obtaining different scenarios to meet our growing requirements in this arena. This study included a best practices survey of public and private enterprises, and input from NSF senior staff on financial and performance information needed to make better management and budgetary decisions. The assessment was completed in August 2002. NSF incorporated the major findings and recommendations from this study into a draft plan for integrating budget, cost, and performance, which has been shared with OMB, the OIG, and with the NSF Advisory Committee on Business and Operations. The draft plan will be updated based on the input and guidance received and will focus on determining the most appropriate and useful cost and performance information to develop and monitor. A major step in this process will be the revision of the NSF GPRA Strategic Plan in FY 2003, because the alignment criteria set forth in the PMA do not correspond to the program framework outlined in NSF's current strategic plan. <u>Summary:</u> Issue addressed with internal management controls and processes and external expert advice.

MAJOR MANAGEMENT CHALLENGE	STEPS TO ADDRESS CHALLENGE
Workforce Planning and Training (Human Capital) (PMA, OMB; GAO; OIG)	
GAO *(GAO-01-236, April 2001)* has identified shortcomings of many agencies involving key elements of modern strategic human capital management, including (1) strategic planning and organizational alignment; (2) leadership continuity and succession planning; and (3) acquiring and developing staff whose size, skills, and deployment meet agency needs. The NSF OIG (December 2002)notes that "[p]lanning for NSF's future workforce needs and training the large number of temporary staff continue to be serious concerns." Personnel records also indicate that since 1996, NSF's reliance on temporary staff has increased in tandem with the size of its appropriation … [and that t]he increase in temporary staff places a greater burden on the agency, particularly Human Resource Management, to continually recruit and train these personnel and find them suitable office space. Additionally, the *President's Management Agenda (2002)* includes strategic management of human capital as a government-wide initiative.	NSF's flexible and motivated workforce currently includes approximately 650 permanent and visiting scientists and engineers (about 65% of whom are permanent government employees), 450 administrative personnel who provide business operations support, and approximately 300 program support personnel. Consistent with the goals of the President's Management Agenda, and NSF enabling legislation, the agency uses personnel flexibilities. These include planned turnover through short-term rotational appointments. NSF has a steadfast commitment to empower a workforce of teams and individuals who are continuously expanding their capabilities to shape the agency's future. To sustain its high-performing workforce, NSF is exploring ways to recruit and retain excellent employees. New initiatives include an updated telecommuting program, strategic recruiting techniques that also seek to increase representation of underrepresented groups in the NSF science and engineering workforce, a renewed focus on continuous learning and an increased emphasis on leadership and succession planning. The formal establishment of the NSF Academy in 2002 is also a critical strategic step. NSF has entered into a multi-year contract to perform a Strategic Business Analysis which will examine organizational alignment and the workforce size, skill mix, and deployment necessary to ensure mission accomplishment. This effort continues through FY 2005; NSF will develop and implement human capital strategies and an human resource accountability system during this timeframe as findings and recommendations are received. Summary: Issue addressed with GPRA FY 2004 Performance Goals IV-13, IV-14, IV-15, IV-16 and internal management controls and processes.

MAJOR MANAGEMENT CHALLENGE	STEPS TO ADDRESS CHALLENGE
Efficiency of the Research Process (OMB)	
In discussions with OMB, NSF has asserted that the current size of its grants and their duration might result in inefficiency at U.S. academic institutions if scientists and engineers devote a greater proportion of their time to preparing proposals than to conducting research. OMB has asked the agency to develop metrics to measure the efficiency of the research process and determine the "right" grant size for the types of proposals that the Foundation funds.	NSF contracted with Mathematica Policy Research, Inc. to assist in the development and administration of two surveys – one for Principal Investigators and one for institutions. An internal NSF Working Group on Award Size and Duration has been established. Focus groups that included both temporary (rotators) and permanent NSF staff provided input to the survey design. Both surveys were administered in early 2002. Final results were provided in May 2002 and shared with the public. The contractor's analysis offered several alternative methods of determining the right grant size. NSF management agreed that increasing the award size and duration is one of the agency's top priorities. The Foundation's long-term goal is to reach an average annualized award size of $250,000 and average award duration of 5.0 years. Summary: Issue addressed with FY 2004 GPRA Goals IV-6 and IV-7; internal management controls and processes; activities external to NSF.

MAJOR MANAGEMENT CHALLENGE	STEPS TO ADDRESS CHALLENGE
Federal Funding of Astronomy and Astrophysics (OMB)	
NSF and NASA provide more than 90 percent of Federal funds for academic astronomy research and facilities. Historically, NASA has funded space-based astronomy and NSF has funded ground-based astronomy as well as unsolicited astronomy research proposals. Recent changes (e.g., the share of grants funding and the need for more integration of ground and space-based facilities) suggest that the Federal government's management and organization of astronomical research should be assessed.	A National Academy of Sciences committee was directed to assess the current disposition of management and operational responsibilities for Federal support of astronomical sciences. The NRC reported in September 2001 and recommended that "The National Science Foundation's astronomy and astrophysics responsibilities should not be transferred to NASA" and that the Federal government should develop a single integrated strategy for astronomy and astrophysics research that includes supporting facilities both on the ground and in space. NSF and NASA have established a joint National Astronomy and Astrophysics Advisory Committee to provide advice upon request to both NSF and NASA on selected issues of mutual interest and concern. NSF and NASA are also working jointly in efforts involving the National Virtual Observatory (NVO), one of the highly recommended initiatives in the NRC's Decadal survey of Astronomy and Astrophysics. Summary: Issue addressed with activities external to NSF.

MAJOR MANAGEMENT CHALLENGE	STEPS TO ADDRESS CHALLENGE
Budget for Administration and Management (OIG)	
In December 2002, the OIG noted that: "It is increasingly apparent that NSF's staff is in need of two basic resources to do its job: office space and travel funds. This year's management certification of the agency's internal controls contains multiple cautionary statements from senior managers about these two issues and their impact on operations." In particular they noted that "the agency cannot afford to wait for the results of its Business Analysis, which is not expected to conclude until 2006, to begin planning for and acquiring new offices." They further note that "[t]he shortage of travel funds affects NSF's ability to successfully address several of the management challenges identified here" and that "NSF should seek to maximize the effectiveness of staff by allocating more funding for these two essential resources."	This resource challenge is being addressed through budget analyses and planning, through ongoing assessments of space management and allocation and through increased emphasis on innovative and creative approaches such as telecommuting. NSF is also exploring cost efficiencies that can be gained in the move to E-travel and in the use of video conferencing. Summary: Issue addressed with internal management controls and processes and activities external to NSF.

APPENDIX C: COMPARISON OF NSF GOALS FY 2003 AND FY 2004

This section compares goals contained in the FY 2003 Revised Final GPRA Performance Plan with those in this FY 2004 GPRA Performance Plan.

Strategic Outcome Goal	FY 2003 Goal (Revised Final Plan)	FY 2004 Goal (Final Plan)	Explanation of Change
PEOPLE – Developing "a diverse, internationally competitive and globally engaged workforce of scientists, engineers, and well-prepared citizens."	III-1a: NSF's performance for the People Strategic Outcome is successful when, in the aggregate, results reported in the period demonstrate significant achievement in the majority of the following indicators: • Development of well-prepared researchers, educators or students whose participation in NSF activities provides experiences that enable them to explore frontiers or challenges of the future; • Contributions to development of a diverse workforce through participation of underrepresented groups in NSF activities; • Development or implementation of other notable approaches or new paradigms that promote progress toward the PEOPLE outcome goal.	III-1: NSF's performance for the People Strategic Outcome is successful when, in the aggregate, results reported in the period demonstrate significant achievement in the majority of the following indicators: • Development of well-prepared researchers, educators or students whose participation in NSF activities provides experiences that enable them to explore frontiers or challenges of the future; • Contributions to development of a diverse workforce through participation of underrepresented groups in NSF activities; • Development or implementation of other notable approaches or new paradigms that promote progress toward the PEOPLE outcome goal.	Unchanged.
	III-1b: NSF will significantly enhance the quality of K-12 mathematics and science education available to all students in Math and Science Partnership schools. Performance Indicators: • Evidence in the award portfolio of the infrastructure to support high quality programs addressing issues related to teacher workforce capacity, including preservice education and inservice professional development of math and science teachers as well as alternative routes into the profession (e.g., scientists and engineers becoming teachers.) • Evidence within Partnership school systems of the infrastructure needed to improve math and science education and to measure improvement, i.e., the adoption of appropriate assessments of student achievement, as well as the initiation of the collection of achievement data that can be disaggregated by ethnicity, socioeconomic status, gender, etc.		The FY 2004 Plan does not contain a performance goal related to the MSP because it will be too early to assess progress for outcomes from NSF investments. As an area of emphasis, the MSP program will be assessed for its potential to generate the proposed outcomes (i.e. the promise/potential of the MSP award portfolio).

Strategic Outcome Goal	FY 2003 Goal (Revised Final Plan)	FY 2004 Goal (Final Plan)	Explanation of Change
IDEAS -- Enabling "discovery across the frontier of science and engineering, connected to learning, innovation, and service to society."	III-2: NSF's performance for the Ideas Strategic Outcome is successful when, in the aggregate, results reported in the period demonstrate significant achievement in the majority of the following indicators: • Discoveries that expand the frontiers of science, engineering, or technology; • Connections between discoveries and their use in service to society; • Partnerships that enable the flow of ideas among the academic, public or private sectors; • Leadership in fostering newly developing or emerging areas.	III-2: NSF's performance for the Ideas Strategic Outcome is successful when, in the aggregate, results reported in the period demonstrate significant achievement in the majority of the following indicators: • Discoveries that expand the frontiers of science, engineering, or technology; • Connections between discoveries and their use in service to society; • Partnerships that enable the flow of ideas among the academic, public or private sectors; • Leadership in fostering newly developing or emerging areas.	Unchanged.
TOOLS -- Providing "broadly accessible, state-of-the-art and shared research and education tools."	III-3: NSF's performance for the Tools Strategic Outcome is successful when, in the aggregate, results reported in the period demonstrate significant achievement in the majority of the following indicators: • Development or provision of tools that enables discoveries or enhances productivity of NSF research or education communities; • Partnerships with local, state or federal agencies, national laboratories, industry or other nations to support and enable development of large facilities or other infrastructure; • Development or implementation of other notable approaches or new paradigms that promote progress toward the TOOLS outcome goal.	III-3: NSF's performance for the Tools Strategic Outcome is successful when, in the aggregate, results reported in the period demonstrate significant achievement in the majority of the following indicators: • Development or provision of tools that enables discoveries or enhances productivity of NSF research or education communities; • Partnerships with local, state or federal agencies, national laboratories, industry or other nations to support and enable development of large facilities or other infrastructure; • Development or implementation of other notable approaches or new paradigms that promote progress toward the TOOLS outcome goal.	Unchanged.

Performance Area	FY 2003 Goal (Revised Final Plan)	FY 2004 Goal (Final Plan)	Explanation of Change
Use of Merit Review	IV-1: At least 85 percent of basic and applied research funds will be allocated to projects that undergo merit review.	IV-1: At least 85 percent of basic and applied research funds will be allocated to projects that undergo merit review.	Unchanged.
Implementation of Merit Review Criteria - Reviewers	IV-2: At least 70 percent of reviews with written comments will address aspects of both generic review criteria.	IV-2: At least 70 percent of reviews with written comments will address aspects of both review criteria.	Unchanged.
Implementation of Merit Review Criteria – Program Officers	IV-3: For at least 80 percent of decisions to fund or decline proposals, program officers will comment on aspects of both generic review criteria.	IV-3: For at least 90 percent of decisions to fund or decline proposals, Program Officers will comment on aspects of both review criteria.	The target level for this goal has been increased from 80 percent to 90 percent.
Time to Prepare Proposals	IV-4: 95 percent of program announcements will be publicly available at least three months prior to the proposal deadline or target date.	IV-4: 95 percent of program announcements will be publicly available at least three months prior to the proposal deadline or target date.	Unchanged.
Time to Decision	IV-5: For 70 percent of proposals, be able to inform applicants whether their proposals have been declined or recommended for funding within six months of receipt.	IV-5: For 70 percent of proposals, be able to inform applicants whether their proposals have been declined or recommended for funding within six months of deadline of target date, or receipt date, whichever is later.	The wording of the goal has been revised slightly to reflect the method used to calculate the “time to decision.”
Award Size	IV-6: Increase average annualized award size for research grants to $125,000.	IV-6: NSF will increase the average annualized award size for research grants to $128,000.	The target level for this goal has been increased by $3,000.
Award Duration	IV-7: Maintain the FY 2002 goal of 3.0 years for the average duration of awards for research grants.	IV-7: The average duration of awards for research grants will be 3.0 years.	Unchanged
Facilities –Construction and Upgrade	IV-8: For ninety percent of construction, acquisition and upgrade projects, keep any negative cost and schedule variances to less than 10 percent of the approved project plan.	IV-8: For ninety percent of construction, acquisition and upgrade projects, keep any negative cost and schedule variances to less than 10 percent of the approved project plan.	Unchanged.
Facilities – Operations and Management	IV-9: For ninety percent of operational facilities, keep scheduled operating time lost to less than 10 percent.	IV-9: For ninety percent of operational facilities, keep scheduled operating time lost to less than 10 percent.	Unchanged.

Performance Area	FY 2003 Goal (Revised Final Plan)	FY 2004 Goal (Final Plan)	Explanation of Change
Cost Efficiency – Videoconferencing	No goal included.	IV-10: NSF will assess the cost efficiencies associated with administrative processes. Performance Indicator: - Calculation of the agency-wide cost-savings realized by the use of videoconferencing.	A cost efficiency goal related to savings resulting from the use of videoconferencing has been added.
Electronic Business	IV-10: NSF will continue to advance "e-business" by receiving through FastLane and processing electronically 90 percent of PI award transfers. IV-11: NSF will continue to advance "e-business" by implementing Phase III of the Electronic Jacket application. Performance Indicator: Implementation of the electronic capability for assigning proposal processing tasks, forwarding proposals to other programs as necessary, and delegating proposal action authority.	IV-11: NSF will integrate its internal electronic grants process with the E-government initiative. Performance Indicators: - 90 percent of program announcements will be posted to Fed Grants. - 75 percent of declined proposals will be processed using E-decline signatures.	The Foundation is moving towards an electronic environment capable of performing all internal and external functions from proposal submission through final project closeout. The FY 2004 goal retains the emphasis on E-business while continuing progress on new tasks in this area.
Security Program – Information Technology and Physical Security	IV-12: NSF will maintain and enhance the agency-wide security program to ensure adequate protection of NSF's IT infrastructure and critical assets. Performance Indicators: - 95 percent of major systems will have approved security plans on file. - 95 percent of major systems will have documented certification and accreditation.	IV-12: NSF will maintain and enhance the agency-wide security program to ensure adequate protection of NSF's infrastructure and critical assets. Performance Indicators: - 95 percent of NSF's major systems will achieve Level 3 compliance in accordance with the NIST Security Self-Assessment Framework. - Implementation of a "Smart ID" pilot to provide staff with a standard identification card for authentication and access control.	For FY 2004 the performance indicators retain the emphasis on information technology security while continuing progress on new tasks in this area. The "Smart ID" pilot indicator has been added.

Performance Area	FY 2003 Goal (Revised Final Plan)	FY 2004 Goal (Final Plan)	Explanation of Change
NSF Staff – Diversity	IV-13: NSF will ensure that diversity considerations are embedded in activities related to agency staffing of scientists and engineers. Performance Indicator: Initiate development of a NSF S&E diversity plan.	IV-13: NSF will ensure that diversity considerations are embedded in activities related to agency staffing of scientists and engineers. Performance Indicator: NSF will complete development of the NSF S&E diversity plan initiated in FY 2003 and begin implementation of its recommendations.	Future goals and associated performance indicators have not yet been developed. The recommendations of the FY 2003 internal, ad hoc task force will guide their development.
	IV-14: NSF will show an increase over FY 2000 in the total number of appointments to NSF science and engineering staff and management from underrepresented groups.	IV-14: NSF will show an increase over FY 2000 in the total number of appointments to NSF science and engineering staff and management from underrepresented groups.	Unchanged.
Workforce Learning	IV-15: NSF will align or develop competency-based curricula, through the NSF Academy, that provide cross-functional, work-based team learning opportunities. Performance Indicator: Initiate development of new courses or revision of existing courses to address program management, leadership development, and technology and business process training.	IV-15: The NSF Academy will develop a broad array of competency-based learning opportunities that will enable all staff to perform critical functions supporting NSF's vision and goals. Performance Indicators: - Identification of staff requiring Facilities / Center Project Management training. - Initiation of development of a curriculum that leads to certification in Facilities / Center Project Management.	The FY 2004 indicator retains the emphasis on workforce learning while implementing specific curricula

Performance Area	FY 2003 Goal (Revised Final Plan)	FY 2004 Goal (Final Plan)	Explanation of Change
Workforce Planning	IV-16: NSF will develop competency-based, occupation classification alternatives that support the agency's strategic business processes and capitalize on its technology enabled business systems. Performance Indicators: - Identification of workforce competencies for all current NSF job families. - Initiate identification of competency-based, classification alternatives.	IV-16: NSF will develop competency-based occupation classification alternatives that support the agency's strategic business processes and capitalize on its technology enabled business systems. Performance Indicators: - Identification of workforce competencies needed to support the majority of NSF's strategic business processes. - Development of new positions or revision of position descriptions in order to address emerging business process requirements.	The FY 2004 indicators retain the emphasis on workforce planning. The first indicator expands NSF's focus to association of workforce competencies with NSF's business processes. The addition or revision of positions in accordance with the identified competencies is added as an indicator.

APPENDIX D: INTERIM ADJUSTMENTS TO NSF GPRA STRATEGIC PLAN FY 2001 – FY 2006 AND DEVELOPMENT OF AN UPDATED STRATEGIC PLAN

Recent NSF planning efforts have focused on developing:

1) A 5-year Administration & Management Strategic Plan.
2) A Large Facility Projects Management and Oversight Plan (submitted to OMB and Congress in September 2001).
3) Changes to NSF's GPRA reporting processes (establishment of the Advisory Committee for GPRA Performance Assessment – utilized in FY 2002 reporting).
4) Strategies to address the President's Management Agenda and other initiatives of the new Administration.
5) Budget-Performance Integration Plan
6) GPRA Strategic Plan – NSF will submit a revised draft of its GPRA Strategic Plan to OMB on March 1, 2003 and a final updated plan no later than September 30, 2003. NSF submitted its existing FY 2001 – 2006 Strategic Plan in September 2000.

Results of the above-mentioned activities will provide guidance for Foundation activities over the next six months, until a revised NSF Strategic Plan is developed and approved by OMB.