



## Response to Senator Paul's "November 2015 Waste Report"

The National Science Foundation (NSF) has been the backbone of America's science and engineering research enterprise for over 70 years. In fact, NSF is the only federal agency that supports all fields of fundamental science and engineering research and education. NSF supports cutting-edge research projects — many of which serve as bellwethers for solutions to the myriad complex issues facing society. NSF programs also traditionally integrate research and education, fast tracking innovation excellence via hands-on learning to train our next generation of researchers and innovators.

Each year, NSF competitively awards thousands of grants that collectively advance our nation's scientific capabilities and engage the talents of hundreds of thousands of researchers, postdoctoral fellows, technicians, teachers and students in every field of science and engineering.

NSF is the primary source of federal funding for non-medical basic research, providing approximately 12,000 new awards annually. Through its merit review process, NSF ensures that proposals submitted are reviewed in a fair, competitive and in-depth manner. Competition for funding is intense, with only about one out of five proposals ultimately being approved.

Each proposal submitted to NSF is reviewed by science and engineering experts well-versed in their particular discipline or field of expertise. All proposals submitted to NSF are reviewed according to two merit review criteria: *Intellectual Merit* and *Broader Impacts*. NSF's merit review process is widely considered to be the "gold standard" of scientific review. Perhaps the best evidence of NSF's success is the repeated replication of its merit review model for discovery, education and innovation around the globe.

The results of this process — funding the best and brightest ideas through competitive merit review — have been profound. NSF-supported research has underpinned multitudinous discoveries leading to new inventions — the Internet, web browsers, Doppler radar, Magnetic Resonance Imaging, DNA fingerprinting, and bar codes — to name a few. These diverse examples underscore NSF's significant contributions to our nation's prosperity, health and wellbeing. NSF-funded discoveries have expanded our understanding of the world in which we live, led to life-saving medical advances, enhanced our national security, improved our everyday lives and yielded insights into the creation of the universe.

NSF's task of identifying and funding work at the frontiers of science and engineering requires keeping close track of research around the United States and the world; maintaining constant contact with the research community to advance the horizons of inquiry; and choosing the most promising people to conduct the research.

The following grant cited in the "November 2015 Waste Report" illustrates an example of promising NSF-funded research awarded support through the merit review process.

## *Climate Change Narrative Game Education (CHANGE)*

NSF Award 1316782

November 2015 Waste Report: “Climate Change: The Video Game”

University of South Florida

---

The Discovery Research PreK-12 program (DRK-12) seeks to significantly enhance the learning and teaching of science, technology, engineering, mathematics and computer science (STEM) by preK-12 students and teachers, through research and development of STEM education innovations and approaches. Projects in the DRK-12 program build on fundamental research in STEM education and prior research and development efforts that provide theoretical and empirical justification for proposed projects. Projects should result in research-informed and field-tested outcomes and products that inform teaching and learning. Teachers and students who participate in DRK-12 studies are expected to enhance their understanding and use of STEM content, practices and skills.

This Climate Change: The Video Game award focused on research on innovative marine science education theories and models for delivering global scientific concepts to high school students. The topics covered within the curriculum are complex and involve numerous factors and uncertainties which are challenging for high school students to comprehend making teaching these topics difficult. This project’s pioneering techniques advanced science education by delivering new findings for instructional technologists and serious game developers regarding effective interface and usability design of intermedia narrative gaming-simulations for education purposes.

A major component of this work involved the design, development, and evaluation of educational computer science-based simulations for teaching and learning in marine biology. The researchers designed and programmed computer science-based simulations to embody core content challenges, and then used a series of formative evaluation/revision cycles to improve the science-based simulations to measure the efficacy of student mastery.

Researchers investigated how the computer science-based simulation affected students’ learning, along with the validity of student beliefs about the changes over time within the marine and coastal habitats. This project found that students who used the CHANGE curriculum scored significantly higher than their peers who did not. The nature and design of the computer science-based simulation had a strong impact on students’ understanding of sea level rise and storms.

This project also studied the way that teachers implemented the CHANGE materials within their classrooms. The research team found that by engaging teachers in action research where teachers’ shared stories of practice and tried new teaching approaches that engaged in systematic inquiry, the pedagogical approach of the educator tended to shift to incorporate student centered discussions and argumentation resulting in place-based teaching rather than teaching from a global context.

References to the iconic game “Oregon trail” and the “Back to the Future” Hollywood film are misleading. The majority of the NSF project in question went into developing and testing cutting-edge innovative curriculum development materials for high school marine science courses and curricular approaches to teaching marine chemistry, estuarine science, marine

physics, population ecology (e.g., producers, invertebrates, and vertebrates), ocean exploration, and marine geology. Effective education plays the most crucial part in our ability to cope with the evolving challenges within the marine sciences. CHANGE was instrumental in educating the underserved low socioeconomic status and minority high school students in Hillsborough County Public School District (West Central Florida).