A Guide to Connections between the GLOBE Program and the Next Generation Science Standards*

Developed by
The Iowa Academy
of Science

For
The GLOBE Program

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ICER-1342903.

A Guide to Connections between the GLOBE Program and the Next Generation Science Standards*

The GLOBE Program: http://www.globe.gov

Next Generation Science Standards: http://www.nextgenscience.org/

Link to NGSS Standards by DCI: http://www.nextgenscience.org/search-standards-dci

Link to NGSS Standards by Topic: http://www.nextgenscience.org/search-standards

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Developed for
The GLOBE® Program
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GLOBE is an interagency program with a management infrastructure funded by the National Aeronautics and Space Administration (NASA) and the National Science Foundation (NSF). GLOBE is also supported by the National Oceanic and Atmospheric Administration (NOAA), the U.S. Department of State and implemented through a cooperative agreement between NASA and the University Corporation for Atmospheric Research (UCAR).

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The Iowa Academy of Science
50 BRC
University of Northern Iowa
Cedar Falls, Iowa 50614-0508
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The mission of the Iowa Academy of Science is to further scientific research, science education, public understanding of science and recognize excellence in these endeavors.

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Credits

Project Leadership Team

Marcene M. Seavey	Project Director	Program Director, Iowa Academy of Science
David Bydlowski		Science Consultant, Wayne RESA
Kristin Wegner		Project Manager, The GLOBE Program

Workshop Planning Team

Jennifer Bourgeault	Partnership Coordinator	NCES GLOBE Partnership
David Bydlowski	Science Consultant	Wayne RESA
Lynne Harris Hehr	Director	STEM Center for Math & Science Ed and Arkansas NASA EDC, University of Arkansas
Marcene M. Seavey	Project Director	Iowa Academy of Science, Iowa GLOBE Partnership
Kristin Wegner	Project Manager	The GLOBE Program

Workshop Team

Susan K. Beach, District Librarian/NASA Education Specialist, St. Croix Curriculum Center

Jennifer Bourgeault, Partnership Coordinator, NCES GLOBE Partnership

David Bydlowski, Science Consultant, Wayne RESA

Svetlana Darche, Sr. Research Associate, West Ed

Audra Edwards, 6th Grade Science Teacher, Hawkins Texas

Margaret A. Foletto, Part Time Teacher Trainer, Monterey Bay Aquarium

Matthew S. Gilmore, Associate Professor, University of North Dakota

Lynne Harris Hehr, Director, STEM Center for Math & Science Ed and Arkansas NASA EDC, University of Arkansas

Tina R. Harte, Outreach/Education Specialist , NASA Langley Research Center

Mikell Lynne Hedley, Research Scientists; Project Manager; SATELLITES Education Coordinator, The University of Toledo

Dorian Janney, Education Specialist , NASA-GSFC

Mitchell Klett, Professor, Earth and Space Science, Northern Michigan University

Julie Malmberg, Project Manager, The GLOBE Program

John D. Moore, Director for Geoscience Stem Education, Palmyra Cove Environmental Discovery Center

Kathleen Ann O'Connor, Science Teacher, University Prep Science and Math Middle School

Betsy O'Day, Science Specialist, Hallsville Intermediate

Henry Ortiz, Teacher, North Hollywood High School

David Overoye, Program Manager, Raytheon Web Solutions, Raytheon

Todd E. Toth, Education Specialist , NASA Goddard Space Flight Center

Lynn Vaughan, AMSTI-GLOBE-Research Specialist, University of Alabama Huntsville

Kristin Wegner, Project Manager, The GLOBE Program

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Table of Contents

Connecting the GLOBE Model for Student Scientific Research (MSSR) to NGSS Practices of Science and Engineering

In order to develop an alignment between the GLOBE Program and NGSS it is essential to understand that GLOBE is more than the sum of its individual protocols. Classroom implementation of GLOBE engages students in the development of scientific investigations using ***GLOBE protocols*** to collect data and ***GLOBE activities*** to develop scientific concepts important to making sense of the data. GLOBE Certified Teachers receive professional development that includes how to follow a GLOBE protocol to collect accurate and precise data ***and*** how to build a classroom investigation upon one or more protocols in order to engage students in the GLOBE Model for Student Scientific Research. The Model is an essential part of GLOBE implementation. Students who robotically complete protocols and collect data without asking their own questions, evaluating the data in light of their own observations, and coming to their own conclusions about what the data means are not fully engaged in GLOBE.

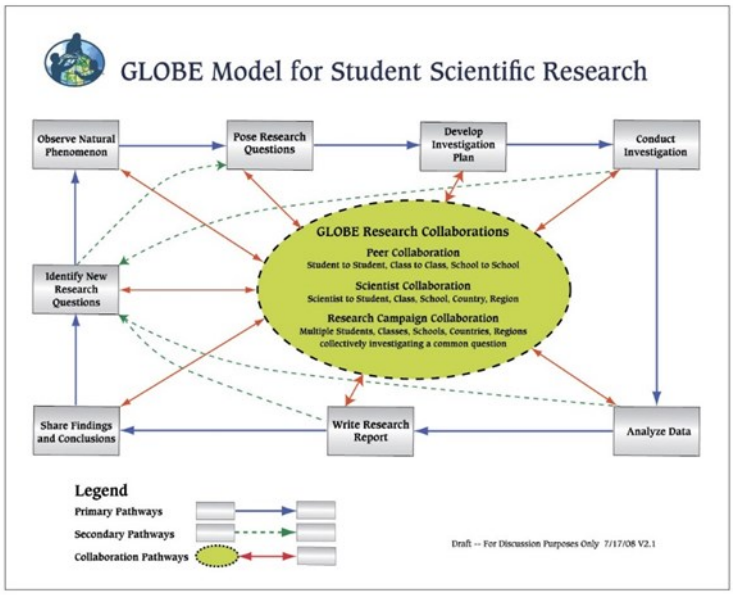


Image courtesy The GLOBE Program

Protocols are not procedures. The instructions within each protocol explain step-by-step how to collect one specific type of data. The Protocols also include background information about the scientific concepts involved, a description of why scientists are interested in the data, sample data with examples of analysis, and descriptions of how that protocol is related to others. However, GLOBE does not dictate what questions and problems teachers and students investigate using GLOBE Protocols, rather GLOBE provides the protocols as common tools that all GLOBE schools may use and the GLOBE Model for Student Scientific Research to assist teachers with using the protocols to engage students in questions and problems that fit their curriculum goals and are of interest to their students and local communities.

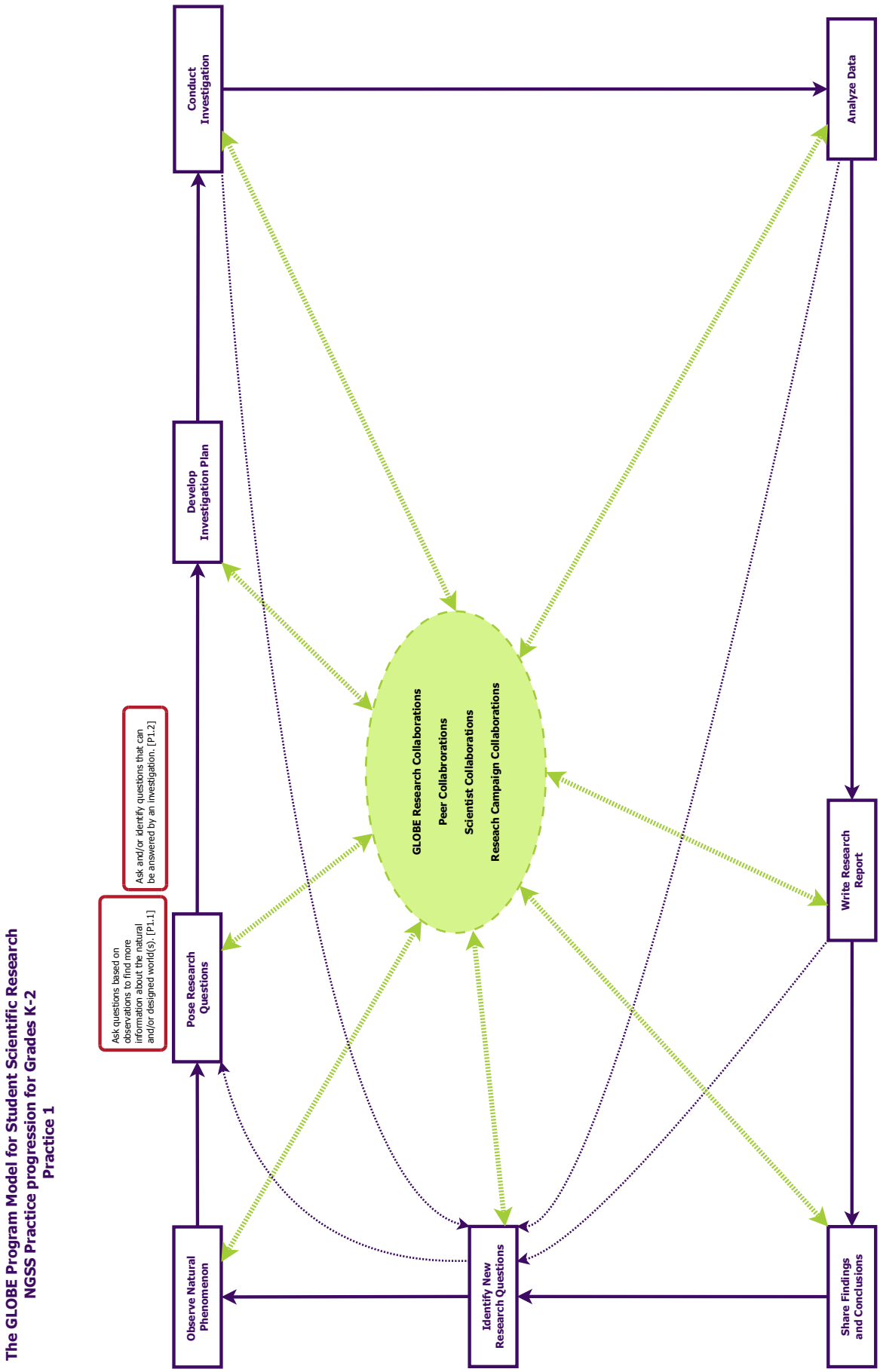
Connecting the GLOBE Program to the Next Generation Science Standards must take this aspect of GLOBE into account. Because implementation of GLOBE relies upon doing more that following the step-by-step data collection instructions within each protocol, making a connection between GLOBE and NGSS must include consideration of how the NGSS practices fit within the GLOBE MSSR.

The diagrams on the following pages map how the NGSS Practices progressions for each grade level (from NGSS Appendix F) fit into in the GLOBE Model for Student Scientific Research.

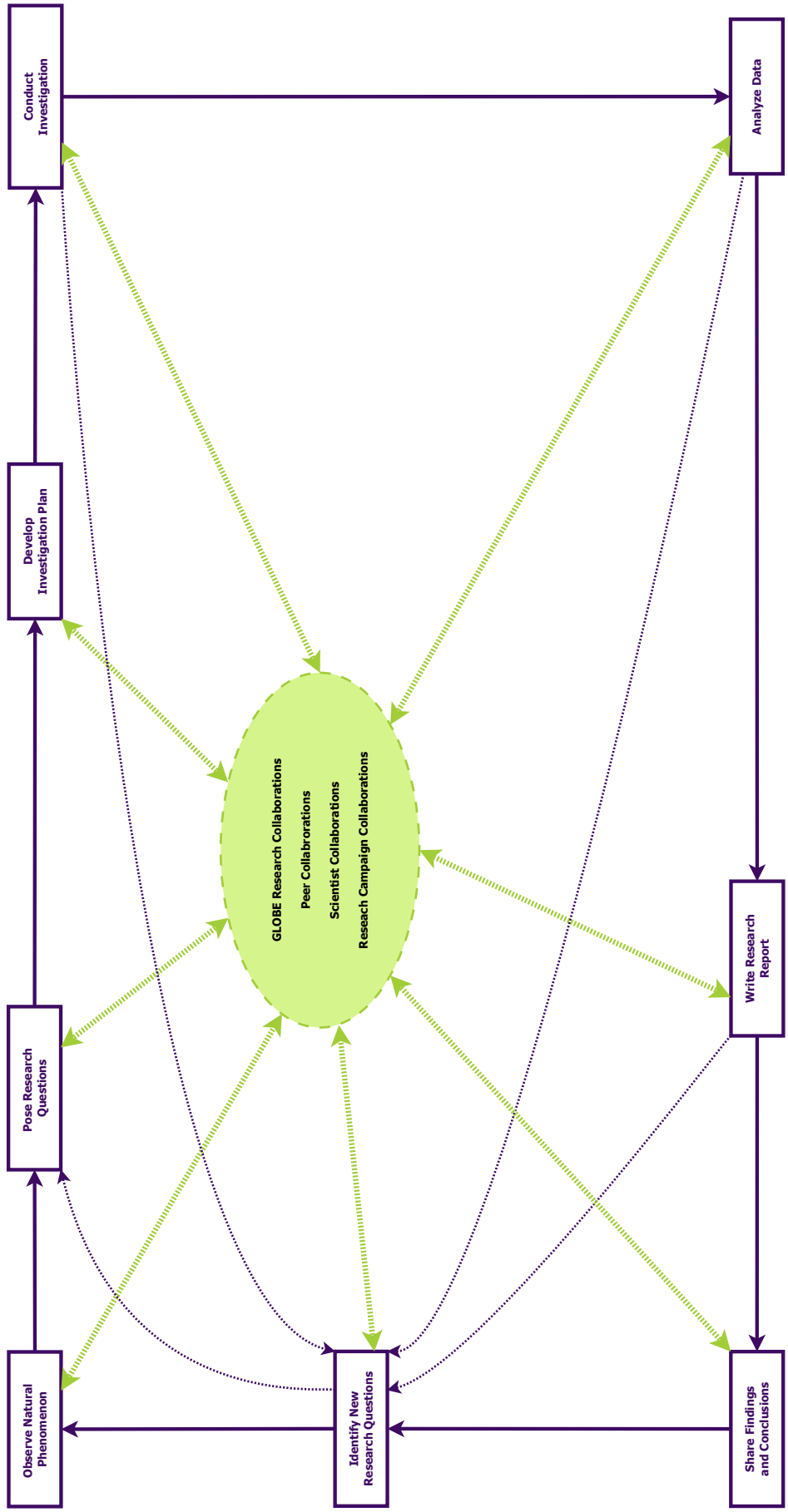
Further Considerations:

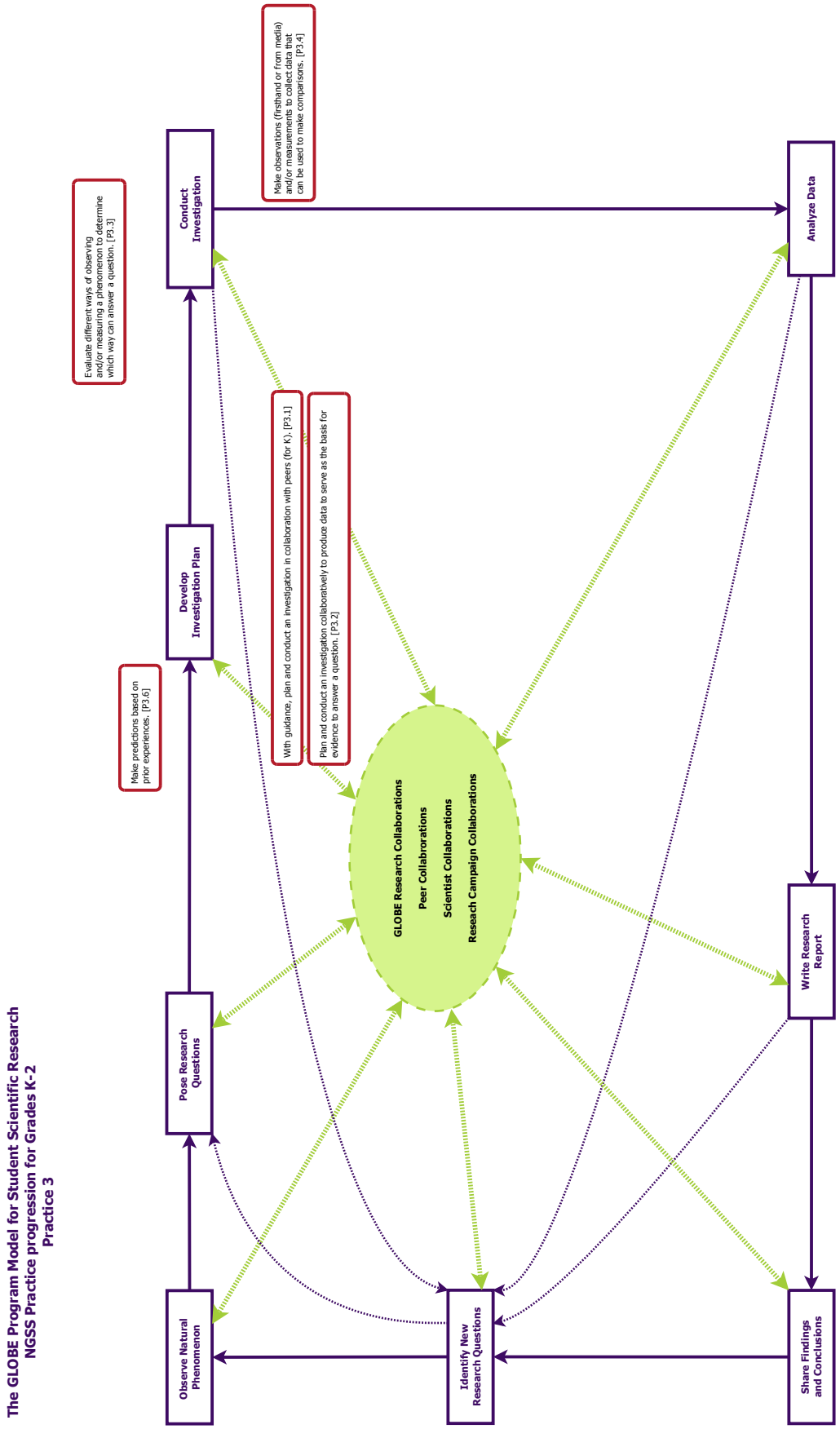
Not all teachers complete all parts of the MSSR model – these diagrams can be used to help teachers identify which practices they are engaging students in regardless of how much of the model is implemented in the classroom.

The diagrams outline how NGSS practices fit within the GLOBE MSSR model only. Individual GLOBE Protocols and activities may engage students in practices not listed in the diagrams.

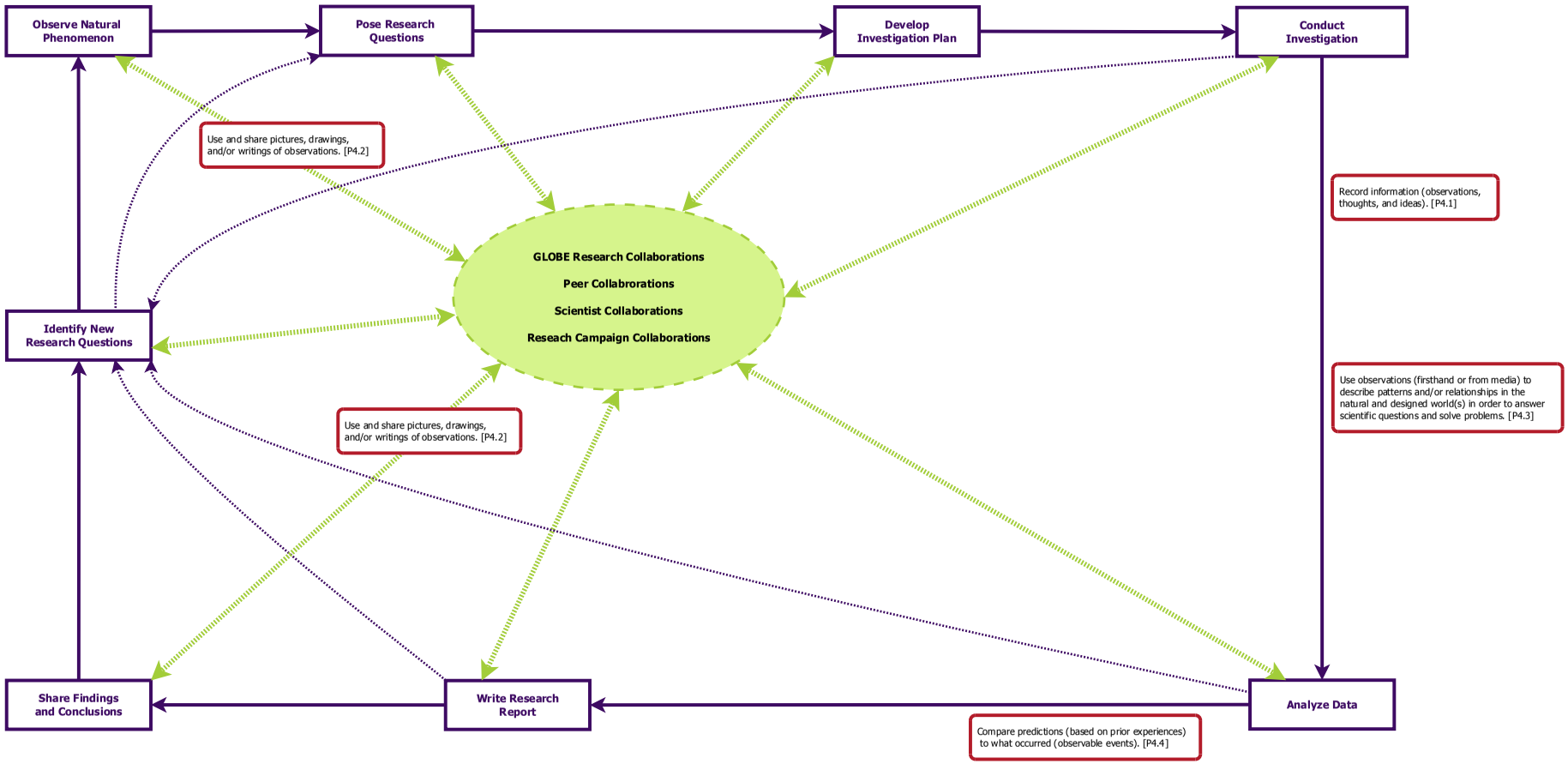

The GLOBE Program Model for Student Scientific Research
NGSS Practice progression for Grades K-2
Practice 1
Observe Natural Phenomenon
Pose Research Questions
Develop Investigation Plan
Conduct Investigation
Analyze Data
Write Research Report
Share Findings and Conclusions
Identify New Research Questions
GLOBE Research Collaborations
Peer Collabrorations
Scientist Collaborations
Reseach Campaign Collaborations
Ask questions based on observations to find more information about the natural and/or designed world(s). [P1.1]
Ask and/or identify questions that can be answered by an investigation. [P1.2]

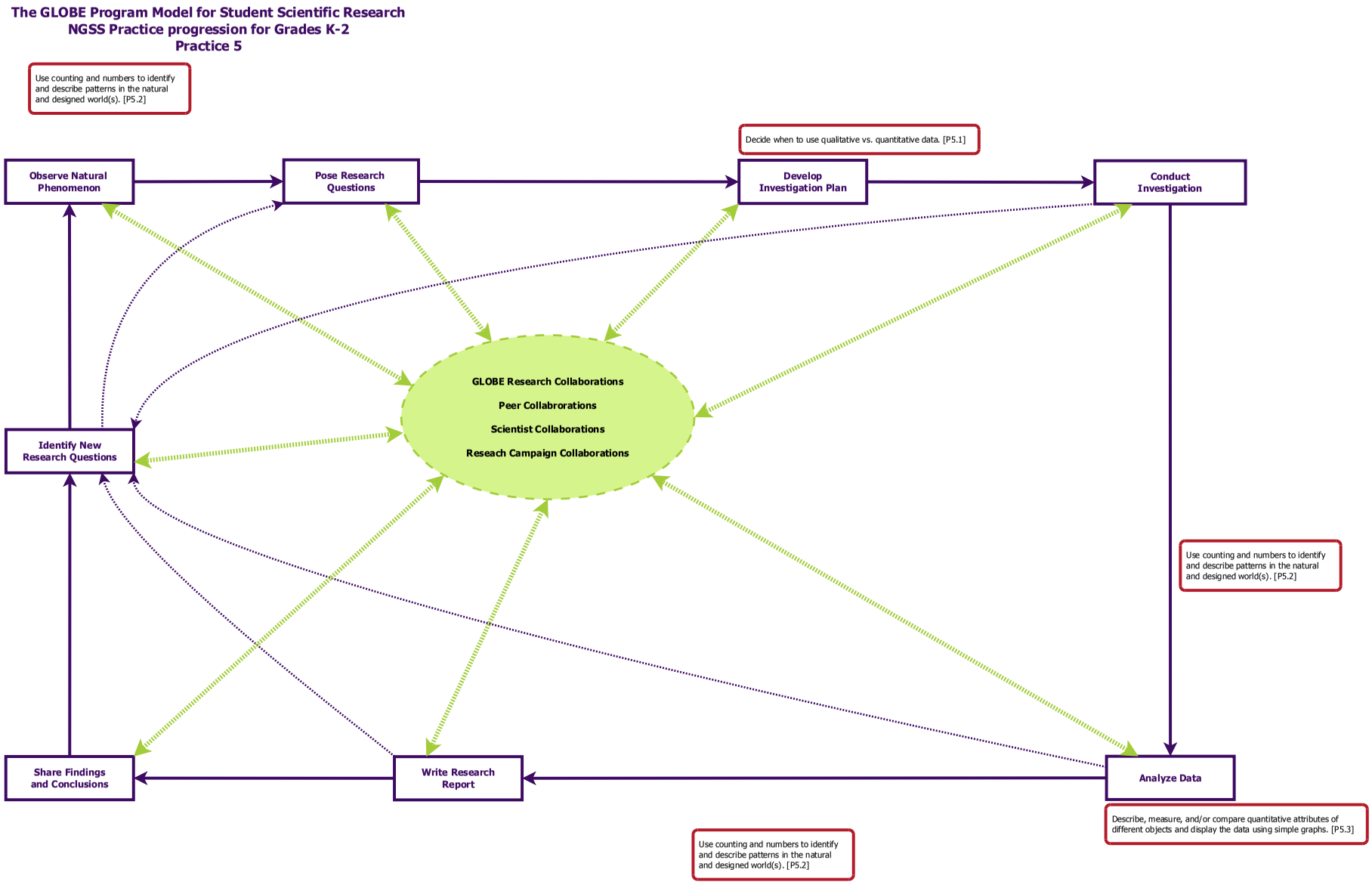
The GLOBE Program Model for Student Scientific Research
NGSS Practice progression for Grades K-2
Practice 2



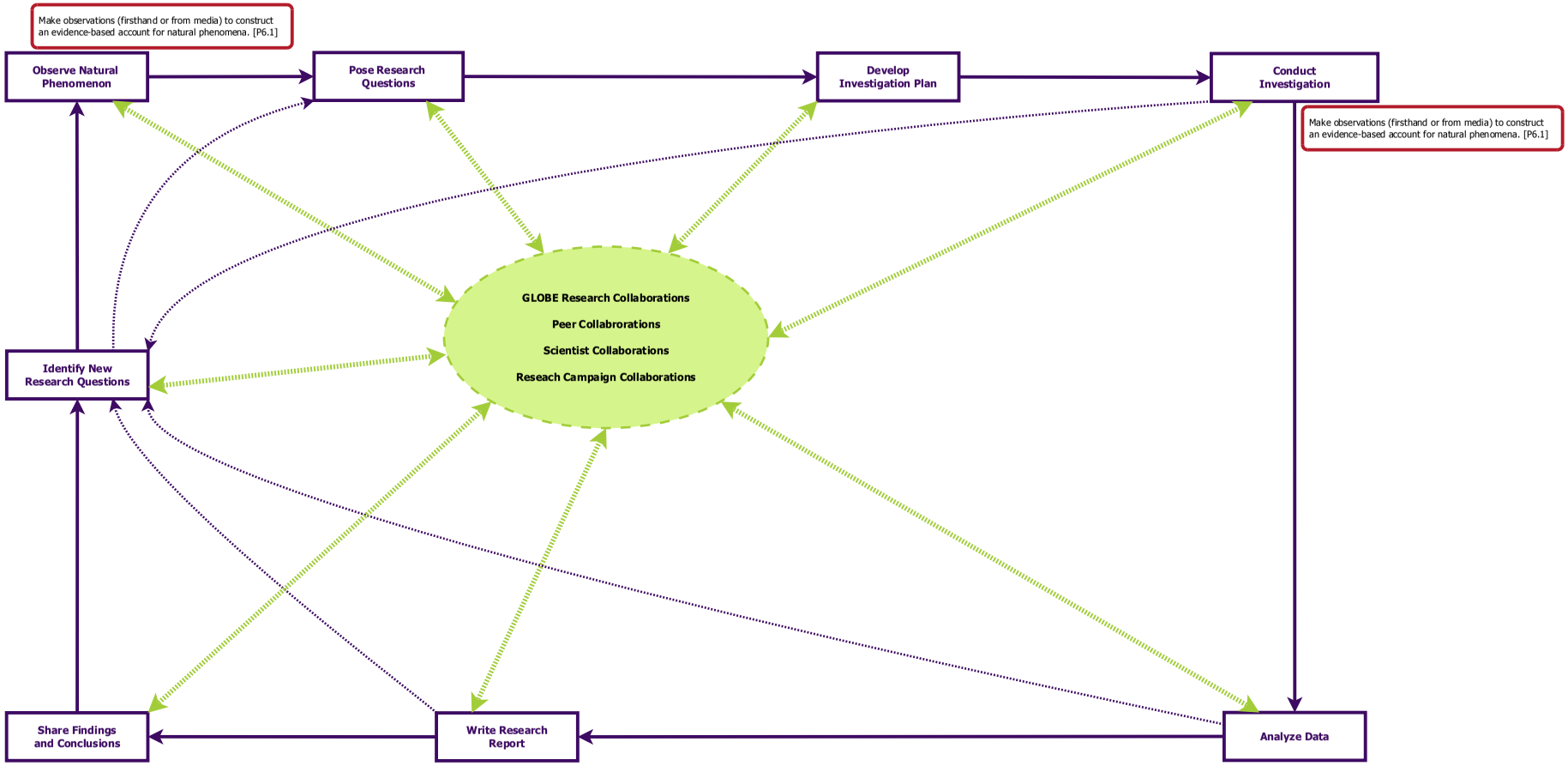

The GLOBE Program Model for Student Scientific Research
NGSS Practice progression for Grades K-2
Practice 3
Observe Natural Phenomenon
Pose Research Questions
Develop Investigation Plan
Conduct Investigation
Analyze Data
Write Research Report
Share Findings and Conclusions
Identify New Research Questions
GLOBE Research Collaborations
Peer Collabrorations
Scientist Collaborations
Reseach Campaign Collaborations
Evaluate different ways of observing and/or measuring a phenomenon to determine which way can answer a question. [P3.3]
Make observations (firsthand or from media) and/or measurements to collect data that can be used to make comparisons. [P3.4]
Make predictions based on prior experiences. [P3.6]
With guidance, plan and conduct an investigation in collaboration with peers (for K). [P3.1]
Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question. [P3.2]

The GLOBE Program Model for Student Scientific Research
NGSS Practice progression for Grades K-2
Practice 4

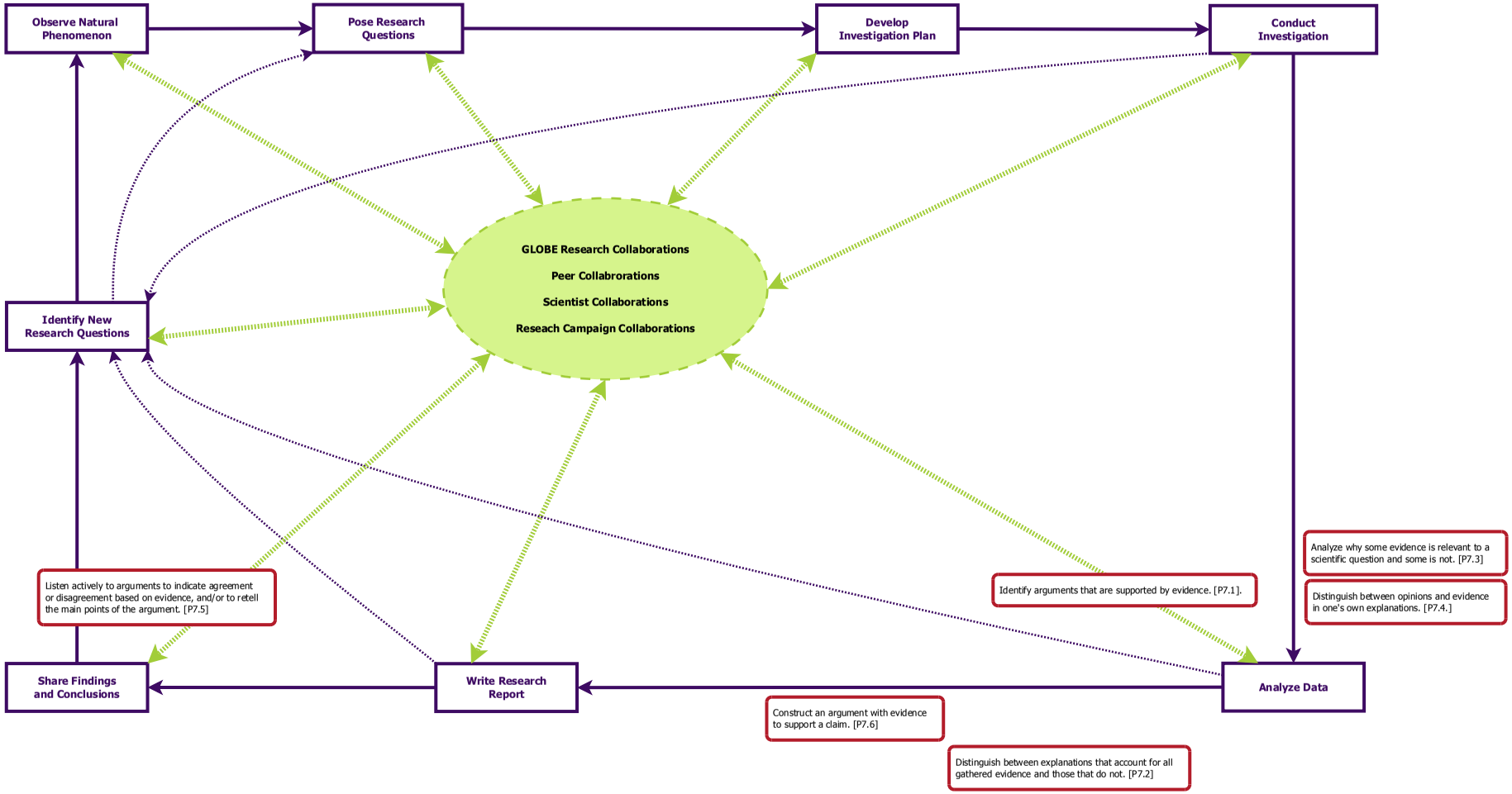



The GLOBE Program Model for Student Scientific Research
NGSS Practice progression for Grades K-2
Practice 5
Use counting and numbers to identify and describe patterns in the natural and designed world(s). [P5.2]
Decide when to use qualitative vs. quantitative data. [P5.1]
Observe Natural Phenomenon
Pose Research Questions
Develop Investigation Plan
Conduct Investigation
GLOBE Research Collaborations
Peer Collabrorations
Scientist Collaborations
Reseach Campaign Collaborations
Identify New Research Questions
Use counting and numbers to identify and describe patterns in the natural and designed world(s). [P5.2]
Share Findings and Conclusions
Write Research Report
Analyze Data
Describe, measure, and/or compare quantitative attributes of different objects and display the data using simple graphs. [P5.3]
Use counting and numbers to identify and describe patterns in the natural and designed world(s). [P5.2]

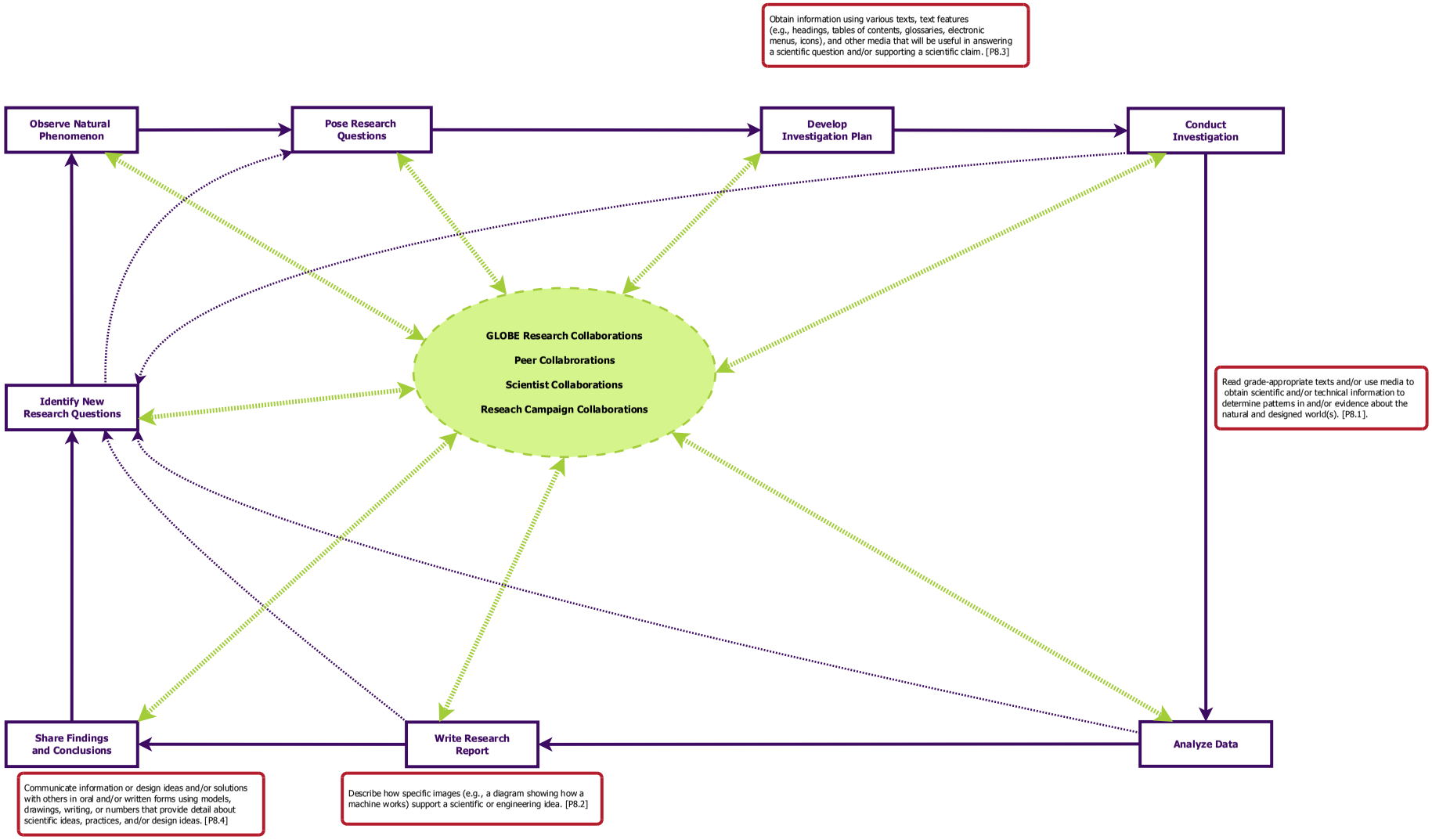
The GLOBE Program Model for Student Scientific Research
NGSS Practice progression for Grades K-2
Practice 6



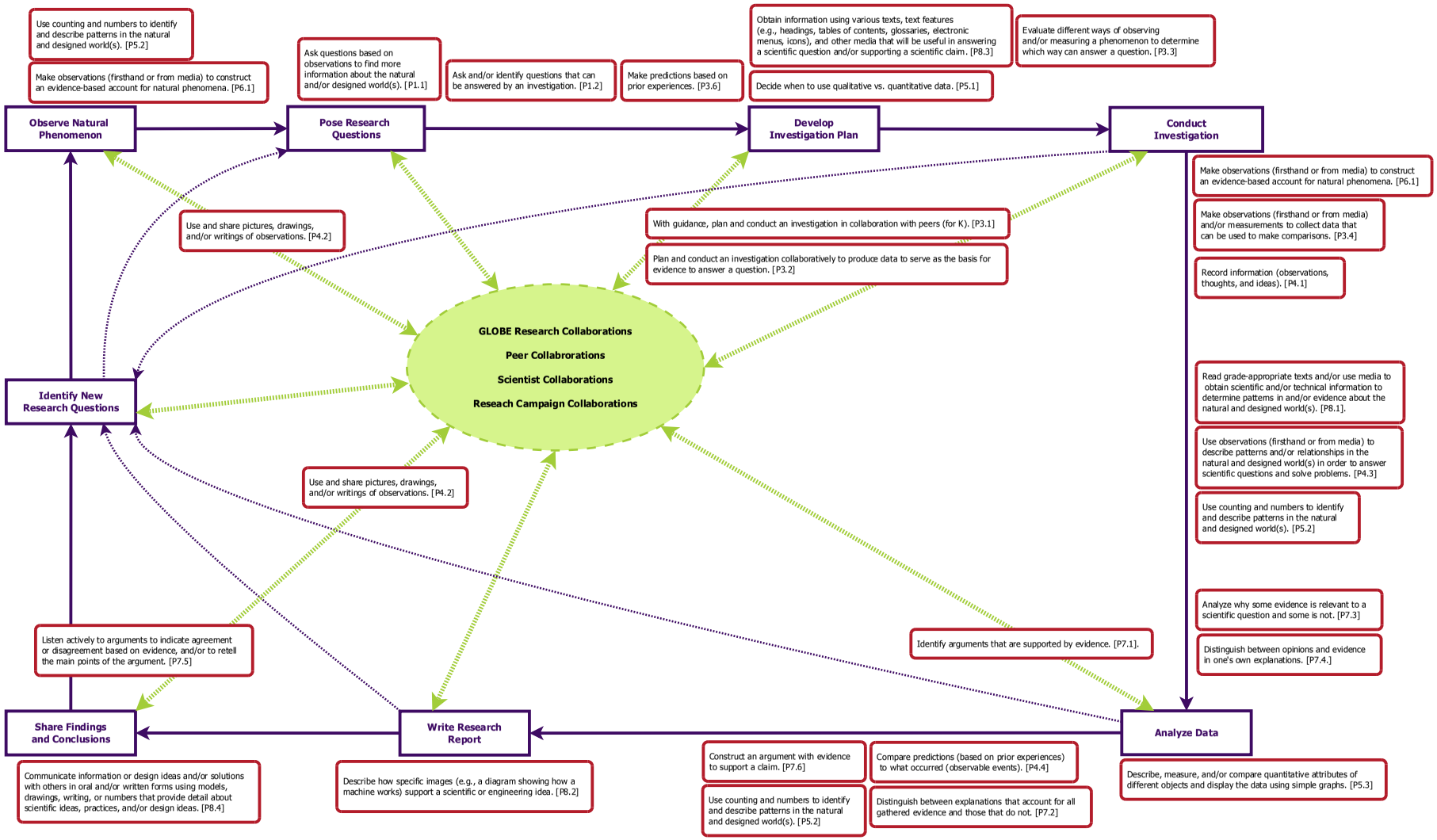
The GLOBE Program Model for Student Scientific Research
NGSS Practice progression for Grades K-2
Practice 7



The GLOBE Program Model for Student Scientific Research
NGSS Practice progression for Grades K-2
Practice 8



The GLOBE Program Model for Student Scientific Research
NGSS Practice progression for Grades K-2
All Practices

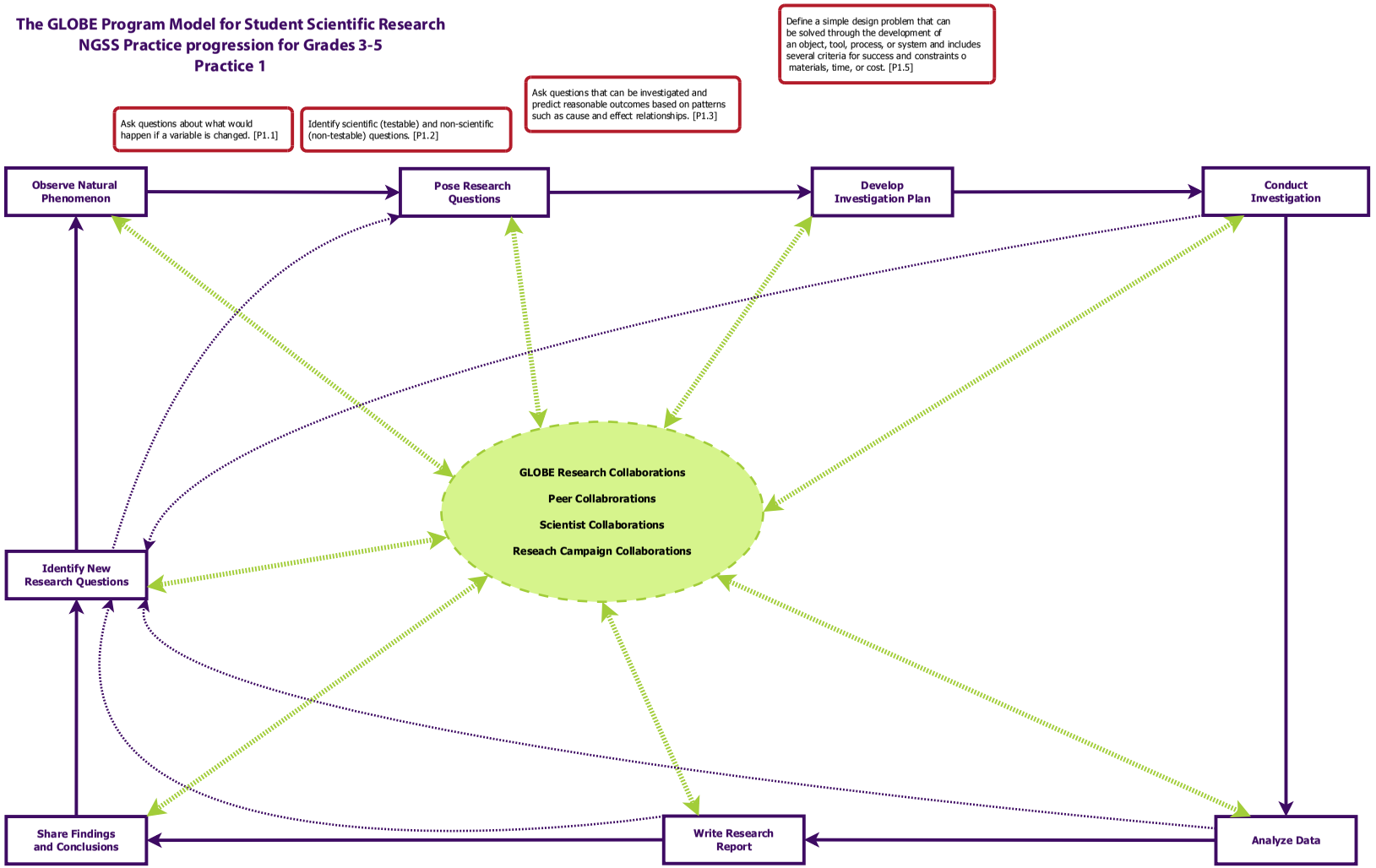


Grades K-2

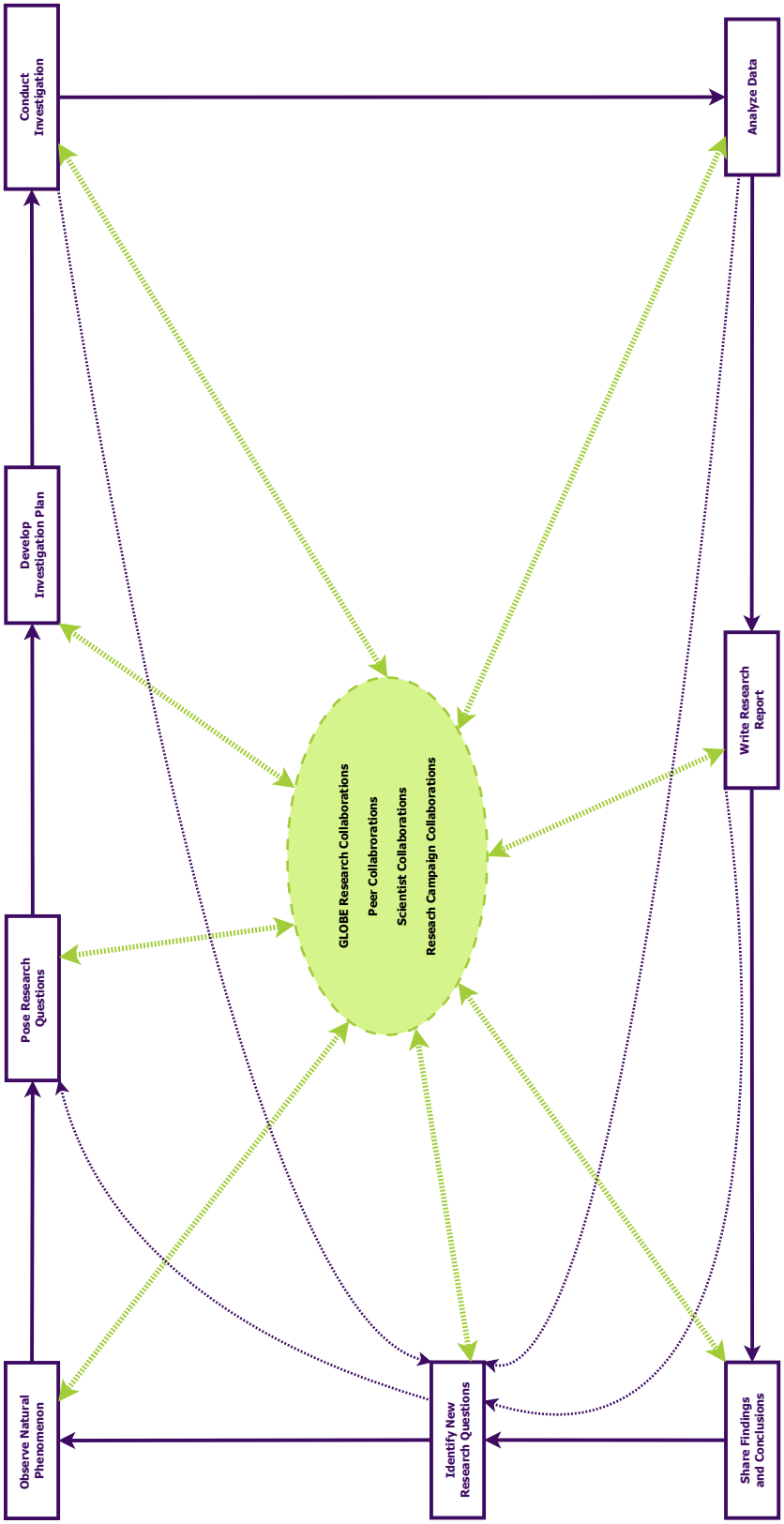
NGSS Practices integrated into the GLOBE Program Model for Student Scientific Research

1. Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested.	*MSSR*	2. Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions.	*MSSR*	*3. Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.*	*MSSR*	*4. Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations.*	*MSSR*
Ask questions based on observations to find more information about the natural and/or designed world(s). [P1.1]	X	Distinguish between a model and the actual object, process, and/or events the model represents. [P2.1]		With guidance, plan and conduct an investigation in collaboration with peers (for K). [P3.1]	X	Record information (observations, thoughts, and ideas). [P4.1]	X
Ask and/or identify questions that can be answered by an investigation. [P1.2]	X	Compare models to identify common features and differences. [P2.2]		Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question. [P3.2]	X	Use and share pictures, drawings, and/or writings of observations. [P4.2]	X
Define a simple problem that can be solved through the development of a new or improved object or tool. [P1.3]		Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s). [P2.3]		Evaluate different ways of observing and/or measuring a phenomenon to determine which way can answer a question. [P3.3]	X	Use observations (firsthand or from media) to describe patterns and/or relationships in the natural and designed world(s) in order to answer scientific questions and solve problems. [P4.3]	X
		Develop a simple model based on evidence to represent a proposed object or tool. [P2.4]		Make observations (firsthand or from media) and/or measurements to collect data that can be used to make comparisons. [P3.4]	X	Compare predictions (based on prior experiences) to what occurred (observable events). [P4.4]	X
				Make observations (firsthand or from media) and/or measurements of a proposed object or tool or solution to determine if it solves a problem or meets a goal. [P3.5]		Analyze data from tests of an object or tool to determine if it works as intended. [P4.5]	
				Make predictions based on prior experiences. [P3.6]	X		

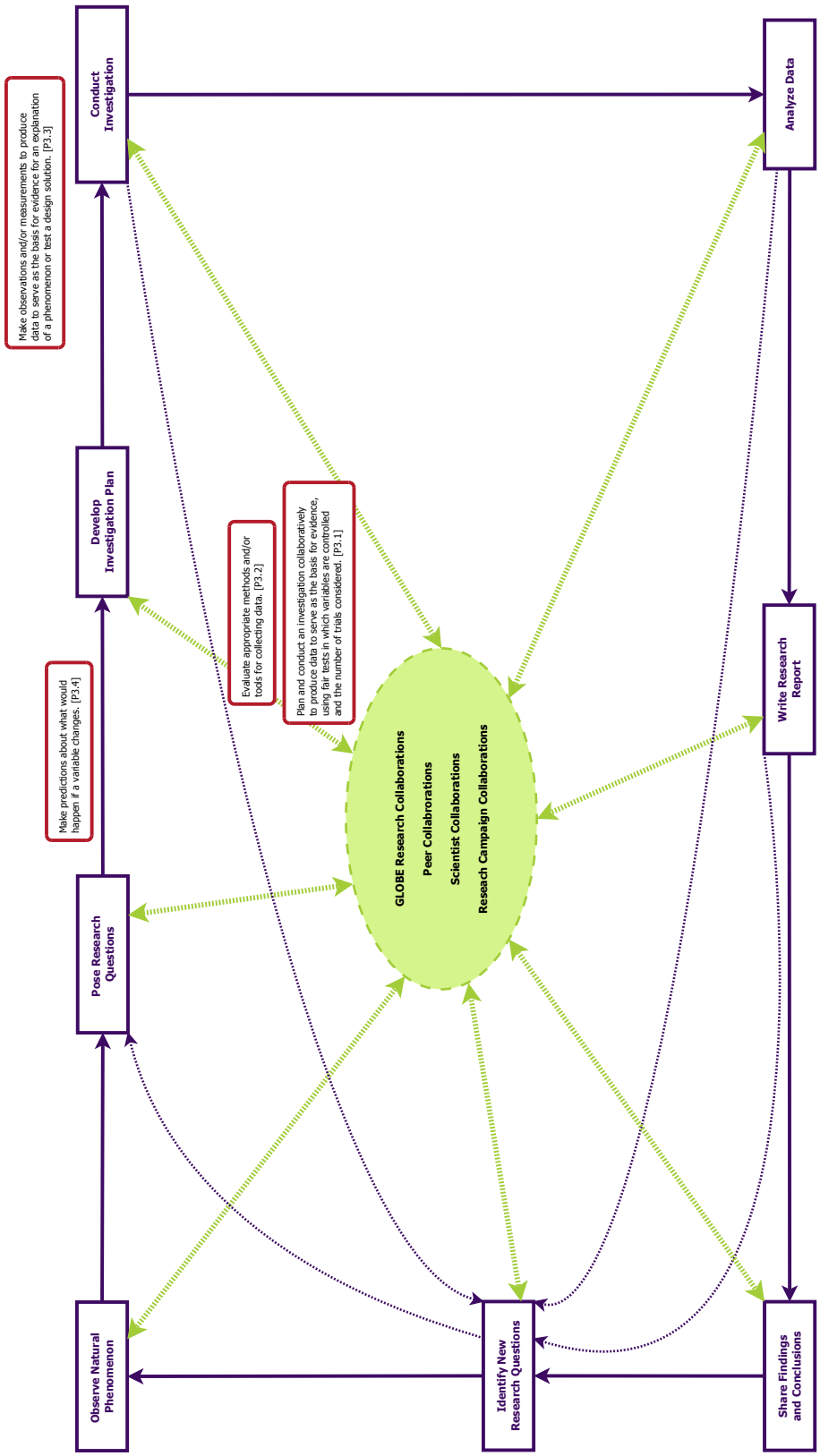
5. Mathematical and computational thinking in K–2 builds on prior experience and progresses to recognizing that mathematics can be used to describe the natural and designed world(s).	***MSSR***	*6. Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions.*	***MSSR***	*7. Engaging in argument from evidence in K–2 builds on prior experiences and progresses to comparing ideas and representations about the natural and designed world(s).*	***MSSR***	*8. Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information.*	***MSSR***
Decide when to use qualitative vs. quantitative data. [P5.1]	X	Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. [P6.1]	X	Identify arguments that are supported by evidence. [P7.1]	X	Read grade-appropriate texts and/or use media to obtain scientific and/or technical information to determine patterns in and/or evidence about the natural and designed world(s). [P8.1]	X
Use counting and numbers to identify and describe patterns in the natural and designed world(s). [P5.2]	X	Use tools and/or materials to design and/or build a device that solves a specific problem or a solution to a specific problem. [P6.2]		Distinguish between explanations that account for all gathered evidence and those that do not. [P7.2]	X	Describe how specific images (e.g., a diagram showing how a machine works) support a scientific or engineering idea. [P8.2]	X
Describe, measure, and/or compare quantitative attributes of different objects and display the data using simple graphs. [P5.3]	X	Generate and/or compare multiple solutions to a problem. [P6.3]		Analyze why some evidence is relevant to a scientific question and some is not. [P7.3]	X	Obtain information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, icons), and other media that will be useful in answering a scientific question and/or supporting a scientific claim. [P8.3]	X
Use quantitative data to compare two alternative solutions to a problem. [P5.4]				Distinguish between opinions and evidence in one's own explanations. [P7.4]	X	Communicate information or design ideas and/or solutions with others in oral and/or written forms using models, drawings, writing, or numbers that provide detail about scientific ideas, practices, and/or design ideas. [P8.4]	X
				Listen actively to arguments to indicate agreement or disagreement based on evidence, and/or to retell the main points of the argument. [P7.5]	X		
				Construct an argument with evidence to support a claim. [P7.6]	X		
				Make a claim about the effectiveness of an object, tool, or solution that is supported by relevant evidence. [P7.7]			


The GLOBE Program Model for Student Scientific Research
NGSS Practice progression for Grades 3-5
Practice 1
Ask questions about what would happen if a variable is changed. [P1.1]
Identify scientific (testable) and non-scientific (non-testable) questions. [P1.2]
Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. [P1.3]
Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints o materials, time, or cost. [P1.5]
Observe Natural Phenomenon
Pose Research Questions
Develop Investigation Plan
Conduct Investigation
GLOBE Research Collaborations
Peer Collabrorations
Scientist Collaborations
Reseach Campaign Collaborations
Identify New Research Questions
Share Findings and Conclusions
Write Research Report
Analyze Data

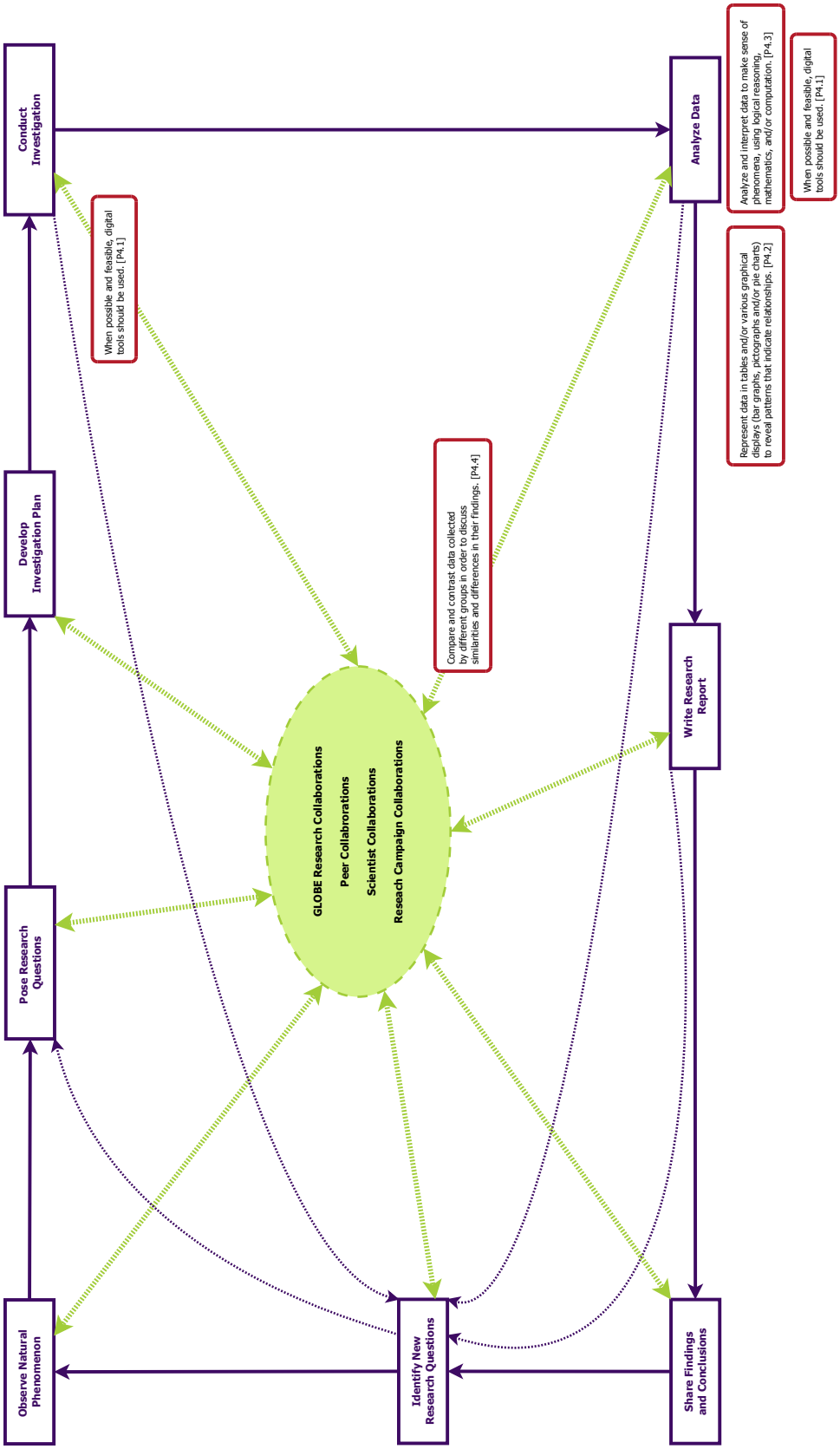
The GLOBE Program Model for Student Scientific Research
NGSS Practice progression for Grades 3-5
Practice 2



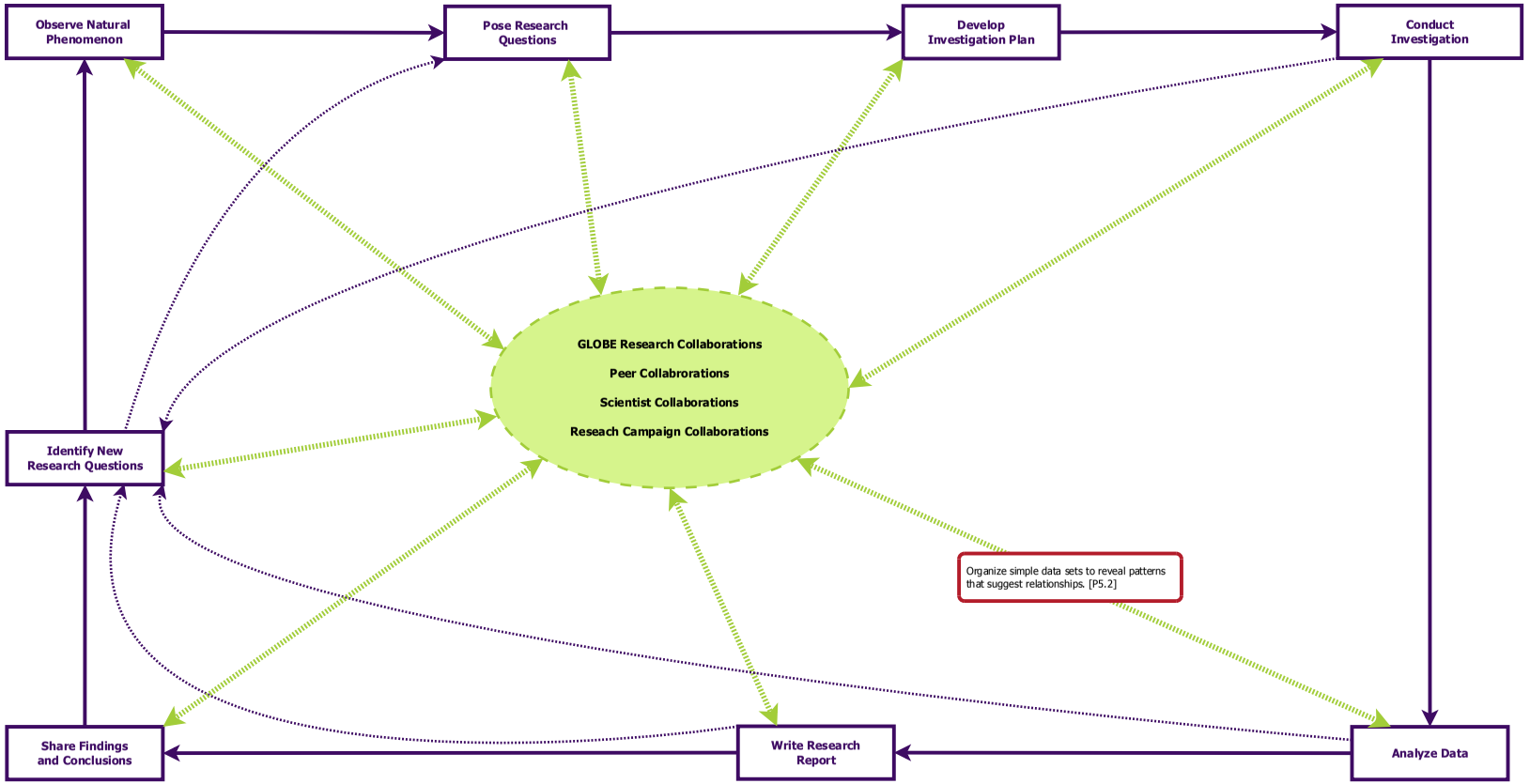
The GLOBE Program Model for Student Scientific Research
NGSS Practice progression for Grades 3-5
Practice 3



The GLOBE Program Model for Student Scientific Research
NGSS Practice progression for Grades 3-5
Practice 4

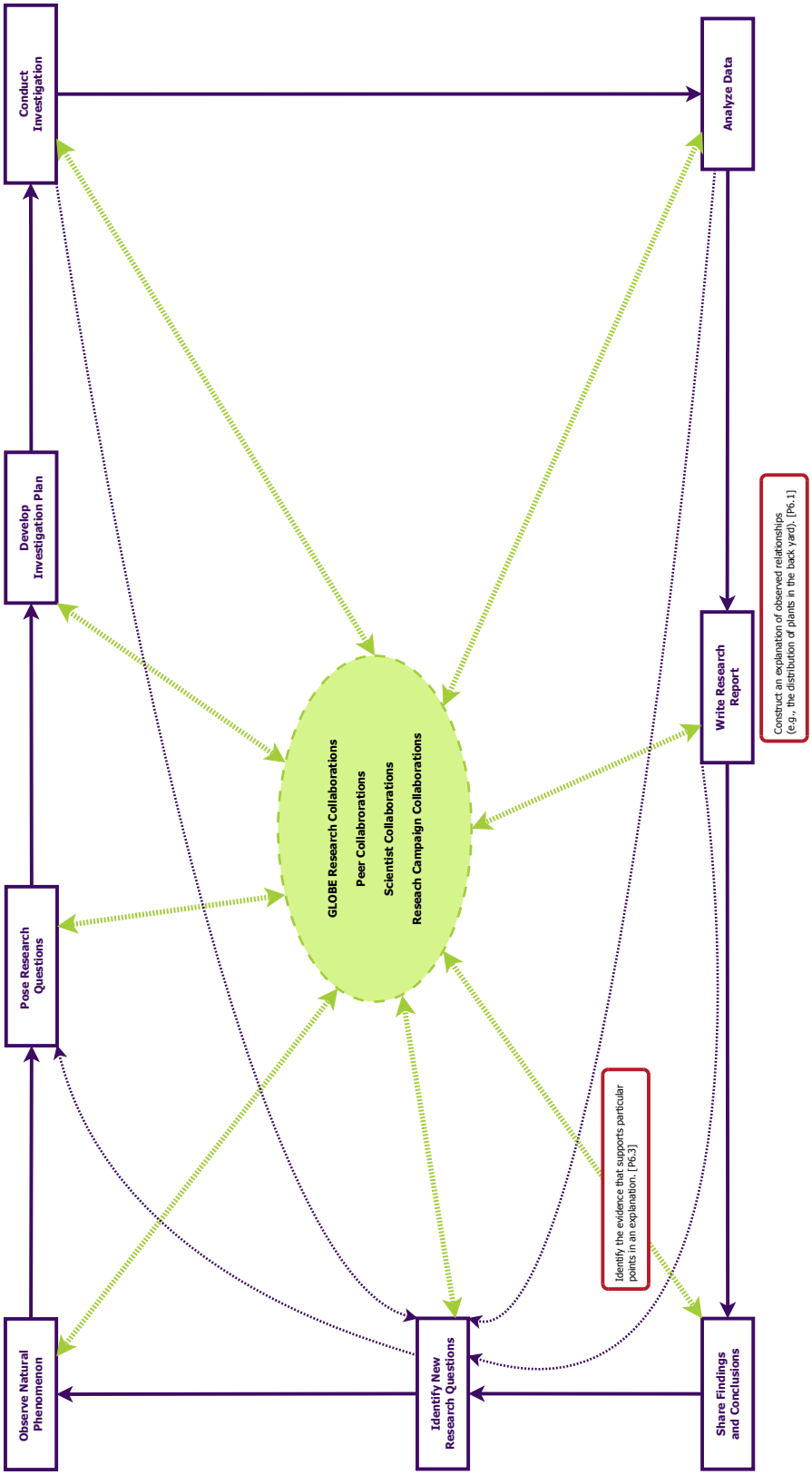


The GLOBE Program Model for Student Scientific Research
NGSS Practice progression for Grades 3-5
Practice 5

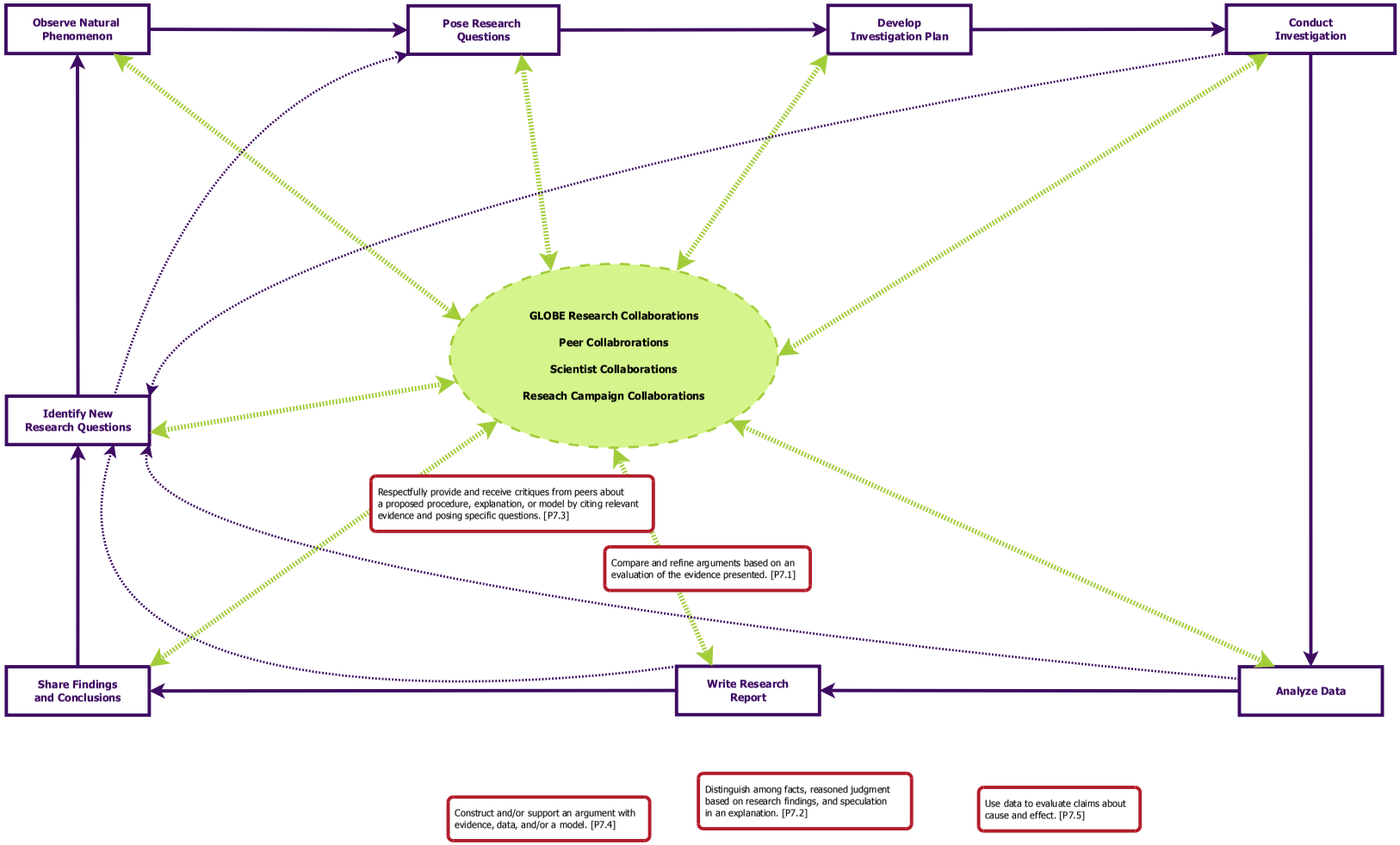


Organize simple data sets to reveal patterns that suggest relationships. [P5.2]

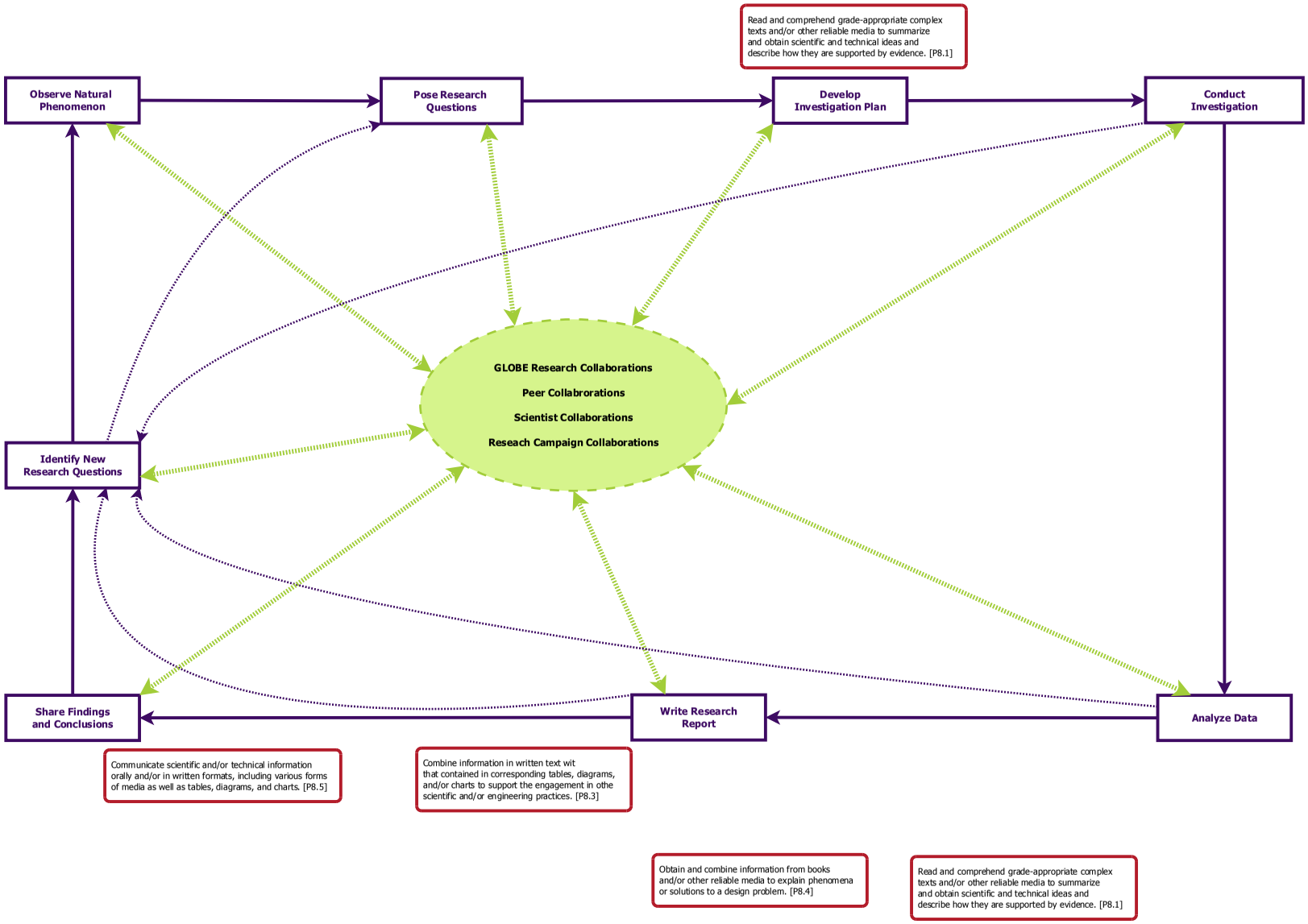
The GLOBE Program Model for Student Scientific Research
NGSS Practice progression for Grades 3-5
Practice 6

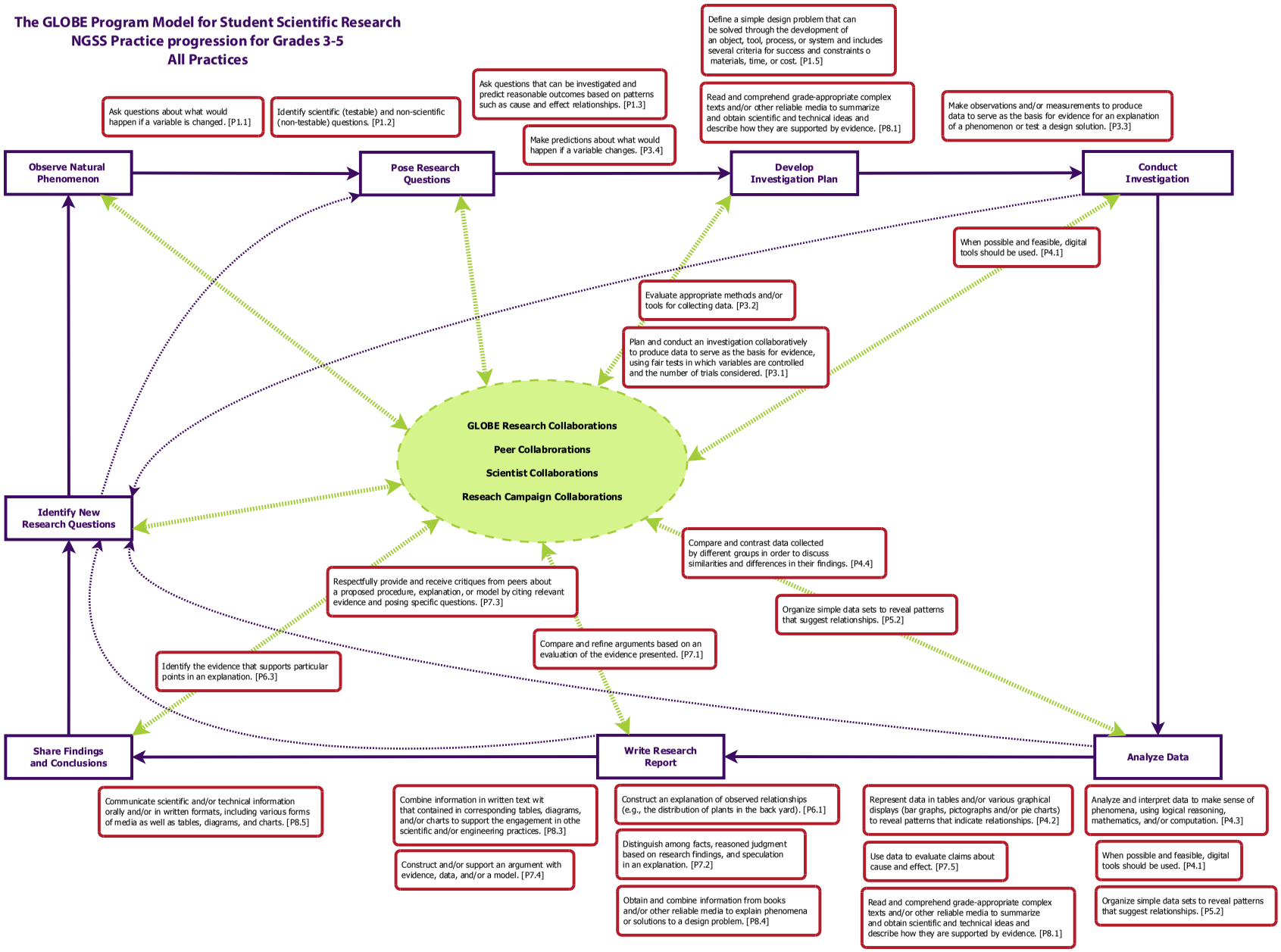


The GLOBE Program Model for Student Scientific Research
NGSS Practice progression for Grades 3-5
Practice 7



The GLOBE Program Model for Student Scientific Research
NGSS Practice progression for Grades 3-5
Practice 8




The GLOBE Program Model for Student Scientific Research
NGSS Practice progression for Grades 3-5
All Practices
Ask questions about what would happen if a variable is changed. [P1.1]
Identify scientific (testable) and non-scientific (non-testable) questions. [P1.2]
Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. [P1.3]
Make predictions about what would happen if a variable changes. [P3.4]
Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints o materials, time, or cost. [P1.5]
Read and comprehend grade-appropriate complex texts and/or other reliable media to summarize and obtain scientific and technical ideas and describe how they are supported by evidence. [P8.1]
Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. [P3.3]
Observe Natural Phenomenon
Pose Research Questions
Develop Investigation Plan
Conduct Investigation
When possible and feasible, digital tools should be used. [P4.1]
Evaluate appropriate methods and/or tools for collecting data. [P3.2]
Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. [P3.1]
GLOBE Research Collaborations
Peer Collabrorations
Scientist Collaborations
Reseach Campaign Collaborations
Identify New Research Questions
Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings. [P4.4]
Respectfully provide and receive critiques from peers about a proposed procedure, explanation, or model by citing relevant evidence and posing specific questions. [P7.3]
Organize simple data sets to reveal patterns that suggest relationships. [P5.2]
Compare and refine arguments based on an evaluation of the evidence presented. [P7.1]
Identify the evidence that supports particular points in an explanation. [P6.3]
Share Findings and Conclusions
Write Research Report
Analyze Data
Communicate scientific and/or technical information orally and/or in written formats, including various forms of media as well as tables, diagrams, and charts. [P8.5]
Combine information in written text wit that contained in corresponding tables, diagrams, and/or charts to support the engagement in othe scientific and/or engineering practices. [P8.3]
Construct and/or support an argument with evidence, data, and/or a model. [P7.4]
Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard). [P6.1]
Distinguish among facts, reasoned judgment based on research findings, and speculation in an explanation. [P7.2]
Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. [P8.4]
Represent data in tables and/or various graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships. [P4.2]
Use data to evaluate claims about cause and effect. [P7.5]
Read and comprehend grade-appropriate complex texts and/or other reliable media to summarize and obtain scientific and technical ideas and describe how they are supported by evidence. [P8.1]
Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation. [P4.3]
When possible and feasible, digital tools should be used. [P4.1]
Organize simple data sets to reveal patterns that suggest relationships. [P5.2]

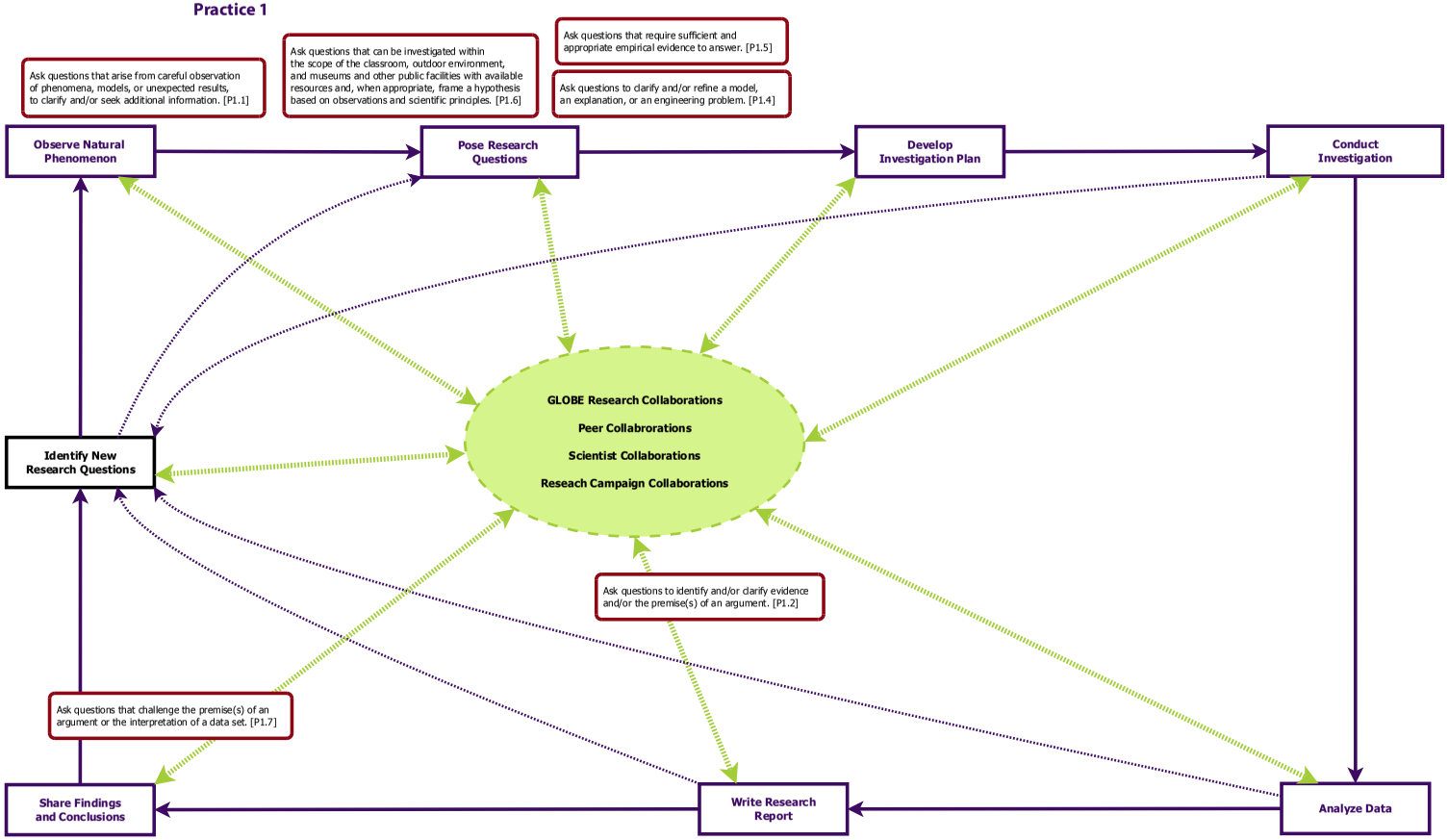
Grades 3-5

NGSS Practices integrated into the GLOBE Program Model for Student Scientific Research

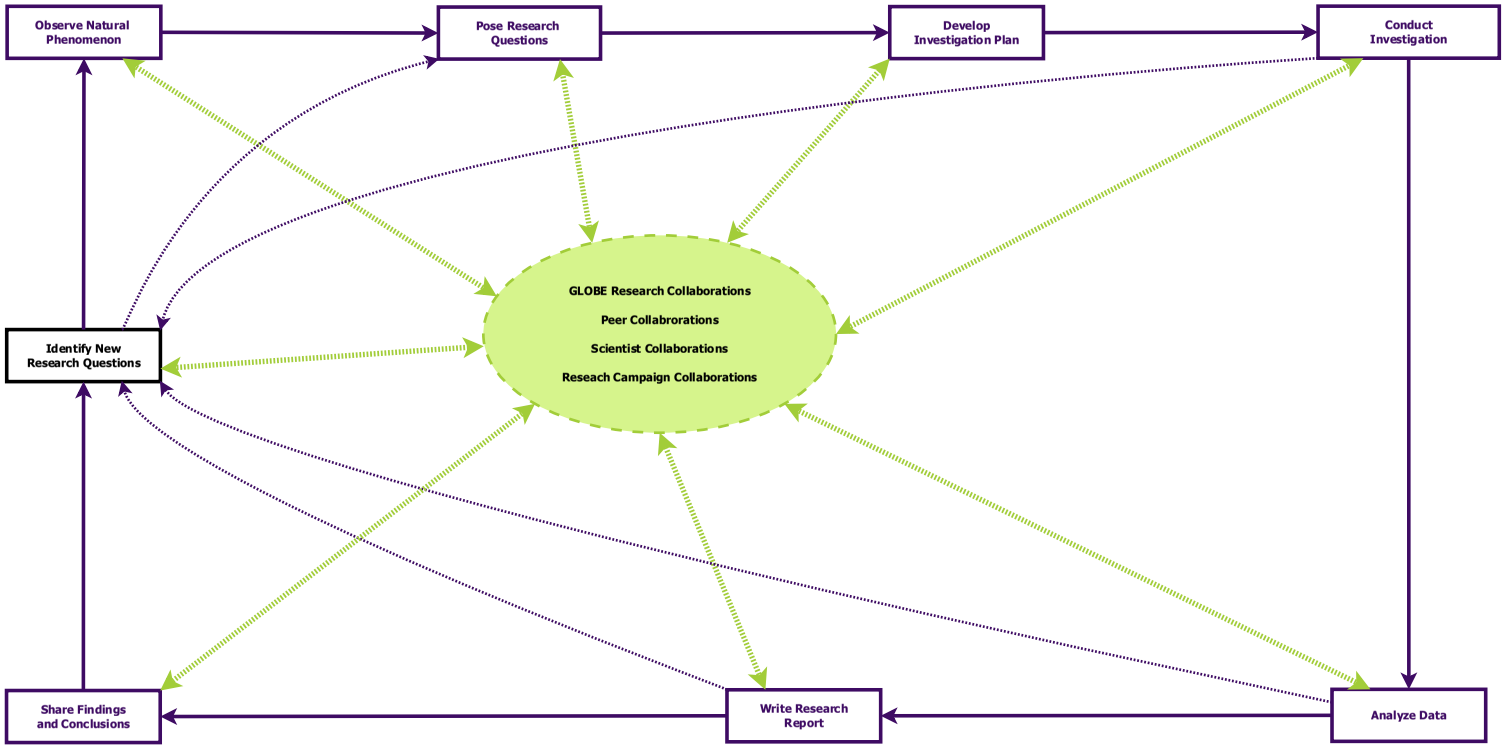
1. Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships.	***MSSR***	2. Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.	***MSSR***	*3. Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.*	***MSSR***	*4. Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations.*	***MSSR***
Ask questions about what would happen if a variable is changed. [P1.1]	X	Identify limitations of models. [P2.1]		Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. [P3.1]	X	When possible and feasible, digital tools should be used. [P4.1]	X
Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. [P2.2]	X	Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. [P2.2]		Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. [P2.2]	X	Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. [P2.2]	X
Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. [P1.3]	X	Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution. [P2.3]		Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. [P3.3]	X	Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation. [P4.3]	X
Use prior knowledge to describe problems that can be solved. [P1.4]		Develop and/or use models to describe and/or predict phenomena. [P2.4]		Make predictions about what would happen if a variable changes. [P3.4]	X	Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings. [P4.4]	X
Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost. [P1.5]	X	Develop a diagram or simple physical prototype to convey a proposed object, tool, or process. [P2.5]		Test two different models of the same proposed object, tool, or process to determine which better meets criteria for success. [P3.5]		Analyze data to refine a problem statement or the design of a proposed object, tool, or process. [P4.5]	
		Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system. [P2.6]				Use data to evaluate and refine design solutions. [P4.6]	

5. Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions.	***MSSR***	*6. Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.*	***MSSR***	*7. Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).*	***MSSR***	*8. Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods.*	***MSSR***
Decide if qualitative or quantitative data are best to determine whether a proposed object or tool meets criteria for success. [P5.1]		Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard). [P6.1]	X	Compare and refine arguments based on an evaluation of the evidence presented. [P7.1]	X	Read and comprehend grade-appropriate complex texts and/or other reliable media to summarize and obtain scientific and technical ideas and describe how they are supported by evidence. [P8.1]	X
Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. [P2.2]	X	Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. [P2.2]		Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. [P2.2]		Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. [P2.2]	
Describe, measure, estimate, and/or graph quantities (e.g., area, volume, weight, time) to address scientific and engineering questions and problems. [P5.3]		Identify the evidence that supports particular points in an explanation. [P6.3]	X	Respectfully provide and receive critiques from peers about a proposed procedure, explanation, or model by citing relevant evidence and posing specific questions. [P7.3]	X	Combine information in written text with that contained in corresponding tables, diagrams, and/or charts to support the engagement in other scientific and/or engineering practices. [P8.3]	X
Create and/or use graphs and/or charts generated from simple algorithms to compare alternative solutions to an engineering problem. [P5.4]		Apply scientific ideas to solve design problems. [P6.4]		Construct and/or support an argument with evidence, data, and/or a model. [P7.4]	X	Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. [P8.4]	X
		Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. [P6.5]		Use data to evaluate claims about cause and effect. [P7.5]	X	Communicate scientific and/or technical information orally and/or in written formats, including various forms of media as well as tables, diagrams, and charts. [P8.5]	X
				Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem. [P7.6]			

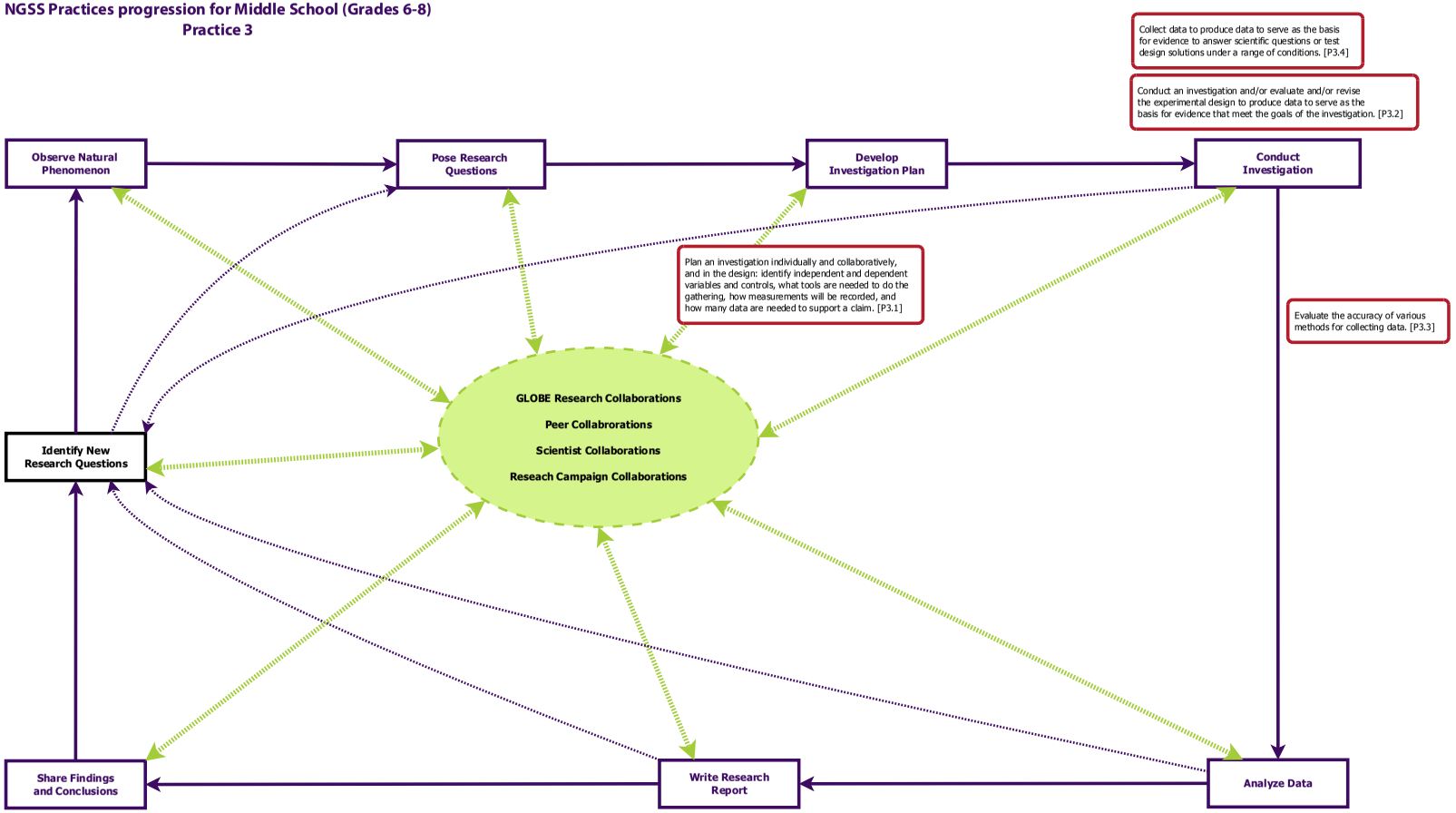
The GLOBE Program Model for Student Scientific Research
NGSS Practices progression for Middle School (Grades 6-8)
Practice 1



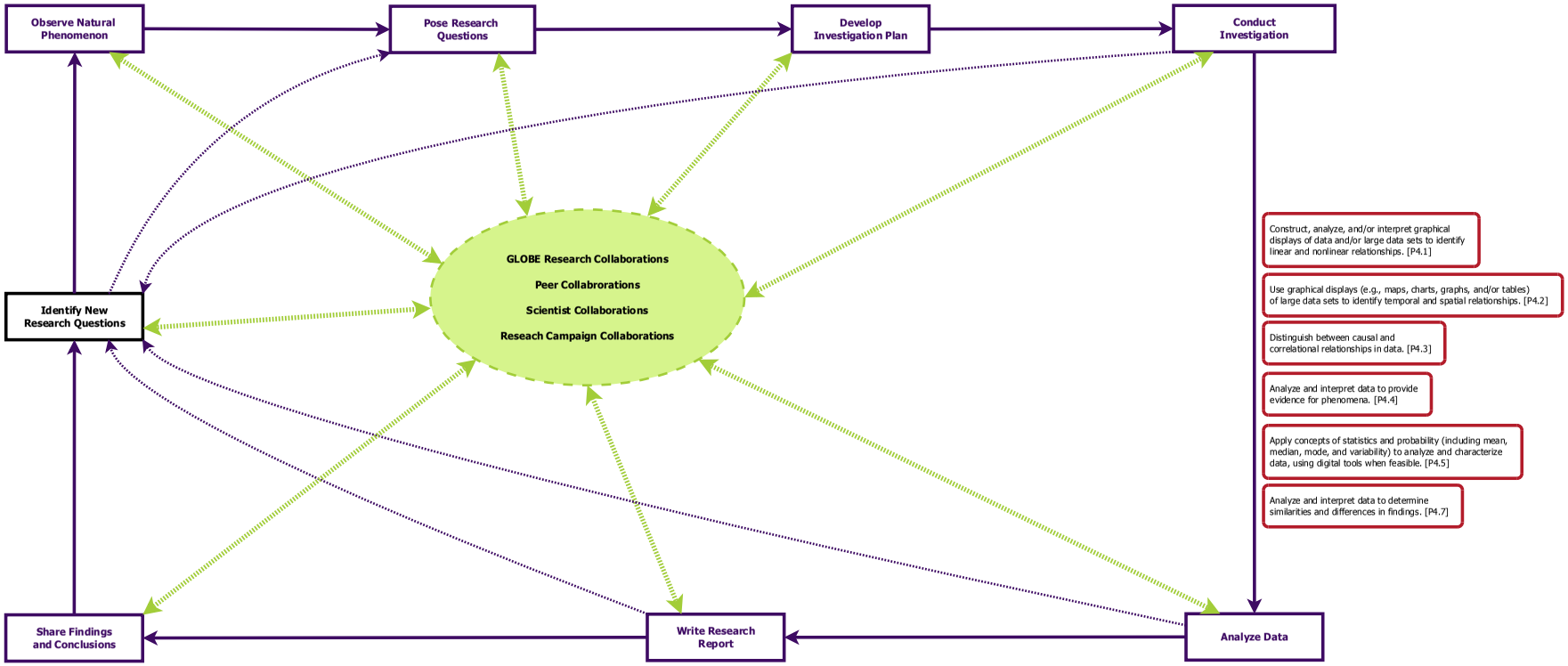
The GLOBE Program Model for Student Scientific Research
NGSS Practices progression for Middle School (Grades 6-8)
Practice 2



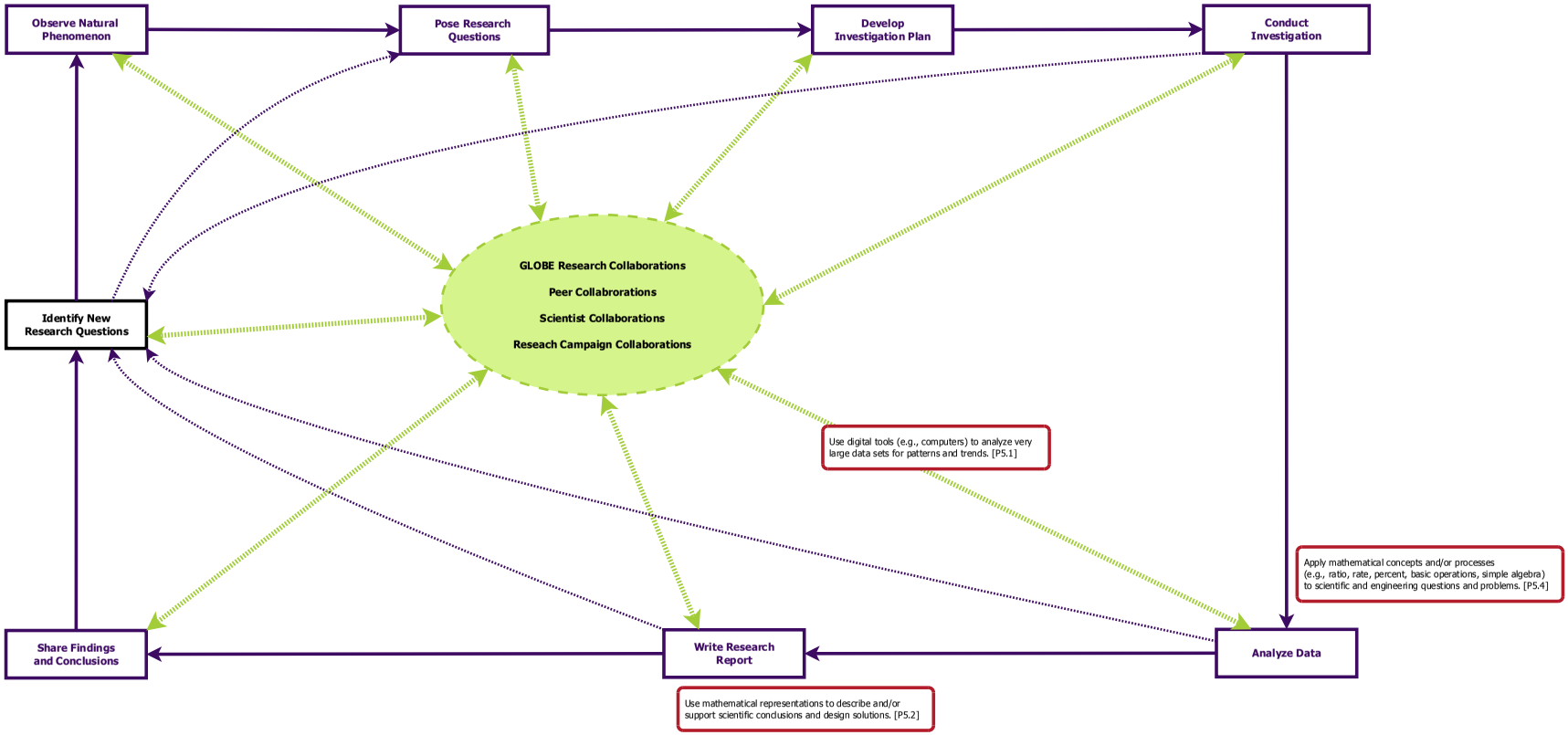
The GLOBE Program Model for Student Scientific Research
NGSS Practices progression for Middle School (Grades 6-8)
Practice 3



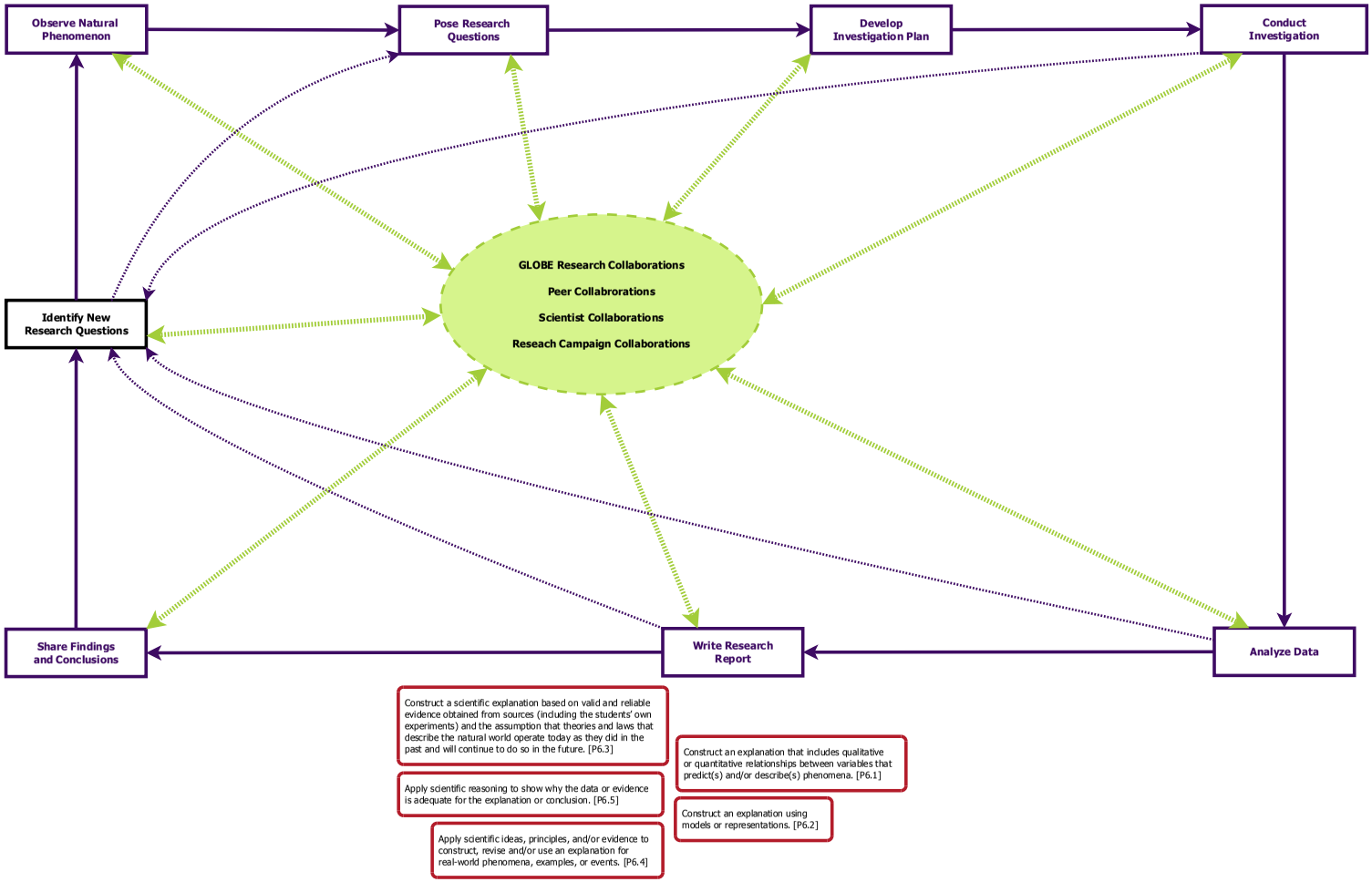
The GLOBE Program Model for Student Scientific Research
NGSS Practices progression for Middle School (Grades 6-8)
Practice 4



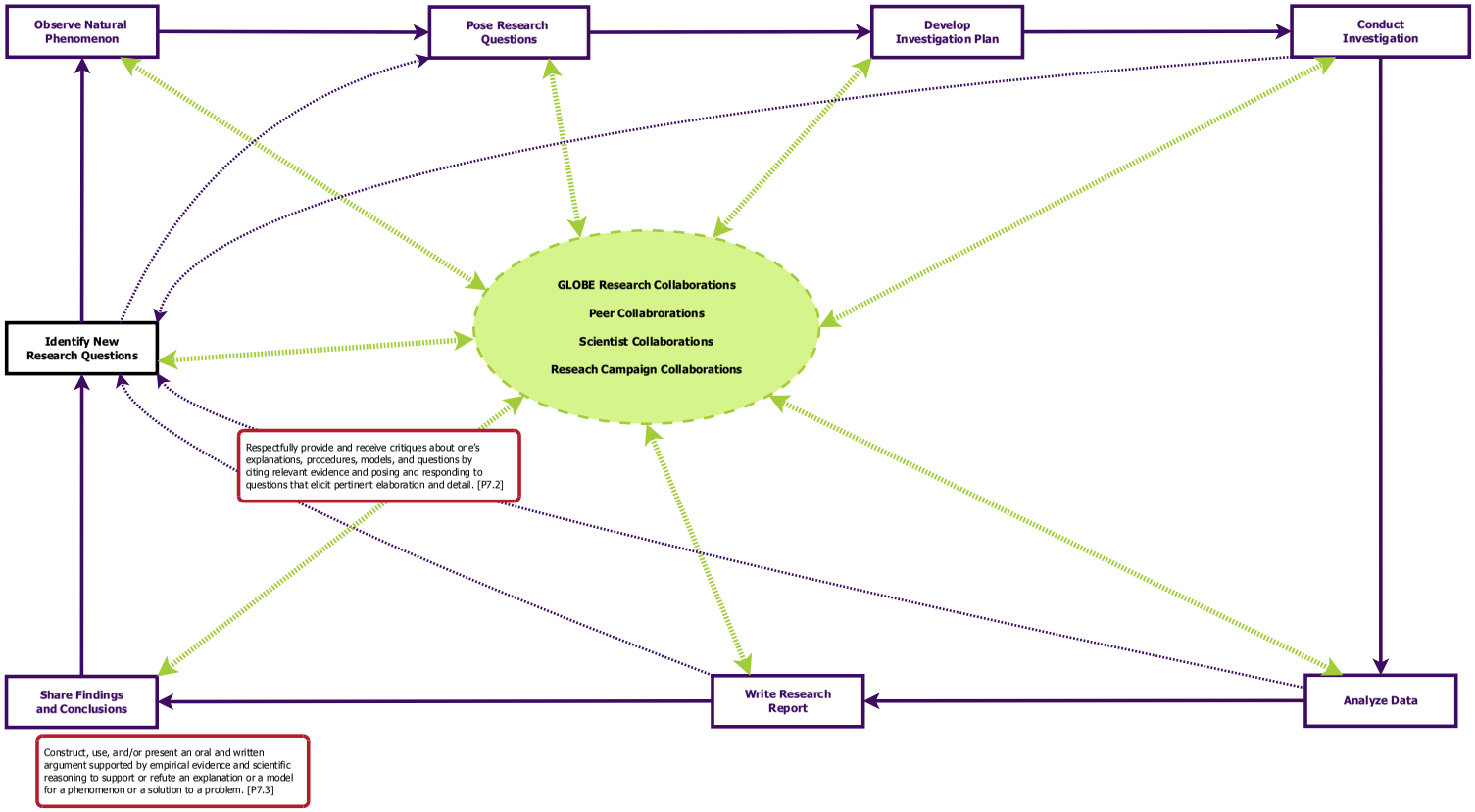
The GLOBE Program Model for Student Scientific Research
NGSS Practices progression for Middle School (Grades 6-8)
Practice 5



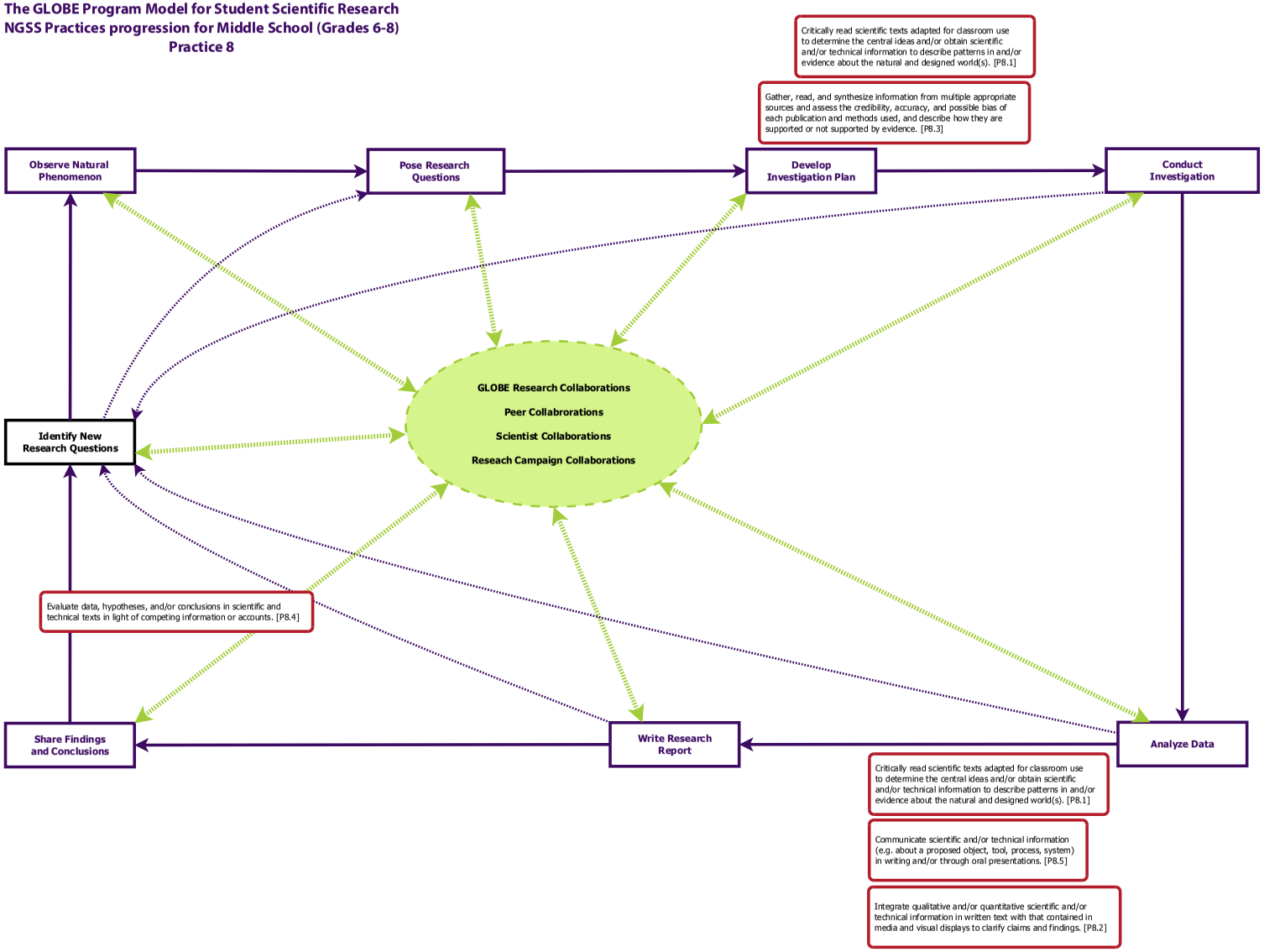
The GLOBE Program Model for Student Scientific Research
NGSS Practices progression for Middle School (Grades 6-8)
Practice 6

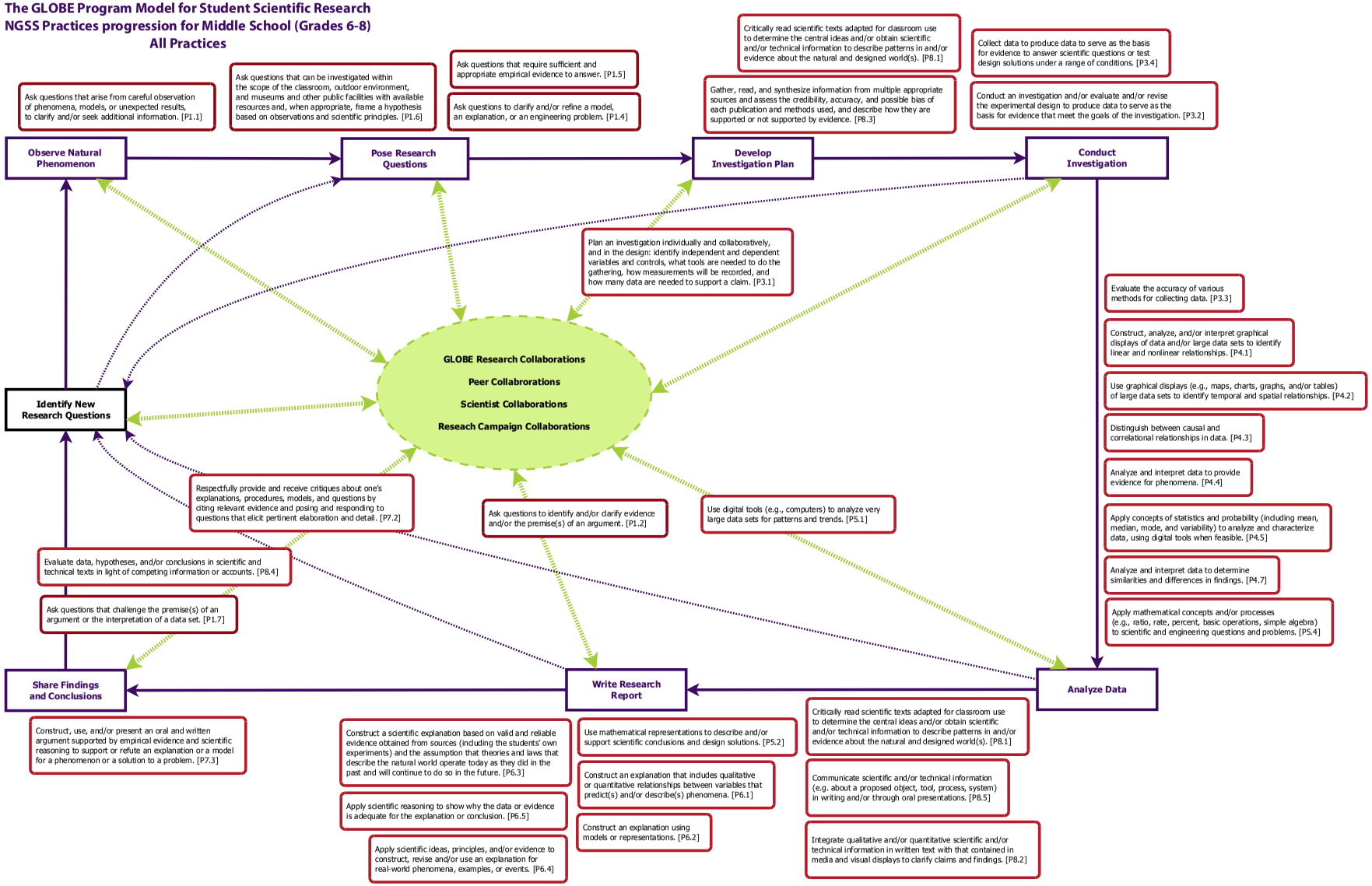


The GLOBE Program Model for Student Scientific Research
NGSS Practices progression for Middle School (Grades 6-8)
Practice 7



The GLOBE Program Model for Student Scientific Research
NGSS Practices progression for Middle School (Grades 6-8)
Practice 8



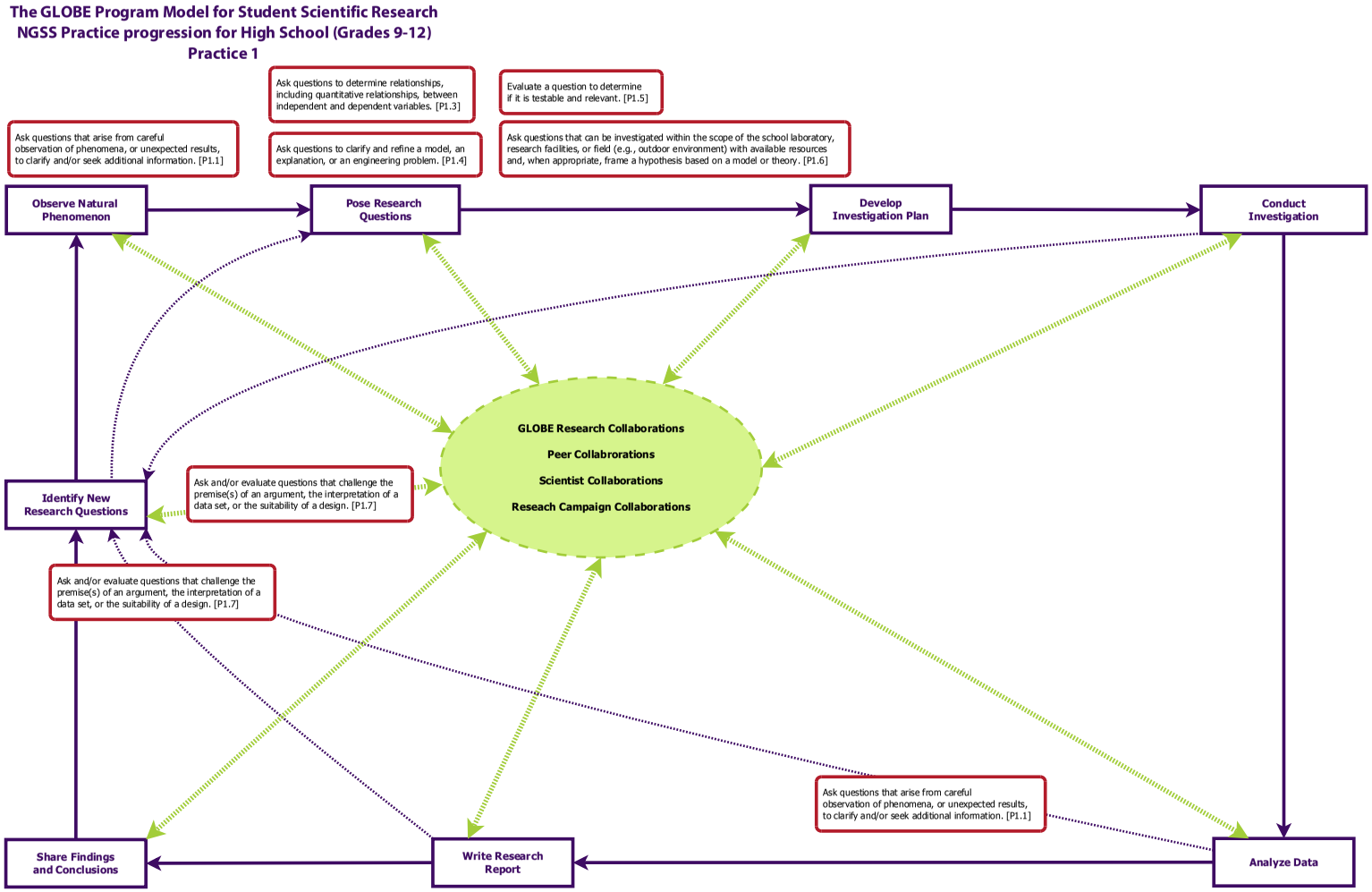

The GLOBE Program Model for Student Scientific Research
NGSS Practices progression for Middle School (Grades 6-8)
All Practices
Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information. [P1.1]
Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles. [P1.6]
Ask questions that require sufficient and appropriate empirical evidence to answer. [P1.5]
Ask questions to clarify and/or refine a model, an explanation, or an engineering problem. [P1.4]
Critically read scientific texts adapted for classroom use to determine the central ideas and/or obtain scientific and/or technical information to describe patterns in and/or evidence about the natural and designed world(s). [P8.1]
Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. [P8.3]
Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions. [P3.4]
Conduct an investigation and/or evaluate and/or revise the experimental design to produce data to serve as the basis for evidence that meet the goals of the investigation. [P3.2]
Observe Natural Phenomenon
Pose Research Questions
Develop Investigation Plan
Conduct Investigation
Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim. [P3.1]
Evaluate the accuracy of various methods for collecting data. [P3.3]
Construct, analyze, and/or interpret graphical displays of data and/or large data sets to identify linear and nonlinear relationships. [P4.1]
Use graphical displays (e.g., maps, charts, graphs, and/or tables) of large data sets to identify temporal and spatial relationships. [P4.2]
Distinguish between causal and correlational relationships in data. [P4.3]
Analyze and interpret data to provide evidence for phenomena. [P4.4]
Apply concepts of statistics and probability (including mean, median, mode, and variability) to analyze and characterize data, using digital tools when feasible. [P4.5]
Analyze and interpret data to determine similarities and differences in findings. [P4.7]
Apply mathematical concepts and/or processes (e.g., ratio, rate, percent, basic operations, simple algebra) to scientific and engineering questions and problems. [P5.4]
GLOBE Research Collaborations
Peer Collabrorations
Scientist Collaborations
Reseach Campaign Collaborations
Identify New Research Questions
Respectfully provide and receive critiques about one's explanations, procedures, models, and questions by citing relevant evidence and posing and responding to questions that elicit pertinent elaboration and detail. [P7.2]
Ask questions to identify and/or clarify evidence and/or the premise(s) of an argument. [P1.2]
Use digital tools (e.g., computers) to analyze very large data sets for patterns and trends. [P5.1]
Evaluate data, hypotheses, and/or conclusions in scientific and technical texts in light of competing information or accounts. [P8.4]
Ask questions that challenge the premise(s) of an argument or the interpretation of a data set. [P1.7]
Share Findings and Conclusions
Write Research Report
Analyze Data
Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. [P7.3]
Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. [P6.3]
Apply scientific reasoning to show why the data or evidence is adequate for the explanation or conclusion. [P6.5]
Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real-world phenomena, examples, or events. [P6.4]
Use mathematical representations to describe and/or support scientific conclusions and design solutions. [P5.2]
Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) and/or describe(s) phenomena. [P6.1]
Construct an explanation using models or representations. [P6.2]
Critically read scientific texts adapted for classroom use to determine the central ideas and/or obtain scientific and/or technical information to describe patterns in and/or evidence about the natural and designed world(s). [P8.1]
Communicate scientific and/or technical information (e.g. about a proposed object, tool, process, system) in writing and/or through oral presentations. [P8.5]
Integrate qualitative and/or quantitative scientific and/or technical information in written text with that contained in media and visual displays to clarify claims and findings. [P8.2]

Middle School - Grades 6-8

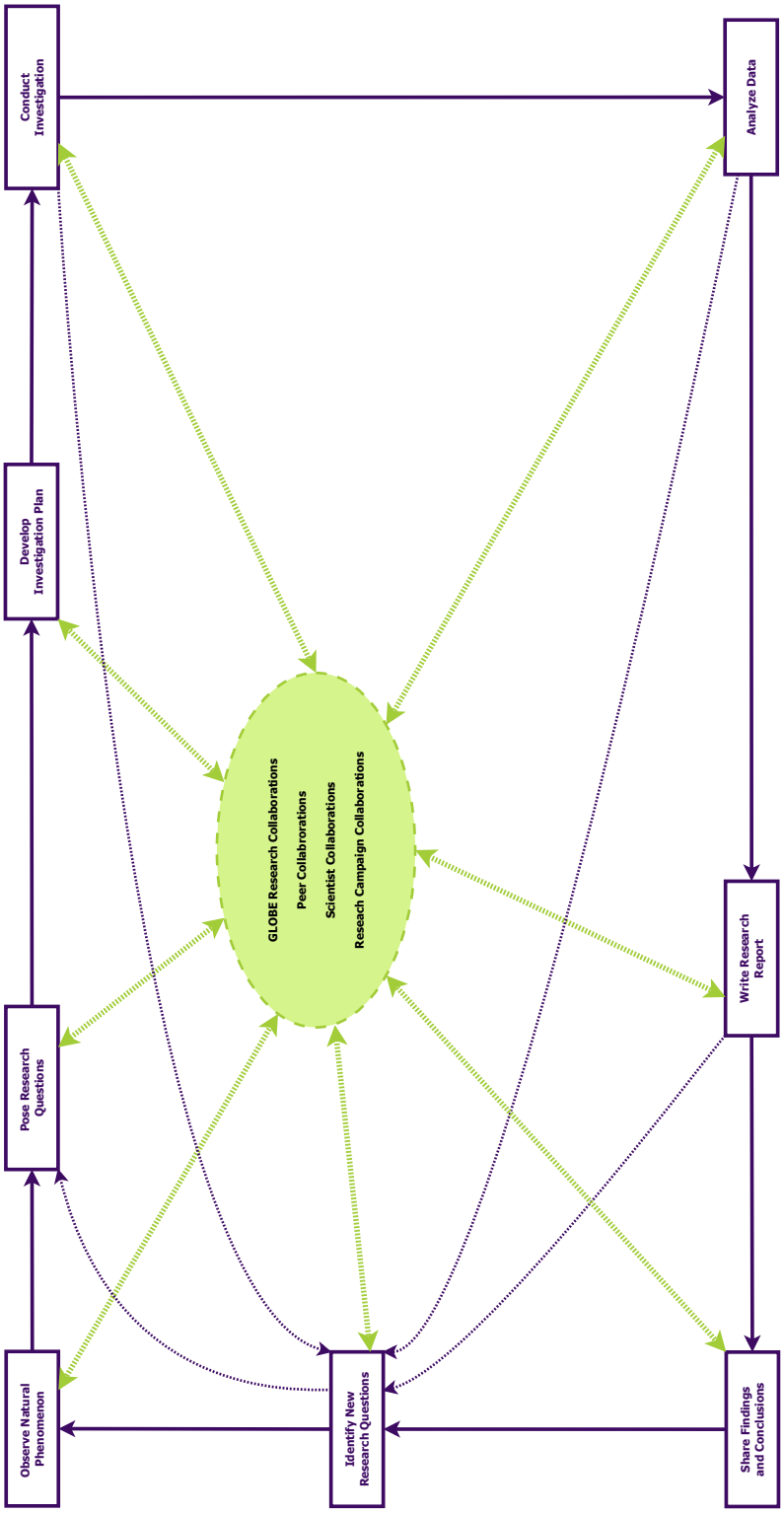
NGSS Practices integrated into the GLOBE Program Model for Student Scientific Research

1. Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.	*MSSR*	2. Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.	*MSSR*	*3. Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions.*	*MSSR*	*4. Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.*	*MSSR*
Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information. [P1.1]	X	Evaluate limitations of a model for a proposed object or tool. [P2.1]		Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim. [P3.1]	X	Construct, analyze, and/or interpret graphical displays of data and/or large data sets to identify linear and nonlinear relationships. [P4.1]	X
Develop or modify a model—based on evidence – to match what happens if a variable or component of a system is changed. [P2.2]	X	Develop or modify a model—based on evidence – to match what happens if a variable or component of a system is changed. [P2.2]		Develop or modify a model—based on evidence – to match what happens if a variable or component of a system is changed. [P2.2]	X	Develop or modify a model—based on evidence – to match what happens if a variable or component of a system is changed. [P2.2]	X
Ask questions to determine relationships between independent and dependent variables and relationships in models. [P1.3]		Use and/or develop a model of simple systems with uncertain and less predictable factors. [P2.3]		Evaluate the accuracy of various methods for collecting data. [P3.3]	X	Distinguish between causal and correlational relationships in data. [P4.3]	X
Ask questions to clarify and/or refine a model, an explanation, or an engineering problem. [P1.4]	X	Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena. [P2.4]		Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions. [P3.4]	X	Analyze and interpret data to provide evidence for phenomena. [P4.4]	X
Ask questions that require sufficient and appropriate empirical evidence to answer. [P1.5]	X	Develop and/or use a model to predict and/or describe phenomena. [P2.5]		Collect data about the performance of a proposed object, tool, process or system under a range of conditions. [P3.5]		Apply concepts of statistics and probability (including mean, median, mode, and variability) to analyze and characterize data, using digital tools when feasible. [P4.5]	X
Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles. [P1.6]	X	Develop a model to describe unobservable mechanisms. [P2.6]				Consider limitations of data analysis (e.g., measurement error), and/or seek to improve precision and accuracy of data with better technological tools and methods (e.g., multiple trials). [P4.6]	
Ask questions that challenge the premise(s) of an argument or the interpretation of a data set. [P1.7]	X	Develop and/or use a model to generate data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs, and those at unobservable scales. [P2.7]				Analyze and interpret data to determine similarities and differences in findings. [P4.7]	X
Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions. [P1.8]						Analyze data to define an optimal operational range for a proposed object, tool, process or system that best meets criteria for success. [P4.8]	

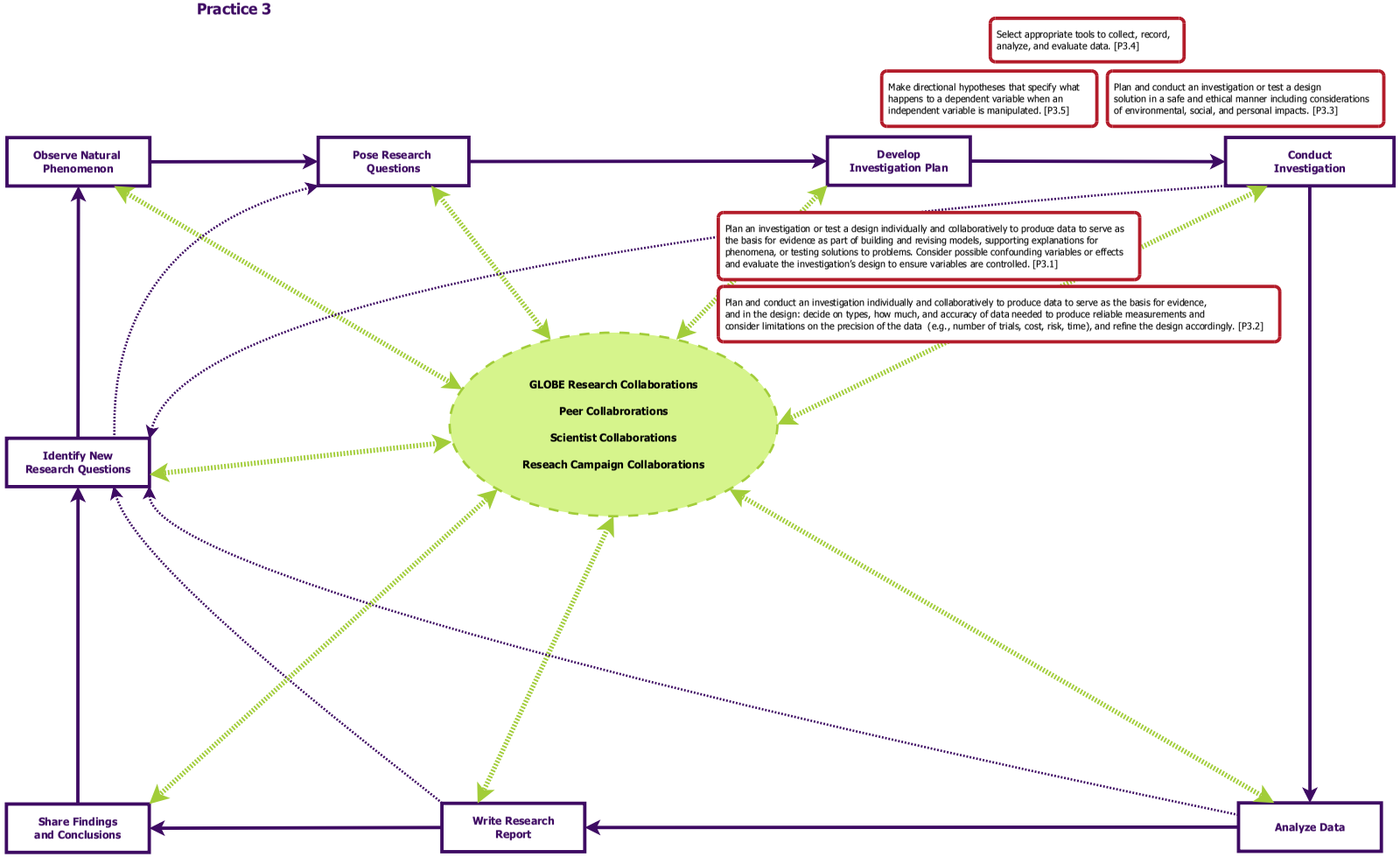
5. Mathematical and computational thinking in 6–8 builds on K–5 experiences and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments.	*MSSR*	*6. Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.*	*MSSR*	*7. Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s).*	*MSSR*	*8. Obtaining, evaluating, and communicating information in 6–8 builds on K–5 experiences and progresses to evaluating the merit and validity of ideas and methods.*	*MSSR*
Use digital tools (e.g., computers) to analyze very large data sets for patterns and trends. [P5.1]	X	Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) and/or describe(s) phenomena. [P6.1]	X	Compare and critique two arguments on the same topic and analyze whether they emphasize similar or different evidence and/or interpretations of facts. [P7.1]		Critically read scientific texts adapted for classroom use to determine the central ideas and/or obtain scientific and/or technical information to describe patterns in and/or evidence about the natural and designed world(s). [P8.1]	X
Develop or modify a model—based on evidence – to match what happens if a variable or component of a system is changed. [P2.2]	X	Develop or modify a model—based on evidence – to match what happens if a variable or component of a system is changed. [P2.2]	X	Develop or modify a model—based on evidence – to match what happens if a variable or component of a system is changed. [P2.2]	X	Develop or modify a model—based on evidence – to match what happens if a variable or component of a system is changed. [P2.2]	X
Create algorithms (a series of ordered steps) to solve a problem. [P5.3]		Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. [P6.3]	X	Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. [P7.3]	X	Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. [P8.3]	X
Apply mathematical concepts and/or processes (e.g., ratio, rate, percent, basic operations, simple algebra) to scientific and engineering questions and problems. [P5.4]	X	Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real-world phenomena, examples, or events. [P6.4]	X	Make an oral or written argument that supports or refutes the advertised performance of a device, process, or system based on empirical evidence concerning whether or not the technology meets relevant criteria and constraints. [P7.4]		Evaluate data, hypotheses, and/or conclusions in scientific and technical texts in light of competing information or accounts. [P8.4]	X
Use digital tools and/or mathematical concepts and arguments to test and compare proposed solutions to an engineering design problem. [P5.5]		Apply scientific reasoning to show why the data or evidence is adequate for the explanation or conclusion. [P6.5]	X	Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. [P7.5]		Communicate scientific and/or technical information (e.g. about a proposed object, tool, process, system) in writing and/or through oral presentations. [P8.5]	X
		Apply scientific ideas or principles to design, construct, and/or test a design of an object, tool, process or system. [P6.6]					
		Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints. [P6.7]					
		Optimize performance of a design by prioritizing criteria, making tradeoffs, testing, revising, and re-testing [P6.8]					


The GLOBE Program Model for Student Scientific Research
NGSS Practice progression for High School (Grades 9-12)
Practice 1
Ask questions to determine relationships, including quantitative relationships, between independent and dependent variables. [P1.3]
Evaluate a question to determine if it is testable and relevant. [P1.5]
Ask questions that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information. [P1.1]
Ask questions to clarify and refine a model, an explanation, or an engineering problem. [P1.4]
Ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory. [P1.6]
Observe Natural Phenomenon
Pose Research Questions
Develop Investigation Plan
Conduct Investigation
GLOBE Research Collaborations
Peer Collabrorations
Scientist Collaborations
Reseach Campaign Collaborations
Identify New Research Questions
Ask and/or evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design. [P1.7]
Ask and/or evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design. [P1.7]
Ask questions that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information. [P1.1]
Share Findings and Conclusions
Write Research Report
Analyze Data

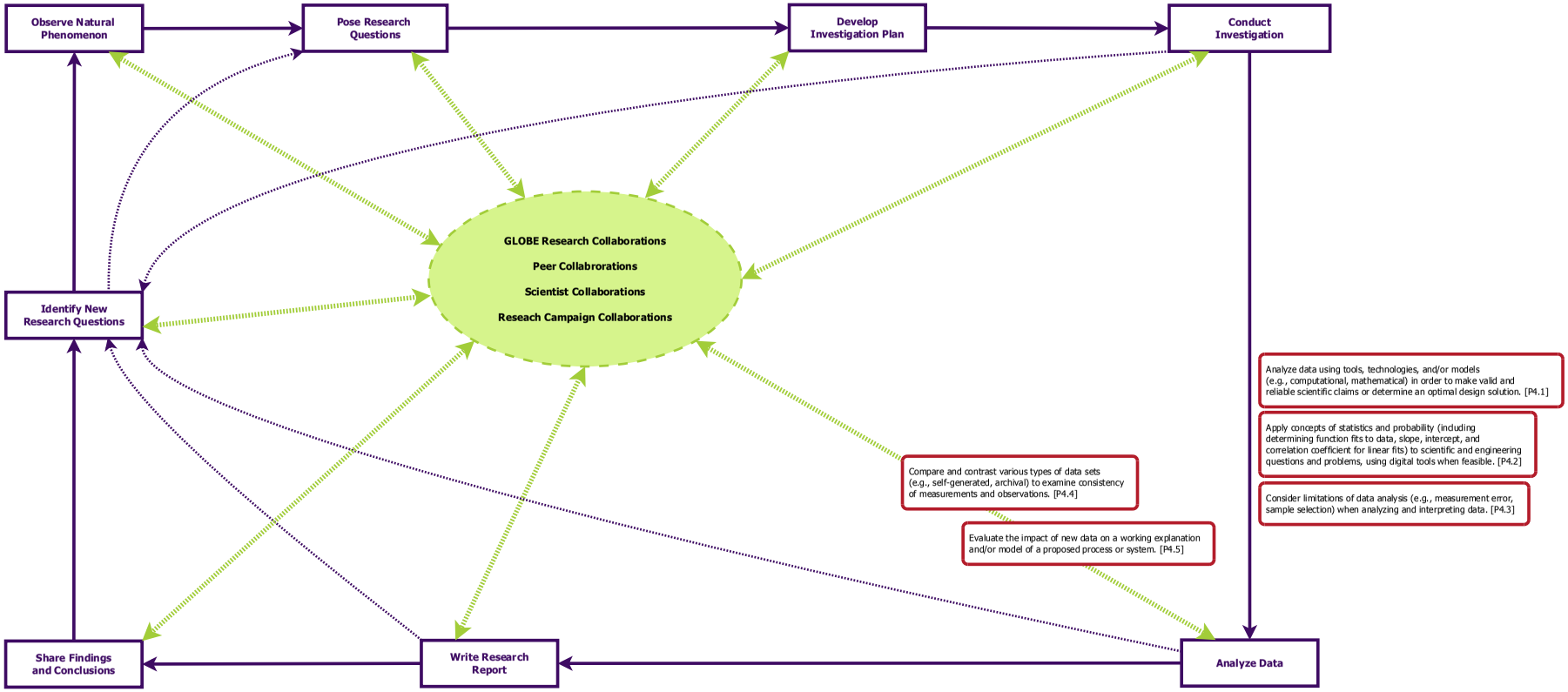
The GLOBE Program Model for Student Scientific Research
NGSS Practice progression for High School (Grades 9-12)
Practice 2



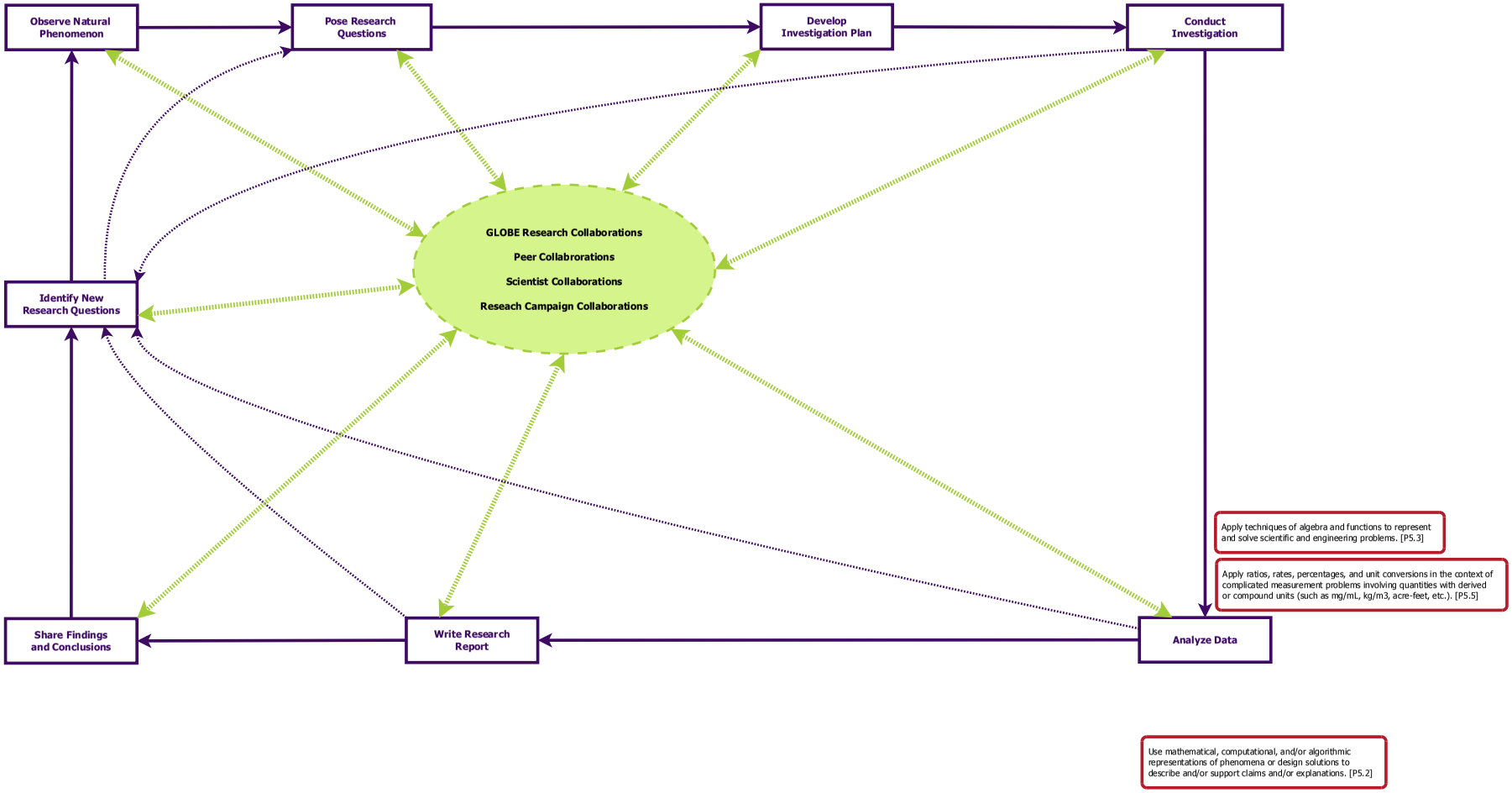
The GLOBE Program Model for Student Scientific Research
NGSS Practice progression for High School (Grades 9-12)
Practice 3



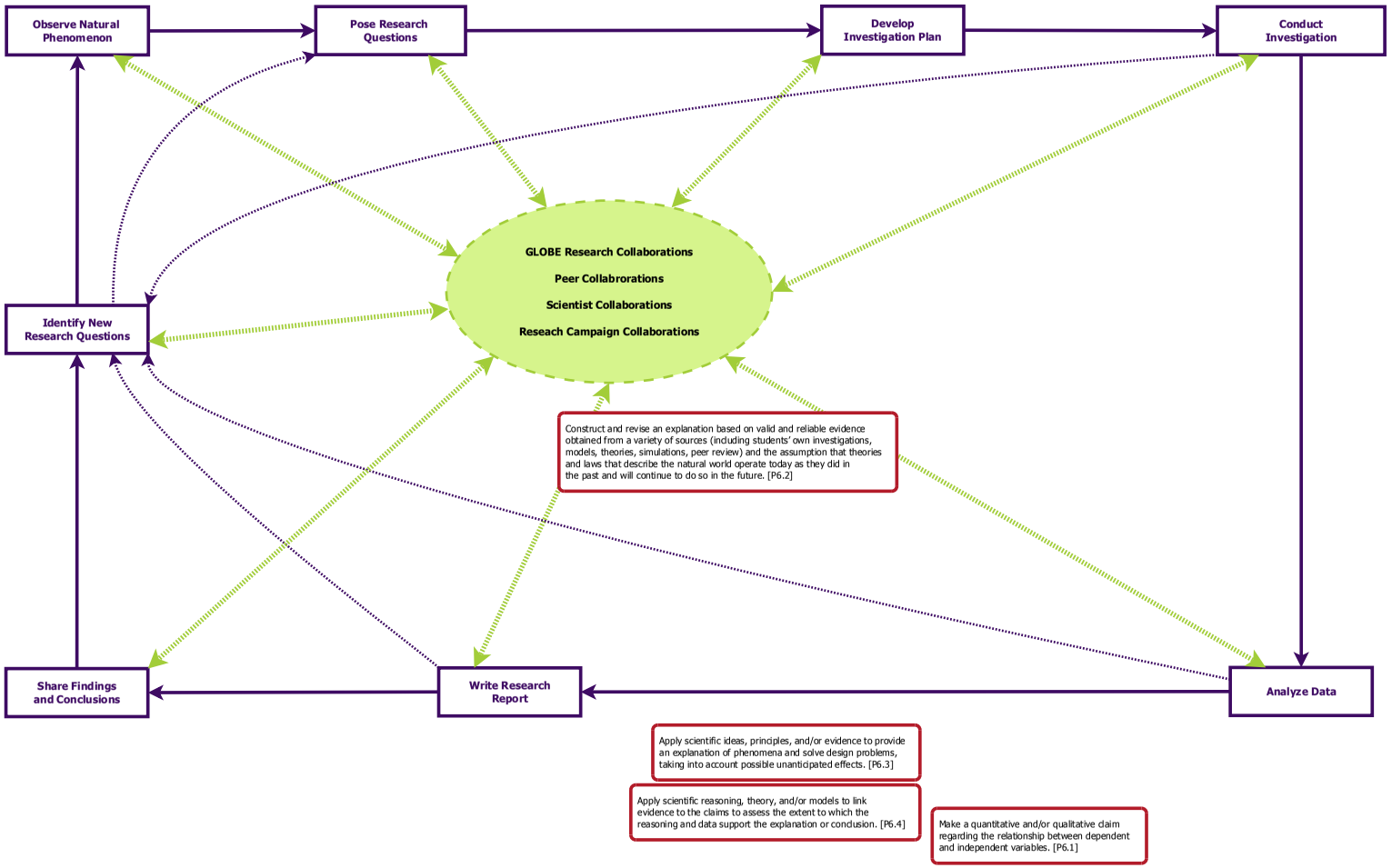
The GLOBE Program Model for Student Scientific Research
NGSS Practice progression for High School (Grades 9-12)
Practice 4



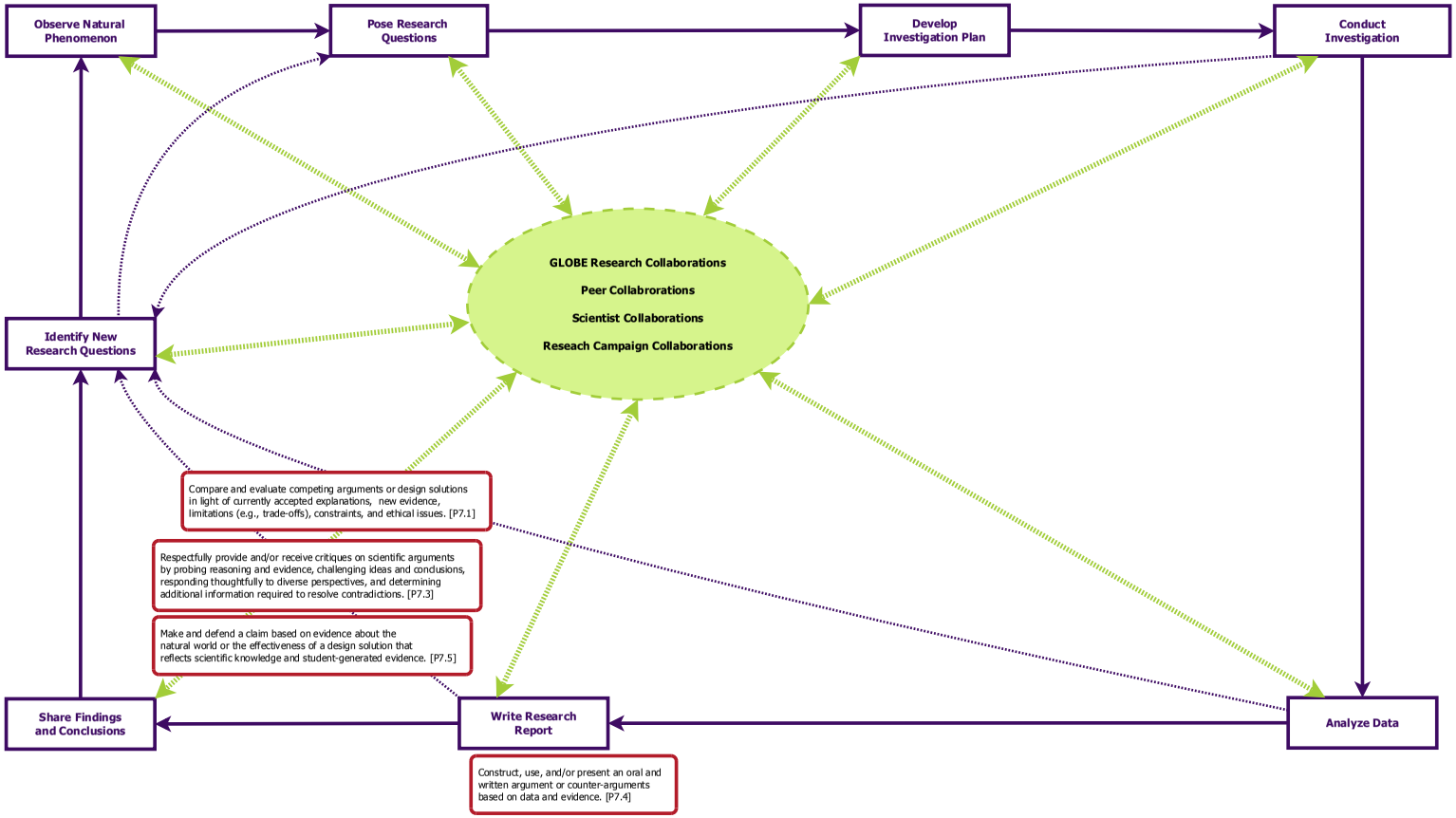
The GLOBE Program Model for Student Scientific Research
NGSS Practice progression for High School (Grades 9-12)
Practice 5



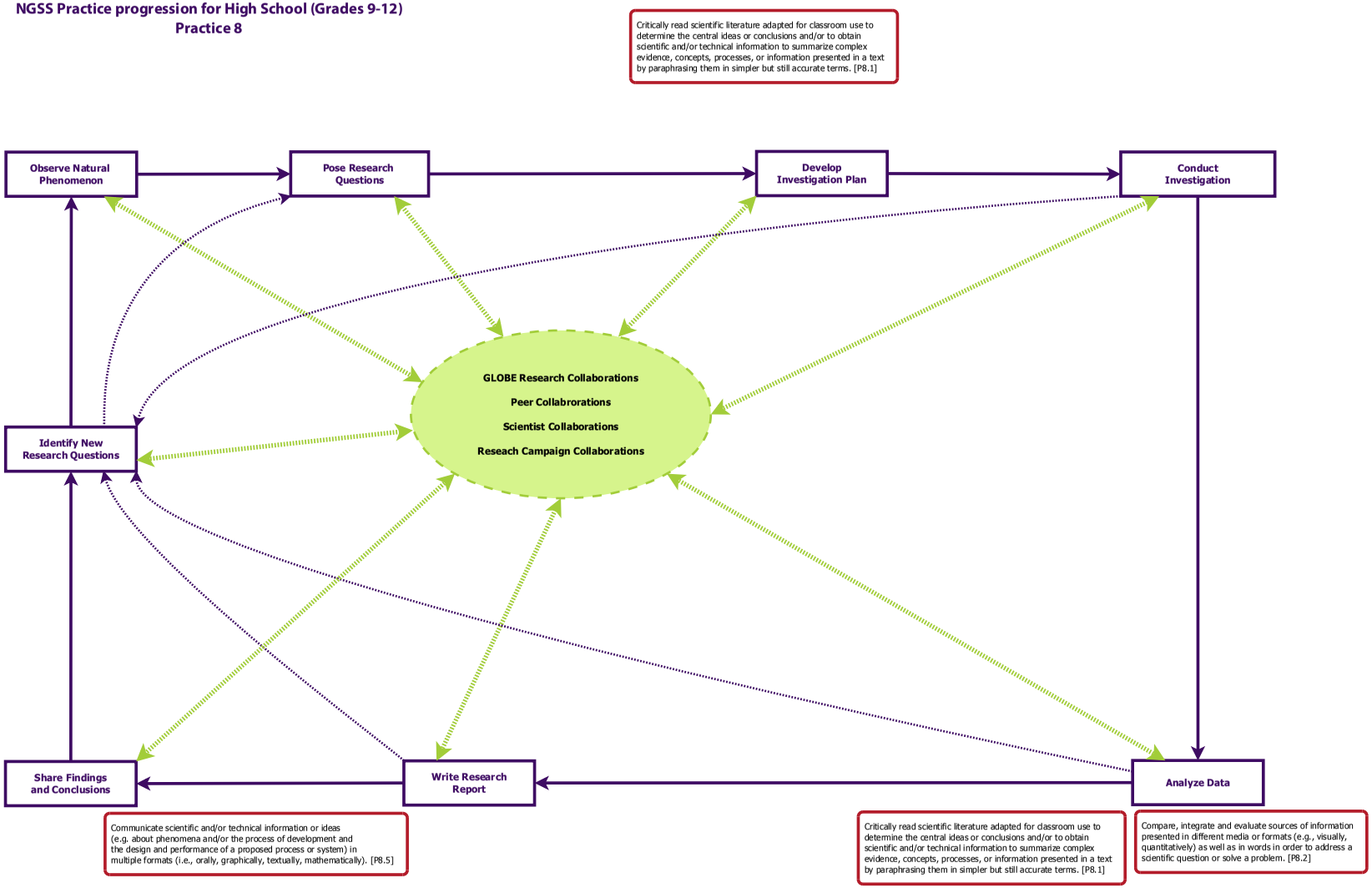
The GLOBE Program Model for Student Scientific Research
NGSS Practice progression for High School (Grades 9-12)
Practice 6

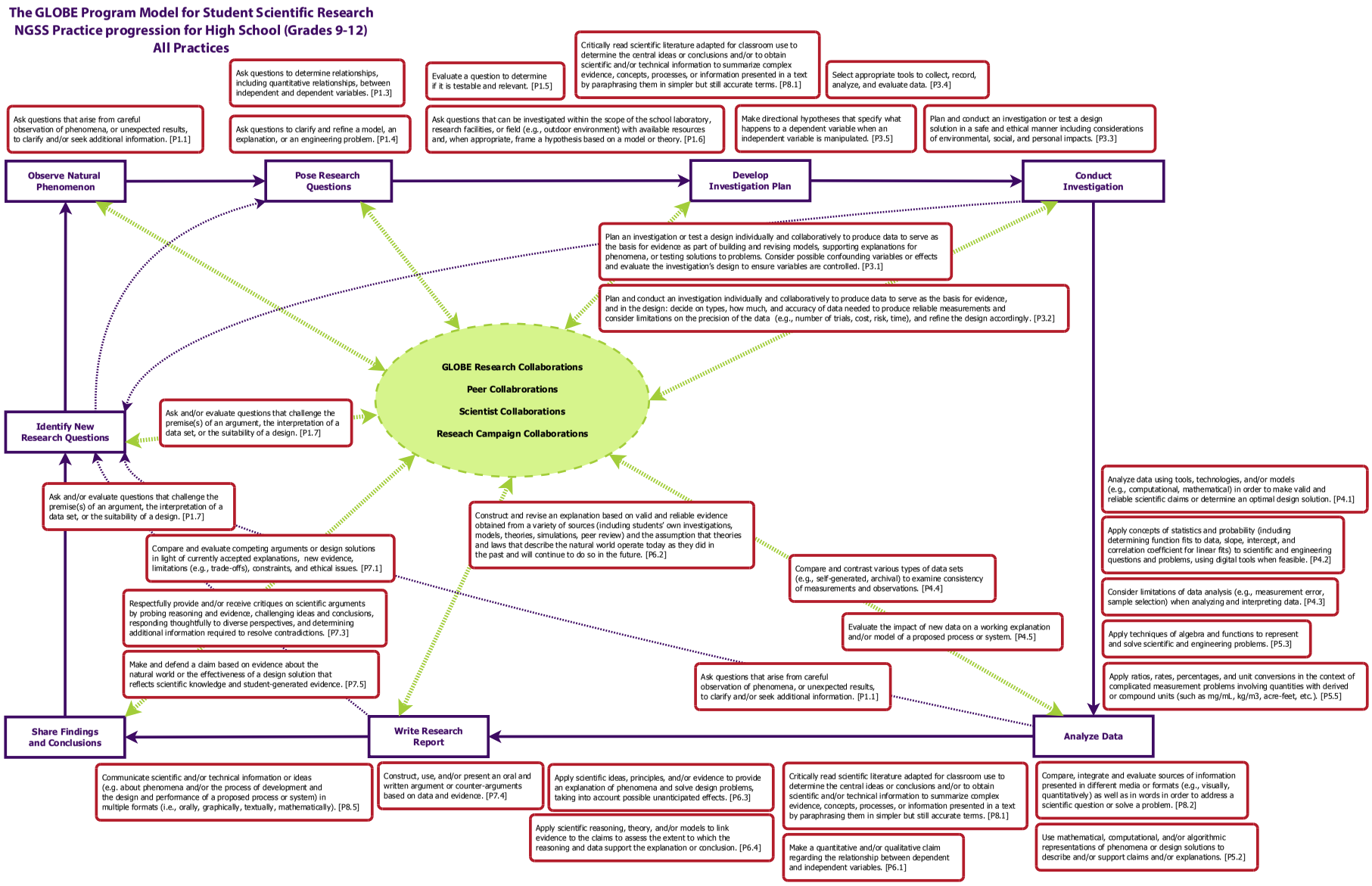


The GLOBE Program Model for Student Scientific Research
NGSS Practice progression for High School (Grades 9-12)
Practice 7



The GLOBE Program Model for Student Scientific Research
NGSS Practice progression for High School (Grades 9-12)
Practice 8




The GLOBE Program Model for Student Scientific Research
NGSS Practice progression for High School (Grades 9-12)
All Practices
Ask questions to determine relationships, including quantitative relationships, between independent and dependent variables. [P1.3]
Evaluate a question to determine if it is testable and relevant. [P1.5]
Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions and/or to obtain scientific and/or technical information to summarize complex evidence, concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. [P8.1]
Select appropriate tools to collect, record, analyze, and evaluate data. [P3.4]
Ask questions that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information. [P1.1]
Ask questions to clarify and refine a model, an explanation, or an engineering problem. [P1.4]
Ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory. [P1.6]
Make directional hypotheses that specify what happens to a dependent variable when an independent variable is manipulated. [P3.5]
Plan and conduct an investigation or test a design solution in a safe and ethical manner including considerations of environmental, social, and personal impacts. [P3.3]
Observe Natural Phenomenon
Pose Research Questions
Develop Investigation Plan
Conduct Investigation
Plan an investigation or test a design individually and collaboratively to produce data to serve as the basis for evidence as part of building and revising models, supporting explanations for phenomena, or testing solutions to problems. Consider possible confounding variables or effects and evaluate the investigation's design to ensure variables are controlled. [P3.1]
Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. [P3.2]
GLOBE Research Collaborations
Peer Collabrorations
Scientist Collaborations
Reseach Campaign Collaborations
Identify New Research Questions
Ask and/or evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design. [P1.7]
Ask and/or evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design. [P1.7]
Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. [P6.2]
Compare and evaluate competing arguments or design solutions in light of currently accepted explanations, new evidence, limitations (e.g., trade-offs), constraints, and ethical issues. [P7.1]
Respectfully provide and/or receive critiques on scientific arguments by probing reasoning and evidence, challenging ideas and conclusions, responding thoughtfully to diverse perspectives, and determining additional information required to resolve contradictions. [P7.3]
Make and defend a claim based on evidence about the natural world or the effectiveness of a design solution that reflects scientific knowledge and student-generated evidence. [P7.5]
Compare and contrast various types of data sets (e.g., self-generated, archival) to examine consistency of measurements and observations. [P4.4]
Evaluate the impact of new data on a working explanation and/or model of a proposed process or system. [P4.5]
Ask questions that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information. [P1.1]
Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. [P4.1]
Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible. [P4.2]
Consider limitations of data analysis (e.g., measurement error, sample selection) when analyzing and interpreting data. [P4.3]
Apply techniques of algebra and functions to represent and solve scientific and engineering problems. [P5.3]
Apply ratios, rates, percentages, and unit conversions in the context of complicated measurement problems involving quantities with derived or compound units (such as mg/mL, kg/m3, acre-feet, etc.). [P5.5]
Share Findings and Conclusions
Write Research Report
Analyze Data
Communicate scientific and/or technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (i.e., orally, graphically, textually, mathematically). [P8.5]
Construct, use, and/or present an oral and written argument or counter-arguments based on data and evidence. [P7.4]
Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. [P6.3]
Apply scientific reasoning, theory, and/or models to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion. [P6.4]
Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions and/or to obtain scientific and/or technical information to summarize complex evidence, concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. [P8.1]
Make a quantitative and/or qualitative claim regarding the relationship between dependent and independent variables. [P6.1]
Compare, integrate and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a scientific question or solve a problem. [P8.2]
Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations. [P5.2]

High School - Grades 9-12

NGSS Practices integrated into the GLOBE Program Model for Student Scientific Research

1. Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.	*MSSR*	2. Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.	*MSSR*	*3. Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.*	*MSSR*	*4. Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.*	*MSSR*
Ask questions that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information. [P1.1]	X	Evaluate merits and limitations of two different models of the same proposed tool, process, mechanism or system in order to select or revise a model that best fits the evidence or design criteria. [P2.1]		Plan an investigation or test a design individually and collaboratively to produce data to serve as the basis for evidence as part of building and revising models, supporting explanations for phenomena, or testing solutions to problems. Consider possible confounding variables or effects and evaluate the investigation's design to ensure variables are controlled. [P3.1]	X	Analyze data using tools, technologies, and/or models (e. [P4.1]g, [P4.1], computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. [P4.1]	X
Design a test of a model to ascertain its reliability. [P2.2]		Design a test of a model to ascertain its reliability. [P2.2]		Design a test of a model to ascertain its reliability. [P2.2]	X	Design a test of a model to ascertain its reliability. [P2.2]	X
Ask questions to determine relationships, including quantitative relationships, between independent and dependent variables. [P1.3]	X	Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system. [P2.3]		Plan and conduct an investigation or test a design solution in a safe and ethical manner including considerations of environmental, social, and personal impacts. [P3.3]	X	Consider limitations of data analysis (e.g., measurement error, sample selection) when analyzing and interpreting data. [P4.3]	X
Ask questions to clarify and refine a model, an explanation, or an engineering problem. [P1.4]	X	Develop and/or use multiple types of models to provide mechanistic accounts and/or predict phenomena, and move flexibly between model types based on merits and limitations. [P2.4]		Select appropriate tools to collect, record, analyze, and evaluate data. [P3.4]	X	Compare and contrast various types of data sets (e.g., self-generated, archival) to examine consistency of measurements and observations. [P4.4]	X
Evaluate a question to determine if it is testable and relevant. [P1.5]	X	Develop a complex model that allows for manipulation and testing of a proposed process or system. [P2.5]		Make directional hypotheses that specify what happens to a dependent variable when an independent variable is manipulated. [P3.5]	X	Evaluate the impact of new data on a working explanation and/or model of a proposed process or system. [P4.5]	X
Ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory. [P1.6]	X	Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems. [P2.6]		Manipulate variables and collect data about a complex model of a proposed process or system to identify failure points or improve performance relative to criteria for success or other variables. [P3.6]		Analyze data to identify design features or characteristics of the components of a proposed process or system to optimize it relative to criteria for success. [P4.6]	
Ask and/or evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design. [P1.7]	X						
Define a design problem that involves the development of a process or system with interacting components and criteria and constraints that may include social, technical, and/or environmental considerations. [P1.8]							

5. Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.	***MSSR***	*6. Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.*	***MSSR***	*7. Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science.*	***MSSR***	*8. Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs.*	***MSSR***
Create and/or revise a computational model or simulation of a phenomenon, designed device, process, or system. [P5.1]		Make a quantitative and/or qualitative claim regarding the relationship between dependent and independent variables. [P6.1]	X	Compare and evaluate competing arguments or design solutions in light of currently accepted explanations, new evidence, limitations (e.g., trade-offs), constraints, and ethical issues. [P7.1]	X	Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions and/or to obtain scientific and/or technical information to summarize complex evidence, concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. [P8.1]	X
Design a test of a model to ascertain its reliability. [P2.2]	X	Design a test of a model to ascertain its reliability. [P2.2]	X	Design a test of a model to ascertain its reliability. [P2.2]		Design a test of a model to ascertain its reliability. [P2.2]	X
Apply techniques of algebra and functions to represent and solve scientific and engineering problems. [P5.3]	X	Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. [P6.3]	X	Respectfully provide and/or receive critiques on scientific arguments by probing reasoning and evidence, challenging ideas and conclusions, responding thoughtfully to diverse perspectives, and determining additional information required to resolve contradictions. [P7.3]	X	Gather, read, and evaluate scientific and/or technical information from multiple authoritative sources, assessing the evidence and usefulness of each source. [P8.3]	
Use simple limit cases to test mathematical expressions, computer programs, algorithms, or simulations of a process or system to see if a model "makes sense" by comparing the outcomes with what is known about the real world. [P5.4]		Apply scientific reasoning, theory, and/or models to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion. [P6.4]	X	Construct, use, and/or present an oral and written argument or counter-arguments based on data and evidence. [P7.4]	X	Evaluate the validity and reliability of and/or synthesize multiple claims, methods, and/or designs that appear in scientific and technical texts or media reports, verifying the data when possible. [P8.4]	
Apply ratios, rates, percentages, and unit conversions in the context of complicated measurement problems involving quantities with derived or compound units (such as mg/mL, kg/m3, acre-feet, etc.). [P5.5]	X	Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. [P6.5]		Make and defend a claim based on evidence about the natural world or the effectiveness of a design solution that reflects scientific knowledge and student-generated evidence. [P7.5]	X	Communicate scientific and/or technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (i.e., orally, graphically, textually, mathematically). [P8.5]	X
				Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and/or logical arguments regarding relevant factors (e.g. economic, societal, environmental, ethical considerations). [P7.6]			

1. Asking questions and defining problems.

Grades K-2		Grades 3-5		Grades 6-8		Grades 9-12	
1. Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested.	*MSSR*	*Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships.*	*MSSR*	*Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.*	*MSSR*	*Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.*	*MSSR*
Ask questions based on observations to find more information about the natural and/or designed world(s). [P1.1]	X	Ask questions about what would happen if a variable is changed. [P1.1]	X	Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information. [P1.1]	X	Ask questions that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information. [P1.1]	X
Ask and/or identify questions that can be answered by an investigation. [P1.2]	X	Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. [P2.2]	X	Develop or modify a model—based on evidence – to match what happens if a variable or component of a system is changed. [P2.2]	X	Design a test of a model to ascertain its reliability. [P2.2]	
Define a simple problem that can be solved through the development of a new or improved object or tool. [P1.3]		Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. [P1.3]	X	Ask questions to determine relationships between independent and dependent variables and relationships in models. [P1.3]		Ask questions to determine relationships, including quantitative relationships, between independent and dependent variables. [P1.3]	X
		Use prior knowledge to describe problems that can be solved. [P1.4]		Ask questions to clarify and/or refine a model, an explanation, or an engineering problem. [P1.4]	X	Ask questions to clarify and refine a model, an explanation, or an engineering problem. [P1.4]	X
		Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost. [P1.5]	X	Ask questions that require sufficient and appropriate empirical evidence to answer. [P1.5]	X	Evaluate a question to determine if it is testable and relevant. [P1.5]	X
				Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles. [P1.6]	X	Ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory. [P1.6]	X
				Ask questions that challenge the premise(s) of an argument or the interpretation of a data set. [P1.7]	X	Ask and/or evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design. [P1.7]	X
				Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions. [P1.8]		Define a design problem that involves the development of a process or system with interacting components and criteria and constraints that may include social, technical, and/or environmental considerations. [P1.8]	

2. Developing and Using Models

Grades K-2		Grades 3-5		Grades 6-8		Grades 9-12	
Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions.	MSSR	Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.	MSSR	Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.	MSSR	Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.	MSSR
Distinguish between a model and the actual object, process, and/or events the model represents. [P2.1]		Identify limitations of models. [P2.1]		Evaluate limitations of a model for a proposed object or tool. [P2.1]		Evaluate merits and limitations of two different models of the same proposed tool, process, mechanism or system in order to select or revise a model that best fits the evidence or design criteria. [P2.1]	
Compare models to identify common features and differences. [P2.2]		Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. [P2.2]		Develop or modify a model—based on evidence – to match what happens if a variable or component of a system is changed. [P2.2]		Design a test of a model to ascertain its reliability. [P2.2]	
Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s). [P2.3]		Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution. [P2.3]		Use and/or develop a model of simple systems with uncertain and less predictable factors. [P2.3]		Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system. [P2.3]	
Develop a simple model based on evidence to represent a proposed object or tool. [P2.4]		Develop and/or use models to describe and/or predict phenomena. [P2.4]		Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena. [P2.4]		Develop and/or use multiple types of models to provide mechanistic accounts and/or predict phenomena, and move flexibly between model types based on merits and limitations. [P2.4]	
		Develop a diagram or simple physical prototype to convey a proposed object, tool, or process. [P2.5]		Develop and/or use a model to predict and/or describe phenomena. [P2.5]		Develop a complex model that allows for manipulation and testing of a proposed process or system. [P2.5]	
		Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system. [P2.6]		Develop a model to describe unobservable mechanisms. [P2.6]		Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems. [P2.6]	
				Develop and/or use a model to generate data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs, and those at unobservable scales. [P2.7]			

3. Planning and Carrying Out Investigations

Grades K-2		Grades 3-5		Grades 6-8		Grades 9-12	
Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.	*MSSR*	*Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.*	*MSSR*	*Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions.*	*MSSR*	*Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.*	*MSSR*
With guidance, plan and conduct an investigation in collaboration with peers (for K). [P3.1]	X	Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. [P3.1]	X	Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim. [P3.1]	X	Plan an investigation or test a design individually and collaboratively to produce data to serve as the basis for evidence as part of building and revising models, supporting explanations for phenomena, or testing solutions to problems. Consider possible confounding variables or effects and evaluate the investigation's design to ensure variables are controlled. [P3.1]	X
Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question. [P3.2]	X	Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. [P2.2]	X	Develop or modify a model—based on evidence – to match what happens if a variable or component of a system is changed. [P2.2]	X	Design a test of a model to ascertain its reliability. [P2.2]	X
Evaluate different ways of observing and/or measuring a phenomenon to determine which way can answer a question. [P3.3]	X	Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. [P3.3]	X	Evaluate the accuracy of various methods for collecting data. [P3.3]	X	Plan and conduct an investigation or test a design solution in a safe and ethical manner including considerations of environmental, social, and personal impacts. [P3.3]	X
Make observations (firsthand or from media) and/or measurements to collect data that can be used to make comparisons. [P3.4]	X	Make predictions about what would happen if a variable changes. [P3.4]	X	Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions. [P3.4]	X	Select appropriate tools to collect, record, analyze, and evaluate data. [P3.4]	X
Make observations (firsthand or from media) and/or measurements of a proposed object or tool or solution to determine if it solves a problem or meets a goal. [P3.5]		Test two different models of the same proposed object, tool, or process to determine which better meets criteria for success. [P3.5]		Collect data about the performance of a proposed object, tool, process or system under a range of conditions. [P3.5]		Make directional hypotheses that specify what happens to a dependent variable when an independent variable is manipulated. [P3.5]	X
Make predictions based on prior experiences. [P3.6]	X					Manipulate variables and collect data about a complex model of a proposed process or system to identify failure points or improve performance relative to criteria for success or other variables. [P3.6]	

4. Analyzing and Interpreting Data

Grades K-2		Grades 3-5		Grades 6-8		Grades 9-12	
Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations.	*MSSR*	*Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations.*	*MSSR*	*Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.*	*MSSR*	*Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.*	*MSSR*
Record information (observations, thoughts, and ideas). [P4.1]	X	When possible and feasible, digital tools should be used. [P4.1]	X	Construct, analyze, and/or interpret graphical displays of data and/or large data sets to identify linear and nonlinear relationships. [P4.1]	X	Analyze data using tools, technologies, and/or models (e. [P4.1]g. [P4.1], computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. [P4.1]	X
Use and share pictures, drawings, and/or writings of observations. [P4.2]	X	Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. [P2.2]	X	Develop or modify a model—based on evidence – to match what happens if a variable or component of a system is changed. [P2.2]	X	Design a test of a model to ascertain its reliability. [P2.2]	X
Use observations (firsthand or from media) to describe patterns and/or relationships in the natural and designed world(s) in order to answer scientific questions and solve	X	Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation. [P4.3]	X	Distinguish between causal and correlational relationships in data. [P4.3]	X	Consider limitations of data analysis (e.g., measurement error, sample selection) when analyzing and interpreting data. [P4.3]	X
Compare predictions (based on prior experiences) to what occurred (observable events). [P4.4]	X	Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings. [P4.4]	X	Analyze and interpret data to provide evidence for phenomena. [P4.4]	X	Compare and contrast various types of data sets (e.g., self-generated, archival) to examine consistency of measurements and observations. [P4.4]	X
Analyze data from tests of an object or tool to determine if it works as intended. [P4.5]		Analyze data to refine a problem statement or the design of a proposed object, tool, or process. [P4.5]		Apply concepts of statistics and probability (including mean, median, mode, and variability) to analyze and characterize data, using digital tools when feasible. [P4.5]	X	Evaluate the impact of new data on a working explanation and/or model of a proposed process or system. [P4.5]	X
		Use data to evaluate and refine design solutions. [P4.6]		Consider limitations of data analysis (e.g., measurement error), and/or seek to improve precision and accuracy of data with better technological tools and methods (e.g., multiple trials). [P4.6]		Analyze data to identify design features or characteristics of the components of a proposed process or system to optimize it relative to criteria for success. [P4.6]	
				Analyze and interpret data to determine similarities and differences in findings. [P4.7]	X		
				Analyze data to define an optimal operational range for a proposed object, tool, process or system that best meets criteria for success. [P4.8]			

5. Using Mathematics and Computational Thinking

Grades K-2		Grades 3-5		Grades 6-8		Grades 9-12	
Mathematical and computational thinking in K–2 builds on prior experience and progresses to recognizing that mathematics can be used to describe the natural and designed world(s).	*MSSR*	*Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions.*	*MSSR*	*Mathematical and computational thinking in 6–8 builds on K–5 experiences and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments.*	*MSSR*	*Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.*	*MSSR*
Decide when to use qualitative vs. quantitative data. [P5.1]	X	Decide if qualitative or quantitative data are best to determine whether a proposed object or tool meets criteria for success. [P5.1]		Use digital tools (e.g., computers) to analyze very large data sets for patterns and trends. [P5.1]	X	Create and/or revise a computational model or simulation of a phenomenon, designed device, process, or system. [P5.1]	
Use counting and numbers to identify and describe patterns in the natural and designed world(s). [P5.2]	X	Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. [P2.2]	X	Develop or modify a model—based on evidence – to match what happens if a variable or component of a system is changed. [P2.2]	X	Design a test of a model to ascertain its reliability. [P2.2]	X
Describe, measure, and/or compare quantitative attributes of different objects and display the data using simple graphs. [P5.3]	X	Describe, measure, estimate, and/or graph quantities (e.g., area, volume, weight, time) to address scientific and engineering questions and problems. [P5.3]		Create algorithms (a series of ordered steps) to solve a problem. [P5.3]		Apply techniques of algebra and functions to represent and solve scientific and engineering problems. [P5.3]	X
Use quantitative data to compare two alternative solutions to a problem. [P5.4]		Create and/or use graphs and/or charts generated from simple algorithms to compare alternative solutions to an engineering problem. [P5.4]		Apply mathematical concepts and/or processes (e.g., ratio, rate, percent, basic operations, simple algebra) to scientific and engineering questions and problems. [P5.4]	X	Use simple limit cases to test mathematical expressions, computer programs, algorithms, or simulations of a process or system to see if a model "makes sense" by comparing the outcomes with what is known about the real world. [P5.4]	
				Use digital tools and/or mathematical concepts and arguments to test and compare proposed solutions to an engineering design problem. [P5.5]		Apply ratios, rates, percentages, and unit conversions in the context of complicated measurement problems involving quantities with derived or compound units (such as mg/mL, kg/m3, acre-feet, etc.). [P5.5]	X

6. Constructing Explanations and Designing Solutions

Grades K-2		*Grades 3-5*		*Grades 6-8*		*Grades 9-12*	
Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions.	*MSSR*	*Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.*	*MSSR*	*Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.*	*MSSR*	*Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.*	*MSSR*
Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. [P6.1]	X	Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard). [P6.1]	X	Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) and/or describe(s) phenomena. [P6.1]	X	Make a quantitative and/or qualitative claim regarding the relationship between dependent and independent variables. [P6.1]	X
Use tools and/or materials to design and/or build a device that solves a specific problem or a solution to a specific problem. [P6.2]		Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. [P2.2]		Develop or modify a model—based on evidence – to match what happens if a variable or component of a system is changed. [P2.2]	X	Design a test of a model to ascertain its reliability. [P2.2]	X
Generate and/or compare multiple solutions to a problem. [P6.3]		Identify the evidence that supports particular points in an explanation. [P6.3]	X	Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. [P6.3]	X	Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. [P6.3]	X
		Apply scientific ideas to solve design problems. [P6.4]		Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real-world phenomena, examples, or events. [P6.4]	X	Apply scientific reasoning, theory, and/or models to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion. [P6.4]	X
		Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. [P6.5]		Apply scientific reasoning to show why the data or evidence is adequate for the explanation or conclusion. [P6.5]	X	Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. [P6.5]	
				Apply scientific ideas or principles to design, construct, and/or test a design of an object, tool, process or system. [P6.6]			
				Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints. [P6.7]			
				Optimize performance of a design by prioritizing criteria, making tradeoffs, testing, revising, and re-testing [P6.8]			

7. Engaging in Argument from Evidence

Grades K-2		Grades 3-5		Grades 6-8		Grades 9-12	
Engaging in argument from evidence in K–2 builds on prior experiences and progresses to comparing ideas and representations about the natural and designed world(s).	*MSSR*	*Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).*	*MSSR*	*Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s).*	*MSSR*	*Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science.*	*MSSR*
Identify arguments that are supported by evidence. [P7.1]	X	Compare and refine arguments based on an evaluation of the evidence presented. [P7.1]	X	Compare and critique two arguments on the same topic and analyze whether they emphasize similar or different evidence and/or interpretations of facts. [P7.1]		Compare and evaluate competing arguments or design solutions in light of currently accepted explanations, new evidence, limitations (e.g., trade-offs), constraints, and ethical issues. [P7.1]	X
Distinguish between explanations that account for all gathered evidence and those that do not. [P7.2]	X	Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. [P2.2]		Develop or modify a model—based on evidence – to match what happens if a variable or component of a system is changed. [P2.2]	X	Design a test of a model to ascertain its reliability. [P2.2]	
Analyze why some evidence is relevant to a scientific question and some is not. [P7.3]	X	Respectfully provide and receive critiques from peers about a proposed procedure, explanation, or model by citing relevant evidence and posing specific questions. [P7.3]	X	Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a [illegible]	X	Respectfully provide and/or receive critiques on scientific arguments by probing reasoning and evidence, challenging ideas and conclusions, responding thoughtfully to diverse [illegible]	X
Distinguish between opinions and evidence in one's own explanations. [P7.4]	X	Construct and/or support an argument with evidence, data, and/or a model. [P7.4]	X	Make an oral or written argument that supports or refutes the advertised performance of a device, process, or system based on empirical evidence concerning whether or not the technology meets relevant criteria and constraints. [P7.4]		Construct, use, and/or present an oral and written argument or counter-arguments based on data and evidence. [P7.4]	X
Listen actively to arguments to indicate agreement or disagreement based on evidence, and/or to retell the main points of the argument. [P7.5]	X	Use data to evaluate claims about cause and effect. [P7.5]	X	Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. [P7.5]		Make and defend a claim based on evidence about the natural world or the effectiveness of a design solution that reflects scientific knowledge and student-generated evidence. [P7.5]	X
Construct an argument with evidence to support a claim. [P7.6]	X	Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem. [P7.6]				Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and/or logical arguments regarding relevant factors (e.g. economic, societal, environmental, ethical considerations). [P7.6]	
Make a claim about the effectiveness of an object, tool, or solution that is supported by relevant evidence. [P7.7]							

8. Obtaining, Evaluating, and Communicating Information

Grades K-2		*Grades 3-5*		*Grades 6-8*		*Grades 9-12*	
Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information.	*MSSR*	*Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods.*	*MSSR*	*Obtaining, evaluating, and communicating information in 6–8 builds on K–5 experiences and progresses to evaluating the merit and validity of ideas and methods.*	*MSSR*	*Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs.*	*MSSR*
Read grade-appropriate texts and/or use media to obtain scientific and/or technical information to determine patterns in and/or evidence about the natural and designed world(s). [P8.1]	X	Read and comprehend grade-appropriate complex texts and/or other reliable media to summarize and obtain scientific and technical ideas and describe how they are supported by evidence. [P8.1]	X	Critically read scientific texts adapted for classroom use to determine the central ideas and/or obtain scientific and/or technical information to describe patterns in and/or evidence about the natural and designed world(s). [P8.1]	X	Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions and/or to obtain scientific and/or technical information to summarize complex evidence, concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. [P8.1]	X
Describe how specific images (e.g., a diagram showing how a machine works) support a scientific or engineering idea. [P8.2]	X	Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. [P2.2]		Develop or modify a model—based on evidence – to match what happens if a variable or component of a system is changed. [P2.2]	X	Design a test of a model to ascertain its reliability. [P2.2]	X
Obtain information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, icons), and other media that will be useful in answering a scientific question and/or supporting a scientific claim. [P8.3]	X	Combine information in written text with that contained in corresponding tables, diagrams, and/or charts to support the engagement in other scientific and/or engineering practices. [P8.3]	X	Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. [P8.3]	X	Gather, read, and evaluate scientific and/or technical information from multiple authoritative sources, assessing the evidence and usefulness of each source. [P8.3]	
Communicate information or design ideas and/or solutions with others in oral and/or written forms using models, drawings, writing, or numbers that provide detail about scientific ideas, practices, and/or design ideas. [P8.4]	X	Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. [P8.4]	X	Evaluate data, hypotheses, and/or conclusions in scientific and technical texts in light of competing information or accounts. [P8.4]	X	Evaluate the validity and reliability of and/or synthesize multiple claims, methods, and/or designs that appear in scientific and technical texts or media reports, verifying the data when possible. [P8.4]	
		Communicate scientific and/or technical information orally and/or in written formats, including various forms of media as well as tables, diagrams, and charts. [P8.5]	X	Communicate scientific and/or technical information (e.g. about a proposed object, tool, process, system) in writing and/or through oral presentations. [P8.5]	X	Communicate scientific and/or technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (i.e., orally, graphically, textually, mathematically). [P8.5]	X

GLOBE NGSS DCI Connections Overview

Elementary (K–2)	[A = Activities, P = Protocol(s), B = Book(s)]								
	Atmosphere	*Soils*	*Landcover*	*Hydrology*	*Seasons/Earth as a System*	*Earth as a System Poster*	*Climate Foundations*	*Elementary GLOBE*	*Other GLOBE Resources*
K-PS2 Matter and Stability: Forces and Interactions									
K-PS3 Energy	P							A/B	
K-LS1 From molecules to organisms: Structures and processes					P				
K-ESS2 Earth's Systems	P							B	
K-ESS3 Earth and Human Activity									
1-PS4 Waves and Their Applications in Technologies for Information Transfer									
1-LS1 From Molecules to Organisms: Structure and Processes									
1-LS3 Heredity: Inheritance and Variation of Traits									
1-ESS1 Earth's Place in the Universe									
2-PS1 Matter and Its Interactions									
2-LS2 Ecosystems: Interactions, Energy, and Dynamics								A	
2-LS4 Biological Evolution: Unity and Diversity		A		A	A/P			A/B	
2-ESS1 Earth's Place in the Universe									
2-ESS2 Earth's Systems				A					
K-2-ETS1 Engineering Design									

Kindergarten						
Physical Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	K-PS2-1	Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.	None.			
	K-PS2-2	Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.*	None.			
	K-PS3-1	Make observations to determine the effect of sunlight on Earth's surface.	All About Earth Our World on Stage	Earth as a System	Elementary GLOBE Book	Elementary GLOBE
			We're All Connected: Earth System Interactions	Earth as a System	Activity	Elementary GLOBE
			Earth System Play	Earth as a System	Activity	Elementary GLOBE
			Surface Temperature	Atmosphere	Protocol	GLOBE Teacher's Guide
	K-PS3-2	Use tools and materials to design and build a structure that will reduce the warming effect of sunlight on an area.*	None.			
Kindergarten						
Life Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	K-LS1-1	Use observations to describe patterns of what plants and animals (including humans) need to survive.	Ruby-throated Hummingbird Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide

Kindergarten						
Earth and Space Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	K-ESS2-1	Use and share observations of local weather conditions to describe patterns over time.	Discoveries at Willow Creek	Earth as a System	Elementary GLOBE Book	Elementary GLOBE
			The Mystery of the Missing Hummingbirds	Earth as a System	Elementary GLOBE Book	Elementary GLOBE
			We're All Connected: Earth System Interactions	Earth as a System	Elementary GLOBE Book	Elementary GLOBE
			Cloud Protocols	Atmosphere	Protocol	GLOBE Teacher's Guide
			Max/Min/Current Air Temperature Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
			Precipitation Protocols	Atmosphere	Protocol	GLOBE Teacher's Guide
	K-ESS2-2	Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs.	None.			
	K-ESS3-1	Use a model to represent the relationship between the needs of different plants or animals (including humans) and the places they live.	None.			
	K-ESS3-2	Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather.*	None.			
	K-ESS3-3	Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.*	None.			

1st Grade						
Physical Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	1-PS4-1	Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate.	None.			
	1-PS4-2	Make observations to construct an evidence-based account that objects can be seen only when illuminated.	None.			
	1-PS4-3	Plan and conduct an investigation to determine the effect of placing objects made with different materials in the path of a beam of light.	None.			
	1-PS4-4	Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance.*	None.			

1st Grade						
Life Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	1-LS1-1	Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs.*	None.			
	1-LS1-2	Read texts and use media to determine patterns in behavior of parents and offspring that help offspring survive.	None.			
	1-LS3-1	Make observations to construct an evidence-based account that young plants and animals are like, but not exactly like, their parents.	None.			
1st Grade						
Earth and Space Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	1-ESS1-1	Use observations of the sun, moon, and stars to describe patterns that can be predicted.	None.			
	1-ESS1-2	Make observations at different times of year to relate the amount of daylight to the time of year.	None.			

2nd Grade						
Physical Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	2-PS1-1	Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.	None.			
	2-PS1-2	Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.*	None.			
	2-PS1-3	Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object.	None.			
	2-PS1-4	Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot.	None.			

2nd Grade						
Life Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	2-LS2-1	Plan and conduct an investigation to determine if plants need sunlight and water to grow.	Earth System in a Bottle	Earth as a System	Activity	Elementary GLOBE
	2-LS2-2	Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants.*	None.			
	2-LS4-1	Make observations of plants and animals to compare the diversity of life in different habitats.	The Mystery of the Missing Hummingbirds	Earth as a System	Elementary GLOBE Book	Elementary GLOBE
			All Year Long	Earth as a System	Activity	Elementary GLOBE
			The Colors of the Seasons	Earth as a System	Activity	Elementary GLOBE
			Honing In On Hummingbirds	Earth as a System	Activity	Elementary GLOBE
			P1: Green-up Cards	Earth as a System	Activity	GLOBE Teacher's Guide
			P2: A Sneak Preview of Budburst	Earth as a System	Activity	GLOBE Teacher's Guide
			P3: A First Look at Phenology	Earth as a System	Activity	GLOBE Teacher's Guide
			P4: A Beginning Look at Photosynthesis	Earth as a System	Activity	GLOBE Teacher's Guide
			Water Wonders	Hydrology	Activity	Elementary GLOBE
			We All Need Soil!	Soil	Activity	Elementary GLOBE

2nd Grade						
Life Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	2-LS4-1	Make observations of plants and animals to compare the diversity of life in different habitats.	Ruby-throated Hummingbird Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
			Arctic Bird Migration Monitoring Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
			Budburst Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
			Green-Down Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
			Green-Up Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
			Phenological Gardens Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide

2nd Grade						
Earth and Space Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	2-ESS1-1	Make observations from media to construct an evidence-based account that Earth events can occur quickly or slowly.	None.			
	2-ESS2-1	Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.*	None.			
	2-ESS2-2	Develop a model to represent the shapes and kinds of land and bodies of water in an area.	Model a Catchment Basin	Hydrology	Activity	GLOBE Teacher's Guide
			Water Walk	Hydrology	Activity	GLOBE Teacher's Guide
			Measure Up	Hydrology	Activity	Elementary GLOBE
	2-ESS2-3	Obtain information to identify where water is found on Earth and that it can be solid or liquid.	None.			

Kindergarten - 2nd Grade						
Engineering, Technology, and Applications of Science						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	2-ETS1-1	Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.	None.			
	2-ETS1-2	Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.	None.			
	2-ETS1-3	Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.	None.			

GLOBE NGSS DCI Connections Overview

Elementary (3-5)	[A = Activities, P = Protocol(s)]								
	Atmosphere	*Soils*	*Landcover*	*Hydrology*	*Seasons/Earth as a System*	*Earth as a System Poster*	*Climate Foundations*	*Elementary GLOBE*	*Other GLOBE Resources*
3-PS2 Motion and Stability: Forces and Interactions									
3-LS1 From Molecules to Organisms: Structures and Processes									
3-LS2 Ecosystems: Interactions, Energy, and Dynamics									
3-LS3 Heredity: Inheritance and Variation of Traits									
3-LS4 Biological Evolution: Unity and Diversity			P						
3-ESS2 Earth's Systems	P				A	A		A	
3-ESS3 Earth and Human Activity									
4-PS3 Energy									
4-PS4 Waves and Their Applications in Technologies for Information Transfer									
4-LS1 From Molecules to Organisms: Structures and Processes				A	P			A	
4-ESS1 Earth's Place in the Universe									
4-ESS2 Earth's Systems			P						
4-ESS3 Earth and Human Activity									
5-PS1 Matter and Its Interactions									
5-PS2 Motion and Stability: Forces and Interactions									
5-PS3 Energy									
5-LS1 From Molecules to Organisms: Structures and Processes									
5-LS2 Ecosystems: Interactions, Energy, and Dynamics									
5-ESS1 Earth's Place in the Universe									
5-ESS2 Earth's Systems	A/P	P	P	P	A/P	A			
5-ESS3 Earth and Human Activity				A					
3-5-ETS1 Engineering Design									

3rd Grade						
Physical Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	3-PS2-1	Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.	None.			
	3-PS2-2	Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.	None.			
	3-PS2-3	Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.	None.			
	3-PS2-4	Define a simple design problem that can be solved by applying scientific ideas about magnets.*	None.			
3rd Grade						
Life Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	3-LS1-1	Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death.	None.			
	3-LS2-1	Construct an argument that some animals form groups that help members survive.	Arctic Bird Migration Monitoring Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
	3-LS3-1	Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms.	None.			

3rd Grade						
Life Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	3-LS3-2	Use evidence to support the explanation that traits can be influenced by the environment.	None.			
	3-LS4-1	Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago.	None.			
	3-LS4-2	Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing.	None.			
	3-LS4-3	Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.	None.			
	3-LS4-4	Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.*	Site Selection	Land Cover	Protocol	GLOBE Teacher's Guide
			Manual Land Cover Mapping Protocol	Land Cover	Protocol	GLOBE Teacher's Guide

3rd Grade						
Earth and Space Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	3-ESS2-1	Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.	Max/Min/Current Air Temperature Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
			Precipitation Protocols	Atmosphere	Protocol	GLOBE Teacher's Guide
			Cloud Protocols	Atmosphere	Protocol	GLOBE Teacher's Guide
			S1: What Can We Learn About Our Seasons?	Earth as a System	Activity	GLOBE Teacher's Guide
			All Year Long	Earth as a System	Activity	Elementary GLOBE
			ESS: 2 Exploring Annual Changes (2007)	Earth as a System	Activity	Earth as a System Packet (2007)
	3-ESS2-2	Obtain and combine information to describe climates in different regions of the world.	From Weather to Climate – Air Temperature Data	Climate Foundations	Activity	GLOBE Website
			What is your Climate Classification	Climate Foundations	Activity	GLOBE Website
			ESS: 2 Exploring Annual Changes (2007)	Earth as a System	Activity	Earth as a System Packet (2007)
	3-ESS3-1	Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard.*	None.			

4th Grade						
Physical Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	4-PS3-1	Use evidence to construct an explanation relating the speed of an object to the energy of that object.	None.			
	4-PS3-2	Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.	None.			
	4-PS3-3	Ask questions and predict outcomes about the changes in energy that occur when objects collide.	None.			
	4-PS3-4	Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.*	None.			
	4-PS4-1	Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.	None.			
	4-PS4-2	Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.	None.			
	4-PS4-3	Generate and compare multiple solutions that use patterns to transfer information.*	None.			

4th Grade						
Life Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	4-LS1-1	Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.	Water Wonders	Hydrology	Activity	Elementary GLOBE
	4-LS1-2	Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.	Honing In On Hummingbirds	Earth as a System	Activity	Elementary GLOBE
			Ruby-throated Hummingbird Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide

4th Grade						
Earth and Space Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	4-ESS1-1	Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.	None.			
	4-ESS2-1	Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.	None.			
	4-ESS2-2	Analyze and interpret data from maps to describe patterns of Earth's features.	None.			
	4-ESS3-1	Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.	None.			
	4-ESS3-2	Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.*	None.			

5th Grade						
Physical Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	5-PS1-1	Develop a model to describe that matter is made of particles too small to be seen.	None.			
	5-PS1-2	Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved.	None.			
	5-PS1-3	Make observations and measurements to identify materials based on their properties.	None.			
	5-PS1-4	Conduct an investigation to determine whether the mixing of two or more substances results in new substances.	None.			
	5-PS2-1	Support an argument that the gravitational force exerted by Earth on objects is directed down.	None.			
	5-PS3-1	Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.	None.			

5th Grade						
Life Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	5-LS1-1	Support an argument that plants get the materials they need for growth chiefly from air and water.	None.			
	5-LS2-1	Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.	None.			
5th Grade						
Earth and Space Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	5-ESS1-1	Support an argument that the apparent brightness of the sun and stars is due to their relative distances from Earth.	None.			
	5-ESS1-2	Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.	None.			

5th Grade						
Earth and Space Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	5-ESS2-1	Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.	GC2: Components of the earth system working together	Earth as a System	Activity	GLOBE Teacher's Guide
			ESS: 3. Explore Relationships between Types of Data (across columns) (1987)	Earth as a System	Activity	Earth as a Sysyem (1987)
			Land, Water and Air	Atmosphere	Activity	GLOBE Teacher's Guide
			LC1: Connecting the parts of the study site	Earth as a System	Activity	GLOBE Teacher's Guide
			LC2: Representing the study site in a diagram	Earth as a System	Activity	GLOBE Teacher's Guide
			LC4: Diagramming the study site for others	Earth as a System	Activity	GLOBE Teacher's Guide
			LC5: Comparing the study site to one in another region	Earth as a System	Activity	GLOBE Teacher's Guide
			Digital Multi-Day Max/Min/Current Air and Soil Temperature Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
			Automated Soil and Air Temperature Monitoring Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
			AWS WeatherBug Protocol	Atmosphere	Protocol	GLOBE Website
			Davis Weather Station Protocol	Atmosphere	Protocol	GLOBE Website

5th Grade						
Earth and Space Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	5-ESS2-1	Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.	RainWise Weather Station Protocol	Atmosphere	Protocol	GLOBE Website
			WeatherHawk Weather Station Protocol	Atmosphere	Protocol	GLOBE Website
			Cloud Protocols	Atmosphere	Protocol	GLOBE Teacher's Guide
			Digital Multi-Day Max/Min/Current Air and Soil Temperature Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
			Max/Min/Current Air Temperature Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
			Precipitation Protocols	Atmosphere	Protocol	GLOBE Teacher's Guide
			Relative Humidity Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
			Surface Temperature Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
			Green-Down Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide

5th Grade						
Earth and Space Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	5-ESS2-1	Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.	Green-Up Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
			Phenological Gardens Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
			Land Cover Sample Site Protocol	Land Cover	Protocol	GLOBE Teacher's Guide
			Manual Land Cover Mapping Protocol	Land Cover	Protocol	GLOBE Teacher's Guide
			Dissolved Oxygen Protocol	Hydrology	Protocol	GLOBE Teacher's Guide
			Water Temperature Protocol	Hydrology	Protocol	GLOBE Teacher's Guide
			Water Transparency Protocol	Hydrology	Protocol	GLOBE Teacher's Guide
			Infiltration Protocol	Soil	Protocol	GLOBE Teacher's Guide
			Soil Temperature	Soil	Protocol	GLOBE Teacher's Guide
			Soil Characterization	Soil	Protocol	GLOBE Teacher's Guide

5th Grade						
Earth and Space Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	5-ESS2-2	Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.	None.			
	5-ESS3-1	Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.	Model a Catchment Basin	Hydrology	Activity	GLOBE Teacher's Guide
3rd - 5th Grade						
Engineering, Technology, and Applications of Science						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	5-ETS1-1	Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.	None.			
	5-ETS1-2	Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.	None.			
	5-ETS1-3	Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.	None.			

GLOBE NGSS DCI Connections Overview

Middle School (6–8)	[A = Activities, P = Protocol(s)]								
	Atmosphere	*Soils*	*Landcover*	*Hydrology*	*Phenology/Earth as a System*	*Earth as a System Poster*	*Climate Foundations*	*Elementary GLOBE*	*Other GLOBE Resources*
MS-PS1 Matter and Its Interactions	P	P							
MS-PS2 Motion and Stability: Forces and Interactions									
MS-PS3 Energy									
MS-PS4 Waves and Their Applications in Technologies for Information Transfer	P								
MS-LS1 From Molecules to Organisms: Structure and Processes				P	A/P	A			
MS-LS2 Ecosystems: Interactions, Energy, and Dynamics			P	A/P	A/P	A			A
MS-LS3 Heredity: Inheritance and Variation of Traits									
MS-LS4 Biological Evolution: Unity and Diversity									
MS-ESS1 Earth's Place in the Universe					A				
MS-ESS2 Earth's Systems	A/P	A		A	A		A		A
MS-ESS3 Earth and Human Activity			P	A		A	A		A
MS-ETS1 Engineering Design	A			A					

Middle School (Grades 6-8)						
Physical Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	MS-PS1-1	Develop models to describe the atomic composition of simple molecules and extended structures.	Cloud Protocols	Atmosphere	Protocol	GLOBE Teacher's Guide
	MS-PS1-2	Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.	Soil Characterization	Soil	Protocol	GLOBE Teacher's Guide
	MS-PS1-3	Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.	Soil Characterization	Soil	Protocol	GLOBE Teacher's Guide
			Bulk Density	Soil	Protocol	GLOBE Teacher's Guide
			Soil Site Selection and Exposure	Soil	Protocol	GLOBE Teacher's Guide
			Soil Particle Density	Soil	Protocol	GLOBE Teacher's Guide
			Soil Particle Size Distribution	Soil	Protocol	GLOBE Teacher's Guide
			Soil pH	Soil	Protocol	GLOBE Teacher's Guide
			Soil Fertility	Soil	Protocol	GLOBE Teacher's Guide

Middle School (Grades 6-8)						
Physical Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	MS-PS1-4	Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.	Cloud Protocols	Atmosphere	Protocol	GLOBE Teacher's Guide
	MS-PS1-5	Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.	Soil Characterization	Soil	Protocol	GLOBE Teacher's Guide
	MS-PS1-6	Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.*	None.			
	MS-PS2-1	Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.*	None.			
	MS-PS2-2	Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.	None.			
	MS-PS2-3	Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.	None.			
	MS-PS2-4	Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.	None.			

Middle School (Grades 6-8)						
Physical Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	MS-PS2-5	Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.	None.			
	MS-PS3-1	Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.	None.			
	MS-PS3-2	Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.	None.			
	MS-PS3-3	Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.*	None.			
	MS-PS3-4	Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.	None.			
	MS-PS3-5	Construct, use, and present arguments to support the claim that when the motion energy of an object changes, energy is transferred to or from the object.	None.			

Middle School (Grades 6-8)						
Physical Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	MS-PS4-1	Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.	None.			
	MS-PS4-2	Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.	Aerosols Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
			Water Vapor Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
	MS-PS4-3	Integrate qualitative scientific and technical information to support the claim that digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information.	None.			

Middle School (Grades 6-8)						
Life Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	MS-LS1-1	Conduct an investigation to provide evidence that living things are made of cells, either one cell or many different numbers and types of cells.	P4: A Beginning Look at Photosynthesis	Earth as a System	Activity	GLOBE Teacher's Guide
	MS-LS1-2	Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function.	None.			
	MS-LS1-3	Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.	None.			
	MS-LS1-4	Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.	P2: A Sneak Preview of Budburst	Earth as a System	Activity	GLOBE Teacher's Guide
			Budburst Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
			Green-Up Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
			Lilac Phenology Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
			Ruby-throated Hummingbird Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide

Middle School (Grades 6-8)						
Life Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	MS-LS1-5	Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.	P2: A Sneak Preview of Budburst	Earth as a System	Activity	GLOBE Teacher's Guide
			P3: A First Look at Phenology	Earth as a System	Activity	GLOBE Teacher's Guide
			ESS: 3. Explore Relationships between Types of Data (across columns) (1987)	Earth as a System	Activity	Earth as a Sysyem (1987)
			ESS: 4. Global Patterns (1987)	Earth as a System	Activity	Earth as a Sysyem (1987)
			Green-Down Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
			Green-Up Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
			Budburst Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
			Ruby-throated Hummingbird Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide

Middle School (Grades 6-8)						
Life Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	MS-LS1-5	Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.	Arctic Bird Migration Monitoring Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
			Seaweed Reproductive Phenology Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
			Phenological Gardens Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
			Freshwater Macroinvertebrates	Hydrology	Protocol	GLOBE Teacher's Guide
			Alkalinity Protocol	Hydrology	Protocol	GLOBE Teacher's Guide
			Dissolved Oxygen Protocol	Hydrology	Protocol	GLOBE Teacher's Guide
			Electrical Conductivity Protocol	Hydrology	Protocol	GLOBE Teacher's Guide
			Instrument Construction, Site Selection, Documenting Your Hydrology Site, Sampling Procedures	Hydrology	Protocol	GLOBE Teacher's Guide

Middle School (Grades 6-8)						
Life Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	MS-LS1-5	Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.	Nitrate Protocol	Hydrology	Protocol	GLOBE Teacher's Guide
			Optional Salinity Titration	Hydrology	Protocol	GLOBE Teacher's Guide
			pH Protocol	Hydrology	Protocol	GLOBE Teacher's Guide
			Salinity Protocol	Hydrology	Protocol	GLOBE Teacher's Guide
			Water Temperature Protocol	Hydrology	Protocol	GLOBE Teacher's Guide
			Water Transparency Protocol	Hydrology	Protocol	GLOBE Teacher's Guide

Middle School (Grades 6-8)						
Life Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	MS-LS1-6	Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.	P2: A Sneak Preview of Budburst	Earth as a System	Activity	GLOBE Teacher's Guide
			P4: A Beginning Look at Photosynthesis	Earth as a System	Activity	GLOBE Teacher's Guide
			P5: Investigating Leaf Pigments	Earth as a System	Activity	GLOBE Teacher's Guide
			P6: Global Patterns in Green-up and Green-down	Earth as a System	Activity	GLOBE Teacher's Guide
			Green-Up Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
			Green-Down Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
			Budburst Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
			P1: Green-up Cards	Earth as a System	Activity	GLOBE Teacher's Guide

Middle School (Grades 6-8)						
Life Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	MS-LS1-7	Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.	None.			
	MS-LS1-8	Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.	None.			
	MS-LS2-1	Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.	GC2: Components of the earth system working together	Earth as a System	Activity	GLOBE Teacher's Guide
			P2: A Sneak Preview of Budburst	Earth as a System	Activity	GLOBE Teacher's Guide
			RC2: Effects of inputs and outputs on a region	Earth as a System	Activity	GLOBE Teacher's Guide
			ESS: 3. Explore Relationships between Types of Data (across columns) (1987)	Earth as a System	Activity	Earth as a Sysyem (1987)
			ESS: 4. Global Patterns (1987)	Earth as a System	Activity	Earth as a Sysyem (1987)

Middle School (Grades 6-8)						
Life Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	MS-LS2-1	Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.	Arctic Bird Migration Monitoring Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
			Budburst Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
			Green-Down Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
			Green-Up Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
			Ruby-throated Hummingbird Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
			Freshwater Macroinvertebrates	Hydrology	Protocol	GLOBE Teacher's Guide
	MS-LS2-2	Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.	None.			

Middle School (Grades 6-8)						
Life Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	MS-LS2-3	Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.	Carbon Cycle Adventure Story	Carbon	Activity	Other
			Carbon Travels Game	Carbon	Activity	Other
			Turnover Rate & Residence Time	Carbon	Activity	Other
	MS-LS2-4	Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.	P3: A First Look at Phenology	Earth as a System	Activity	GLOBE Teacher's Guide
			P2: A Sneak Preview of Budburst	Earth as a System	Activity	GLOBE Teacher's Guide
			P7: Temperature and Precipitation as Limiting Factors in Ecosystems	Earth as a System	Activity	GLOBE Teacher's Guide
			Green-Down Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
			Green-Up Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
			Budburst Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide

Middle School (Grades 6-8)						
Life Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	MS-LS2-4	Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.	Ruby-throated Hummingbird Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
			Arctic Bird Migration Monitoring Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
			Phenological Gardens Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
			Freshwater Macroinvertebrates	Hydrology	Protocol	GLOBE Teacher's Guide
			Land Cover Change Detection Protocol	Land Cover	Protocol	GLOBE Teacher's Guide
	MS-LS2-5	Evaluate competing design solutions for maintaining biodiversity and ecosystem services.*	Model a Catchment Basin	Hydrology	Activity	GLOBE Teacher's Guide

Middle School (Grades 6-8)						
Life Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	MS-LS3-1	Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism.	None.			
	MS-LS3-2	Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.	None.			
	MS-LS4-1	Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past.	None.			
	MS-LS4-2	Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships.	None.			
	MS-LS4-3	Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy.	None.			

Middle School (Grades 6-8)						
Life Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	MS-LS4-4	Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment.	None.			
	MS-LS4-5	Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms.	None.			
	MS-LS4-6	Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.	None.			

Middle School (Grades 6-8)						
Earth and Space Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	MS-ESS1-1	Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.	S4: Modeling the Reasons for Seasonal Change	Earth as a System	Activity	GLOBE Teacher's Guide
			S5: Seasonal Change on Land and Water	Earth as a System	Activity	GLOBE Teacher's Guide
	MS-ESS1-2	Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.	None.			
	MS-ESS1-3	Analyze and interpret data to determine scale properties of objects in the solar system.	None.			
	MS-ESS1-4	Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history.	None.			

Middle School (Grades 6-8)						
Earth and Space Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	MS-ESS2-1	Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.	GC2: Components of the earth system working together	Earth as a System	Activity	GLOBE Teacher's Guide
			LC1: Connecting the parts of the study site	Earth as a System	Activity	GLOBE Teacher's Guide
			Model Your Water Balance	Hydrology	Activity	GLOBE Teacher's Guide
			Soil: The Great Decomposer	Soil	Activity	GLOBE Teacher's Guide
	MS-ESS2-2	Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.	Model a Catchment Basin	Hydrology	Activity	GLOBE Teacher's Guide
			Why Do We Study Soil?	Soil	Activity	GLOBE Teacher's Guide
			Just Passing Through: Beginning Level	Soil	Activity	GLOBE Teacher's Guide
			Just Passing Through	Soil	Activity	GLOBE Teacher's Guide

Middle School (Grades 6-8)						
Earth and Space Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	MS-ESS2-3	Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions.	FLEXE - Ecology Unit Activity 2	FLEXE	Activity	Other
	MS-ESS2-4	Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.	Land, Water and Air	Atmosphere	Activity	GLOBE Teacher's Guide
			Precipitation Protocols	Atmosphere	Protocol	GLOBE Teacher's Guide
			Relative Humidity Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
			Watershed Dynamics Module I #1 Natural Water Availability	Watershed Dynamics	Other	GLOBE Website
	MS-ESS2-5	Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.	Observing, Describing, and Identifying Clouds	Atmosphere	Activity	GLOBE Teacher's Guide
			Aerosols Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
			Automated Soil and Air Temperature Monitoring Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
			AWS WeatherBug Protocol	Atmosphere	Protocol	GLOBE Website
			Barometric Pressure Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
			Davis Weather Station Protocol	Atmosphere	Protocol	GLOBE Website

Middle School (Grades 6-8)						
Earth and Space Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	MS-ESS2-5	Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.	Cloud Protocols	Atmosphere	Protocol	GLOBE Teacher's Guide
			Digital Multi-Day Max/Min/Current Air and Soil Temperature Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
			Instrument Construction, Site Selection and Set-Up	Atmosphere	Protocol	GLOBE Teacher's Guide
			Max/Min/Current Air Temperature Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
			Precipitation Protocols	Atmosphere	Protocol	GLOBE Teacher's Guide
			RainWise Weather Station Protocol	Atmosphere	Protocol	GLOBE Website
			Relative Humidity Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
			Surface Ozone Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
			Surface Temperature Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
			Water Vapor Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
			WeatherHawk Weather Station Protocol	Atmosphere	Protocol	GLOBE Website

Middle School (Grades 6-8)						
Earth and Space Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	MS-ESS2-6	Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.	GC1: Your regional and global connection	Earth as a System	Activity	GLOBE Teacher's Guide
			S4: Modeling the Reasons for Seasonal Change	Earth as a System	Activity	GLOBE Teacher's Guide
			GC2: Components of the earth system working together	Earth as a System	Activity	GLOBE Teacher's Guide
			From Weather to Climate – Air Temperature Data	Climate Foundations	Activity	GLOBE Website
	MS-ESS3-1	Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.	Model Your Water Balance	Hydrology	Activity	GLOBE Teacher's Guide
	MS-ESS3-2	Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.	None.			
	MS-ESS3-3	Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.*	RC2: Effects of inputs and outputs on a region	Earth as a System	Activity	GLOBE Teacher's Guide
			Land Cover Sample Site Protocol	Land Cover	Protocol	GLOBE Teacher's Guide

Middle School (Grades 6-8)						
Earth and Space Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	MS-ESS3-3	Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.*	Watershed Dynamics Module II #1 Rainwater Runoff Podcast	Watershed Dynamics	Other	GLOBE Website
			Watershed Dynamics Module II #2 Building a Watershed Model	Watershed Dynamics	Other	GLOBE Website
			Watershed Dynamics Module II #3 Measuring Streamflow Lab/Virtual River	Watershed Dynamics	Other	GLOBE Website
			Watershed Dynamics Module II #4 Just Passing Through/Infiltration Protocol**	Watershed Dynamics	Other	GLOBE Website
			Watershed Dynamics Module II #5 Netlogo Runoff Model	Watershed Dynamics	Other	GLOBE Website
			Watershed Dynamics Module II #6 Analyzing Hydrographs	Watershed Dynamics	Other	GLOBE Website
			Watershed Dynamics Module II #7 FieldScope/Urban Sprawl	Watershed Dynamics	Other	GLOBE Website
			Watershed Dynamics Module II #8 Extentions	Watershed Dynamics	Other	GLOBE Website
	MS-ESS3-4	Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.	None.			
	MS-ESS3-5	Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.	None.			

Middle School (Grades 6-8)						
Engineering, Technology, and Applications of Science						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	MS-ETS1-1	Define the criteria & constraints of a design problem w/ sufficient precision to ensure a successful solution, taking into account relevant scientific principles & potential impacts on people & the natural environment that may limit possible solutions.	Building a Thermometer	Atmosphere	Activity	GLOBE Teacher's Guide
			Making a Sundial	Atmosphere	Activity	GLOBE Teacher's Guide
			Instrument Construction, Site Selection and Set-Up	Atmosphere	Protocol	GLOBE Teacher's Guide
			Model a Catchment Basin	Hydrology	Activity	GLOBE Teacher's Guide
	MS-ETS1-2	Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.	Building a Thermometer	Atmosphere	Activity	GLOBE Teacher's Guide
			Making a Sundial	Atmosphere	Activity	GLOBE Teacher's Guide
			Instrument Construction, Site Selection and Set-Up	Atmosphere	Protocol	GLOBE Teacher's Guide
			Model a Catchment Basin	Hydrology	Activity	GLOBE Teacher's Guide

Middle School (Grades 6-8)						
Engineering, Technology, and Applications of Science						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	MS-ETS1-3	Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.	Building a Thermometer	Atmosphere	Activity	GLOBE Teacher's Guide
			Making a Sundial	Atmosphere	Activity	GLOBE Teacher's Guide
			Instrument Construction, Site Selection and Set-Up	Atmosphere	Protocol	GLOBE Teacher's Guide
			Model a Catchment Basin	Hydrology	Activity	GLOBE Teacher's Guide
	MS-ETS1-4	Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.	Building a Thermometer	Atmosphere	Activity	GLOBE Teacher's Guide
			Making a Sundial	Atmosphere	Activity	GLOBE Teacher's Guide
			Instrument Construction, Site Selection and Set-Up	Atmosphere	Protocol	GLOBE Teacher's Guide
			Model a Catchment Basin	Hydrology	Activity	GLOBE Teacher's Guide

GLOBE NGSS DCI Connections Overview

High School (9–12)	Atmosphere	Soils	Landcover	Hydrology	Phenology/Earth as a System	Earth as a System Poster	Climate Foundations	Elementary GLOBE	Other GLOBE Resources
	[A = Activities, P = Protocol(s)]								
HS-PS1 Matter and Its Interactions									
HS-PS2 Motion and Stability: Forces and Interactions									
HS-PS3 Energy	A								
HS-PS4 Waves and Their Applications in Technologies for Information Transfer	P			P					
HS-LS1 From Molecules to Organisms: Structures and Processes		A	P		A/P	A			A/P
HS-LS2 Ecosystems: Interactions, Energy, and Dynamics	A		P	P	A/P				A/P
HS-LS3 Heredity: Inheritance and Variation of Traits									
HS-LS4 Biological Evolution: Unity and Diversity			A/P			A	A		A
HS-ESS1 Earth's Place in the Universe	P	P							A
HS-ESS2 Earth's Systems	A/P	P	A/P	P	A	A			A/P
HS-ESS3 Earth and Human Activity	P		P		A	A	A/P		A
HS-ETS1 Engineering Design			A						A

High School (Grades 9-12)						
Physical Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	HS-PS1-1	Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.	None.			
	HS-PS1-2	Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.	None.			
	HS-PS1-3	Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.	None.			
	HS-PS1-4	Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.	None.			
	HS-PS1-5	Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.	None.			
	HS-PS1-6	Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.*	None.			
	HS-PS1-7	Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.	None.			
	HS-PS1-8	Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.	None.			

High School (Grades 9-12)						
Physical Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	HS-PS2-1	Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.	None.			
	HS-PS2-2	Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.	None.			
	HS-PS2-3	Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.*	None.			
	HS-PS2-4	Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.	None.			
	HS-PS2-5	Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.	None.			

High School (Grades 9-12)						
Physical Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	HS-PS3-1	Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.	None.			
	HS-PS3-2	Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as either motions of particles or energy stored in fields.	None.			
	HS-PS3-3	Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.*	Building a GLOBE Sun Photometer (pc board V3.0)	Atmosphere	Activity	Other
	HS-PS3-4	Plan & conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temp are combined within a closed system results in a more uniform energy distribution among the components in the system.	None.			
	HS-PS3-5	Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.	None.			

High School (Grades 9-12)						
Physical Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	HS-PS4-1	Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.	Water Vapor Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
			Aerosols Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
	HS-PS4-2	Evaluate questions about the advantages of using a digital transmission and storage of information.	None.			
	HS-PS4-3	Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.	None.			
	HS-PS4-4	Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.	None.			

High School (Grades 9-12)						
Physical Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	HS-PS4-5	Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.*	Aerosols Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
			Max/Min/Current Air Temperature Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
			AWS WeatherBug Protocol	Atmosphere	Protocol	GLOBE Website
			Davis Weather Station Protocol	Atmosphere	Protocol	GLOBE Website
			RainWise Weather Station Protocol	Atmosphere	Protocol	GLOBE Website
			WeatherHawk Weather Station Protocol	Atmosphere	Protocol	GLOBE Website
			Water Temperature Protocol	Hydrology	Protocol	GLOBE Teacher's Guide
			Soil Temperature	Soil	Protocol	GLOBE Teacher's Guide

High School (Grades 9-12)						
Life Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	HS-LS1-1	Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.	None.			
	HS-LS1-2	Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.	Paper Clip Simulation & Model	Carbon	Activity	Other
			Plant a Plant Experiments	Carbon	Activity	Other
			P4: A Beginning Look at Photosynthesis	Earth as a System	Activity	GLOBE Teacher's Guide
			P5: Investigating Leaf Pigments	Earth as a System	Activity	GLOBE Teacher's Guide
			P6: Global Patterns in Green-up and Green-down	Earth as a System	Activity	GLOBE Teacher's Guide
	HS-LS1-3	Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.	Plant a Plant Experiments	Carbon	Activity	Other
			Paper Clip Simulation & Model	Carbon	Activity	Other
			Global Carbon Cycle Model with Feedbacks	Carbon	Activity	Other
			Biomass Accumulation Model	Carbon	Activity	Other
			P4: A Beginning Look at Photosynthesis	Earth as a System	Activity	GLOBE Teacher's Guide
	HS-LS1-4	Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.	None.			

High School (Grades 9-12)						
Life Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	HS-LS1-5	Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.	Plant a Plant Experiments	Carbon	Activity	Other
			Allometry Not A Llama Tree	Carbon	Activity	Other
			Tree Circumference	Carbon	Protocol	Other
			S5: Seasonal Change on Land and Water	Earth as a System	Activity	GLOBE Teacher's Guide
			P4: A Beginning Look at Photosynthesis	Earth as a System	Activity	GLOBE Teacher's Guide
			P5: Investigating Leaf Pigments	Earth as a System	Activity	GLOBE Teacher's Guide
			P6: Global Patterns in Green-up and Green-down	Earth as a System	Activity	GLOBE Teacher's Guide
			P7: Temperature and Precipitation as Limiting Factors in Ecosystems	Earth as a System	Activity	GLOBE Teacher's Guide
			Budburst Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
			Green-Up Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
			Green-Down Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
			Lilac Phenology Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide

High School (Grades 9-12)						
Life Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	HS-LS1-5	Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.	Phenological Gardens Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
			Seaweed Reproductive Phenology Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
			Earth as a System Poster (1987)	Earth as a System	Other	Other
			Earth as a System Poster (2007)	Earth as a System	Other	Other
			Biometry Protocol	Land Cover	Protocol	GLOBE Teacher's Guide
	HS-LS1-6	Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.	P4: A Beginning Look at Photosynthesis	Earth as a System	Activity	GLOBE Teacher's Guide
			Plant a Plant Experiments	Carbon	Activity	Other
			Biomass Accumulation Model	Carbon	Activity	Other
			Carbon Cycle Adventure Story	Carbon	Activity	Other
			Carbon Travels Game	Carbon	Activity	Other
			Carbon Cycle Standard Sample Site	Carbon	Protocol	Other
			Carbon Cycle Non-standard Sample	Carbon	Protocol	Other
			Biomass Units	Carbon	Activity	Other
			Tree Biomass Analysis	Carbon	Protocol	Other
			Shrubs	Carbon	Protocol	Other
			Heraceous	Carbon	Protocol	Other
			FLEXE - Ecology Unit Activity 3	FLEXE	Activity	Other
			FLEXE - Ecology Unit Activity 6	FLEXE	Activity	Other

High School (Grades 9-12)						
Life Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	HS-LS1-7	Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.	Carbon Cycle Adventure Story	Carbon	Activity	Other
			Carbon Travels Game	Carbon	Activity	Other
			Soil: The Great Decomposer	Soil	Activity	GLOBE Teacher's Guide
	HS-LS2-1	Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.	Making a Contour Map	Atmosphere	Activity	GLOBE Teacher's Guide
			GC2: Components of the earth system working together	Earth as a System	Activity	GLOBE Teacher's Guide
			P7: Temperature and Precipitation as Limiting Factors in Ecosystems	Earth as a System	Activity	GLOBE Teacher's Guide
			RC1: Defining regional boundaries	Earth as a System	Activity	GLOBE Teacher's Guide
			RC2: Effects of inputs and outputs on a region	Earth as a System	Activity	GLOBE Teacher's Guide
			LC1: Connecting the parts of the study site	Earth as a System	Activity	GLOBE Teacher's Guide
			LC3: Using graphs to show connections	Earth as a System	Activity	GLOBE Teacher's Guide
			LC5: Comparing the study site to one in another region	Earth as a System	Activity	GLOBE Teacher's Guide

High School (Grades 9-12)						
Life Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	HS-LS2-1	Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.	Ruby-throated Hummingbird Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
			Seaweed Reproductive Phenology Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
			Earth as a System Poster (1987)	Earth as a	Other	Other
			Earth as a System Poster (2007)	Earth as a	Other	Other
			Freshwater Macroinvertebrates	Hydrology	Protocol	GLOBE Teacher's Guide
			pH Protocol	Hydrology	Protocol	GLOBE Teacher's Guide
			Biometry Protocol	Land Cover	Protocol	GLOBE Teacher's Guide
	HS-LS2-2	Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.	Making a Contour Map	Atmosphere	Activity	GLOBE Teacher's Guide

High School (Grades 9-12)						
Life Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	HS-LS2-2	Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.	GC2: Components of the earth system working together	Earth as a System	Activity	GLOBE Teacher's Guide
			P7: Temperature and Precipitation as Limiting Factors in Ecosystems	Earth as a System	Activity	GLOBE Teacher's Guide
			RC1: Defining regional boundaries	Earth as a System	Activity	GLOBE Teacher's Guide
			RC2: Effects of inputs and outputs on a region	Earth as a System	Activity	GLOBE Teacher's Guide
			LC1: Connecting the parts of the study site	Earth as a System	Activity	GLOBE Teacher's Guide
			LC3: Using graphs to show connections	Earth as a System	Activity	GLOBE Teacher's Guide
			LC5: Comparing the study site to one in another region	Earth as a System	Activity	GLOBE Teacher's Guide
			Ruby-throated Hummingbird Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
			Seaweed Reproductive Phenology Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide

High School (Grades 9-12)						
Life Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	HS-LS2-2	Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.	Earth as a System Poster (1987)	Earth as a	Other	Other
			Earth as a System Poster (2007)	Earth as a	Other	Other
			Freshwater Macroinvertebrates	Hydrology	Protocol	GLOBE Teacher's Guide
			pH Protocol	Hydrology	Protocol	GLOBE Teacher's Guide
			Biometry Protocol	Land Cover	Protocol	GLOBE Teacher's Guide
	HS-LS2-3	Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.	Carbon Cycle Adventure Story	Carbon	Activity	Other
			Carbon Travels Game	Carbon	Activity	Other
			FLEXE - Ecology Unit Activity 6	FLEXE	Activity	Other
			P4: A Beginning Look at Photosynthesis	Earth as a System	Activity	GLOBE Teacher's Guide
			FLEXE - Ecology Unit Activity 7	FLEXE	Activity	Other

High School (Grades 9-12)						
Life Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	HS-LS2-4	Use a mathematical representation to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.	Biomass Accumulation Model	Carbon	Activity	Other
			FLEXE - Ecology Unit Activity 6	FLEXE	Activity	Other
			Carbon Travels Game	Carbon	Activity	Other
			Allometry Not A Llama Tree	Carbon	Activity	Other
			Tree Biomass Analysis	Carbon	Protocol	Other
			Carbon Cycle Adventure Story	Carbon	Activity	Other
			Human Carbon Pool	Carbon	Activity	Other
	HS-LS2-5	Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.	Global Carbon Cycle Model with Feedbacks	Carbon	Activity	Other
			Carbon Cycle Adventure Story	Carbon	Activity	Other
			Carbon Travels Game	Carbon	Activity	Other
			Biomass Accumulation Model	Carbon	Activity	Other
			Carbon Travels Game	Carbon	Activity	Other
			P4: A Beginning Look at Photosynthesis	Earth as a System	Activity	GLOBE Teacher's Guide
			FLEXE - Ecology Unit Activity 6	FLEXE	Activity	Other
			FLEXE - Ecology Unit Activity 7	FLEXE	Activity	Other
			FLEXE - Ecology Unit Activity 6	FLEXE	Activity	Other
	HS-LS2-6	Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.	RC2: Effects of inputs and outputs on a region	Earth as a System	Activity	GLOBE Teacher's Guide
			FLEXE - Ecology Unit Activity 6	FLEXE	Activity	Other
			FLEXE - Ecology Unit Activity 7	FLEXE	Activity	Other

High School (Grades 9-12)						
Life Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	HS-LS2-7	Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.	Allometry Not A Llama Tree	Carbon	Activity	Other
			Tree Biomass Analysis	Carbon	Protocol	Other
			Carbon Cycle Adventure Story	Carbon	Activity	Other
			Human Carbon Pool	Carbon	Activity	Other
			Discovery Area	Land Cover	Activity	GLOBE Teacher's Guide
	HS-LS2-8	Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.	Ruby-throated Hummingbird Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
			Arctic Bird Migration Monitoring Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
	HS-LS3-1	Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.	None.			
	HS-LS3-2	Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.	None.			
	HS-LS3-3	Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.	None.			

High School (Grades 9-12)						
Life Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	HS-LS4-1	Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.	None.			
	HS-LS4-2	Construct an explanation based on evidence that the process of evolution primarily results from four factors (see notes for full text of factors).	FLEXE - Ecology Unit Activity 6	FLEXE	Activity	Other
	HS-LS4-3	Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.	Land Cover Sample Site Protocol	Land Cover	Protocol	GLOBE Teacher's Guide
			Land Cover Change Detection Protocol	Land Cover	Protocol	GLOBE Teacher's Guide
	HS-LS4-4	Construct an explanation based on evidence for how natural selection leads to adaptation of populations.	What is your Climate Classification	Climate Foundations	Activity	GLOBE Website
			ESS: 1 Exploring Single Images (2007)	Earth as a System	Activity	Earth as a System Packet (2007)
			ESS: 1. Explore a Single Map (1987)	Earth as a System	Activity	Earth as a Sysyem (1987)
			ESS: 2 Exploring Annual Changes (2007)	Earth as a System	Activity	Earth as a System Packet (2007)
			ESS: 2. Explore Annual Changes (within a column) (1987)	Earth as a System	Activity	Earth as a Sysyem (1987)
			ESS: 3 Exploring Relationships Between Two Variables (2007)	Earth as a System	Activity	Earth as a System Packet (2007)

High School (Grades 9-12)						
Life Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	HS-LS4-4	Construct an explanation based on evidence for how natural selection leads to adaptation of populations.	ESS: 3. Explore Relationships between Types of Data (across columns) (1987)	Earth as a System	Activity	Earth as a Sysyem (1987)
			ESS: 4 Exploring Relationships Among Variables for a Particular Month (2007)	Earth as a System	Activity	Earth as a System Packet (2007)
			ESS: 4. Global Patterns (1987)	Earth as a System	Activity	Earth as a Sysyem (1987)
			ESS: 5 Exploring Relationships Among Variables Six Months Apart (2007)	Earth as a System	Activity	Earth as a System Packet (2007)
			ESS: 5. Link with GLOBE Data (1987)	Earth as a System	Activity	Earth as a Sysyem (1987)
			Earth as a System Poster (1987)	Earth as a	Other	Other
			Earth as a System Poster (2007)	Earth as a	Other	Other
			FLEXE - Ecology Unit Activity 4	FLEXE	Activity	Other
			FLEXE - Ecology Unit Activity 5	FLEXE	Activity	Other
	HS-LS4-5	Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.	FLEXE - Ecology Unit Activity 6	FLEXE	Activity	Other
			FLEXE - Ecology Unit Activity 7	FLEXE	Activity	Other
			Land Cover Sample Site Protocol	Land Cover	Protocol	GLOBE Teacher's Guide
			Land Cover Change Detection Protocol	Land Cover	Protocol	GLOBE Teacher's Guide
	HS-LS4-6	Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.*	Discovery Area	Land Cover	Activity	GLOBE Teacher's Guide

High School (Grades 9-12)						
Earth and Space Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	HS-ESS1-1	Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy that eventually reaches Earth in the form of radiation.	None.			
	HS-ESS1-2	Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe.	Soil Characterization	Soil	Protocol	GLOBE Teacher's Guide
			Dissolved Oxygen Protocol	Hydrology	Protocol	GLOBE Teacher's Guide
			Biomass Accumulation Model	Carbon	Activity	Other
	HS-ESS1-3	Communicate scientific ideas about the way stars, over their life cycle, produce elements.	None.			
	HS-ESS1-4	Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.	None.			
	HS-ESS1-5	Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.	None.			
	HS-ESS1-6	Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.	None.			

High School (Grades 9-12)						
Earth and Space Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	HS-ESS2-1	Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.	None.			
	HS-ESS2-2	Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.	Aerosols Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
			Water Vapor Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
			Barometric Pressure Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
			Relative Humidity Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
			Precipitation Protocols	Atmosphere	Protocol	GLOBE Teacher's Guide
			Max/Min/Current Air Temperature Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
			Digital Multi-Day Max/Min/Current Air and Soil Temperature Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
			Automated Soil and Air Temperature Monitoring Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
			Surface Ozone Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide

High School (Grades 9-12)						
Earth and Space Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	HS-ESS2-2	Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.	AWS WeatherBug Protocol	Atmosphere	Protocol	GLOBE Website
			Davis Weather Station Protocol	Atmosphere	Protocol	GLOBE Website
			RainWise Weather Station Protocol	Atmosphere	Protocol	GLOBE Website
			WeatherHawk Weather Station Protocol	Atmosphere	Protocol	GLOBE Website
			Surface Temperature Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
			Global Carbon Cycle Model with	Carbon	Activity	Other
			Simple C Cycle Model	Carbon	Activity	Other
			Paper Clip Simulation & Model	Carbon	Activity	Other
			Land Cover Change Detection Protocol	Land Cover	Protocol	GLOBE Teacher's Guide
			GLOBE Landsat Satillite Images	Land Cover	Other	Other
			GLOBE Visualization Tool	Multiple Areas	Web Feature	GLOBE Website

High School (Grades 9-12)						
Earth and Space Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	HS-ESS2-2	Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.	Soil Characterization	Soil	Protocol	GLOBE Teacher's Guide
			Soil Temperature	Soil	Protocol	GLOBE Teacher's Guide
			Gravimetric Soil Moisture	Soil	Protocol	GLOBE Teacher's Guide
			Bulk Density	Soil	Protocol	GLOBE Teacher's Guide
			Soil Particle Density	Soil	Protocol	GLOBE Teacher's Guide
			Soil Particle Size Distribution	Soil	Protocol	GLOBE Teacher's Guide
			Soil pH	Soil	Protocol	GLOBE Teacher's Guide
			Soil Fertility	Soil	Protocol	GLOBE Teacher's Guide
			Digital Multi-Day Max/Min/Current Air and Soil Temperature Protocol	Soil	Protocol	GLOBE Teacher's Guide

High School (Grades 9-12)						
Earth and Space Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	HS-ESS2-2	Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.	Digital Multi-Day Soil Temperatures Protocol	Soil	Protocol	GLOBE Teacher's Guide
			Automated Soil and Air Temperature Monitoring Protocol	Soil	Protocol	GLOBE Teacher's Guide
			Soil Moisture Sensor Protocol	Soil	Protocol	GLOBE Teacher's Guide
			Infiltration Protocol	Soil	Protocol	GLOBE Teacher's Guide
			Davis Soil Moisture and Temperature Station Protocol	Soil	Protocol	GLOBE Teacher's Guide
	HS-ESS2-3	Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.	Learning to Use Visualizations	Atmosphere	Activity	GLOBE Teacher's Guide
			Cloud Protocols	Atmosphere	Protocol	GLOBE Teacher's Guide
			Cloud Chart	Atmosphere	Other	GLOBE Website
			GLOBE Visualization Tool	Multiple Areas	Web Feature	GLOBE Website

High School (Grades 9-12)						
Earth and Space Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	HS-ESS2-4	Use a model to describe how variations in the flow of energy into and out of Earth systems result in changes in climate.	Surface Temperature Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
			Cloud Chart	Atmosphere	Other	GLOBE Website
			Global Carbon Cycle Model with Feedbacks	Carbon	Activity	Other
			ESS: 3 Exploring Relationships Between Two Variables (2007)	Earth as a System	Activity	Earth as a System Packet (2007)
			ESS: 3. Explore Relationships between Types of Data (across columns) (1987)	Earth as a System	Activity	Earth as a Sysyem (1987)
			ESS: 4 Exploring Relationships Among Variables for a Particular Month (2007)	Earth as a System	Activity	Earth as a System Packet (2007)
			ESS: 4. Global Patterns (1987)	Earth as a System	Activity	Earth as a Sysyem (1987)
			P6: Global Patterns in Green-up and Green-down	Earth as a System	Activity	GLOBE Teacher's Guide
			GLOBE Visualization Tool	Multiple Areas	Web Feature	GLOBE Website

High School (Grades 9-12)						
Earth and Space Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	HS-ESS2-5	Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.	Alkalinity Protocol	Hydrology	Protocol	GLOBE Teacher's Guide
			Dissolved Oxygen Protocol	Hydrology	Protocol	GLOBE Teacher's Guide
			Freshwater Macroinvertebrates	Hydrology	Protocol	GLOBE Teacher's Guide
			Instrument Construction, Site Selection, Documenting Your Hydrology Site, Sampling Procedures	Hydrology	Protocol	GLOBE Teacher's Guide
			Nitrate Protocol	Hydrology	Protocol	GLOBE Teacher's Guide
			Optional Salinity Titration	Hydrology	Protocol	GLOBE Teacher's Guide
			pH Protocol	Hydrology	Protocol	GLOBE Teacher's Guide
			Salinity Protocol	Hydrology	Protocol	GLOBE Teacher's Guide
			Water Temperature Protocol	Hydrology	Protocol	GLOBE Teacher's Guide
			Water Transparency Protocol	Hydrology	Protocol	GLOBE Teacher's Guide

High School (Grades 9-12)						
Earth and Space Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	HS-ESS2-5	Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.	Electrical Conductivity Protocol	Hydrology	Protocol	GLOBE Teacher's Guide
			GLOBE Visualization Tool	Multiple Areas	Web Feature	GLOBE Website
	HS-ESS2-6	Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.	Global Carbon Cycle Model with Feedbacks	Carbon	Activity	Other
			Simple C Cycle Model	Carbon	Activity	Other
			Carbon Travels Game	Carbon	Activity	Other
			Allometry Not A Llama Tree	Carbon	Activity	Other
			Tree Mapping	Carbon	Protocol	Other
	HS-ESS2-7	Construct an argument based on evidence about the simultaneous coevolution of Earth systems and life on Earth.	None.			

High School (Grades 9-12)						
Earth and Space Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	HS-ESS3-1	Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.	Global Carbon Cycle Model with Feedbacks	Carbon	Activity	Other
			ESS: 5. Link with GLOBE Data (1987)	Earth as a System	Activity	Earth as a Sysyem (1987)
			Land Cover Change Detection Protocol	Land Cover	Protocol	GLOBE Teacher's Guide
			Computerized MultiSpec Land Cover Mapping Protocol	Land Cover	Protocol	GLOBE Teacher's Guide
			Manual Land Cover Mapping Protocol	Land Cover	Protocol	GLOBE Teacher's Guide
			Student Climate Research Campaign	Multiple Areas	Field Campaign	GLOBE Website
	HS-ESS3-2	Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.*	None.			
	HS-ESS3-3	Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.	Paper Clip Simulation & Model	Carbon	Activity	Other

High School (Grades 9-12)						
Earth and Space Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	HS-ESS3-4	Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.*	Surface Temperature Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
			Surface Ozone Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
			ESS: 1. Explore a Single Map (1987)	Earth as a System	Activity	Earth as a Sysyem (1987)
			ESS: 1 Exploring Single Images (2007)	Earth as a System	Activity	Earth as a System Packet (2007)
			ESS: 2 Exploring Annual Changes (2007)	Earth as a System	Activity	Earth as a System Packet (2007)
			ESS: 2. Explore Annual Changes (within a column) (1987)	Earth as a System	Activity	Earth as a Sysyem (1987)
			Land Cover Change Detection Protocol	Land Cover	Protocol	GLOBE Teacher's Guide
			GLOBE Landsat Satillite Images	Land Cover	Other	Other
			GLOBE Visualization Tool	Multiple Areas	Web Feature	GLOBE Website
			GLOBE Visualization Tool	Multiple Areas	Web Feature	GLOBE Website

High School (Grades 9-12)						
Earth and Space Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	HS-ESS3-5	Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.	Surface Temperature Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
			Biomass Accumulation Model	Carbon	Activity	Other
			Global Carbon Cycle Model with	Carbon	Activity	Other
			RC1: Defining regional boundaries	Earth as a System	Activity	GLOBE Teacher's Guide
			RC2: Effects of inputs and outputs on a region	Earth as a System	Activity	GLOBE Teacher's Guide
			GLOBE Visualization Tool	Multiple Areas	Web Feature	GLOBE Website

High School (Grades 9-12)						
Earth and Space Sciences						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	HS-ESS3-6	Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.*	Surface Temperature Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
			ESS: 1 Exploring Single Images (2007)	Earth as a System	Activity	Earth as a System Packet (2007)
			ESS: 1. Explore a Single Map (1987)	Earth as a System	Activity	Earth as a Sysyem (1987)
			ESS: 2 Exploring Annual Changes (2007)	Earth as a System	Activity	Earth as a System Packet (2007)
			ESS: 2. Explore Annual Changes (within a column) (1987)	Earth as a System	Activity	Earth as a Sysyem (1987)
			Land Cover Change Detection Protocol	Land Cover	Protocol	GLOBE Teacher's Guide
			GLOBE Landsat Satillite Images	Land Cover	Other	Other
			GLOBE Visualization Tool	Multiple Areas	Web Feature	GLOBE Website

High School (Grades 9-12)						
Engineering, Technology, and Applications of Science						
	Student Performance Expectation (SPE)		**Use these GLOBE Resources**	**Investigation Area**	**Resource Type**	**Source**
	HS-ETS1-1	Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.	None.			
	HS-ETS1-2	Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.	Getting to Know Your Satellite Imagery and GLOBE Study Site	Land Cover	Activity	GLOBE Teacher's Guide
			Discovery Area	Land Cover	Activity	GLOBE Teacher's Guide
	HS-ETS1-3	Evaluate a solution to a complex real-world problem based on prioritized criteria & trade-offs that account for a range of constraints, including cost, safety, reliability, & aesthetics, & possible social, cultural, & environmental impacts.	Global Carbon Cycle Model with	Carbon	Activity	Other
			Paper Clip Simulation & Model	Carbon	Activity	Other
			Plant a Plant Experiments	Carbon	Activity	Other
			Getting to Know Your Satellite Imagery and GLOBE Study Site	Land Cover	Activity	GLOBE Teacher's Guide
			Discovery Area	Land Cover	Activity	GLOBE Teacher's Guide
	HS-ETS1-4	Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.	Global Carbon Cycle Model with Feedbacks	Carbon	Activity	Other

Structure and Properties of Matter		Use these GLOBE Resources	Investigation Area	Resource Type	Source
2-PS1-1	Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.	None.			
2-PS1-2	Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.*	None.			
2-PS1-3	Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object.	None.			
2-PS1-4	Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot.	None.			
5-PS1-1	Develop a model to describe that matter is made of particles too small to be seen.	None.			
5-PS1-2	Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved.	None.			
5-PS1-3	Make observations and measurements to identify materials based on their properties.	None.			
5-PS1-4	Conduct an investigation to determine whether the mixing of two or more substances results in new substances.	None.			

Structure and Properties of Matter		Use these GLOBE Resources	Investigation Area	Resource Type	Source
MS-PS1-1	Develop models to describe the atomic composition of simple molecules and extended structures.	Cloud Protocols	Atmosphere	Protocol	GLOBE Teacher's Guide
MS-PS1-3	Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.	Soil Characterization	Soil	Protocol	GLOBE Teacher's Guide
		Bulk Density	Soil	Protocol	GLOBE Teacher's Guide
		Soil Site Selection and Exposure	Soil	Protocol	GLOBE Teacher's Guide
		Soil Particle Density	Soil	Protocol	GLOBE Teacher's Guide
		Soil Particle Size Distribution	Soil	Protocol	GLOBE Teacher's Guide
		Soil pH	Soil	Protocol	GLOBE Teacher's Guide
		Soil Fertility	Soil	Protocol	GLOBE Teacher's Guide
MS-PS1-4	Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.	Cloud Protocols	Atmosphere	Protocol	GLOBE Teacher's Guide
HS-PS1-1	Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.	None.			
HS-PS1-3	Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.	None.			
HS-PS1-8	Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.	None.			

Chemical Reactions		Use these GLOBE Resources	Investigation Area	Resource Type	Source
MS-PS1-2	Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.	Soil Characterization	Soil	Protocol	GLOBE Teacher's Guide
MS-PS1-5	Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.	Soil Characterization	Soil	Protocol	GLOBE Teacher's Guide
MS-PS1-6	Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.*	None.			
HS-PS1-2	Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.	None.			
HS-PS1-4	Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.	None.			
HS-PS1-5	Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.	None.			
HS-PS1-6	Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.*	None.			
HS-PS1-7	Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.	None.			

Forces and Interactions		Use these GLOBE Resources	Investigation Area	Resource Type	Source
K-PS2-1	Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.	None.			
K-PS2-2	Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.*	None.			
3-PS2-1	Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.	None.			
3-PS2-2	Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.	None.			
3-PS2-3	Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.	None.			
3-PS2-4	Define a simple design problem that can be solved by applying scientific ideas about magnets.*	None.			

Forces and Interactions		Use these GLOBE Resources	Investigation Area	Resource Type	Source
MS-PS2-1	Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.*	None.			
MS-PS2-2	Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.	None.			
MS-PS2-3	Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.	None.			
MS-PS2-4	Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.	None.			
MS-PS2-5	Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.	None.			

Forces and Interactions		Use these GLOBE Resources	Investigation Area	Resource Type	Source
HS-PS2-1	Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.	None.			
HS-PS2-2	Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.	None.			
HS-PS2-3	Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.*	None.			
HS-PS2-4	Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.	None.			
HS-PS2-5	Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.	None.			

Energy		Use these GLOBE Resources	Investigation Area	Resource Type	Source
4-PS3-1	Use evidence to construct an explanation relating the speed of an object to the energy of that object.	None.			
4-PS3-2	Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.	None.			
4-PS3-3	Ask questions and predict outcomes about the changes in energy that occur when objects collide.	None.			
4-PS3-4	Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.*	None.			
4-ESS3-1	Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.	None.			
MS-PS3-1	Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.	None.			
MS-PS3-2	Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.	None.			
MS-PS3-3	Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.*	None.			
MS-PS3-4	Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.	None.			
MS-PS3-5	Construct, use, and present arguments to support the claim that when the motion energy of an object changes, energy is transferred to or from the object.	None.			

Energy		Use these GLOBE Resources	Investigation Area	Resource Type	Source
HS-PS3-1	Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.	None.			
HS-PS3-2	Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as either motions of particles or energy stored in fields.	None.			
HS-PS3-3	Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.*	Building a GLOBE Sun Photometer (pc board V3.0)	Atmosphere	Activity	Other
HS-PS3-4	Plan & conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temp are combined within a closed system results in a more uniform energy distribution among the components in the system.	None.			
HS-PS3-5	Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.	None.			

Waves		Use these GLOBE Resources	Investigation Area	Resource Type	Source
1-PS4-1	Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate.	None.			
1-PS4-2	Make observations to construct an evidence-based account that objects can be seen only when illuminated.	None.			
1-PS4-3	Plan and conduct an investigation to determine the effect of placing objects made with different materials in the path of a beam of light.	None.			
1-PS4-4	Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance.*	None.			
4-PS4-1	Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.	None.			
4-PS4-3	Generate and compare multiple solutions that use patterns to transfer information.*	None.			
MS-PS4-1	Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.	None.			
MS-PS4-2	Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.	Aerosols Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
		Water Vapor Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
MS-PS4-3	Integrate qualitative scientific and technical information to support the claim that digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information.	None.			

Waves and Electromagnetic Radiation		Use these GLOBE Resources	Investigation Area	Resource Type	Source
HS-PS4-1	Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.	Water Vapor Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
		Aerosols Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
HS-PS4-2	Evaluate questions about the advantages of using a digital transmission and storage of information.	None.			
HS-PS4-3	Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.	None.			
HS-PS4-4	Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.	None.			
HS-PS4-5	Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.*	Aerosols Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
		AWS WeatherBug Protocol	Atmosphere	Protocol	GLOBE Website
		Davis Weather Station Protocol	Atmosphere	Protocol	GLOBE Website
		RainWise Weather Station Protocol	Atmosphere	Protocol	GLOBE Website
		WeatherHawk Weather Station Protocol	Atmosphere	Protocol	GLOBE Website
		Soil Temperature	Soil	Protocol	GLOBE Teacher's Guide
		Max/Min/Current Air Temperature Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
		Water Temperature Protocol	Hydrology	Protocol	GLOBE Teacher's Guide

Structure and Function		Use these GLOBE Resources	Investigation Area	Resource Type	Source
1-LS1-1	Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs.*	None.			
1-LS1-2	Read texts and use media to determine patterns in behavior of parents and offspring that help offspring survive.	None.			
1-LS3-1	Make observations to construct an evidence-based account that young plants and animals are like, but not exactly like, their parents.	None.			
4-PS4-2	Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.	None.			
4-LS1-1	Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.	Water Wonders	Hydrology	Activity	Elementary GLOBE
4-LS1-2	Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.	Honing In On Hummingbirds	Earth as a System	Activity	Elementary GLOBE
		Ruby-throated Hummingbird Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
MS-LS1-1	Conduct an investigation to provide evidence that living things are made of cells, either one cell or many different numbers and types of cells.	P4: A Beginning Look at Photosynthesis	Earth as a System	Activity	GLOBE Teacher's Guide
MS-LS1-2	Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function.	None.			
MS-LS1-3	Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.	None.			
MS-LS1-8	Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.	None.			

Structure and Function		Use these GLOBE Resources	Investigation Area	Resource Type	Source
HS-LS1-1	Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.	None.			
HS-LS1-2	Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.	P4: A Beginning Look at Photosynthesis	Earth as a System	Activity	GLOBE Teacher's Guide
		P5: Investigating Leaf Pigments	Earth as a System	Activity	GLOBE Teacher's Guide
		P6: Global Patterns in Green-up and Green-down	Earth as a System	Activity	GLOBE Teacher's Guide
		Paper Clip Simulation & Model	Carbon	Activity	Other
		Plant a Plant Experiments	Carbon	Activity	Other
HS-LS1-3	Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.	Plant a Plant Experiments	Carbon	Activity	Other
HS-LS1-3		Paper Clip Simulation & Model	Carbon	Activity	Other
HS-LS1-3		Global Carbon Cycle Model with Feedbacks	Carbon	Activity	Other
HS-LS1-3		Biomass Accumulation Model	Carbon	Activity	Other
HS-LS1-3		P4: A Beginning Look at Photosynthesis	Earth as a System	Activity	GLOBE Teacher's Guide

Matter and Energy in Organisms and Ecosystems		Use these GLOBE Resources	Investigation Area	Resource Type	Source
5-PS3-1	Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.	None.			
5-LS1-1	Support an argument that plants get the materials they need for growth chiefly from air and water.	None.			
5-LS2-1	Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.	None.			
MS-LS1-6	Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.	Green-Up Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
		Green-Down Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
		Budburst Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
		P1: Green-up Cards	Earth as a System	Activity	GLOBE Teacher's Guide
		P2: A Sneak Preview of Budburst	Earth as a System	Activity	GLOBE Teacher's Guide
		P4: A Beginning Look at Photosynthesis	Earth as a System	Activity	GLOBE Teacher's Guide
		P5: Investigating Leaf Pigments	Earth as a System	Activity	GLOBE Teacher's Guide
		P6: Global Patterns in Green-up and Green-down	Earth as a System	Activity	GLOBE Teacher's Guide
MS-LS1-7	Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.	None.			

Matter and Energy in Organisms and Ecosystems		Use these GLOBE Resources	Investigation Area	Resource Type	Source
MS-LS2-1	Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.	Freshwater Macroinvertebrates	Hydrology	Protocol	GLOBE Teacher's Guide
		ESS: 3. Explore Relationships between Types of Data (across columns) (1987)	Earth as a System	Activity	Earth as a Sysyem (1987)
		ESS: 4. Global Patterns (1987)	Earth as a System	Activity	Earth as a Sysyem (1987)
		Arctic Bird Migration Monitoring Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
		Budburst Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
		Green-Down Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
		Green-Up Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
		Ruby-throated Hummingbird Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
		GC2: Components of the earth system working together	Earth as a System	Activity	GLOBE Teacher's Guide
		P2: A Sneak Preview of Budburst	Earth as a System	Activity	GLOBE Teacher's Guide
		RC2: Effects of inputs and outputs on a region	Earth as a System	Activity	GLOBE Teacher's Guide
MS-LS2-3	Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.	Carbon Cycle Adventure Story	Carbon	Activity	Other
MS-LS2-3		Carbon Travels Game	Carbon	Activity	Other
MS-LS2-3		Turnover Rate & Residence Time	Carbon	Activity	Other

Matter and Energy in Organisms and Ecosystems		Use these GLOBE Resources	Investigation Area	Resource Type	Source
MS-LS2-4	Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.	Green-Down Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
		Green-Up Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
		Budburst Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
		Ruby-throated Hummingbird Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
		Arctic Bird Migration Monitoring Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
		Phenological Gardens Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
		P3: A First Look at Phenology	Earth as a System	Activity	GLOBE Teacher's Guide
		Freshwater Macroinvertebrates	Hydrology	Protocol	GLOBE Teacher's Guide
		P2: A Sneak Preview of Budburst	Earth as a System	Activity	GLOBE Teacher's Guide
		P7: Temperature and Precipitation as Limiting Factors in Ecosystems	Earth as a System	Activity	GLOBE Teacher's Guide
		Land Cover Change Detection Protocol	Land Cover	Protocol	GLOBE Teacher's Guide

Matter and Energy in Organisms and Ecosystems		Use these GLOBE Resources	Investigation Area	Resource Type	Source
HS-LS1-5	Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.	S5: Seasonal Change on Land and Water	Earth as a System	Activity	GLOBE Teacher's Guide
		Earth as a System Poster (1987)	Earth as a System	Other	Other
		Earth as a System Poster (2007)	Earth as a System	Other	Other
		P4: A Beginning Look at Photosynthesis	Earth as a System	Activity	GLOBE Teacher's Guide
		P5: Investigating Leaf Pigments	Earth as a System	Activity	GLOBE Teacher's Guide
		Plant a Plant Experiments	Carbon	Activity	Other
		P6: Global Patterns in Green-up and Green-down	Earth as a System	Activity	GLOBE Teacher's Guide
		P7: Temperature and Precipitation as Limiting Factors in Ecosystems	Earth as a System	Activity	GLOBE Teacher's Guide
		Budburst Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
		Green-Up Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
		Green-Down Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
		Lilac Phenology Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
		Phenological Gardens Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
		Seaweed Reproductive Phenology Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
		Tree Circumference	Carbon	Protocol	Other
		Allometry Not A Llama Tree	Carbon	Activity	Other
		Biometry Protocol	Land Cover	Protocol	GLOBE Teacher's Guide

Matter and Energy in Organisms and Ecosystems		Use these GLOBE Resources	Investigation Area	Resource Type	Source
HS-LS1-6	Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.	P4: A Beginning Look at Photosynthesis	Earth as a System	Activity	GLOBE Teacher's Guide
		Plant a Plant Experiments	Carbon	Activity	Other
		Biomass Accumulation Model	Carbon	Activity	Other
		Carbon Cycle Adventure Story	Carbon	Activity	Other
		Carbon Travels Game	Carbon	Activity	Other
		Carbon Cycle Standard Sample Site Set-up	Carbon	Protocol	Other
		Carbon Cycle Non-standard Sample Site Set-up	Carbon	Protocol	Other
		Biomass Units	Carbon	Activity	Other
		Tree Biomass Analysis	Carbon	Protocol	Other
		Shrubs	Carbon	Protocol	Other
		Heraceous	Carbon	Protocol	Other
		FLEXE - Ecology Unit Activity 3	FLEXE	Activity	Other
		FLEXE - Ecology Unit Activity 6	FLEXE	Activity	Other
HS-LS1-7	Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.	Soil: The Great Decomposer	Soil	Activity	GLOBE Teacher's Guide
		Carbon Cycle Adventure Story	Carbon	Activity	Other
		Carbon Travels Game	Carbon	Activity	Other
HS-LS2-3	Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.	Carbon Cycle Adventure Story	Carbon	Activity	Other
		Carbon Travels Game	Carbon	Activity	Other
		FLEXE - Ecology Unit Activity 6	FLEXE	Activity	Other
		P4: A Beginning Look at Photosynthesis	Earth as a System	Activity	GLOBE Teacher's Guide
		FLEXE - Ecology Unit Activity 7	FLEXE	Activity	Other

Matter and Energy in Organisms and Ecosystems		Use these GLOBE Resources	Investigation Area	Resource Type	Source
HS-LS2-4	Use a mathematical representation to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.	Biomass Accumulation Model	Carbon	Activity	Other
		FLEXE - Ecology Unit Activity 6	FLEXE	Activity	Other
		Carbon Travels Game	Carbon	Activity	Other
		Allometry Not A Llama Tree	Carbon	Activity	Other
		Tree Biomass Analysis	Carbon	Protocol	Other
		Carbon Cycle Adventure Story	Carbon	Activity	Other
		Human Carbon Pool	Carbon	Activity	Other
HS-LS2-5	Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.	Global Carbon Cycle Model with Feedbacks	Carbon	Activity	Other
		Carbon Cycle Adventure Story	Carbon	Activity	Other
		Carbon Travels Game	Carbon	Activity	Other
		FLEXE - Ecology Unit Activity 6	FLEXE	Activity	Other
		P4: A Beginning Look at Photosynthesis	Earth as a System	Activity	GLOBE Teacher's Guide
		FLEXE - Ecology Unit Activity 7	FLEXE	Activity	Other
		Biomass Accumulation Model	Carbon	Activity	Other
		FLEXE - Ecology Unit Activity 6	FLEXE	Activity	Other
		Carbon Travels Game	Carbon	Activity	Other
HS-LS2-7	Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.	Allometry Not A Llama Tree	Carbon	Activity	Other
		Tree Biomass Analysis	Carbon	Protocol	Other
		Carbon Cycle Adventure Story	Carbon	Activity	Other
		Human Carbon Pool	Carbon	Activity	Other

Interdependent Relationships in Ecosystems		Use these GLOBE Resources	Investigation Area	Resource Type	Source
K-LS1-1	Use observations to describe patterns of what plants and animals (including humans) need to survive.	Ruby-throated Hummingbird Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
K-ESS2-2	Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs.	None.			
K-ESS3-1	Use a model to represent the relationship between the needs of different plants or animals (including humans) and the places they live.	None.			
K-ESS3-3	Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.*	None.			

Interdependent Relationships in Ecosystems		Use these GLOBE Resources	Investigation Area	Resource Type	Source
2-LS2-2	Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants.*	None.			
2-LS4-1	Make observations of plants and animals to compare the diversity of life in different habitats.	All Year Long	Earth as a System	Activity	Elementary GLOBE
		The Colors of the Seasons	Earth as a System	Activity	Elementary GLOBE
		Honing In On Hummingbirds	Earth as a System	Activity	Elementary GLOBE
		The Mystery of the Missing Hummingbirds	Earth as a System	Elementary GLOBE Book	Elementary GLOBE
		Water Wonders	Hydrology	Activity	Elementary GLOBE
		We All Need Soil!	Soil	Activity	Elementary GLOBE
		Ruby-throated Hummingbird Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
		Arctic Bird Migration Monitoring Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
		Budburst Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
		Green-Down Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
		Green-Up Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
		Phenological Gardens Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
		P1: Green-up Cards	Earth as a System	Activity	GLOBE Teacher's Guide
		P2: A Sneak Preview of Budburst	Earth as a System	Activity	GLOBE Teacher's Guide
		P3: A First Look at Phenology	Earth as a System	Activity	GLOBE Teacher's Guide
		P4: A Beginning Look at Photosynthesis	Earth as a System	Activity	GLOBE Teacher's Guide

Interdependent Relationships in Ecosystems		Use these GLOBE Resources	Investigation Area	Resource Type	Source
3-LS2-1	Construct an argument that some animals form groups that help members survive.	Arctic Bird Migration Monitoring Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
3-LS4-1	Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago.	None.			
3-LS4-3	Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.	None.			
3-LS4-4	Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.*	Site Selection	Land Cover	Protocol	GLOBE Teacher's Guide
		Manual Land Cover Mapping Protocol	Land Cover	Protocol	GLOBE Teacher's Guide
MS-LS2-2	Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.	None.			
MS-LS2-5	Evaluate competing design solutions for maintaining biodiversity and ecosystem services.*	Model a Catchment Basin	Hydrology	Activity	GLOBE Teacher's Guide

Interdependent Relationships in Ecosystems		Use these GLOBE Resources	Investigation Area	Resource Type	Source
HS-LS2-1	Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.	Making a Contour Map	Atmosphere	Activity	GLOBE Teacher's Guide
		Biometry Protocol	Land Cover	Protocol	GLOBE Teacher's Guide
		GC2: Components of the earth system working together	Earth as a System	Activity	GLOBE Teacher's Guide
		P7: Temperature and Precipitation as Limiting Factors in Ecosystems	Earth as a System	Activity	GLOBE Teacher's Guide
		RC1: Defining regional boundaries	Earth as a System	Activity	GLOBE Teacher's Guide
		RC2: Effects of inputs and outputs on a region	Earth as a System	Activity	GLOBE Teacher's Guide
		LC1: Connecting the parts of the study site	Earth as a System	Activity	GLOBE Teacher's Guide
		LC3: Using graphs to show connections	Earth as a System	Activity	GLOBE Teacher's Guide
		LC5: Comparing the study site to one in another region	Earth as a System	Activity	GLOBE Teacher's Guide
		Ruby-throated Hummingbird Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
		Seaweed Reproductive Phenology Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
		Earth as a System Poster (1987)	Earth as a System	Other	Other
		Earth as a System Poster (2007)	Earth as a System	Other	Other
		Freshwater Macroinvertebrates	Hydrology	Protocol	GLOBE Teacher's Guide
		pH Protocol	Hydrology	Protocol	GLOBE Teacher's Guide

Interdependent Relationships in Ecosystems		Use these GLOBE Resources	Investigation Area	Resource Type	Source
HS-LS2-6	Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new	RC2: Effects of inputs and outputs on a region	Earth as a System	Activity	GLOBE Teacher's Guide
		FLEXE - Ecology Unit Activity 6	FLEXE	Activity	Other
		FLEXE - Ecology Unit Activity 7	FLEXE	Activity	Other
HS-LS2-7	Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.*	Discovery Area	Land Cover	Activity	GLOBE Teacher's Guide
HS-LS2-8	Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.	Ruby-throated Hummingbird Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
		Arctic Bird Migration Monitoring Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide

Interdependent Relationships in Ecosystems		Use these GLOBE Resources	Investigation Area	Resource Type	Source
HS-LS2-2	Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.	Earth as a System Poster (1987)	Earth as a System	Other	Other
		Earth as a System Poster (2007)	Earth as a System	Other	Other
		Biometry Protocol	Land Cover	Protocol	GLOBE Teacher's Guide
		Making a Contour Map	Atmosphere	Activity	GLOBE Teacher's Guide
		Freshwater Macroinvertebrates	Hydrology	Protocol	GLOBE Teacher's Guide
		Ruby-throated Hummingbird Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
		Seaweed Reproductive Phenology Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
		GC2: Components of the earth system working together	Earth as a System	Activity	GLOBE Teacher's Guide
		P7: Temperature and Precipitation as Limiting Factors in Ecosystems	Earth as a System	Activity	GLOBE Teacher's Guide
		RC1: Defining regional boundaries	Earth as a System	Activity	GLOBE Teacher's Guide
		RC2: Effects of inputs and outputs on a region	Earth as a System	Activity	GLOBE Teacher's Guide
		LC1: Connecting the parts of the study site	Earth as a System	Activity	GLOBE Teacher's Guide
		pH Protocol	Hydrology	Protocol	GLOBE Teacher's Guide
		LC3: Using graphs to show connections	Earth as a System	Activity	GLOBE Teacher's Guide
		LC5: Comparing the study site to one in another region	Earth as a System	Activity	GLOBE Teacher's Guide
HS-LS4-6	Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.*	Discovery Area	Land Cover	Activity	GLOBE Teacher's Guide

Growth, Development and Reproduction of Organisms		Use these GLOBE Resources	Investigation Area	Resource Type	Source
MS-LS1-4	Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.	P2: A Sneak Preview of Budburst	Earth as a System	Activity	GLOBE Teacher's Guide
		Budburst Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
		Green-Up Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
		Lilac Phenology Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
		Ruby-throated Hummingbird Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
MS-LS1-5	Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.	Green-Down Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
		Green-Up Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
		Budburst Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
		Ruby-throated Hummingbird Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
		Arctic Bird Migration Monitoring Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
		Seaweed Reproductive Phenology Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
		Phenological Gardens Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide

Growth, Development and Reproduction of Organisms		Use these GLOBE Resources	Investigation Area	Resource Type	Source
MS-LS1-5	Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.	Freshwater Macroinvertebrates	Hydrology	Protocol	GLOBE Teacher's Guide
		Alkalinity Protocol	Hydrology	Protocol	GLOBE Teacher's Guide
		Dissolved Oxygen Protocol	Hydrology	Protocol	GLOBE Teacher's Guide
		Electrical Conductivity Protocol	Hydrology	Protocol	GLOBE Teacher's Guide
		Instrument Construction, Site Selection, Documenting Your Hydrology Site, Sampling Procedures	Hydrology	Protocol	GLOBE Teacher's Guide
		Nitrate Protocol	Hydrology	Protocol	GLOBE Teacher's Guide
		Optional Salinity Titration	Hydrology	Protocol	GLOBE Teacher's Guide
		pH Protocol	Hydrology	Protocol	GLOBE Teacher's Guide
		Salinity Protocol	Hydrology	Protocol	GLOBE Teacher's Guide
		Water Temperature Protocol	Hydrology	Protocol	GLOBE Teacher's Guide
		Water Transparency Protocol	Hydrology	Protocol	GLOBE Teacher's Guide
		P2: A Sneak Preview of Budburst	Earth as a System	Activity	GLOBE Teacher's Guide
		P3: A First Look at Phenology	Earth as a System	Activity	GLOBE Teacher's Guide
		ESS: 3. Explore Relationships between Types of Data (across columns) (1987)	Earth as a System	Activity	Earth as a Sysyem (1987)
		ESS: 4. Global Patterns (1987)	Earth as a System	Activity	Earth as a Sysyem (1987)

Growth, Development and Reproduction of Organisms		Use these GLOBE Resources	Investigation Area	Resource Type	Source
MS-LS3-1	Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism.	None.			
MS-LS3-2	Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.	None.			
MS-LS4-5	Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms.	None.			

Inheritance and Variation of Traits: Life Cycles and Traits		Use these GLOBE Resources	Investigation Area	Resource Type	Source
3-LS1-1	Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death.	None.			
3-LS3-1	Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms.	None.			
3-LS3-2	Use evidence to support the explanation that traits can be influenced by the environment.	None.			
3-LS4-2	Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing.	None.			
MS-LS4-1	Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past.	None.			
MS-LS4-2	Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships.	None.			
MS-LS4-3	Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy.	None.			

Inheritance and Variation of Traits: Life Cycles and Traits		Use these GLOBE Resources	Investigation Area	Resource Type	Source
MS-LS4-4	Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment.	None.			
MS-LS4-6	Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.	None.			
HS-LS1-4	Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.	None.			
HS-LS3-1	Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.	None.			
HS-LS3-2	Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.	None.			
HS-LS3-3	Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.	None.			

Natural Selection		Use these GLOBE Resources	Investigation Area	Resource Type	Source
HS-LS4-1	Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.	None.			
HS-LS4-2	Construct an explanation based on evidence that the process of evolution primarily results from four factors (see notes for full text of factors).	FLEXE - Ecology Unit Activity 6	FLEXE	Activity	Other
HS-LS4-3	Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.	Land Cover Sample Site Protocol	Land Cover	Protocol	GLOBE Teacher's Guide
		Land Cover Change Detection Protocol	Land Cover	Protocol	GLOBE Teacher's Guide

Natural Selection		Use these GLOBE Resources	Investigation Area	Resource Type	Source
HS-LS4-4	Construct an explanation based on evidence for how natural selection leads to adaptation of populations.	What is your Climate Classification	Climate Foundations	Activity	GLOBE Website
		FLEXE - Ecology Unit Activity 4	FLEXE	Activity	Other
		FLEXE - Ecology Unit Activity 5	FLEXE	Activity	Other
		Earth as a System Poster (1987)	Earth as a System	Other	Other
		Earth as a System Poster (2007)	Earth as a System	Other	Other
		ESS: 1 Exploring Single Images (2007)	Earth as a System	Activity	Earth as a System Packet (2007)
		ESS: 1. Explore a Single Map (1987)	Earth as a System	Activity	Earth as a Sysyem (1987)
		ESS: 2 Exploring Annual Changes (2007)	Earth as a System	Activity	Earth as a System Packet (2007)
		ESS: 2. Explore Annual Changes (within a column) (1987)	Earth as a System	Activity	Earth as a Sysyem (1987)
		ESS: 3 Exploring Relationships Between Two Variables (2007)	Earth as a System	Activity	Earth as a System Packet (2007)
		ESS: 3. Explore Relationships between Types of Data (across columns) (1987)	Earth as a System	Activity	Earth as a Sysyem (1987)
		ESS: 4 Exploring Relationships Among Variables for a Particular Month (2007)	Earth as a System	Activity	Earth as a System Packet (2007)
		ESS: 4. Global Patterns (1987)	Earth as a System	Activity	Earth as a Sysyem (1987)
		ESS: 5 Exploring Relationships Among Variables Six Months Apart (2007)	Earth as a System	Activity	Earth as a System Packet (2007)
		ESS: 5. Link with GLOBE Data (1987)	Earth as a System	Activity	Earth as a Sysyem (1987)
HS-LS4-5	Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.	Land Cover Sample Site Protocol	Land Cover	Protocol	GLOBE Teacher's Guide
		Land Cover Change Detection Protocol	Land Cover	Protocol	GLOBE Teacher's Guide
		FLEXE - Ecology Unit Activity 6	FLEXE	Activity	Other
		FLEXE - Ecology Unit Activity 7	FLEXE	Activity	Other

Space Systems		Use these GLOBE Resources	Investigation Area	Resource Type	Source
1-ESS1-1	Use observations of the sun, moon, and stars to describe patterns that can be predicted.	None.			
1-ESS1-2	Make observations at different times of year to relate the amount of daylight to the time of year.	None.			
5-PS2-1	Support an argument that the gravitational force exerted by Earth on objects is directed down.	None.			
5-ESS1-1	Support an argument that the apparent brightness of the sun and stars is due to their relative distances from Earth.	None.			
5-ESS1-2	Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.	None.			
MS-ESS1-1	Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.	S4: Modeling the Reasons for Seasonal Change	Earth as a System	Activity	GLOBE Teacher's Guide
		S5: Seasonal Change on Land and Water	Earth as a System	Activity	GLOBE Teacher's Guide
MS-ESS1-2	Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.	None.			
HS-ESS1-1	Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy that eventually reaches Earth in the form of radiation.	None.			
HS-ESS1-2	Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe.	Biomass Accumulation Model	Carbon	Activity	Other
		Dissolved Oxygen Protocol	Hydrology	Protocol	GLOBE Teacher's Guide
		Soil Characterization	Soil	Protocol	GLOBE Teacher's Guide
HS-ESS1-3	Communicate scientific ideas about the way stars, over their life cycle, produce elements.	None.			
HS-ESS1-4	Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.	None.			

History of Earth		Use these GLOBE Resources	Investigation Area	Resource Type	Source
MS-ESS1-4	Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history.	None.			
MS-ESS2-2	Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.	Why Do We Study Soil?	Soil	Activity	GLOBE Teacher's Guide
		Model a Catchment Basin	Hydrology	Activity	GLOBE Teacher's Guide
		Just Passing Through: Beginning Level	Soil	Activity	GLOBE Teacher's Guide
		Just Passing Through	Soil	Activity	GLOBE Teacher's Guide
MS-ESS2-3	Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions.	FLEXE - Ecology Unit Activity 2	FLEXE	Activity	Other
HS-ESS1-5	Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.	None.			
HS-ESS1-6	Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.	None.			
HS-ESS2-1	Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.	None.			

Earth's Systems		Use these GLOBE Resources	Investigation Area	Resource Type	Source
2-ESS1-1	Make observations from media to construct an evidence-based account that Earth events can occur quickly or slowly.	None.			
2-ESS2-1	Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.*	None.			
2-ESS2-2	Develop a model to represent the shapes and kinds of land and bodies of water in an area.	Model a Catchment Basin	Hydrology	Activity	GLOBE Teacher's Guide
		Water Walk	Hydrology	Activity	GLOBE Teacher's Guide
		Measure Up	Hydrology	Activity	Elementary GLOBE
2-ESS2-3	Obtain information to identify where water is found on Earth and that it can be solid or liquid.	None.			
4-ESS1-1	Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.	None.			
4-ESS2-1	Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.	None.			
4-ESS2-2	Analyze and interpret data from maps to describe patterns of Earth's features.	None.			
4-ESS3-2	Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.*	None.			

Earth's Systems		Use these GLOBE Resources	Investigation Area	Resource Type	Source
5-ESS2-1	Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.	Land, Water and Air	Atmosphere	Activity	GLOBE Teacher's Guide
		Cloud Protocols	Atmosphere	Protocol	GLOBE Teacher's Guide
		Digital Multi-Day Max/Min/Current Air and Soil Temperature Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
		Max/Min/Current Air Temperature Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
		Precipitation Protocols	Atmosphere	Protocol	GLOBE Teacher's Guide
		Relative Humidity Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
		Surface Temperature Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
		GC2: Components of the earth system working together	Earth as a System	Activity	GLOBE Teacher's Guide
		ESS: 3. Explore Relationships between Types of Data (across columns) (1987)	Earth as a System	Activity	Earth as a Sysyem (1987)
		LC1: Connecting the parts of the study site	Earth as a System	Activity	GLOBE Teacher's Guide
		LC2: Representing the study site in a diagram	Earth as a System	Activity	GLOBE Teacher's Guide
		LC4: Diagramming the study site for others	Earth as a System	Activity	GLOBE Teacher's Guide
		LC5: Comparing the study site to one in another region	Earth as a System	Activity	GLOBE Teacher's Guide

Earth's Systems		Use these GLOBE Resources	Investigation Area	Resource Type	Source
5-ESS2-1	Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.	Green-Down Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
		Green-Up Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
		Phenological Gardens Protocol	Earth as a System	Protocol	GLOBE Teacher's Guide
		Dissolved Oxygen Protocol	Hydrology	Protocol	GLOBE Teacher's Guide
		Water Temperature Protocol	Hydrology	Protocol	GLOBE Teacher's Guide
		Water Transparency Protocol	Hydrology	Protocol	GLOBE Teacher's Guide
		Land Cover Sample Site Protocol	Land Cover	Protocol	GLOBE Teacher's Guide
		Manual Land Cover Mapping Protocol	Land Cover	Protocol	GLOBE Teacher's Guide
		Infiltration Protocol	Soil	Protocol	GLOBE Teacher's Guide
		Soil Temperature	Soil	Protocol	GLOBE Teacher's Guide
		Soil Characterization	Soil	Protocol	GLOBE Teacher's Guide
5-ESS2-2	Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.	None.			
5-ESS3-1	Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.	Model a Catchment Basin	Hydrology	Activity	GLOBE Teacher's Guide

Earth's Systems		Use these GLOBE Resources	Investigation Area	Resource Type	Source
MS-ESS2-1	Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.	GC2: Components of the earth system working together	Earth as a System	Activity	GLOBE Teacher's Guide
		LC1: Connecting the parts of the study site	Earth as a System	Activity	GLOBE Teacher's Guide
		Model Your Water Balance	Hydrology	Activity	GLOBE Teacher's Guide
		Soil: The Great Decomposer	Soil	Activity	GLOBE Teacher's Guide
MS-ESS2-4	Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.	Watershed Dynamics Module I #1 Natural Water Availability	Watershed Dynamics	Other	GLOBE Website
		Land, Water and Air	Atmosphere	Activity	GLOBE Teacher's Guide
		Precipitation Protocols	Atmosphere	Protocol	GLOBE Teacher's Guide
		Relative Humidity Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
MS-ESS3-1	Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.	Model Your Water Balance	Hydrology	Activity	GLOBE Teacher's Guide

Earth's Systems		Use these GLOBE Resources	Investigation Area	Resource Type	Source
HS-ESS2-2	Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.	Aerosols Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
		Water Vapor Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
		Barometric Pressure Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
		Relative Humidity Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
		Precipitation Protocols	Atmosphere	Protocol	GLOBE Teacher's Guide
		Max/Min/Current Air Temperature Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
		Digital Multi-Day Max/Min/Current Air and Soil Temperature Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
		Automated Soil and Air Temperature Monitoring Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
		Surface Temperature Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
		Surface Ozone Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
		AWS WeatherBug Protocol	Atmosphere	Protocol	GLOBE Website
		Davis Weather Station Protocol	Atmosphere	Protocol	GLOBE Website
		RainWise Weather Station Protocol	Atmosphere	Protocol	GLOBE Website
		WeatherHawk Weather Station Protocol	Atmosphere	Protocol	GLOBE Website
		Global Carbon Cycle Model with Feedbacks	Carbon	Activity	Other
		Simple C Cycle Model	Carbon	Activity	Other
		Paper Clip Simulation & Model	Carbon	Activity	Other
		Land Cover Change Detection Protocol	Land Cover	Protocol	GLOBE Teacher's Guide
		GLOBE Landsat Satillite Images	Land Cover	Other	Other
		GLOBE Visualization Tool	Multiple Areas	Web Feature	GLOBE Website

Earth's Systems		Use these GLOBE Resources	Investigation Area	Resource Type	Source
HS-ESS2-2	Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.	Soil Site Selection and Exposure	Soil	Protocol	GLOBE Teacher's Guide
		Soil Characterization	Soil	Protocol	GLOBE Teacher's Guide
		Soil Temperature	Soil	Protocol	GLOBE Teacher's Guide
		Gravimetric Soil Moisture	Soil	Protocol	GLOBE Teacher's Guide
		Bulk Density	Soil	Protocol	GLOBE Teacher's Guide
		Soil Particle Density	Soil	Protocol	GLOBE Teacher's Guide
		Soil Particle Size Distribution	Soil	Protocol	GLOBE Teacher's Guide
		Soil pH	Soil	Protocol	GLOBE Teacher's Guide
		Soil Fertility	Soil	Protocol	GLOBE Teacher's Guide
		Digital Multi-Day Max/Min/Current Air and Soil Temperature Protocol	Soil	Protocol	GLOBE Teacher's Guide
		Digital Multi-Day Soil Temperatures Protocol	Soil	Protocol	GLOBE Teacher's Guide
		Automated Soil and Air Temperature Monitoring Protocol	Soil	Protocol	GLOBE Teacher's Guide
		Soil Moisture Sensor Protocol	Soil	Protocol	GLOBE Teacher's Guide
		Infiltration Protocol	Soil	Protocol	GLOBE Teacher's Guide
		Davis Soil Moisture and Temperature Station Protocol	Soil	Protocol	GLOBE Teacher's Guide
HS-ESS2-3	Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.	Learning to Use Visualizations	Atmosphere	Activity	GLOBE Teacher's Guide
		Cloud Protocols	Atmosphere	Protocol	GLOBE Teacher's Guide
		Cloud Chart	Atmosphere	Other	GLOBE Website
		GLOBE Visualization Tool	Multiple Areas	Web Feature	GLOBE Website

Earth's Systems		Use these GLOBE Resources	Investigation Area	Resource Type	Source
HS-ESS2-5	Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.	Alkalinity Protocol	Hydrology	Protocol	GLOBE Teacher's Guide
		Dissolved Oxygen Protocol	Hydrology	Protocol	GLOBE Teacher's Guide
		Electrical Conductivity Protocol	Hydrology	Protocol	GLOBE Teacher's Guide
		Freshwater Macroinvertebrates	Hydrology	Protocol	GLOBE Teacher's Guide
		Instrument Construction, Site Selection, Documenting Your Hydrology Site, Sampling Procedures	Hydrology	Protocol	GLOBE Teacher's Guide
		Nitrate Protocol	Hydrology	Protocol	GLOBE Teacher's Guide
		Optional Salinity Titration	Hydrology	Protocol	GLOBE Teacher's Guide
		pH Protocol	Hydrology	Protocol	GLOBE Teacher's Guide
		Salinity Protocol	Hydrology	Protocol	GLOBE Teacher's Guide
		Water Temperature Protocol	Hydrology	Protocol	GLOBE Teacher's Guide
		Water Transparency Protocol	Hydrology	Protocol	GLOBE Teacher's Guide
		Electrical Conductivity Protocol	Hydrology	Protocol	GLOBE Teacher's Guide
		Water Transparency Protocol	Hydrology	Protocol	GLOBE Teacher's Guide
		GLOBE Visualization Tool	Multiple Areas	Web Feature	GLOBE Website
HS-ESS2-6	Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.	Global Carbon Cycle Model with Feedbacks	Carbon	Activity	Other
		Simple C Cycle Model	Carbon	Activity	Other
		Carbon Travels Game	Carbon	Activity	Other
		Allometry Not A Llama Tree	Carbon	Activity	Other
		Tree Mapping	Carbon	Protocol	Other
HS-ESS2-7	Construct an argument based on evidence about the simultaneous coevolution of Earth systems and life on Earth.	None.			

Weather and Climate		Use these GLOBE Resources	Investigation Area	Resource Type	Source
K-PS3-1	Make observations to determine the effect of sunlight on Earth's surface.	All About Earth Our World on Stage	Earth as a System	Elementary GLOBE Book	Elementary GLOBE
		We're All Connected: Earth System Interactions	Earth as a System	Activity	Elementary GLOBE
		Earth System Play	Earth as a System	Activity	Elementary GLOBE
		Surface Temperature	Atmosphere	Protocol	GLOBE Teacher's Guide
K-PS3-2	Use tools and materials to design and build a structure that will reduce the warming effect of sunlight on an area.*	None.			
K-ESS2-1	Use and share observations of local weather conditions to describe patterns over time.	Discoveries at Willow Creek	Earth as a System	Elementary GLOBE Book	Elementary GLOBE
		The Mystery of the Missing Hummingbirds	Earth as a System	Elementary GLOBE Book	Elementary GLOBE
		We're All Connected: Earth System Interactions	Earth as a System	Elementary GLOBE Book	Elementary GLOBE
		Cloud Protocols	Atmosphere	Protocol	GLOBE Teacher's Guide
		Max/Min/Current Air Temperature Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
		Precipitation Protocols	Atmosphere	Protocol	GLOBE Teacher's Guide
K-ESS3-2	Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather.*	None.			

Weather and Climate		Use these GLOBE Resources	Investigation Area	Resource Type	Source
3-ESS2-1	Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.	Cloud Protocols	Atmosphere	Protocol	GLOBE Teacher's Guide
		Max/Min/Current Air Temperature Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
		Precipitation Protocols	Atmosphere	Protocol	GLOBE Teacher's Guide
		S1: What Can We Learn About Our Seasons?	Earth as a System	Activity	GLOBE Teacher's Guide
		All Year Long	Earth as a System	Activity	Elementary GLOBE
		ESS: 2 Exploring Annual Changes (2007)	Earth as a System	Activity	Earth as a System Packet (2007)
3-ESS2-2	Obtain and combine information to describe climates in different regions of the world.	From Weather to Climate – Air Temperature Data	Climate Foundations	Activity	GLOBE Website
		What is your Climate Classification	Climate Foundations	Activity	GLOBE Website
		ESS: 2 Exploring Annual Changes (2007)	Earth as a System	Activity	Earth as a System Packet (2007)
3-ESS3-1	Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard.*	None.			

Weather and Climate		Use these GLOBE Resources	Investigation Area	Resource Type	Source
MS-ESS2-5	Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.	Observing, Describing, and Identifying Clouds	Atmosphere	Activity	GLOBE Teacher's Guide
		Aerosols Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
		Automated Soil and Air Temperature Monitoring Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
		AWS WeatherBug Protocol	Atmosphere	Protocol	GLOBE Website
		Barometric Pressure Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
		Cloud Protocols	Atmosphere	Protocol	GLOBE Teacher's Guide
		Davis Weather Station Protocol	Atmosphere	Protocol	GLOBE Website
		Digital Multi-Day Max/Min/Current Air and Soil Temperature Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
		Instrument Construction, Site Selection and Set-Up	Atmosphere	Protocol	GLOBE Teacher's Guide
		Max/Min/Current Air Temperature Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
		Precipitation Protocols	Atmosphere	Protocol	GLOBE Teacher's Guide
		RainWise Weather Station Protocol	Atmosphere	Protocol	GLOBE Website
		Relative Humidity Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
		Surface Ozone Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
		Surface Temperature Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
		Water Vapor Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
		WeatherHawk Weather Station Protocol	Atmosphere	Protocol	GLOBE Website

Weather and Climate		Use these GLOBE Resources	Investigation Area	Resource Type	Source
MS-ESS2-6	Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.	GC1: Your regional and global connection	Earth as a System	Activity	GLOBE Teacher's Guide
		S4: Modeling the Reasons for Seasonal Change	Earth as a System	Activity	GLOBE Teacher's Guide
		GC2: Components of the earth system working together	Earth as a System	Activity	GLOBE Teacher's Guide
		From Weather to Climate – Air Temperature Data	Climate Foundations	Activity	GLOBE Website
MS-ESS3-5	Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.	None.			

Weather and Climate		Use these GLOBE Resources	Investigation Area	Resource Type	Source
HS-ESS2-4	Use a model to describe how variations in the flow of energy into and out of Earth systems result in changes in climate.	Surface Temperature Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
		Cloud Chart	Atmosphere	Other	GLOBE Website
		Global Carbon Cycle Model with Feedbacks	Carbon	Activity	Other
		ESS: 3 Exploring Relationships Between Two Variables (2007)	Earth as a System	Activity	Earth as a System Packet (2007)
		ESS: 3. Explore Relationships between Types of Data (across columns) (1987)	Earth as a System	Activity	Earth as a Sysyem (1987)
		ESS: 4 Exploring Relationships Among Variables for a Particular Month (2007)	Earth as a System	Activity	Earth as a System Packet (2007)
		ESS: 4. Global Patterns (1987)	Earth as a System	Activity	Earth as a Sysyem (1987)
		P6: Global Patterns in Green-up and Green-down	Earth as a System	Activity	GLOBE Teacher's Guide
		GLOBE Visualization Tool	Multiple Areas	Web Feature	GLOBE Website
HS-ESS3-5	Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.	Global Carbon Cycle Model with Feedbacks	Carbon	Activity	Other
		Surface Temperature Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
		GLOBE Visualization Tool	Multiple Areas	Web Feature	GLOBE Website
		RC1: Defining regional boundaries	Earth as a System	Activity	GLOBE Teacher's Guide
		RC2: Effects of inputs and outputs on a region	Earth as a System	Activity	GLOBE Teacher's Guide
		Biomass Accumulation Model	Carbon	Activity	Other

Human Impacts		Use these GLOBE Resources	Investigation Area	Resource Type	Source
MS-ESS3-2	Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.	None.			
MS-ESS3-3	Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.*	RC2: Effects of inputs and outputs on a region	Earth as a System	Activity	GLOBE Teacher's Guide
		Land Cover Sample Site Protocol	Land Cover	Protocol	GLOBE Teacher's Guide
		Watershed Dynamics Module II #1 Rainwater Runoff Podcast	Watershed Dynamics	Other	GLOBE Website
		Watershed Dynamics Module II #2 Building a Watershed Model	Watershed Dynamics	Other	GLOBE Website
		Watershed Dynamics Module II #3 Measuring Streamflow Lab/Virtual River	Watershed Dynamics	Other	GLOBE Website
		Watershed Dynamics Module II #4 Just Passing Through/Infiltration Protocol**	Watershed Dynamics	Other	GLOBE Website
		Watershed Dynamics Module II #5 Netlogo Runoff Model	Watershed Dynamics	Other	GLOBE Website
		Watershed Dynamics Module II #6 Analyzing Hydrographs	Watershed Dynamics	Other	GLOBE Website
		Watershed Dynamics Module II #7 FieldScope/Urban Sprawl	Watershed Dynamics	Other	GLOBE Website
		Watershed Dynamics Module II #8 Extentions	Watershed Dynamics	Other	GLOBE Website
MS-ESS3-4	Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.	None.			

Human Impacts		Use these GLOBE Resources	Investigation Area	Resource Type	Source
HS-ESS3-1	Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.	Global Carbon Cycle Model with Feedbacks	Carbon	Activity	Other
		ESS: 5. Link with GLOBE Data (1987)	Earth as a System	Activity	Earth as a Sysyem (1987)
		Land Cover Change Detection Protocol	Land Cover	Protocol	GLOBE Teacher's Guide
		Computerized MultiSpec Land Cover Mapping Protocol	Land Cover	Protocol	GLOBE Teacher's Guide
		Manual Land Cover Mapping Protocol	Land Cover	Protocol	GLOBE Teacher's Guide
		Student Climate Research Campaign	Multiple Areas	Field Campaign	GLOBE Website
HS-ESS3-2	Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.*	None.			
HS-ESS3-3	Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.	Paper Clip Simulation & Model	Carbon	Activity	Other

Human Impacts		Use these GLOBE Resources	Investigation Area	Resource Type	Source
HS-ESS3-4	Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.*	Surface Temperature Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
		Surface Ozone Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
		ESS: 1. Explore a Single Map (1987)	Earth as a System	Activity	Earth as a Sysyem (1987)
		ESS: 1 Exploring Single Images (2007)	Earth as a System	Activity	Earth as a System Packet (2007)
		ESS: 2 Exploring Annual Changes (2007)	Earth as a System	Activity	Earth as a System Packet (2007)
		ESS: 2. Explore Annual Changes (within a column) (1987)	Earth as a System	Activity	Earth as a Sysyem (1987)
		Land Cover Change Detection Protocol	Land Cover	Protocol	GLOBE Teacher's Guide
		GLOBE Landsat Satillite Images	Land Cover	Other	Other
		GLOBE Visualization Tool	Multiple Areas	Web Feature	GLOBE Website
HS-ESS3-6	Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.*	Surface Temperature Protocol	Atmosphere	Protocol	GLOBE Teacher's Guide
		ESS: 1 Exploring Single Images (2007)	Earth as a System	Activity	Earth as a System Packet (2007)
		ESS: 1. Explore a Single Map (1987)	Earth as a System	Activity	Earth as a Sysyem (1987)
		ESS: 2 Exploring Annual Changes (2007)	Earth as a System	Activity	Earth as a System Packet (2007)
		ESS: 2. Explore Annual Changes (within a column) (1987)	Earth as a System	Activity	Earth as a Sysyem (1987)
		Land Cover Change Detection Protocol	Land Cover	Protocol	GLOBE Teacher's Guide
		GLOBE Landsat Satillite Images	Land Cover	Other	Other
		GLOBE Visualization Tool	Multiple Areas	Web Feature	GLOBE Website

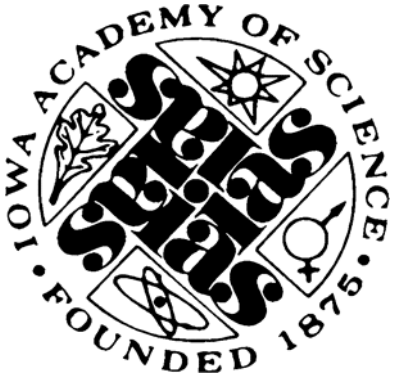
Engineering Design		Use these GLOBE Resources	Investigation Area	Resource Type	Source
2-ETS1-1	Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.	None.			
2-ETS1-2	Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.	None.			
2-ETS1-3	Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.	None.			
5-ETS1-1	Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.	None.			
5-ETS1-2	Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.	None.			
5-ETS1-3	Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.	None.			

Engineering Design		Use these GLOBE Resources	Investigation Area	Resource Type	Source
MS-ETS1-1	Define the criteria & constraints of a design problem w/ sufficient precision to ensure a successful solution, taking into account relevant scientific principles & potential impacts on people & the natural environment that may limit possible solutions.	Instrument Construction, Site Selection and Set-Up	Atmosphere	Protocol	GLOBE Teacher's Guide
		Building a Thermometer	Atmosphere	Activity	GLOBE Teacher's Guide
		Making a Sundial	Atmosphere	Activity	GLOBE Teacher's Guide
		Model a Catchment Basin	Hydrology	Activity	GLOBE Teacher's Guide
MS-ETS1-2	Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.	Building a Thermometer	Atmosphere	Activity	GLOBE Teacher's Guide
		Making a Sundial	Atmosphere	Activity	GLOBE Teacher's Guide
		Instrument Construction, Site Selection and Set-Up	Atmosphere	Protocol	GLOBE Teacher's Guide
		Model a Catchment Basin	Hydrology	Activity	GLOBE Teacher's Guide
MS-ETS1-3	Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.	Instrument Construction, Site Selection and Set-Up	Atmosphere	Protocol	GLOBE Teacher's Guide
		Building a Thermometer	Atmosphere	Activity	GLOBE Teacher's Guide
		Making a Sundial	Atmosphere	Activity	GLOBE Teacher's Guide
		Model a Catchment Basin	Hydrology	Activity	GLOBE Teacher's Guide
MS-ETS1-4	Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.	Model a Catchment Basin	Hydrology	Activity	GLOBE Teacher's Guide
		Instrument Construction, Site Selection and Set-Up	Atmosphere	Protocol	GLOBE Teacher's Guide
		Building a Thermometer	Atmosphere	Activity	GLOBE Teacher's Guide
		Making a Sundial	Atmosphere	Activity	GLOBE Teacher's Guide

Engineering Design		Use these GLOBE Resources	Investigation Area	Resource Type	Source
HS-ETS1-1	Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.	None.			
HS-ETS1-2	Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.	Getting to Know Your Satellite Imagery and GLOBE Study Site	Land Cover	Activity	GLOBE Teacher's Guide
		Discovery Area	Land Cover	Activity	GLOBE Teacher's Guide
HS-ETS1-3	Evaluate a solution to a complex real-world problem based on prioritized criteria & trade-offs that account for a range of constraints, including cost, safety, reliability, & aesthetics, & possible social, cultural, & environmental impacts.	Global Carbon Cycle Model with Feedbacks	Carbon	Activity	Other
		Paper Clip Simulation & Model	Carbon	Activity	Other
		Plant a Plant Experiments	Carbon	Activity	Other
		Getting to Know Your Satellite Imagery and GLOBE Study Site	Land Cover	Activity	GLOBE Teacher's Guide
		Discovery Area	Land Cover	Activity	GLOBE Teacher's Guide
HS-ETS1-4	Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.	Global Carbon Cycle Model with Feedbacks	Carbon	Activity	Other

A Guide to Connections between the GLOBE Program

and the Next Generation Science Standards*



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