Clarifying Science through Natural Events

Middle School Alignment Document
Next Generation Science Standards, Common Core State Standards, and 21st Century Skills

WHAT STUDENTS DO: Determine the threats and/or benefits of a natural event/hazard.

Natural events (hurricanes, tsunamis, floods, earthquakes, volcanoes, forest fires, comets and asteroids, etc) provide engaging inquiry themes for learning science, technology, math, geography, and problem solving – and in the process students can examine their fears in the light of scientific knowledge. Students study a type of natural event, learn why it occurs, where the probable locations of occurrence are, what causes damage, what conditions create especially destructive events, and what the probability of a destructive event is. It is important that students spend some time thinking about possible ways to reduce the negative impact of damaging natural events to reduce fear and increase empowerment.

NGSS CORE & COMPONENT QUESTIONS

How do Earth's surface processes and human activities affect each other?
NGSS Core Idea ESS3: Earth and Human Activity

How do natural hazards affect individuals and societies?
NGSS Core Idea ESS3.B: Natural Hazards

INSTRUCTIONAL OBJECTIVES

Students will be able to

IO1: **Use a model to explain a natural event or hazard and their impacts on the stability of the environment and populations**

IO2: **Investigate and describe viable methods to minimize impacts and maximize benefits of natural events**

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1.0 About This Activity

Mars lessons leverage *A Taxonomy for Learning, Teaching, and Assessing* by Anderson and Krathwohl (2001) (see *Section 4* and *Teacher Guide* at the end of this document). This taxonomy provides a framework to help organize and align learning objectives, activities, and assessments. The taxonomy has two dimensions. The first dimension, cognitive process, provides categories for classifying lesson objectives along a continuum, at increasingly higher levels of thinking; these verbs allow educators to align their instructional objectives and assessments of learning outcomes to an appropriate level in the framework in order to build and support student cognitive processes. The second dimension, knowledge, allows educators to place objectives along a scale from concrete to abstract. By employing Anderson and Krathwohl's (2001) taxonomy, educators can better understand the construction of instructional objectives and learning outcomes in terms of the types of student knowledge and cognitive processes they intend to support. All activities provide a mapping to this taxonomy in the Teacher Guide (at the end of this lesson), which carries additional educator resources. Combined with the aforementioned taxonomy, the lesson design also draws upon Miller, Linn, and Gronlund's (2009) methods for (a) constructing a general, overarching, instructional objective with specific, supporting, and measurable learning outcomes that help assure the instructional objective is met, and (b) appropriately assessing student performance in the intended learning-outcome areas through rubrics and other measures. Construction of rubrics also draws upon Lanz's (2004) guidance, designed to measure science achievement.

How Students Learn: Science in the Classroom (Donovan & Bransford, 2005) advocates the use of a research-based instructional model for improving students' grasp of central science concepts. Based on conceptual-change theory in science education, the 5E Instructional Model (BSCS, 2006) includes five steps for teaching and learning: Engage, Explore, Explain, Elaborate, and Evaluate. The Engage stage is used like a traditional warm-up to pique student curiosity, interest, and other motivation-related behaviors and to assess students' prior knowledge. The Explore step allows students to deepen their understanding and challenges existing preconceptions and misconceptions, offering alternative explanations that help them form new schemata. In Explain, students communicate what they have learned, illustrating initial conceptual change. The Elaborate phase gives students the opportunity to apply their newfound knowledge to novel situations and supports the reinforcement of new schemata or its transfer. Finally, the Evaluate stage serves as a time for students' own formative assessment, as well as for educators' diagnosis of areas of confusion and differentiation of further instruction. This five-part sequence is the organizing tool for the Imagine Mars instructional series. The 5E stages can be cyclical and iterative.

2.0 Instructional Objectives, Learning Outcomes, & Standards

Instructional objectives and learning outcomes are aligned with

- National Research Council's, *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*
- Achieve Inc.'s, *Next Generation Science Standards (NGSS)*
- National Governors Association Center for Best Practices (NGA Center) and Council of Chief State School Officers (CCSSO)'s, *Common Core State Standards for English Language Arts & Literacy in History/Social Studies, Science, and* Technical Subjects
- Partnership for 21st Century Skills, *A Framework for 21st Century Learning*

The following chart provides details on alignment among the core and component NGSS questions, instructional objectives, learning outcomes, and educational standards.

- Your **instructional objectives (IO)** for this lesson align with the NGSS Framework and NGSS.
- You will know that you have achieved these instructional objectives if students demonstrate the related **learning outcomes (LO)**.
- You will know the level to which your students have achieved the learning outcomes by using the suggested **rubrics** (see Teacher Guide at the end of this lesson).

Quick View of Standards Alignment:

The Teacher Guide at the end of this lesson provides full details of standards alignment, rubrics, and the way in which instructional objectives, learning outcomes, 5E activity procedures, and assessments were derived through, and align with, Anderson and Krathwohl's (2001) taxonomy of knowledge and cognitive process types. For convenience, a quick view follows:

How do Earth's surface processes and human activities affect each other?

NGSS Core Idea ESS3: Earth and Human Activity

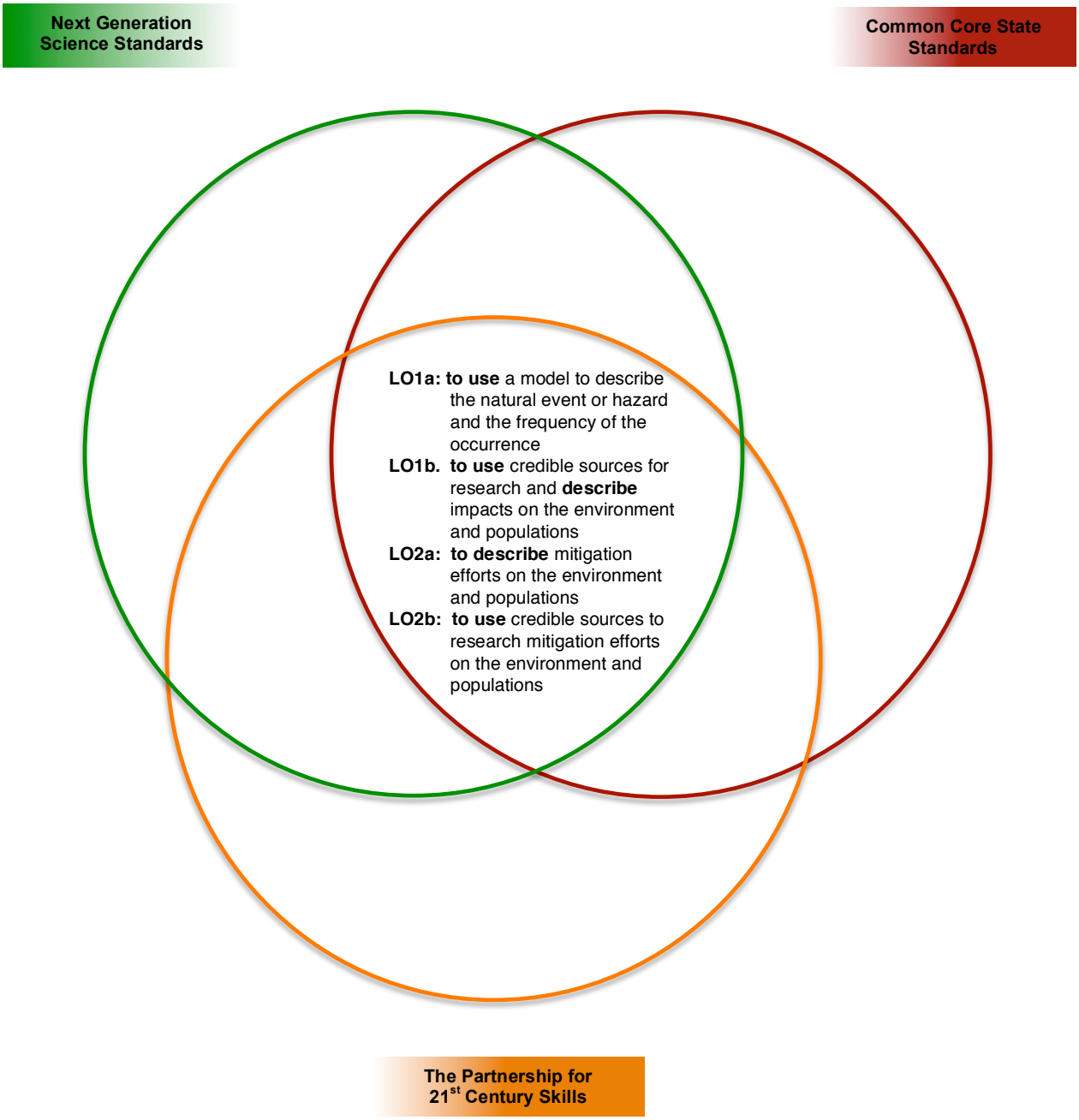
How do natural hazards affect individuals and societies?

NGSS Core Idea ESS3.B: Natural Hazards

Instructional Objective *Students will be able*	**Learning Outcomes** *Students will demonstrate the measurable abilities*	**Standards** *Students will address*
IO1: **Use a model to explain a natural event or hazard and their impacts on the stability of the environment and populations**	**LO1a.** to use a model to describe the natural event or hazard and the frequency of the occurrence **LO1b.** to use credible sources for research and describe impacts on the environment and populations	**DISCIPLINARY CORE IDEA:** ESS3.B: Natural Hazards **PRACTICES:** 1. Developing and Using Models 2. Constructing Explanations and Designing Solutions 3. Obtaining, Evaluating, and Communicating Information **CROSSCUTTING CONCEPTS:** 1. Patterns 2. Scale, Proportion, and Quantity 3. Cause and Effect 4. Stability and Change
IO2: **Investigate and describe viable methods to minimize impacts and maximize benefits of natural events**	**LO2a:** to describe mitigation efforts on the environment and populations **LO2b:** to use credible sources to research mitigation efforts on the environment and populations	**DISCIPLINARY CORE IDEA:** ESS3.B: Natural Hazards **PRACTICES:** 1. Constructing Explanations and Designing Solutions 2. Obtaining, Evaluating, and Communicating Information **CROSSCUTTING CONCEPTS:** 1. Cause and Effect 2. Structure and Function

3.0 Learning Outcomes, NGSS, Common Core, & 21st Century Skills Connections

The connections diagram is used to organize the learning outcomes addressed in the lesson to establish where each will meet the Next Generation Science Standards, ELA Common Core Standards, and the 21st Century Skills and visually determine where there are overlaps in these documents.



4.0 Evaluation/Assessment

Rubric: A rubric has been provided to assess student understanding of the simulation and to assess metacognition. A copy has been provided in the Student Guide for students to reference prior to the simulation. This rubric will allow them to understand the expectations set before them.

5.0 References

Achieve, Inc. (2013). *Next generation science standards*. Achieve, Inc. on behalf of the twenty-six states and partners that collaborated on the NGSS.

Anderson, L.W., & Krathwohl (Eds.). (2001). *A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives.* New York: Longman.

Bybee, R., Taylor, J., Gardner, A., Van Scotter, P., Carson Powell, J., Westbrook, A., Landes, N. (2006) *The BSCS 5E instructional model: origins, effectiveness, and applications.* Colorado Springs: BSCS.

Donovan, S. & Bransford, J. D. (2005). *How Students Learn: History, Mathematics, and Science in the Classroom.* Washington, DC: The National Academies Press.

Miller, Linn, & Gronlund. (2009). *Measurement and assessment in teaching*. Upper Saddle River, NJ: Pearson.

National Academies Press. (1996, January 1). *National science education standards*. Retrieved February 7, 2011 from http://www.nap.edu/catalog.php?record_id=4962

National Governors Association Center for Best Practices & Council of Chief State School Officers. (2010). *Common Core State Standards*. Washington, DC: Authors.

National Research Council. (2012). *A framework for K-12 science education: Practices, crosscutting concepts, and core ideas.* Committee on a Conceptual Framework for New K-12 Science Education Standards. Board on Science Education, Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press.

The Partnership for 21st Century Skills (2011). *A framework for 21st century learning.* Retrieved March 15, 2012 from http://www.p21.org

(L) Teacher Resource. Clarifying Science through Natural Events NGSS Alignment (1 of 3)

You will know the level to which your students have achieved the **Learning Outcomes**, and thus the **Instructional Objective(s)**, by using the suggested **Rubrics** below.

Related Standard(s)

This lesson supports the preparation of students toward achieving Performance Expectations using the Practices, Cross-Cutting Concepts and Disciplinary Core Ideas defined below:

(MS-ESS3-2)

Next Generation Science Standards Alignment (NGSS)

Instructional Objective	Science and Engineering Practices	Disciplinary Core Idea	Crosscutting Concepts
IO1: **Use a model to explain a natural event or hazard and their impacts on the stability of the environment and populations**	**Developing and Using Models:** Develop and/or use a model to predict and/or describe phenomena. **Constructing Explanation and Designing Solutions:** Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) and/or describe(s) phenomena. Construct an explanation using models or representations. Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real-world phenomena, examples, or events.	**ESS3.B: Natural Hazards** Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events. (MS-ESS3-2)	**Stability and Change**: Stability might be disturbed either by sudden events or gradual changes that accumulate over time.
IO2: **Investigate and describe viable methods to minimize**	**Obtaining, Evaluating, and Communicating Information:** 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	**ESS3.B: Natural Hazards** Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events. (MS-ESS3-2)	**Structure and Function:** Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used.

impacts and maximize benefits of natural events	evidence about the natural and designed world(s). Communicate scientific and/or technical information (e.g. about a proposed object, tool, process, system) in writing and/or through oral presentations.		

(L) Teacher Resource. Clarifying Science through Natural Events NGSS Alignment (2 of 3)

Next Generation Science Standards Alignment (NGSS)

Learning Outcomes	Science and Engineering Practices	Disciplinary Core Idea	Crosscutting Concepts
LO1a: **to use a model to describe the natural event or hazard and the frequency of the occurrence**	**Developing and Using Models:** Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena. Develop and/or use a model to predict and/or describe phenomena. **Constructing Explanations and Designing Solutions:** Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) and/or describe(s) phenomena. Construct an explanation using models or representations. 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. Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real-world phenomena, examples, or events.	**ESS3.B: Natural Hazards** Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events. (MS-ESS3-2)	**Patterns:** Patterns in rates of change and other numerical relationships can provide information about natural and human designed systems. Patterns can be used to identify cause and effect relationships. **Scale, Proportion, and Quantity:** Proportional relationships (e.g., speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes. **Cause and Effect:** Cause and effect relationships may be used to predict phenomena in natural or designed systems. Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.

LO1b: **to use credible sources for research and describe impacts on the environment and populations**	**Obtaining, Evaluating, and Communicating Information:** Gather, read, 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. 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). Communicate scientific and/or technical information (e.g. about a proposed object, tool, process, system) in writing and/or through oral presentations. **Constructing Explanations and Designing Solutions:** Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) and/or describe(s) phenomena. Construct an explanation using models or representations. 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. Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real-world phenomena, examples, or events.	**ESS3.B: Natural Hazards** Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events. (MS-ESS3-2)	**Cause and Effect:** Cause and effect relationships may be used to predict phenomena in natural or designed systems. Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.

LO2a: **to describe mitigation efforts on the environment and populations**	**Constructing Explanations and Designing Solutions:** Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) and/or describe(s) phenomena. Construct an explanation using models or representations. 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. Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real-world phenomena, examples, or events.	**ESS3.B: Natural Hazards** Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events. (MS-ESS3-2)	**Cause and Effect:** Cause and effect relationships may be used to predict phenomena in natural or designed systems. Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
LO2b: **to use credible sources to research mitigation efforts on the environment and populations**	**Obtaining, Evaluating, and Communicating Information:** Gather, read, 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. 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).	**ESS3.B: Natural Hazards** Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events. (MS-ESS3-2)	**Cause and Effect:** Cause and effect relationships may be used to predict phenomena in natural or designed systems. Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.

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Common Core State Standards

Instructional Objective	Reading Standards for Literacy in Science and Technical Subjects (6-8)	Writing Standards for Literacy in Science and Technical Subjects (6-8)	Speaking and Listening Standards (6-8)
IO1: **Use a model to explain a natural event or hazard and their impacts on the stability of the environment and populations** **IO2:** **Investigate and describe viable methods to minimize impacts and maximize benefits of natural events**	**Key Ideas and Details:** **Grade 6-8:** Cite specific textual evidence to support analysis of science and technical texts. Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions. **Craft and Structure:** **Grade 6-8:** Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6–8 texts and topics. **Integration of Knowledge and Ideas:** **Grade 6-8:** Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).	**Text Types and Purposes:** **Grade 6-8:** Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. • Introduce a topic clearly, previewing what is to follow; organize ideas, concepts, and information into broader categories as appropriate to achieving purpose; include formatting (e.g., headings), graphics (e.g., charts, tables), and multimedia when useful to aiding comprehension. • Develop the topic with relevant, well-chosen facts, definitions, concrete details, quotations, or other information and examples. • Use appropriate and varied transitions to create cohesion and clarify the relationships among ideas and concepts. • Use precise language and domain-specific vocabulary to inform about or explain the topic. • Establish and maintain a formal style and objective tone. • Provide a concluding statement or section that follows from and supports the information or explanation presented. **Production and Distribution:** Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. Use technology, including the Internet, to	**Comprehension and Collaboration:** **Grade 6:** Interpret information presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how it contributes to a topic, text, or issue under study. **Grade 7:** Analyze the main ideas and supporting details presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how the ideas clarify a topic, text, or issue under study. **Presentation of Knowledge and Ideas:** **Grade 6:** Present claims and findings, sequencing ideas logically and using pertinent descriptions, facts, and details to accentuate main ideas or themes; use appropriate eye contact, adequate volume, and clear pronunciation. **Grade 7 & 8:** Present claims and findings, emphasizing salient points in a focused, coherent manner with pertinent descriptions, facts, details, and examples; use appropriate eye contact, adequate volume, and clear pronunciation.

		produce and publish writing and present the relationships between information and ideas clearly and efficiently. **Research to Build and Present Knowledge:** **Grades 6-8:** Draw evidence from informational texts to support analysis reflection, and research	

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Common Core State Standards			
Learning Outcome	**Reading Standards for Literacy in Science and Technical Subjects (6-8)**	**Writing Standards for Literacy in Science and Technical Subjects (6-8)**	**Speaking and Listening Standards (6-8)**
LO1a: to use a model to describe the natural event or hazard and the frequency of the occurrence **LO2a:** to describe mitigation efforts on the environment and populations	**Key Ideas and Details:** **Grade 6-8:** Cite specific textual evidence to support analysis of science and technical texts. Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions. **Craft and Structure:** **Grade 6-8:** Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6–8 texts and topics. **Integration of Knowledge and Ideas:** **Grade 6-8:** Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).	**Text Types and Purposes:** **Grade 6-8:** Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. • Introduce a topic clearly, previewing what is to follow; organize ideas, concepts, and information into broader categories as appropriate to achieving purpose; include formatting (e.g., headings), graphics (e.g., charts, tables), and multimedia when useful to aiding comprehension. • Develop the topic with relevant, well-chosen facts, definitions, concrete details, quotations, or other information and examples. • Use appropriate and varied transitions to create cohesion and clarify the relationships among ideas and concepts. • Use precise language and domain-specific vocabulary to inform about or explain the topic. • Establish and maintain a formal style and objective tone. • Provide a concluding statement or section that follows from and supports the information or explanation presented. **Production and Distribution:** Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. Use technology, including the Internet, to	**Comprehension and Collaboration:** **Grade 6:** Interpret information presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how it contributes to a topic, text, or issue under study. **Grade 7:** Analyze the main ideas and supporting details presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how the ideas clarify a topic, text, or issue under study. **Presentation of Knowledge and Ideas:** **Grade 6:** Present claims and findings, sequencing ideas logically and using pertinent descriptions, facts, and details to accentuate main ideas or themes; use appropriate eye contact, adequate volume, and clear pronunciation. **Grade 7 & 8:** Present claims and findings, emphasizing salient points in a focused, coherent manner with pertinent descriptions, facts, details, and examples; use appropriate eye contact, adequate volume, and clear pronunciation.

		produce and publish writing and present the relationships between information and ideas clearly and efficiently. **Research to Build and Present Knowledge:** **Grades 6-8:** Draw evidence from informational texts to support analysis reflection, and research	
LO1b: **to use credible sources for research and describe impacts on the environment and populations** **LO2b:** **to use credible sources to research mitigation efforts on the environment and populations**	**Key Ideas and Details:** **Grade 6-8:** Cite specific textual evidence to support analysis of science and technical texts. Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions. **Craft and Structure:** **Grade 6-8:** Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6–8 texts and topics. Identify aspects of a text that reveal an author's point of view or purpose (e.g., loaded language, inclusion or avoidance of particular facts). **Integration of Knowledge and Ideas:** **Grade 6-8:** Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). Distinguish among fact, opinion, and reasoned judgment in a text.	**Text Types and Purposes:** **Grade 6-8:** Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. • Introduce a topic clearly, previewing what is to follow; organize ideas, concepts, and information into broader categories as appropriate to achieving purpose; include formatting (e.g., headings), graphics (e.g., charts, tables), and multimedia when useful to aiding comprehension. • Develop the topic with relevant, well-chosen facts, definitions, concrete details, quotations, or other information and examples. • Use appropriate and varied transitions to create cohesion and clarify the relationships among ideas and concepts. • Use precise language and domain-specific vocabulary to inform about or explain the topic. • Establish and maintain a formal style and objective tone. • Provide a concluding statement or section that follows from and supports the information or explanation presented. **Production and Distribution:** Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. Use technology, including the Internet, to produce and publish writing and present the relationships between information and ideas	**Comprehension and Collaboration:** **Grade 6:** Interpret information presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how it contributes to a topic, text, or issue under study. **Grade 7:** Analyze the main ideas and supporting details presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how the ideas clarify a topic, text, or issue under study. **Presentation of Knowledge and Ideas:** **Grade 6:** Present claims and findings, sequencing ideas logically and using pertinent descriptions, facts, and details to accentuate main ideas or themes; use appropriate eye contact, adequate volume, and clear pronunciation. **Grade 7 & 8:** Present claims and findings, emphasizing salient points in a focused, coherent manner with pertinent descriptions, facts, details, and examples; use appropriate eye contact, adequate volume, and clear pronunciation.

		clearly and efficiently. **Research to Build and Present Knowledge:** **Grades 6-8:** Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. Draw evidence from informational texts to support analysis reflection, and research	

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21st Century Skills

Learning Outcomes	21st Century Skill	Grade 8 Benchmark
LO1a: to use a model to describe the natural event or hazard and the frequency of the occurrence	**Communication**	Students are familiar with the use of computational models as tools to describe and predict real-world phenomena.
	Flexibility and Adaptability	Students can identify the difference between scientific theories (which can be improved through new evidence and expanded through exceptions to observed patterns) and beliefs (which may or may not be based on evidence). Students can provide examples that show how people often rely on scientific information to inform personal choices and societal practices, and that changes in scientific understanding can affect those choices.
LO1b: to use credible sources for research and describe impacts on the environment and populations	**Information Literacy**	Students are able to locate reliable scientific information in reputable reference books, back issues of journals and magazines, on websites, and in computer databases.
	Media Literacy	Students are able to identify and critique arguments in which the claims are not consistent with the evidence given.
LO2a: to describe mitigation efforts on the environment and populations	**Flexibility and Adaptability**	Students can identify the difference between scientific theories (which can be improved through new evidence and expanded through exceptions to observed patterns) and beliefs (which may or may not be based on evidence). Students can provide examples that show how people often rely on scientific information to inform personal choices and societal practices, and that changes in scientific understanding can affect those choices.
LO2b: to use credible sources to research mitigation efforts on the environment and populations	**Information Literacy**	Students are able to locate reliable scientific information in reputable reference books, back issues of journals and magazines, on websites, and in computer databases.
	Media Literacy	Students are able to identify and critique arguments in which the claims are not consistent with the evidence given.

(O) Teacher Resource. Clarifying Science through Natural Events NGSS Rubric (1 of 3)

Related Rubrics for the Assessment of Learning Outcomes Associated with the Above Standard(s):

Next Generation Science Standards Alignment (NGSS)

Learning Outcome	Expert	Proficient	Intermediate	Beginner
LO1a: to use a model to describe the natural event or hazard and the frequency of the occurrence	Description of the event or hazard is covered accurately and fully, using evidence from the model. Student fully and accurately addressees the frequency of the event and or the ability to predict.	Description of the event or hazard is adequate, using evidence from the model. Student correctly addressees the frequency of the event and or the ability to predict.	Description of the event or hazard uses some evidence from the model and some prior misconception. Student discusses the frequency of the event and or the ability to predict.	Description of the event and frequency is based on and supported by evidence of prior misconceptions.
LO1b: to use credible sources for research and **describe** impacts on the environment and populations	Resources for research are from many credible, primary sources (such as journal publications and .gov sites) and avoiding .com sites, blogs, and secondary sources of information (such as news sites). Description of the impacts is covered accurately and fully, using evidence from the research.	Resources for research are mostly from credible, primary sources (such as journal publications and .gov sites) and only using one .com site, blog, or secondary source of information (such as news sites). Description of the impacts is covered accurately and fully, using evidence from the research.	Some resources for research are credible, primary sources (such as journal publications and .gov sites), but a few are from .com sites, blogs, or secondary source of information (such as news sites). Description of the impacts is discussed, using evidence from the research.	Majority or all of resources are from secondary sources. Impacts are discussed and may be based on prior misconceptions.
LO2a: to describe mitigation efforts on the environment and populations	Description of the mitigation effort is covered accurately and fully, using evidence from the research.	Description of the mitigation effort is adequate, using evidence from the research	Description of the mitigation effort uses some evidence from the research and some prior misconception.	Description of the mitigation effort is based on and supported by evidence of prior misconceptions.

LO2b: to use credible sources to research mitigation efforts on the environment and populations	Resources for research are from many credible, primary sources (such as journal publications and .gov sites) and avoiding .com sites, blogs, and secondary sources of information (such as news sites).	Resources for research are mostly from credible, primary sources (such as journal publications and .gov sites) and only using one .com site, blog, or secondary source of information (such as news sites).	Some resources for research are credible, primary sources (such as journal publications and .gov sites), but a few are from .com sites, blogs, or secondary source of information (such as news sites).	Majority or all of resources are from secondary sources.

(P) Teacher Resource. Clarifying Science through Natural Events CCSS Rubric (2 of 3)

Common Core State Standards

	Expert	Proficient	Intermediate	Beginner
Research to Build and Present Knowledge	Recalls relevant information from experience; summarizes information in finished work; draws evidence from informational texts to support analysis, reflection, and research.	Recalls relevant information from experience; draws evidence from informational texts to support analysis, reflection, and research.	Recalls information from experience; draws evidence from informational texts to support analysis, reflection, and research.	Recalls information from experience.
Effective Demonstration of Comprehension and Collaboration and Production and Distribution	Uses a variety of media formats and accurately applies them to clearly describe the natural event or hazard and mitigation efforts.	Uses a variety of media formats and applies them to describe the natural event or hazard and mitigation efforts.	Uses one media format and applies it to describe the natural event or hazard and mitigation efforts.	Attempts to describe the natural event/hazard, and/or mitigation efforts without the use of media.
Text Types and Purpose	Introduces topic clearly, provides a general observation and focus, and groups related information logically; Develops the topic with facts, definitions, concrete details, or other examples related to the topic; Links ideas using words, phrases, and clauses; Use domain-specific vocabulary to explain the topic; Provides a concluding statement related to the explanation.	Introduces topic clearly, provides a general observation, or groups related information logically; Develops the topic with concrete details, or other examples related to the topic; Links ideas using words or phrases; Uses domain-specific vocabulary to explain the topic; Provides a concluding statement related to the explanation.	Introduces topic, provides a general observation; Develops the topic with details, or other examples related to the topic; Links ideas using words or phrases; Uses domain-specific vocabulary to explain the topic; May or may not provide a concluding statement.	Introduces topic; Develops the topic with details, or other examples, potentially unrelated; Uses specific vocabulary to explain the topic; May or may not provide a concluding statement.
Key Ideas and Details	Uses specific evidence from text to support ideas. Develops an accurate and in depth summary, extending prior understanding and opinions.	Uses specific evidence from text to support ideas. Develops an in depth summary, extending prior understanding and opinions.	Uses information from text to support ideas. Develops a summary, extending prior understanding and opinions.	Supports ideas with details, relying on prior understanding and opinions.

Craft and Structure	Develops strong, accurate vocabulary through research and mitigation efforts.	Develops strong, vocabulary through research and mitigation efforts.	Develops vocabulary through research and mitigation efforts.	Vocabulary is rudimentary and based on prior understanding.
Integration of Knowledge	Successfully combines information from lesson with resources to develop a deep understanding of the topic.	Successfully combines information from lesson with resources to develop an understanding of topic.	Combines information from lesson with resources to develop a summary of topic.	References text from resources to develop a summary of topic.

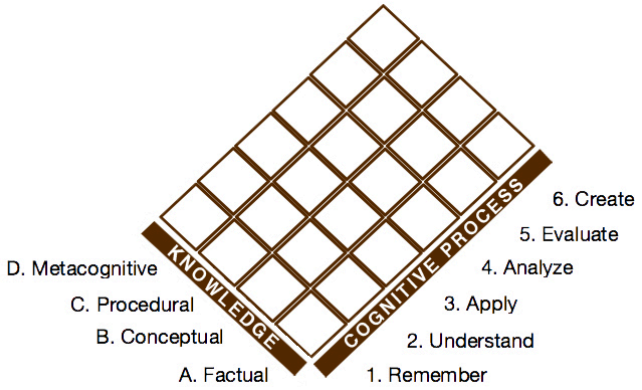
(Q) Teacher Resource. Clarifying Science through Natural Events 21st Century Skills Rubric (3 of 3)

Partnership for 21st Century Skills

	Expert	Proficient	Intermediate	Beginner
Effectiveness of Communication	Successfully uses a variety of models to describe and predict real-world phenomena.	Successfully uses a model to describe and predict real-world phenomena.	Uses a model to attempt a description of real-world phenomena.	Uses prior misconceptions to describe real-world phenomena.
Effectiveness of Media and Information Literacy	Locates reliable scientific information in reputable reference books, back issues of journals and magazines, on websites, and in computer databases.	Locates reliable scientific information in reputable reference books, back issues of journals *or* magazines, on websites.	Locates scientific information from a mixed variety of sources, some reputable, others less likely.	Locates information from websites indiscriminately.
Effectiveness of Flexibility and Adaptability	Successfully corrects thinking on natural events and hazards using a variety of evidence and uses that information to choose an appropriate mitigation effort.	Successfully corrects majority of thinking on natural events and hazards using a variety of evidence and uses that information to choose an appropriate mitigation effort.	Primarily uses evidence on natural events and hazards to correct thinking with a few beliefs embedded and uses that information to choose an appropriate mitigation effort.	Uses beliefs on natural events and hazards to choose a mitigation effort.

(R) Teacher Resource. Placement of Instructional Objective and Learning Outcomes in Taxonomy (1 of 3)

This lesson adapts Anderson and Krathwohl's (2001) taxonomy, which has two domains: Knowledge and Cognitive Process, each with types and subtypes (listed below). Verbs for objectives and outcomes in this lesson align with the suggested knowledge and cognitive process area and are mapped on the next page(s). Activity procedures and assessments are designed to support the target knowledge/cognitive process.



Knowledge	Cognitive Process
A. Factual **Aa:** Knowledge of Terminology **Ab:** Knowledge of Specific Details & Elements **B. Conceptual** **Ba:** Knowledge of classifications and categories **Bb:** Knowledge of principles and generalizations **Bc:** Knowledge of theories, models, and structures **C. Procedural** **Ca:** Knowledge of subject-specific skills and algorithms **Cb:** Knowledge of subject-specific techniques and methods **Cc:** Knowledge of criteria for determining when to use appropriate procedures **D. Metacognitive** **Da:** Strategic Knowledge **Db:** Knowledge about cognitive tasks, including appropriate contextual and conditional knowledge **Dc:** Self-knowledge	**1. Remember** **1.1** Recognizing (Identifying) **1.2** Recalling (Retrieving) **2. Understand** **2.1** Interpreting (Clarifying, Paraphrasing, Representing, Translating) **2.2** Exemplifying (Illustrating, Instantiating) **2.3** Classifying (Categorizing, Subsuming) **2.4** Summarizing (Abstracting, Generalizing) **2.5** Inferring (Concluding, Extrapolating, Interpolating, Predicting) **2.6** Comparing (Contrasting, Mapping, Matching) **2.7** Explaining (Constructing models) **3. Apply** **3.1** Executing (Carrying out) **3.2** Implementing (Using) **4. Analyze** **4.1** Differentiating (Discriminating, distinguishing, focusing, selecting) **4.2** Organizing (Finding coherence, integrating, outlining, parsing, structuring) **4.3** Attributing (Deconstructing) **5. Evaluate** **5.1** Checking (Coordinating, Detecting, Monitoring, Testing) **5.2** Critiquing (Judging) **6. Create** **6.1** Generating (Hypothesizing) **6.2** Planning (Designing) **6.3** Producing (Constructing)

(R) Teacher Resource. Placement of Instructional Objective and Learning Outcomes in Taxonomy (2 of 3)

The design of this activity leverages Anderson & Krathwohl's (2001) taxonomy as a framework. Pedagogically, it is important to ensure that objectives and outcomes are written to match the knowledge and cognitive process students are intended to acquire.

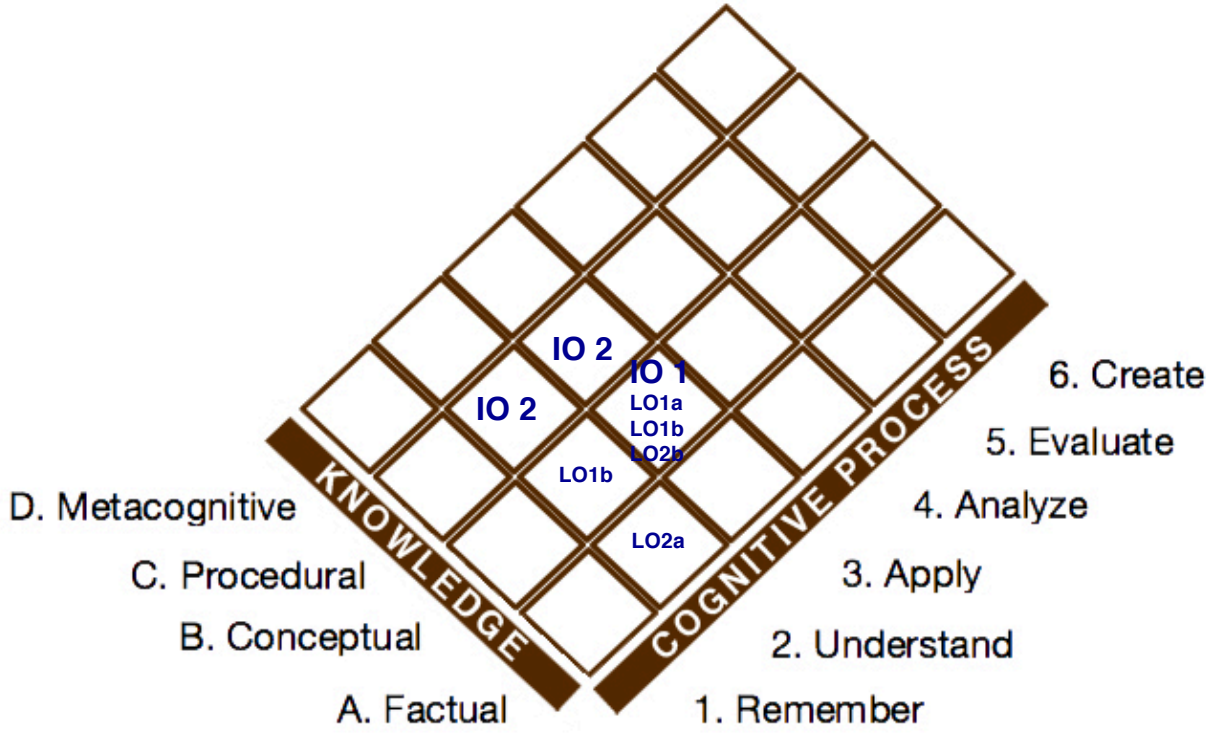
IO1: Use a model to explain a natural event or hazard and their impacts on the stability of the environment and populations (3.2; Bc)
IO2: Investigate and describe viable methods to minimize impacts and maximize benefits of natural events (3.1 & 2.4; Cc)

LO1a. to use a model to describe the natural event or hazard and the frequency of the occurrence (3.2; Bc)

LO1b. to use credible sources for research and **describe** impacts on the environment and populations (3.2 & 2.4; Bc)

LO2a. to describe mitigation efforts on the environment and populations (2.4; Ab)

LO2b. to use credible sources to research mitigation efforts on the environment and populations (3.2; Bc)



(R) Teacher Resource. Placement of Instructional Objective and Learning Outcomes in Taxonomy (3 of 3)

The design of this activity leverages Anderson & Krathwohl's (2001) taxonomy as a framework. Below are the knowledge and cognitive process types students are intended to acquire per the instructional objective(s) and learning outcomes written for this lesson. The specific, scaffolded 5E steps in this lesson (see Procedures) and the formative assessments (worksheets in the Student Guide and rubrics in the Teacher Guide) are written to support those objective(s) and learning outcomes. Refer to previous pages for the full list of categories in the taxonomy from which the following were selected. The prior page provides a visual description of the placement of learning outcomes that enable the overall instructional objective(s) to be met.

At the end of the lesson, students will be able

IO1: Use a model
- **3.2:** to use
- **Bc:** Knowledge of theories, models, and structures

IO2: Investigate and describe
- **3.1:** to carry out
- **2.4:** to summarize
- **Cc:** Knowledge of criteria for determining when to use appropriate procedures

To meet that instructional objective, students will demonstrate the abilities:

LO1a: to use
- 3.2: to use
- Bc: Knowledge of theories, models, and structures

LO1b: to use; to describe
- 3.2: to use
- 2.4: to summarize
- Bc: Knowledge of theories, models, and structures

LO2a: to describe
- 2.4: to summarize
- Ab: Knowledge of Specific Details & Elements

LO2b: to use
- 3.2: to use
- Bc: Knowledge of theories, models, and structures