Unit 6.5 Natural Hazards

Content Area: **Science**
Course(s): **Science 6**
Time Period: **Marking Period 1**
Length: **MP 1**
Status: **Published**

Essential Questions

Where do natural hazards happen and how do we prepare for them?

Lesson 1 What happens to acommunity when a tsunami occurs?

Lesson 2 Where do tsunamis happen and what causes them?

Lesson 3 What causes a tsunami to form and move?

Lesson 4 How can we forecast where and when tsunamis will happen and which communities are at risk?

Lesson 5 How can we reduce damagefrom a tsunami wave?

Lesson 6 How are tsunamis detectedand warning signals sent?

Lesson 7 What are ways we can communicate with people before and during a tsunami?

Lesson 8 Which emergency communication systems are the most reliable in a hazard?

Lesson 9 How can we model the systems put into place to protect communities?

Lesson 10 How can we effectively prepare our communities for a natural hazard?

Big Ideas

Unit Summary and Storyline

This unit begins with students experiencing, through text and video, a devastating natural event that caused major flooding in coastal towns of Japan. This event was the 2011 Great Sendai or Tōhoku earthquake and subsequent tsunami that caused major loss of life and property in Japan. Through this anchoring phenomenon, students think about ways to detect tsunamis, warn people, and reduce damage from the wave. As students design solutions to solve this problem, they begin to wonder about the natural hazard itself: what causes it, where it happens, and how it causes damage.

The first part of the unit focuses on identifying where tsunamis occur, how they form, how they move across the ocean, and what happens as they approach shore. The second part of the unit transitions students to consider combinations of engineering design solutions and technologies to mitigate the effects of tsunamis. Finally, students apply their understanding to consider how to communicate about another natural hazard to stakeholders in a community.

*Note about recent changes to this unit - In February 2022 the development team adjusted the unit to include a new section building towards MS-PS4-3: Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals. This updated version integrates a new Lesson 8 into the storyline that focuses on developing PS4-3 through further exploration of hazard communication systems and different signals used to send alerts to communities. Using text, images, and videos, students explore the evolution of emergency communication systems over time. They obtain information about the benefits and challenges of different systems, and in particular, the types of signals used to alert people. Students gather information from the text and multimedia to support the claim that digital signals are more reliable ways to transmit information. The remaining lessons in the unit are unchanged.

Anchoring Phenomenon

- For the anchoring phenomenon, students read text and watch videos of the 2011 Great Sendai or Tōhoku earthquake and tsunami that occurred off the east coast of Japan. This natural hazard caused great devastation to Japan's coastal communities despite the occurrence of tsunami's in this area throughout Japan's history and the engineering preparation that had been done in the area to protect communities. It provides a rich context in which to investigate our abilities to forecast hazards and use engineering design solutions and technologies to mitigate the effects of hazards. Importantly, this phenomenon also highlights the importance of education and communication with people for how to prepare and respond during a natural hazard.

  Each OpenSciEd unit's anchoring phenomenon is chosen from a group of possible phenomena after analyzing student interest survey results and consulting with several external advisory panels. The tsunami hazard for this unit was chosen for three reasons:

  - Tsunami hazards build directly upon Disciplinary Core Ideas (DCIs) from 4th grade in which students learned about physical waves. It advances their understanding of mechanical waves by providing a much larger scale phenomenon to investigate.
  - Tsunami hazards also directly build upon Disciplinary Core Ideas from grades 6-8 regarding geologic processes and changes in Earth's surface in OpenSciEd Unit 6.4: What causes Earth's surface to change? (Everest Unit), which comes just prior to this unit in the OpenSciEd Scope and Sequence. Students leverage their ideas about movement of Earth's plates to develop a causal mechanism for how tsunamis form.
  - Tsunamis have not had a direct impact on US communities in recent years and students in the US have likely not experienced one directly. This is an important consideration in choosing a natural hazard for in depth investigation since a distal hazard is least likely to elicit direct emotional response from students who may have experienced direct devastation from other types of hazards, such as floodings, tornadoes, earthquakes, and/or hurricanes.

Enduring Understandings

Next Generation Standards

- 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.
- MS-PS4-3: Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.
- MS-ETS1-1*: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on

people and the natural environment that may limit possible solutions.
- MS-ETS1-2*: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

Disciplinary Core Ideas

- ESS3.B: 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. Students use historical tsunami data, videos, simulations, and physical models to investigate where and why tsunamis form, how they move across the ocean, and what happens as the wave approaches shore. They also use historical data for nine other natural hazards to determine general patterns of risk and their own local level of risk for each hazard.
- ETS1.A: The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. Students use criteria and constraints, based on the science and engineering ideas developed in the unit, to evaluate design solutions and technologies that work together to mitigate the effects of natural hazards.
- ETS1.B: There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. Students systematically evaluate structure design solutions and technologies to determine how well they meet criteria and constraints for communities and stakeholder groups.

Crosscutting Concepts

- Cause and Effect: Students will build a Tsunami Chain of Event diagram that links together cause-and-effect relationships across science and engineering ideas from the unit. These science and engineering ideas are developed in Lessons 2-7.
- System and System Models: Integrated with the Tsunami Chain of Events is a Hazard System Model that links components of subsystems with those science and engineering ideas about tsunamis. These components and subsystems are developed in Lessons 5-7 and integrated in Lesson 8.
- Stability and Change: Throughout the unit, students often consider the rate of onset of hazards and how quickly a "sudden event" can disrupt the stability of a system. This aspect of the crosscutting concept is used to consider how people will need to respond in such an event.
- The unit also includes opportunities to practice using Patterns; Scale, Proportion, & Quantity; Energy and Matter; and Structure and Function

Cross-Curricular Integration

Integration Area: Language Arts

MS-ESS1-3 Analyze and interpret data to determine scale properties of objects in the solar system.

W.IW.6.2 Write informative/explanatory texts (including the narration of historical events, scientific procedures/ experiments, or technical processes) to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.

Activity:

Students will CERs (Claim, Evidence & Reason) on Structures of the Universe and Stars. This shows if students are able to convey their thinking and decision making in writing form

- Students will be answering the question (their claim), "Which of the 5 structures of space is the largest?".
- Students provide evidence that supports their claim.
- Students will then write a reasoning that explains what their claim is, state knowledge they have on the topic, evidence to prove their topic, and close their reasoning with their claim again.

Integration Area: Math

MS-ESS1-2 Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system. Students will discover how gravity is not the same on all planets.

6.EE.B.7 Solve real-world and mathematical problems by writing and solving equations of the form x+p=q and px=q for cases in which p, q, and x are all nonnegative rational numbers.

Activity:

Students will compare Astronaut Sam's Weight on 8 different planets.

- Students will be provided with the gravity on each of the 8 different planets.
- They will then get what Astronaut Sam's weight on Earth and use equations to figure out how much he will weigh on the other planet.

Language Arts Companion Standards:

W.IW.6.2 . Write informative/explanatory texts (including the narration of historical events, scientific procedures/ experiments, or technical processes) to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.

RL.CR.6.1. Cite textual evidence and make relevant connections to support analysis of what a literary text says explicitly as well as inferences drawn from the text.

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RL.TS.6.4. Analyze how a particular piece (e.g., sentence, chapter, scene, stanza, or section) fits into the overall structure of a text and contributes to the development of the ideas, theme, setting, or plot.

RI.PP.6.5. Identify author's purpose perspective or potential bias in a text and explain the impact on the reader's interpretation.

RI.AA.6.7. Trace the development of and evaluate the argument and specific claims in a text, distinguishing claims that are supported by reasons and evidence from claims that are not.

Activity:

Gravitational Tides: How does gravity impact tides? What effect do the positions of the moon and the sun have during a spring or neap tide? Write an essay that explains the impact of gravity on tides that uses evidence from a variety of credible sources.

Diversity Integration

Objective: Students will complete a graphic organizer on a Scientist from a diverse background or protected class.

Activity:

1. Students are to make a copy of the graphic organizer that they are to complete on the scientists.
2. They will then need to complete the organizer by doing research on the person and their field of science that the scientists work in.
3. After finding information about the scientist, they will then need to write a paragraph on the person and explain to us "Why is this scientist famous? What have they done in their lifetime to help out the world?"

Science and Engineering Practices

- **Analyzing and Interpreting Data**: Students construct and/or use multiple graphical displays (e.g., maps, scatter plots) of large data sets to identify linear relationship and distinguish between correlation and causation.
- **Mathematics and Computation Thinking:** This is the first time in 6th grade that students use digital tools to build their own scatter plots with large data sets and look for patterns and trends between multiple variables.
- **Constructing Explanations and Designing Solutions:** Students construct written explanations during the mid-point (Lesson 4) and summative (Lesson 9) assessments to apply science ideas and evidence to identify areas of risk and why, and to use relationships between variables to support a prediction of risk for tsunami and local natural hazards.
- **Engaging in Argument from Evidence**: For the first time in 6th grade students are evaluating

competing design solutions based on jointly developed and agreed-upon design criteria. Initial students are given some criteria for the tsunami design solutions, but later in the unit, they develop their own jointly agreed-upon criteria for natural hazards communication systems. This scaffolding allows students to practice developing criteria and constraints as a class and then apply them to design solutions.

- **Obtaining, Evaluating, and Communicating Information:** Throughout the unit students are gathering, reading, synthesizing and evaluating information from multiple sources (e.g., text, data, maps, graphs, images). The scaffolding around this practice lessens so that by the final project in Lesson 9, students are gathering, evaluating, and communicating information independently with a guiding framework for the kinds of information they need, but flexibility to allow

Science and Society

Aryabhata

Early Indian astronomer

Copernicus

Made the first models of the solar system

Isaac Newton

3 Laws of motion, Law of universal gravitation

Galilei Galileo

Acceleration due to gravity

CSDT Technology Integration

8.1.8.NI.2 Model the role of protocols in transmitting data across networks and the Internet and how they enable secure and errorless communication.

8.1.8.DA.1 Organize and transform data collected using computational tools to make it usable for a specific purpose.

Activity:

Students will work with their partner to do web-based research on each of the planets of the Solar System on their chromebooks and create a model of the planets' order and distance from the Sun.

Lab

Lab: Exploring Natural Hazards

https://docs.google.com/document/d/1lDBQ7V-wn-nTg8aM8_g4VdHfny7R8LyUhRMgNGxXgEE/edit?usp=drive_link

Objective:

Students will explore different types of natural hazards and understand their impact on the environment and human life. They will also learn how to mitigate these hazards.

Reflective Questions:

- What changes did you observe in the sand and buildings during the flood?
- How did the wind affect the landscape and structures?
- What strategies could be used to prevent these hazards in real life?

Assessments:

- Students will write a brief report summarizing their observations and answering the reflection questions.
- Teachers will evaluate the reports based on understanding, creativity, and application of concepts.

Lab: Understanding Natural Hazards

- Students will write a brief report summarizing their observations and answering the reflection questions.
- Teachers will evaluate the reports based on understanding, creativity, and application of concepts.

Objective:

Students will explore and understand the effects and causes of natural hazards such as earthquakes and tsunamis through a hands-on model demonstration.

Reflective Questions:

1. Discuss the observations and ask the students to reflect on the following questions:
2. What happened to the buildings during the earthquake simulation?

3. How did the tsunami affect the landscape?

4. What could be done to minimize damage from these natural hazards?

Assessment:

- Written Reflection:
  Students write a paragraph summarizing what they learned about the impact of earthquakes and tsunamis on structures.

- Quiz Questions:

    1. What are some natural factors that contribute to the occurrence of earthquakes?

    2. How can human structures be designed to withstand natural hazards like tsunamis?

Resources

Scientific Inquiry

MS-ESS1-1 (5.4.8.A.1) *Reasons for the Seasons*, p. 10-16
MS-ESS1-1 (5.4.8.A.2) *Moon Phases and Eclipses*, p. 22-26