

Unit 8.6

Reducing the Impacts of Natural Hazards

Public Preview

Unit Summary

In this unit, students take on the role of scientists who conduct a Hazard Assessment for one U.S. state. They use historical data to support a long-term forecast about which natural hazard is likely to most threaten the state. They investigate what causes the hazard and the damages associated with it. Based on this information, they identify technologies that the state could invest in to reduce the hazard's negative effects on people and property.

A natural hazard is an event resulting from Earth system processes that has a negative impact on humans and the built environment. Students make a natural hazard forecast based on patterns in historical data about the locations, magnitude, and frequency of past natural hazard events (MS-ESS3-2). They support their forecast with an understanding of the cause of natural hazards and the association of natural hazards with certain geographic features. To extend their understanding of why earthquakes are found in a particular pattern around the world, they investigate the motions of tectonic plates (MS-ESS2-3). They recognize that some natural hazards have precursors that allow scientists and emergency managers to warn the public, while others do not (MS-ESS3-2). They use their understanding of the causes and impacts of the natural hazard to identify appropriate technologies to reduce the dangers that the hazard poses to people and property.

Unit Challenge Question

- How can science and engineering help protect people from natural hazards?

Unit Big Ideas

- Scientists and emergency managers can use patterns in the magnitude, location, and frequency of past natural hazard events to make a long-term forecast about where and when a natural hazard is likely to occur.

- If natural hazards have reliable precursors, instruments can help monitor natural hazards and make reliable short-term forecasts to warn people.
- By understanding how natural hazards cause damages, engineers can design technologies to reduce the negative impacts that natural hazards have on people.

Connection to 21st Century Issues

Populations around the United States are subject to a variety of natural hazards including drought, blizzards, floods, hurricanes, tornadoes, earthquakes, landslides, volcanic eruptions, and tsunamis. When people are not prepared for a natural hazard event of high magnitude, a natural disaster may occur. A natural disaster occurs when a natural hazard causes severe economic and social consequences. In the recent past, state and federal agencies have established historical databases of these events to inform long-term forecasts about natural hazards so that people living in areas at risk can prepare. They have also developed computer models to produce short-term forecasts for those natural hazards that have reliable precursors, such as tornadoes, hurricanes, and floods. Reducing the impacts of natural hazards is not solely reliant on scientific understanding of when and where an event may occur, nor solely reliant on technical understanding of how to physically restrain the forces of an earthquake or hurricane. Social science research in the wake of disasters such as Hurricane Katrina suggests that unequal distribution of economic resources and unequal access to social institutions can magnify the effects of a catastrophic natural hazard event. However, improved scientific understanding of natural hazards and the subsequent development of technologies have undoubtedly saved lives and reduced economic loss in the United States over the past century.

Unit Challenge

Unit Challenge Summary

Students will produce a Hazard Assessment for a selected U.S. state. The Hazard Assessment will include concepts and data from Lessons 3-6. Lessons 1 and 2 introduce students to natural hazards and Hazard Assessments. In Lesson 3, students will begin their Hazard Forecast by analyzing data about the location, size, and frequency of past natural hazard events across the United States. They will use this information to identify which three natural hazards most affect their assigned state. In Lesson 4, they will analyze data

on the damages and severity of past natural hazard events, and identify which hazard is most threatening. In Lesson 5, they will investigate the causes and triggers of the most threatening natural hazard affecting their state. In Lesson 6, they will identify if the hazard has reliable precursors and identify which technologies can be implemented for short-term forecasting of the hazard. In Lesson 7, they will identify other technologies that the state could use to reduce the risk from the natural hazard. In the final lesson of the unit, they will compose a Public Service Announcement (PSA) that identifies the most threatening natural hazard, the likely impacts of the hazard, its precursors and whether it can be forecast, and the three technologies that state and local officials could use to reduce these impacts.

Unit Challenge Scenario

State governors around the country request your help. Major natural disasters have occurred throughout the United States over the past ten years. The governors fear that they don't know enough about natural hazards. Their top concern is protecting lives, if they are threatened, and then property. You and your classmates are scientists who work for the U.S. Geological Survey. You will be divided into teams to help each governor. The governors request that you:

- identify which natural hazard is likely to most threaten people and property in their state.
- identify technologies that can help protect people and property from that natural hazard.
- create a Public Service Announcement (PSA) to inform the public about what you learn.

You will present your PSA to a panel from the Federal Emergency Management Agency (FEMA). The teams that support their forecasts with evidence will receive \$1 million from FEMA to help their assigned state.

Unit Challenge Student Products & Teacher Resources

Exemplary Student Products and Other Teacher Resources:

Students produce two products in this unit as part of the unit challenge. One is a Hazard Assessment Organizer where students organize their claims and evidence throughout the unit; the other is a communication piece ("Public Service Announcement") which is a written and oral summary of their claims and evidence. Exemplary student products are below:

- Exemplar Student Product #1: Unit Challenge Hazard Assessment Organizer
- Exemplar Student Product #2: Public Service Announcement
- 8.6_Unit Summary Table: Teacher Version

Unit Challenge Student Resources

- 8.6_UnitSummaryTable_StudentVersion_NoAnswers
- 8.6_UnitChallenge_Student_Organizer
- Public Service Announcement Student Product Checklist

Lesson Sequencing Table			
Lesson #	Lesson Questions	What students do...	# days
1	Introduction of Unit Challenge Question: <ul style="list-style-type: none"> How can science and engineering help protect people from natural hazards? 	Students demonstrate their prior knowledge about the effects of natural hazards and ways to reduce these effects. They are introduced to the Unit Challenge and compile a list of questions they will need to investigate in order to complete it.	2
2	<ul style="list-style-type: none"> How can we predict where and when a flood will occur? 	Students model a flood and observe that floods occur in the same places in a pattern. They recognize that they cannot predict the flooding with certainty, but that they can make statements about how likely it is that a flood may occur in a particular place.	3
3	<ul style="list-style-type: none"> Which natural hazards are most likely to occur in each state? 	Students begin their investigations into the Unit Challenge by using historical data to create maps that show the likelihood of six types of natural hazard events across the United States. They forecast which hazards are most likely to occur in their assigned Unit Challenge state.	3
4	<ul style="list-style-type: none"> How does a natural hazard cause negative impacts? Which natural hazards are likely to cause the worst impacts in each state? 	Students investigate the impacts of hurricanes and use a model to construct an explanation for how hurricanes cause damage to property. Students analyze historical data to make a prediction about which states are most likely to suffer the worst impacts from hurricanes. They use historical data from their state as evidence to forecast which natural hazard is most likely to have the worst impacts on their assigned state. They construct an explanation for how their state's most threatening natural hazard causes damages. They will continue studying this natural hazard for the rest of the Unit Challenge.	3
5	<ul style="list-style-type: none"> Why do natural hazards occur in some areas but not others? How can we forecast which areas a natural hazard is most likely to affect? 	Students observe that earthquakes occur near particular geographic features. They model earthquake hazards and determine what causes them. They investigate whether other natural hazards are also associated with geographic features. They use maps and an understanding of what cause natural hazards as evidence to forecast which parts of the state are most likely to be affected by their state's most threatening natural hazard. Students also examine	5

		evidence for the motion of tectonic plates and model Earth's internal convection to explain the movement of tectonic plates.	
6	<ul style="list-style-type: none"> How can we reliably predict when a natural hazard will occur? 	Students compare historical data from the days preceding a past hurricane and earthquake and look for signs or precursors that might indicate when or where that natural hazard will occur. They read case studies to determine whether their state's most threatening natural hazard has precursors that can lead to a reliable forecast.	3
7	<ul style="list-style-type: none"> How can technology reduce the effects of a natural hazard? 	Students design and test structures to withstand wind (hurricanes and tornadoes), water (flooding and hurricanes), and shaking (earthquakes). They identify three technologies that can be used to reduce the effects of their state's most threatening natural hazard.	2-3
L-UC	Unit Challenge Question: <ul style="list-style-type: none"> How can science and engineering help protect people from natural hazards? 	Students compile their Public Service Announcements about their state's most threatening natural hazard and present them to the class.	5

Select Assessment Tools

The tools below are just **some** of the assessment opportunities that are available in this unit. The tools in this section have undergone more formal review.

Pre-Post Assessment:

- Unit 8.6 Pre-Post Assessment- Student Version
- Unit 8.6 Pre-Post Assessment- Teacher Version

Embedded Assessment:

- Lesson 05 Check Your Progress
 - 8.6_L05_Check_Student_EA_StudentCopy
 - 8.6_L05_Check_Teacher_EA_StudentExemplar
 - 8.6_L05_Check_Teacher_EA_InstructionsRubric

Teacher Note: The documents for the Embedded Assessment are under review. This document will be updated when they are posted online.

Unit Challenge Student Product Proficiency Rubrics:

- 8.6_UnitChallengePSA_Teacher_InstructionsRubric

Teacher Note: The Unit Challenge Rubric is under review. The document will be updated when it is posted online.

Unit Content Resources:

- [NGSSConnections](#)
- [Prior and Future Knowledge](#)
- [Unit Materials List](#)
- Compiled Gotta Have Checklist*
- Unit External Web Links*
- Unit Synopsis Video*
- Teacher Background Content Resources*

*Available to teachers who have completed the Unit Primer as part of the Mi-STAR Professional Learning Program

Unit Advance Preparation:

- Consult the Unit Materials Shopping List
- Complete the Unit Planning Tool