GENERATIONGENIUS
ALWAYS QUESTION. ALWAYS WONDER.

LESSON PLAN

PREDICTING NATURAL DISASTERS

GRADES 6-8

SUMMARY

In this lesson, students will do the following: Analyze the 2018 USGS National Seismic Hazard map to make predictions about earthquake activity. Engage in an engineering design challenge and conduct an investigation to determine which types of structures can withstand the greatest seismic activity.

NEXT GENERATION SCIENCE STANDARDS CORRELATION

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-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.

Science & Engineering Practices	Connections to Classroom Activity
Analyzing and Interpreting Data	• Students analyze the 2018 USGS National Seismic Hazard map to make observations and predictions about earthquake activity.

Disciplinary Core Ideas	Connections to Classroom Activity
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. **ETS1.B: Developing Possible Solutions** There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.	• Students use seismic activity mapping to predict where future events may occur. Students will then use engineering design principles to build structures most capable of withstanding seismic activity.| Students will compare similarities and differences of those structures to determine the most optimal design solutions.

Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors.

ETS1.C: Optimizing the Design Solution

Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design.

Cross Cutting Concepts	Connections to Classroom Activity
Patterns	• Students use models of seismic activity to observe patterns where earthquake events have happened and are predicted to happen in the future.

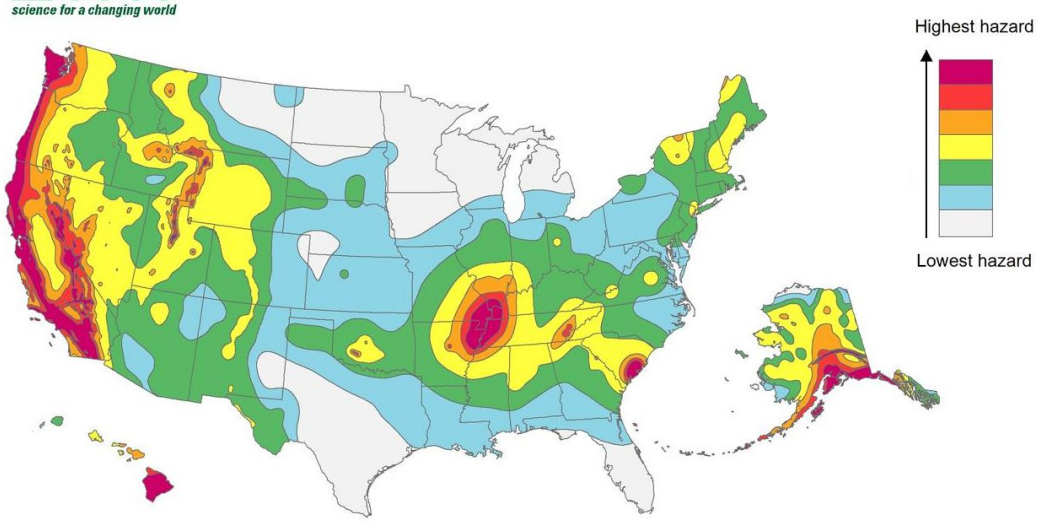
DURATION

90 min.

ENGAGE

Day 1

Show students the 2018 USGS National Seismic Hazard map.



MATERIALS

Each of the following items are needed for each pair of (2) students:

- 1 medium-sized ball of modeling clay
- 50 straws/wooden skewers (each approximately 6–8 inches in length)
- 2 racquet/superballs balls
- 2 thick pieces of cardboard (boxes can be cut into 12 × 12 pieces)
- 2 large, thick rubber bands
- 1 ruler
- Masking tape or duct tape

Explain to students that this is an image created by the United States Geologic Survey. The USGS is a scientific agency created by Congress in 1879 for the purposes of conducting scientific research related to geologic activity (how the layers of Earth behave and change over time). It is a governmental organization that collects data about earthquakes and uses it to make predictions about future events, thus is a reliable source.

Tell students this image is the USGS Long-Term National Seismic Hazard Map. It shows the areas of the United States that have the highest risk of earthquake activity based on data collected in the past about the frequency (how many) and intensity (how large) earthquakes have occurred/been. Ask students to observe the picture for two minutes by themselves. Have students write down things they notice and wonder about the image. Let students share with partners and in small groups what they notice and wonder about the image. Students may mention some of the following things:

- *There is highest risk along the west coast of California and southern coast of Alaska.*
- *A high-risk zone exists where Illinois, Indiana, Kentucky, Tennessee, Missouri, and Arkansas all meet.*
- *There are moderate risk areas in the western and mid-eastern United States.*
- *Areas of moderate risk are also where mountain ranges are—the Rockies and Appalachian.*
- *Students may recall from a previous lesson or grade level that these areas are where tectonic plates meet.*

Encourage student discussion, specifically about the region where you live. Use probing questions with students such as:

- *What do you notice about the earthquake risk where we live?*
- *What is your evidence that supports your claim?*
- *Why do you think the region where you live is different from other areas?*
- *What experiences do you have with earthquakes where you live?*

Ask students to share any knowledge they have about the destruction earthquakes cause when they occur in different areas. Record these ideas on a poster paper or dry erase board to maintain visibility for students throughout the lesson. Students will mention buildings being destroyed and other examples of destruction occurring from high magnitude earthquakes, such as cracks in the road and items falling off shelves. Some students may mention that when earthquakes occur on the ocean floor, they can cause natural disasters called *tsunamis*.

Once students have shared ideas about the destruction that earthquakes cause, have them generate ideas in small groups about what causes some structures to be destroyed in earthquakes and others not. Students will make predictions that some buildings and bridges are built with stronger materials (steel) or in ways and shapes that help prevent them from being destroyed in earthquakes. Students may mention that buildings with strong, wide bases may sustain earthquake damage better than tall, narrow buildings. Students may also make connections to bridges and their strength being dependent on shapes that make up the structure (triangles and trapezoids). Allow students to explore bridges and buildings of different shapes and sizes on the internet and in books to make predictions about which types of structures would be the most capable of withstanding an earthquake.

Tell students they are going to work together as engineers to design and build a structure that will withstand earthquake activity.

EXPLORE

Day 2

Tell students they are going to engage in an engineering design challenge. The challenge is to figure out what types of structures, or buildings, are the strongest and should be built in areas that have a high risk of earthquakes.

Place students into groups of two and tell them they have 10 minutes to design/sketch a structure that will be able to withstand a small “earthquake” using the materials they have available to them. Tell students what materials they have to use. ***(NOTE: A modification to this lesson could include allowing students to bring materials from home or allowing students to use other common classroom materials besides those listed.)***

Explain to students that they will assemble a device called a shake table to test their designs. Pre-assemble at least one shake table to show the class the device that will be used to test their designs. ***(NOTE: To save time, you may decide to assemble shake tables for students, or provide them instructions below on how to assemble their own. See "Instructions for assembling a shake table" below.)***

After students have designed and sketched their structures, give them 15 minutes to build the most stable structure possible using modeling clay and whatever other materials you have provided them (straws, sticks, classroom materials, etc.). When students are finished, have each group test the strength of their devices publicly for the class. As each group tests their structure for stability, have students record observations about similarities and differences among the structures, and what makes the strongest structures.

After all groups have tested their structures, allow students 15 minutes to "redesign" their structures based on evidence they compiled when designing and testing their own structures, as well as observing the testing of other structures. Encourage students to take into consideration all information they have compiled to this point to build their most stable building, including similarities and differences among structures they observed having the strongest design. Provide students 15 minutes to build their redesigned, most stable building. Repeat the testing process with the class. As students test their buildings on the shake table, ask them to share with the class evidence they compiled and how it informed the redesign of their structure.

Students will notice that:

- structures with wider bases have more stability when shaken than structures with narrow bases.
- triangle shapes are stronger than squares or rectangles because each side of the triangle absorbs energy when shaken.
- structures with reinforcements in the walls (smaller cross pieces that connect to larger pieces) allow structures to withstand more intense seismic activity.

Instructions for assembling a shake table:

1. Stretch the rubber bands around the two pieces of cardboard attaching them together.
2. Separate the cardboard pieces enough to slide the tennis balls between them.
3. Tape the ruler to the top piece of cardboard as a handle to shake the device.
4. Pull the handle (ruler) back and forth to test the shake table.

EXPLAIN

WATCH THE GENERATION GENIUS PREDICTING NATURAL DISASTERS VIDEO AS A GROUP

ELABORATE

Have students return to their design groups and construct explanations based on evidence that describes the following: (1) their original design structure and an explanation for its design, (2) observations made during the initial testing phase, and (3) their ideas for redesigning their structure after an initial build and group testing.
Have students share those scientific explanations publicly with the class. Allow for students to ask follow-up questions and make affirming comments to their peers about their design process, paying particular attention to how their thinking evolved over the course of the project.

EVALUATE

There are multiple ways to assess your students' understanding of this topic. The exit ticket is an opportunity for students to use the science ideas they built in the lesson in a new context. Alternatively, you can use the Kahoot! quiz (which provides downloadable scores at the end of the game) and/or the paper quiz. All these resources are located right below the video in the assessment section.

EXTENSION

Have students use any materials they would like to build a structure that could withstand a landslide. Share with students that landslides often occur as a result of tectonic plates and rock shifting (similar to earthquakes), extreme weather events, and sometimes both. Encourage students to consider what design methods and constraints should be considered when building a structure that would withstand a landslide.