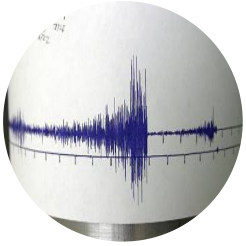

All Shook Up

Earthquakes

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Grade Level	6th – 8th Grade	**Time Frame**	2-3 class period(s)
Subject	Science	**Duration**	160 minutes

Essential Question

What resources do geologists use to study earthquakes?

Summary

Students will examine various forms of earthquake data, ranging from intensity, magnitude, and first-person accounts, to explore which factors contribute to earthquake damage and how geologists use this information to pinpoint the epicenter and focus of an earthquake. Students will look at USGS data and analyze first-person accounts and damage reports to determine earthquake intensity. They will also view an interview with a geologist.

Snapshot

Engage

Students examine both a visual and an audio representation of the seismic waves recorded from the 2011 Japanese earthquake. Students discuss how these representations relate to ground movement during an earthquake and what information they might provide a scientist.

Explore

Students read interviews from individuals who experienced the 1994 Northridge earthquake, detailing the damage and what happened during the quake. Students play the role of a USGS scientist analyzing the data and determining the earthquake intensity by zip code.

Explain

Students present their findings from the Explore section. Students compare the types of earthquake waves, the manner in which these waves function, and how they relate to damage at the surface.

Extend

Students watch an interview with a geologist and then jigsaw a set of articles from various news sources and the USGS describing earthquakes around the globe. Students analyze the key information regarding each earthquake's magnitude, intensity, epicenter, and focus. Students will summarize the data from each article.

Evaluate

Students take on the role of a science reporter by writing a news article covering an earthquake, using key academic vocabulary and concepts relating to seismology and including survivor interviews.

Standards

Next Generation Science Standards (Grades 6, 7, 8)

MS-ESS2-2: Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.
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.

Oklahoma Academic Standards (6th Grade)

6.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.
6.ESS2.5 : Collect data to provide evidence for how the motions and complex interactions of air masses result in changes in weather conditions.

Attachments

- Earthquake Intensity—All Shook Up.pdf
- Lesson Slides—All Shook Up.pptx
- Modified Mercalli Intensity Scale—All Shook Up - Spanish.docx
- Modified Mercalli Intensity Scale—All Shook Up - Spanish.pdf
- Modified Mercalli Intensity Scale—All Shook Up.docx
- Modified Mercalli Intensity Scale—All Shook Up.pdf
- News Article Analysis—All Shook Up - Spanish.docx
- News Article Analysis—All Shook Up - Spanish.pdf
- News Article Analysis—All Shook Up.docx
- News Article Analysis—All Shook Up.pdf
- Rubric—All Shook Up - Spanish.docx
- Rubric—All Shook Up - Spanish.pdf
- Rubric—All Shook Up.docx
- Rubric—All Shook Up.pdf

Materials

- Earthquake Intensity (attached; 1 per group—handout pages 1-5 and 7 only, page 6 is the answer key)
- Modified Mercalli Intensity Scale (attached; 1 per group)
- Colored pencils
- Sticky notes
- Slinky (1 per group if possible)
- Earthquake articles (links to 4 examples included in slides)
- News Article Analysis (attached; 1 per student)
- Rubric (attached; 1 per student)

Engage

Use **slides 3 and 4** to introduce the essential question and lesson objectives to students.

Go to **slide 5**. Show students the sculpture created from the Tohoku Japanese earthquake's seismic wave. Ask students to come up with and discuss descriptive words and possible meanings for the sculpture with their Elbow Partner. After students share their thoughts, go to **slide 6** to provide information about how and why it was created.

Go to **slide 7**. Have students listen to this audio version of the same seismic wave (or you may choose this one). Begin by asking students to answer the following questions on a sticky note: *How do scientists measure earthquakes? What do scientists learn from these measurements? How do scientists use these measurements?*

Ask students to do a Commit and Toss with their answers. Next, ask a few volunteers to share the answers on the sticky note they picked up.

Sample Student Responses

Scientist use seismographs to measure how the ground moves. They can use this information to figure out how big an earthquake was and where it started.

Explore

Go to **slide 8** to show students the Modified Mercalli Intensity scale, and explain how this scale is used and how it differs from the Moment Magnitude scale or Richter scale. **Slide 9** and the Modified Mercalli Intensity Scale Handout give an expanded description of the scale. Ask students what they notice about the amount of damage as the numbers increase.

Teacher's Note: Modified Mercalli Intensity Scale

The Modified Mercalli Intensity (MMI) scale measures the intensity of an earthquake. It is a measure of the effects of an earthquake (i.e., damage and/or eyewitness accounts of earthquake motion), whereas Moment Magnitude scale or Richter scale are a measure of the amount of energy released during an earthquake. For example, you can have an earthquake with a high Moment Magnitude rating (lots of energy release) in an unpopulated area, therefore having little effect and a low MMI rating.

Go to **slide 10**. Explain to students that they will be playing the role of a United States Geological Survey (USGS) geologist who is surveying the damage from a recent earthquake. Tell them they will be reading first-person accounts describing what occurred during the earthquake and the damage caused. They will use this information to assign an intensity value based on the Modified Mercalli Intensity Scale.

Teacher's Note: Nature of Science

This is a great opportunity to point out to students the subjective nature of data analysis and how science in the real world can have a subjective quality to it. *(i.e., Scientific knowledge is open to revision in light of new evidence.*)

Arrange students in groups of 3-4, and give each group a copy of the **Earthquake Intensity** handout and **a Modified Mercalli Intensity Scale** handout. (The Earthquake Intensity Handout includes a blank Northridge map, the colored MMI scale, and Northridge first-person narratives. Give pages 1-5 and 7 to students, but do not give them page 6 yet, as that is the answer key.) Explain to students that in their group, they will be reading the accounts for each zip code affected by the earthquake and coloring in the map according to these accounts. Have each group analyze the first-person accounts and, based off of the MMI Scale, assign an intensity value to each zip code. Assign roles to the students within groups to accomplish the various tasks (e.g., reading, interpreting the scale, coloring the map, etc.).

Have students use colored pencils to code the intensity scale at the bottom based on the colors in the answer key. A standard pack of colored pencils should have the appropriate colors to match the scale, but you can adjust the colors as necessary. Regardless of which colors are available, identify the colors your students will be using in advance to standardize what they see on their peers' maps when they complete the Gallery Walk later in the lesson.

Intensity Scale Color Code

I=white; II-III=light purple; IV=light blue; V=green; VI=yellow; VII=light orange; VIII=dark orange; IX=red; X-XII=maroon.

Teacher's Note: Example

Use **slide 11** to complete an example with your students before asking them to begin the activity. This should help to clarify any confusion students may have about what they are supposed to do.

Explain

Go to **slide 12**. Prepare students to do a Gallery Walk by having them hang their finished maps on the wall. Students will take a few minutes to walk from map to map investigating the work of the other groups. The goal will be to compare and contrast their findings and decisions about earthquake intensity. Have the students discuss in their groups whether the maps were similar or different and explain why they might be different even though every group used the same data.

Teacher's Note: Nature of Science

Use this opportunity to discuss objectivity and reliability when analyzing data.

Go to **slide 13**. Ask the students: *What pieces of data were you using to determine the intensity at different locations?*

Sample Student Responses

We looked at personal testimonies, descriptions of damage caused by the earthquake, and descriptions of the ground and other objects moving.

Ask the students: *What caused the actual damage during the earthquake?* Next, ask them: *If the earthquake's epicenter was miles away from us, how is it possible for us to feel the ground move?*

Go to **slide 14**. Introduce the idea of seismic waves if the students do not mention them first. Explain to the students that two types of seismic waves occur during an earthquake: P waves (primary) and S waves (secondary). Click on "P waves" in the slide to show students a video of what this type of wave looks like. Then click on "S waves" to show them a video of what this type of wave looks like. Demonstrate the motion related to these waves using a Slinky.

Teacher's Note: Slinky

If you have enough Slinkies, this is a great opportunity for students to practice creating the waves themselves. If you have only one Slinky, you can adjust accordingly to demonstrate the wave types for students. If you don't have any Slinkies, show students the demonstration using this Slinky Demonstration of P and S waves video. P waves are "compressional" and move straight down the Slinky in the same direction that the Slinky is pushed. S waves move side to side when the Slinky is shaken.

In their notebooks or on pieces of paper, have the students write a description and draw a model (diagram) of each type of wave they observe using the Slinky.

Extend

Go to **slide 15**. Show students the video of an interview with a geologist. Inform students that they will continue to serve as geologists in a new activity for the remainder of the lesson.

Teacher's Note: Earthquakes

Make copies of any earthquake news articles you plan to use. You should make sure to include news articles detailing more recent significant earthquakes from around the globe. See below for a list of recommended searches for students.

Go to **slide 16**. Students will remain in their groups from earlier in the lesson. Each group will select an earthquake to research, and then each student in the group should read a different article about that earthquake. Ask students to use CUS and Discuss to circle new words, underline key details, and star main ideas. You may also choose to use another analytical reading strategy to have students analyze their article. Give each student a **News Article Analysis** handout to document their article findings. Each student will share what they learned from their article with the group.

Information the students will be looking for in each article includes:

- Where did the earthquake take place?
- Where was the epicenter?
- What was the magnitude of the earthquake?
- What time was it when the earthquake hit?
- What type of damage occurred?
- Thinking as a geologist, how would you explain the severity of damage?

Go to **slide 17** to recommend some videos about recent earthquakes to students. They may choose their earthquake from this list, or they may have another in mind they'd like to research. Recommendations include: 2019 Ridgecrest earthquakes (California), 2020 Caribbean (Jamaica), 2016 Oklahoma, and 2017 Greenland. You may also wish to direct students to this site about Oklahoma earthquakes.

Have the groups share out the information they found about their earthquake with the class through a class discussion.

Sample Student Response

The 2011 Japanese earthquake was centered near the coast of Honshu, Japan, and hit in March of 2011. It was rated at a 9.0 magnitude, and over 15,700 people were killed. It occurred on a fault between the Pacific and North American plates, and the plates moved upward 30-40 meters in the ocean and created a tsunami with enormous wave surges.

Evaluate

Go to **slide 18**. Students will now put themselves in the shoes of a scientific news reporter and write a news article covering a fictional earthquake. The earthquake they are reporting on has a magnitude between 6 and 9 on the Richter scale. It can be located anywhere in the world in any type of setting (e.g., urban, rural, or suburban).

Give students a copy of the **Rubric** to guide the development of their news article. Instruct students to include the following key information about the earthquake in their news article:

- Epicenter and location
- Time and date it occurred
- Magnitude
- Descriptions of the damage
- 3-5 first-person accounts of some of the survivors

Sample First-Person Account Narrative

I spoke with John Doe, one of the survivors on the scene. "It was horrible. I was making myself some breakfast, when I felt a little bump. A few seconds later, I heard a sound like a freight train, and then I heard my dishes start to rattle right before everything started shaking violently. I could hardly stand. Things were falling off shelves and breaking on the floor. The lights went out, and the room went pitch black. Next thing I knew, there was a loud crash, and I was pinned to the floor. After it was over, my neighbors helped me get out of the building. Part of my ceiling had caved in during the quake. There were others in my building not as lucky as I was; they are still trying to dig them out." Scientists at NOAA reported the epicenter of the 6.9 quake to be near ______ in the early morning hours just before dawn.

Teacher's Note: News Article

You may wish to have students turn in their news articles to you as summative products, but you might also consider having the students post their articles to a site such as VoiceThread, where students can view each other's articles and then leave feedback using a comment, video, or voice memo.

Possible Differentiations

Students can extend this lesson further by creating a public service announcement video or flyer to inform the local community about earthquake basics and safety. To allow time for this differentiation, you may choose to provide the students with fewer narratives or less data during the Explore section. You could also consider a cross-curricular activity by working with the art teacher to have students construct their own sculpture or painting to represent a particular earthquake or tsunami.

Resources

- Crafalik. (2009, February 1). *Seismic waves* [Video]. TeacherTube. https://www.teachertube.com/videos/77594
- Georgia Tech. (2012, March 6). Hearing the Japanese earthquake - Clip 1 [Video]. YouTube. https://www.youtube.com/watch?v=6N5SoPwdTS8&feature=emb_logo
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- Oklahoma Geological Survey. (2020, August 13). Recent earthquakes. https://www.ou.edu/ogs/research/earthquakes/recentearthquakes
- Wald, L. & Shindle, W. (2004, July). Magnitude vs. intensity lesson. USGS. https://www.usgs.gov/media/files/magnitude-vs-intensity-lesson
- Wolfram. (2011, March 17). Propagation of seismic waves: P-waves [Video]. YouTube. https://youtu.be/2rYjlVPU9U4
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