# Ground Shaking: Earthquakes Happen Every Day

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| **Author** | Kelly Haarala |
| **Grade Level** | 7-8 |
| **Duration** | 4 class periods |

## National Standards

**GEOGRAPHY**
**Element 1: The World in Spacial Terms**
1. How to use maps and other geographic representations, geospatial technologies, and spatial thinking to understand and communicate information
3. How to analyze the spatial organization of people, places, and environments on Earth's surface
**Element 3: Physical Processes**
7. Physical processes generate patterns of features across Earth's surface
**Essential Element 6: The Uses of Geography**
18. How to apply geography to interpret the present and plan for the future

**NEXT GENERATION OF SCIENCE STANDARDS**
**MS. Human Impacts**
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. Engineering Design**
MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that optimal design can be achieved.

## AZ Standards

**ELA**
**Reading**
**Range of Reading and Level of Text Complexity**
7.RI.10 and 8.RI.10 By the end of the year, proficiently and independently read and comprehend informational texts and nonfiction in a text complexity range determined by qualitative and quantitative measures appropriate to grade 7/grade 8.
**Writing**
**Production and Distribution of Writing**
7.W.4 and 8.W.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

**SCIENCE**
**Earth and Space Standards**
8.E1U3.7 Obtain, evaluate, and communicate information about data and historical patterns to predict natural hazards and other geological events**.**

**MATHEMATICS**
**Math Equations and Expressions**
7.EE.B.3 Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form.
Convert between forms as appropriate and assess the reasonableness of answers.

## Arizona Social Science Standards

**The use of geographic representations and tools helps individuals understand their world.**
7.G1.1 Use and construct maps and other geographic representations to explain the spatial patterns of cultural and environmental characteristics. Key tools and representations such as maps, globes, aerial and other photos, remotely sensed images, tables, graphs, and geospatial technology
7.G1.2 Analyze various geographic representations and use geographic tools to explain relationships between the location of places and their environments.
8.G1.1 Use geographic tools and representations to analyze historical and modern political and economic issues and events. Key tools and representations such as maps, globes, aerial and other photos, remotely sensed images, tables, graphs, and geospatial technology

## SIOP Elements

| Preparation | Scaffolding | Grouping Option |
|---|---|---|
| **Adapting content**<br>Linking to background<br>**Linking to past learning**<br>Strategies used | **Modeling**<br>**Guided practice**<br>**Independent practice**<br>**Comprehensible input** | Whole class<br>**Small groups**<br>**Partners**<br>**Independent** |
| **Integrating Processes** | **Application** | **Assessment** |
| **Reading**<br>**Writing**<br>**Speaking**<br>Listening | **Hands on**<br>Meaningful<br>Linked to objectives<br>**Promotes engagement** | **Individual**<br>Group<br>**Written**<br>Oral |

**Arizona English Language Proficiancy Standards**

**Stage IV Reading**
**Standard 4: The student will analyze text for expression, enjoyment, and response to other related content areas.**
B-8: summarizing the main idea and supporting details from text.
B-14: drawing conclusions from information implied or inferred in a literary selection.
**Stage IV Writing**
**Standard 1: The student will express his or her thinking and ideas in a variety of writing genres.**
B-4: writing a paragraph based on research using topic sentences, main ideas, relevant facts, details, and concluding statements.
**Standard 4: The student will integrate elements of effective writing to develop engaging and focused text.**
B-2: writing a paragraph, focused on a topic, that includes details, clear sequencing, and transitional words and phrases to connect ideas.
B-3: writing a paragraph using selected words that convey intended meaning.

## Overview

Earthquakes are an everyday occurence around the world. Students should know the relationship between the location of earthquakes and tectonic plates, as well as looking at how earthquakes are measured.

## Purpose

In this lesson, students will learn how earthquakes and tectonic plates are interconnected, as well as how to make a working seismograph. This lesson includes strategies for diverse learners (ELLs).

## Key Vocabulary

**tectonic plates:** plates of rock that make up the earth's crust
**earthquake:** moving of the Earth's surface due to a movement of a fault
**fault:** the place where two tectonic plates meet
**magnitude:** size or measurable quality
**seismograph:** a machine that measures the time and magnitude of an earthquake
**seismogram:** the chart of an earthquake that a seismograph creates
**Richter scale:** measures the amount of energy released from an earthquake, ranging from 0-10
**epicenter:** the central point of an earthquake

## Materials

- Computer, projector, and Internet access

- World Map https://geoalliance.asu.edu/sites/default/files/maps/World-at.pdf
- Tectonic Plates maps (labeled and unlabeled) https://geoalliance.asu.edu/sites/default/files/maps/PlateTectonicsLabeled.pdf https://geoalliance.asu.edu/sites/default/files/maps/PlateTectonics.pdf
- Understanding Positive and Negative Latitude and Longitude
- First 6 pages of IRIS earthquake data
- Day One Homework
- Close Read Annotation Instructions
- How Do Seismographs Work? Reading and Worksheet and What is the Richter Scale? Pg2
- Glimpse of a Seismograph Label the Pictures and Answer Key
- Day Two Homework
- Engineering Design Process worksheet
- Green, blue and yellow colored pencils/markers
- Suggested materials to build a seismograph **for each group**:
    - Shoe box
    - Variety of string (cord, yarn, twine, fishing line)
    - Variety of writing utensils (pencils, markers, pens)
    - Scissors
    - Variety of paper (blank, lined, graph)
    - Variety of weights (beans, pasta, marbles, washers, rocks)
    - Plastic cups
    - Masking/scotch tape
    - Paper towel rolls
    - Pipe cleaners
    - Paper plates
    - Paper clips
    - Rubber bands
    - Any other supplies at teacher discretion
- Doc Cam (optional)
- iSeismometer iPhone app (optional)
- Vocabulary Cards
- Vocabulary Test and Answer Key
- Final Assessment

## Objectives

The student will be able to:

1. analyze and explain the relationship between earthquakes and tectonic plates.

2. describe how a seismograph records an earthquake.

3. create a working seismograph out of everyday materials.

## Procedures

*Prerequisite Knowledge: Students should be familiar with latitude and longitude and be able to graph coordinates on a coordinate plane. They should also understand what tectonic plates are and how they work.*

**SESSION ONE**

**Engage:**
a. Show students Earthquake Destruction on YouTube (.47 min)
http://www.youtube.com/watch?v=4Y-62Ti5_6s
b. Give students this writing prompt and allow them two minutes to write: *Pick one person that stuck out to you in the videot. How do you think they were feeling? How could you tell? If you were him/her, what would you be thinking?*
c. Ask three students to share out their journal entries.

**Explore:**
a. Explain to students that you'll be giving them coordinates to earthquakes that have occurred in the last thirty days.
b. Pass out the World map, Understanding Positive and Negative Latitude and Longitude, and IRIS earthquake data sheet from http://www.iris.edu/seismon/eventlist/index.phtml
c. Instruct them to draw a line across the paper on the Prime Meridian and Equator. This breaks the map up into quadrants **(Scaffolding: Modeling)**
d. Tell them to label the quadrants with the positive/negative coordinates. (Quadrant 1 (+,+), Quadrant 2 (-,+), Quadrant 3 (-,-), Quadrant 4 (+,-))
e. Graph 3-5 the points of latitude and longitude as examples. **(Scaffolding: Guided Practice)**
f. Tell them to graph the remaining points of latitude and longitude of each earthquake using this color scheme: 4 magnitude in green, 5-6 magnitude in blue, and 7+ magnitude in yellow. Allow this activity to take about 20 minutes. **(Scaffolding: Independent Practice)**
g. Tell students to look at their map and ask them to see if they find a pattern.
h. Pass out the labeled Tectonic Plates map to overlay on World map with earthquakes identified.

i. Give students three minutes to look at their map with a partner and make a list of comparisons they see between the two maps. **(Grouping Option: Partners)**

**Explain:**
a. Discuss ideas and comparisons as a class.
b. Keep a running list of similarities and differences.
c. Show students Earthquakes 101 Video (4.27 min) http://www.youtube.com/watch?v=VSgB1IWr6O4 Then show https://earthquake.usgs.gov/earthquakes/map/ Look at the map of the earthquakes.
**(Preparation: Adapting Content)**
d. Demonstrate how the maps match up and how earthquakes tend to fall along the plate boundaries. **(Scaffolding: Modeling, Comprehensible input)**

**Evaluate:**
a. Explain Day One Homework to be completed for the following day and turned in with their World map of earthquakes: **(Assessment: Written, Individual).**

**SESSION TWO**
Prior to this session, instruct students on how to do a close read if they don't alreay have this skill. Close Read Annotation Instructions can be used.
**Engage:**
a. Tell students they have *one minute to write anything they think of when they hear the phrase "on a scale from one to ten*." Then write: *What do you think when someone says 3? What about when someone says 9?* Share a few responses
**(Startegies Used: Linking to Past Learning)**

**Explore:**
a. Explain that you're going to learn how to measure earthquakes, and you'll come back to discussing the writing prompt in relationship to earthquakes.
b. Pass out How does a Seismograph Work? Reading and Worksheet.
c. Tell students that with a partner, they will annotate the reading using the Close Read Annotation Instructions (or your own class instructions).
**(Integrating Processes: Reading, Grouping Option: Partners)**
c. Then have students with a partner complete Page 2. **(Application: Hands on, Grouping Option: Partners)**

**Explain:**
a. Show sketches under the doc cam.
b. Show Glimpse of a Seismograph Key.
c. Project How Does a Seismograph Work? video twice. (.30 min) http://www.youtube.com/watch?v=Gbd1FcuLJLQ&noredirect=1
d. Distribute the Glimpe of a Seismograph (without labels). Instruct students to label all parts.
**(Scaffolding: Guided Practice) (Scaffolding: Comprehensible input)**
e. Then have students refer back to the Session Two reading that included information about the Richter Scale.

**Evaluate:**
a. Explain Day Two Homework to be completed for the following day. **(Assessment: Written, Individual) (Integrating Processes: Writing)**

**SESSION THREE**

**Engage:**
a. Project Seismograph School Project Video. (1.13 min) http://www.youtube.com/watch?v=g11Zo0GDyzk
b. Have students write: *If you were to build a seismograph, what would you start with? Why?*

**Explore:**
a. Group students together in teams of four.
b. Tell them that they are seismologists and were locked out of their lab and can't measure the earthquakes. **(Application: Promotes Engagement)**
c. Pass out Engineering Design Process worksheet. Explain the process and have students complete sections 1-3.
d. Once they have shown their sketch to the teacher, they may select materials for the creation of their seismograph.
e. Allow students to choose from a variety of materials for their weight, string, etc., and build seismographs as a team. (**Grouping Option: Small Group, Integrating Processes: Speaking, Application: Hands On)**
f. Remind them to fill in the Engineering Design Process worksheet as the team is working.

**SESSION FOUR**

**Explain:**
a. Ask students to share what they found to be the most important part of their building process.
b. Allow students to look at other teams' seismographs.
c. Remind students that if it doesn't work, it is okay.

**Elaborate:**
a. Place one student seismograph on a table.

If you have the iSeismometer app, open it and place it on the table too.
b. Let group shake the table to simulate an earthquake **(Application: Promotes Engagement).**
c. Look at the seismogram that was created by the student seismograph. Compare the seismogram on the paper, and the seismogram on the iPhone to determine accuracy.
d. Repeat the process with other student seismographs.

**Evaluate:**
a. As homework, have students complete part 5 of the Engineering Design Process worksheet and the Final Assessment. . **(Assessment: Written, Individual) (Integrating Processes: Writing)**

## Assessment

**Writing, Reading, Geography and Science**
- The Final Assessment can be graded for multiple subjects. Mastery would be considered 80% or higher of the total points.

**Math and Geography**
- The graphing of latitude and longitude coordinates of earthquakes on the map can be graded for accuracy. Mastery will be considered 80% or higher.

**Science**
- Engineering Design Process worksheet will be graded for completeness. A score of 80% or higher would be considered mastery.
- Day One and Day Two Homework can be graded for completeness. A score of 80% or higher would be considered mastery.

**Reading**
- Close reading techniques completed on How Do Seismographs Work? Reading and Worksheet can be graded for following directions and accuracy. A score of 80% or higher would be considered mastery.
- The Vocabulary Test can be given. A score of 80% or higher would be considered mastery.

## Extensions

Several online sites contain great information:
a. USGS Earthquakes Hazards Program
https://www.usgs.gov/natural-hazards/earthquake-hazards
b. Online Game:
https://www.stopdisastersgame.org/
iPad/iPhone Apps
eQuakeMap (free)
Vulcano ($.99)

## Sources

Earthquake Destruction video from Youtube
http://www.youtube.com/watch?v=4Y-62Ti5_6s

Earthquakes 101 Video from Youtube
http://www.youtube.com/watch?v=VSgB1IWr6O4

Earthquakes in the Past 30 Days
https://earthquake.usgs.gov/earthquakes/map/

How a Seismograph Works video from Youtube
http://www.youtube.com/watch?v=Gbd1FcuLJLQ&noredirect=1

Seismograph School Project video on Youtube
http://www.youtube.com/watch?v=g11Zo0GDyzk

World Map and Plate Tectonic Map from Arizona Geographic Alliance
http://geoalliance.asu.edu/azga/

IRIS Seismic Monitor Data
http://www.iris.washington.edu/seismon/eventlist/index.phtml