Ground Shaking: Earthquakes Happen Every Day

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

GEOGRAPHY
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 Linking to background **Linking to past learning** Strategies used	**Modeling** **Guided practice** **Independent practice** **Comprehensible input**	Whole class **Small groups** **Partners** Independent
Integrating Processes	**Application**	**Assessment**
Reading **Writing** **Speaking** **Listening**	**Hands on** Meaningful Linked to objectives **Promotes engagement**	**Individual** Group **Written** Oral

Arizona English Language Proficiancy Standards

Grade 6-8
Basic
Listening and Reading
Standard 1 By the end of each language proficiency level, an English learner can construct meaning from oral presentations and literary and informational text through grade appropriate listening, reading, and viewing.
B-2: recount specific details and information in a variety of texts.
Speaking and Writing
Standard 3 By the end of each language proficiency level, an English learner can speak and write about grade appropriate complex literary and informational texts and topics.
B-3 compose informational text that includes details to develop a topic while using appropriate conventions.
B-5: use examples of precise language and domain-specific vocabulary within informative texts.
Standard 4 By the end of each language proficiency level, an English learner can construct grade appropriate oral and written claims and support them with reasoning and evidence.
B-1: construct a claim about a topic or text.
B-2: supply a reason that supports the opinion and is based on some textual evidence.
Standard 5 By the end of each language proficiency level, an English learner can adapt language choices to purpose, task, and audience when speaking and writing.
B-1 demonstrate awareness of the need to adapt language choices according to purpose, task, and audience.
B-2: use general academic and content specific words, phrases, and phrases to express ideas.
Listening, Speaking, Reading, and Writing
Standard 6 By the end of each language proficiency level, an English learner can participate in grade-appropriate oral and written exchanges of information, ideas, and analyses, responding to peer, audience, or reader comments and questions.
B-1: participate in discussions about familiar topics and texts.
B-2: participate in written exchanges about familiar topics and texts.
B-5: contribute relevant information and evidence to collaborative oral and written discussions.
Standard 7 By the end of each language proficiency level, an English learner can conduct research and evaluate and communicate findings to answer questions or solve problems.
B-2: paraphrase observations/information notes with labeled illustrations, diagrams, or other graphics, as appropriate.

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

Ground Shaking: Earthquakes Happen Everyday

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 video. 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. **(Integrated Processes: Writing, Speaking, Listening)**

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. **(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 a 3 on the scale? What about when someone says a 9 on the scale?* 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, Listening; 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

ELA, Geography and Science
The Final Assessment can be graded using the point system given. Mastery would be considered a score of 80% or higher.

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
The Engineering Design Process worksheet can be graded for completeness. A score of 80% or higher will be considered mastery.

Day One and Day Two Homework can be graded for completeness. A score of 80% or higher will be considered mastery.

ELA
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 will be considered mastery.

The Vocabulary Test can be given to measure language acquisition. A score of 80% or higher will 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 Maps from Arizona Geographic Alliance
https://geoalliance.asu.edu/sites/default/files/maps/World-at.pdf
https://geoalliance.asu.edu/sites/default/files/maps/PlateTectonicsLabeled.pdf
https://geoalliance.asu.edu/sites/default/files/maps/PlateTectonics.pdf

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