

Lesson on Earthquakes
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There's a Lot of Shaking Going On

Background information:

Earthquakes are caused by a sudden movement in the Earth's crust. An earthquake occurs when rocks have been stressed; the stress is a sudden release of energy that causes the seismic waves, which in turn makes the earth shake. Earthquakes occur constantly all over the world along faults and plate edges. The faults are caused by the cracks in the earth where two plates are moving in different directions. The earth's crust contains several pieces these are called plates. The plates are moving by the motion that occurs from the mantle (layer under the crust). When two plates run into one another or slide past one another an earthquake can occur.

California has more earthquakes than any other state. This is because there are many different fault lines that run underneath the state, Earthquakes can happen at any time, during the day or night. When earthquake fault lines rub together an earthquake happens. There is no way of predicting an earthquake. Earthquake weather is just a myth.

Scientists use a Richter scale to determine the magnitude of an earthquake. Those that register 2.0 are rarely felt, those that are between 2.1 and 4.0 are considered small with minimal damage. If the earthquake measures 5.0 there can be significant damage, anything above 5.0, depending where the epicenter occurred could cause minimal to severe damage. For example if the 5.4 earthquake happened in the middle of a valley with very few homes versus a large city with high buildings, the damage would be much greater in the city.

Engineers, contractors, and people in general are concerned about the damage an earthquake can cause to a building, road, bridge, and to a school. Structures are designed to withstand large magnitudinal earthquakes. Those that build these structures are concerned with the earth's processes, and want to insure the safety of everyone.

This lesson would be over a 3 science periods of 45 minutes each. Prior knowledge and lessons on the Earth's layers, reading seismology map, discussion of Northridge earthquake 1994 and the San Francisco earthquake 1989.

Standards:

Next Generation Science Standards

4-ESS2 Earth's Systems

Disciplinary Core Ideas:

ESS2.B Plate Tectonics and Large-Scale-interactions

The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes occur in patterns. Most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans. Major mountain chains form inside continents or near their edges. Maps can help locate the different land and water features areas of Earth.

ESS3.B Natural Hazards

A variety of hazards result from natural processes (e.g. earthquakes, tsunamis, volcanic eruptions) Humans cannot eliminate the hazards but can take steps to reduce their impacts (4-ESS3-2)

ETS1.B: Designing Solutions to Engineering Problems

Testing a solution involves investigating how well it performs under a range of likely conditions.

(Secondary to 4-ESS3-2).

Science and Engineering Practices:

Planning and Carrying Out investigations

Planning and carrying out investigations to answer questions or test solutions to problems in 3-5 builds on K-2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.

Make observations and or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. (4-ESS2-1)

Analyze and interpret data to make sense of phenomena using logical reasoning.. (4-ESS2--2)

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 3-5 builds on K-2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and designing multiple solutions to design problems.

Identify the evidence that supports particular points in an explanation (4-ESS1-1)

Crosscutting Concepts:

Patterns:

Patterns can be used as evidence to support an explanation
(4-ESS1-1),(4-ESS2-2)

Cause and Effect

Cause and effect relationships are routinely identified, tested, and used to explain change
(4-ESS2-1), (4-ESS3-2)

Nature of Science:

Scientific Knowledge Assumes an Order and Consistency in Natural Systems
(4-ESS1-1).

California Common Core State Standards Connections:

ELA/Literacy

R1.7 Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears. (4-ESS2-2)

W.4.7 Conduct short research projects that build knowledge through investigation of different aspects of a topic. (4-ESS2-

W.4.8.a-d Recall relevant information from experiences or gather relevant information from print and digital sources; take notes, **paraphrase**, and categorize information, and provide a list of sources. **CA** (4-ESS1-1), (4-ESS2-1)

Mathematics

MP.2 Reason abstractly and quantitatively. (4-ESS2-1)

MP.4 Model with mathematics. (4-ESS2-1)

MP.5 Use appropriate tools strategically. (4-ESS2-1)

4.MD.1 Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table. (4-ESS2-1)

4.MD.2

Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale. (4-ESS2-1), (4-ESS2)

Engaging Contexts:

Images of earthquakes will be shown, and view the damage that they can cause for buildings.

Teacher: *We have been studying geology, natural disasters, forces of nature, and earthquakes, over the past few weeks. Although we have not experienced any earthquakes recently where we live, your assignment is to ask your family if they have ever experienced an earthquake. How did they feel, where were they? Was there any damage? Does anyone know where San Francisco is located? (show California map, pointing to San Francisco. There was a large earthquake known as the Loma Prieta Earthquake (show newspaper article on the earthquake of 1989) A lot of buildings crumbled. (Show picture of San Francisco) what are the designs of the building? Discuss write answers on white board. Why do you think that happened? If you were an engineer, what type of buildings do you think would stand up to an earthquake and why?*

Justification:

I choose this topic because in fourth grade we study the landforms of California and natural disasters. California has earthquakes continually some that are not even felt in comparison to those that cause large amounts of damage. By understanding the engineering of buildings to withstand an earthquake, students can research and create their own structure to model buildings that could withstand an earthquake.

Objectives:

Students will be able to:

- Compare structural damage caused by an earthquake.
- Describe the structural damage caused by an earthquake
- Understand the shape and size of a building is important when assessing earthquake damage.
- Design and conduct experiments that will justify answers.
- Compare two earthquakes of equal magnitude and damage that occurred.
- Explain that there is no guaranteed way to predict an earthquake
- Organize, represent, and interpret the data in your journal
- Present structures as a group to your peers
- Develop and analyze the material used for each structure

Materials Needed:

- Toothpicks (6 boxes of 100)**
- Marshmallows small (4 bags)**
- Jell-O in pan (as many pans as there are groups- make the night before and covered, so it doesn't dry out)**
- Ruler**
- Pencil**
- journal**

Lesson Plan: 3-45 minute periods

- Day 1 Engage step**
- Day 2 Engage and explore steps**
- Day 3 Evaluation and presentations**

Engage:

Teacher: "Before we begin our lessons, I would like to know what you remember from our previous lessons. We worked in teams to learn specific vocabulary concerning earthquake, so I'd like you to get out your chromes and go to the following website and proceed to take the formative assessment on earthquakes, this will allow us to review information that may have been misplaced in our heads".

www.seismo.ethz.ch/static/quiz/eng/fragen_antworten/eq_for_kids_02.htm

Students: Will complete the assessment and discuss their scores. In groups the students will write down any questions that they found difficult to answer and research the information from google.

Teacher and Students:

We will be doing an experiment to compare structural damage done by an earthquake. In your groups, with your teammates, decide who is the recorder, facilitator, and the resource monitors. You are all engineers building your own model. The experiment is to see how you build your structure, how earthquake proof, and stable it is during movement.

Two members from each group collect the marshmallows, toothpicks, and Jell-O pan.

Create your structure, and place it on top of the Jell-O pan. Shake the pan back and forth to see if your structure is still intact. You will make three different structures, in size and shape to record your findings on the Earthquake Structural Design Table. (See Earthquake design table)

Use your journal, recording your observations titled "What I have observed?" At the end of your completion, write "What I have learned."
You will also use your rulers for measurement, be sure to work with your group.

Explore: Students will use their Chromebook and explore the teacher approved websites for students. Students will collect information on earthquakes, building engineers, and structures by researching the information.

<https://earthquake.usgs.gov/learn/kids/>

<http://kids.nationalgeographic.com/explore/science/earthquake/#earthquake-houses.jpg>

Explain:

Now that we have completed our research and created our structures, and as a group you have documented your findings in your journal. You will present your findings to your fellow classmates and will be graded as a group. We will develop our rubrics together you have written in your journals, and you have completed your table. You will be graded as a group and develop a rubrics together as a class.

Elaborate:

Students will be in groups of four to complete their STEM challenges on creating a structure that can withstand movement underneath it. Students will follow the

Engineering design process. Identify the problem, brainstorm solutions, select a design, build a model, test and evaluate, optimize the design and share the solution.

Evaluation:

Ongoing formative assessment through group interaction, journal entries, observation of students. By implementing formative assessments the teacher can continually check for understanding, and clarification of the task.

Summative Assessment:

Students will be able to score 80% or better on the group rubric
Students will be able to score 80% on a summative questionnaire at the end of the unit.

Resources:

Teacher Resources (websites and videos)

videos

Plate Tectonics for Kids-from www.makemegenius.comhttps://www.youtube.com/watch?v=tcPghq

Plate Tectonics: Broken Down for Students
<https://www.youtube.com/watch?v=7KtPQis2L0c>

Earthquake Facts for Kids! Bu Mr. DeMaio
<https://www.youtube.com/watch?v=QNbjqWE7Yhc>

Websites

Where Do Earthquakes Happen
www.geo.mtu.edu/UPSeis/where.html

USGS Earthquake Hazards Program
<https://earthquake.usgs.gov>

http://earthquakes.www.seismo.ethz.ch/static/quiz/eng/fragen_antworten/e_Q_for_kids_02.htm