

Lesson #3
Quarter- 1

TITLE: “Are you ready to rumble?”-*Earthquakes*

OVERVIEW:

In the last two lessons students have learned that the Earth has undergone many changes. *Earthquakes* play a vital role in changing the Earth very quickly. Students will learn how *earthquakes* have changed the face of the planet. Not only can *earthquakes* have a huge impact on landscape, they can also greatly affect the lives of people who live through them. In this lesson, students will create a cityscape diorama to see the effects of weak and strong *earthquakes*. They will also reflect on the *earthquake* that happened here in Hawaii in October of 2006. Finally, students will see how *tsunamis* are related to *earthquakes*, and learn how a *tsunami* is generated.

KEY CONCEPTS:

1. The Earth has undergone many fast changes since its inception.
2. *Earthquakes* have greatly changed the Earth’s landscape.
3. *Earthquakes* are mainly caused by the movement of the Earth’s plates.

LESSON DURATION: Two to Three 45 minute periods

STANDARDS AND BENCHMARKS:

Science:

Standard 8: Physical, Earth, and Space Sciences: EARTH AND SPACE SCIENCE:
Understand the Earth and its processes, the solar system, and the universe and its contents
SC 4.8.2 Describe how fast processes sometimes shape and reshape the surface of the Earth

Language Arts:

Standard 1: Reading: CONVENTIONS AND SKILLS: Use knowledge of the conventions of language and texts to construct meaning for a range of literary and informational texts for a variety of purposes
4.1.1 Use new grade-appropriate vocabulary, including homophones and homographs, learned through reading and word study, including root words, affixes, and word origins

Standard 6: Oral Communication: CONVENTIONS AND SKILLS: Apply knowledge of verbal and nonverbal language to communicate effectively in various situations: interpersonal, group, and public: for a variety of purposes
4.6.1 Participate in grade-appropriate oral group activities

TEACHER BACKGROUND:

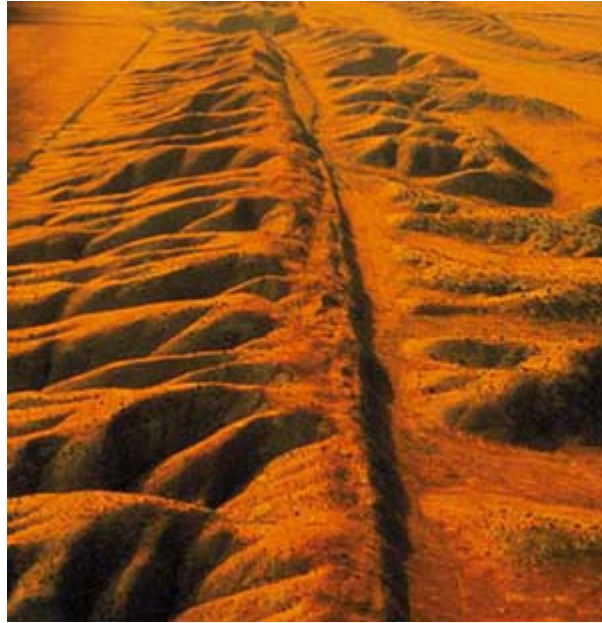
Earthquakes happen every day all around the world. When the Earth's plates move suddenly, it can cause an *earthquake*. Sometimes *earthquakes* are barely noticeable, while other times, they can cause drastic changes in landscape and loss of life. About 75% of *earthquakes* occur in the zone called, the Ring of Fire. The Ring of Fire is located in the Pacific Ocean and is named as such because of the large amount of volcanoes located there.



<http://www.eia.doe.gov/kids/energyfacts/sources/renewable/geothermal.html>

Larger *earthquakes* happen when one plate is forced below another. When two plates are moving towards each other, sometimes, one plate will move under the other. The two plates grind together and cause an *earthquake*.

When the Earth's plates are moving together (at convergent boundaries), the crust above undergoes a great deal of strain. If the plates suddenly shift, it can cause the ground above to shake. In some cases, it may even produce a crack in the earth. These cracks in the Earth are called *faults*. *Faults* can be found all over the Earth and some are so large they form large cracks in the ground. Large *fault* lines, and strong *earthquakes*, can be found at the edges of the earth's plates. Pictured below is a picture of the San Andreas Fault that can be found in California. The San Andreas fault formed as two plate slid past one another (transform boundary).



http://www.lbl.gov/Science-Articles/Research-Review/Highlights/1998/EES_fault.html

Earthquakes originate deep within the Earth. The place where the rocks first jolt is called the *focus*. Vibrations, or *shock waves*, travel from the *focus* very quickly. When a rock is thrown into a pool of water, one can see how the ripples move from the center outwards, very quickly. The vibrations from the *focus*, also move outwards very quickly, with vibrations at the *focus* being the strongest and getting weaker as the vibrations move outwards. Directly above the *focus* on the surface of the Earth is called the *epicenter*. The *epicenter* endures the strongest shaking.

Seismologists, scientists who study *earthquakes*, can measure how strong an *earthquake* is with a seismograph. The *Richter scale* assigns the *earthquake* a numerical value as to how strong the *earthquake* is. The larger the number, the stronger the *earthquake*. Even though technology can measure the strength of an *earthquake*, there is no way to predict when an *earthquake* will happen.

Earthquakes, historically, have caused a great deal of damage to buildings and also the landscape. They have also resulted in loss of life. For now, since *earthquakes* cannot be predicted, it is important to be ready if one hits. Builders and architects build buildings that can withstand the shaking caused by *earthquakes*. People are also learning how they can be prepared if an *earthquake* hits.

While the *earthquake* itself can be damaging, sometimes an *earthquake* can also cause another disaster. For example, if an *earthquake*'s *epicenter* is above the ocean, it can generate huge waves, or a *tsunami*. When a *tsunami* hits the shoreline, it can be catastrophic and completely obliterate everything in its path. *Earthquakes* can also generate *mudflows* and *landslides*. If there is loose land and rock, even a little *earthquake* can shake the piece of land free. If the piece of land flows down hill, it can destroy

everything in its path. When an *earthquake* loosens land and rock, and then heavy rains occur, it can cause a *mudflow* which can, again, destroy everything in its path.

VOCABULARY:

- *Earthquake*- The sudden shaking of the ground; occurs due to movement beneath the Earth's crust.
- *Epicenter*- The place, on the Earth's surface, above the *focus*.
- *Fault*- A crack in the Earth's crust; caused by force of moving plates.
- *Focus*- The place, under the Earth, where an *earthquake* originates.
- *Landslide*- Downward flow of broken pieces of earth and rock.
- *Mudflow*- Downward flow of mud and debris; caused by heavy rainfall.
- *Richter scale*- Scale used to measure the strength of an *earthquake*.
- *Seismologist*- A scientist who studies *earthquakes*.
- *Shock waves*- Vibrations generated from the *earthquake*.
- *Tsunamis*- Huge ocean waves.

MATERIALS NEEDED:

Per student:

- * Lesson #3 Worksheet #1 "Reflection on the *earthquake*"
- * Lesson #3 Worksheet #2 "Cityscape"
- * Shoebox with lid
- * Construction Paper
- * Scissors
- * Tape or Glue
- * Glitter
- * Pebbles, sand and/or rock
- * Lesson #3 Worksheet #3 "*Earthquake* Worksheet" (for extended activity)
- * Lesson #3 Handout #1 "*Tsunami* event cards

Per Class:

- * Pan of water
- * Rock or pebble
- * Computers with internet access

PROCEDURE:

1) Remind students that we've been discussing and learning about how the Earth changes quickly and slowly. Today we'll be learning about *earthquakes*. *Earthquakes* can change the Earth's landscape very quickly. *Earthquakes* can cause a great deal of damage to property and also result in loss of life.

2) Have students discuss what they know about what causes *earthquakes*. Tell them to share in partner groups for 1 minute. After a minute, have some groups share their ideas.

3) Refer back to the lesson on plate tectonics (Lesson 1). Remind students that the plates are constantly moving. Remind students that sometimes the plates are moving together. Ask students what we call the place where two plates are moving together (convergent boundaries). Tell them that sometimes, when two plates are pushing together, it can cause a great deal of pressure. Most *earthquakes* occur at plate boundaries. Have two students come up to the front of the class. Have them face each other and put their hands up, palms facing outwards. Have them push on each other palms with all of their might. Eventually, one student will be pushed back, or their hands might slip (Make sure to choose students will carry out this exercise safely). Explain that this is what happens when plates are pushed together, also. Sometimes, the force will be so great, that they will slip and grind against one another generating an *earthquake*.

4) Tell students that this slipping occurs below the surface of the Earth. The place where the two plates collide and slip is called the *focus*. From this place deep in the Earth, *shock waves* are sent out. The *shock waves*, or vibrations, are strongest at the center and get weaker as they travel farther and farther away. Directly above the *focus* on the Earth's crust is the *epicenter*. Have students come up to the front of the class (If it's easier to manage, have students come up in groups). Have a pan of water on a desk. Drop a pebble in the center of the pan of water. Have students take note of the ripples that travel outward from where the pebble was dropped. This demonstrates the how the *shock waves* travel from the *epicenter*. The ripple is strongest and most noticeable at the center and the ripples get weaker and weaker as they travel outwards. (Continue to add new vocabulary to the word wall).

5) Tell students that *earthquakes* occur every single day. Print out a current map of *earthquakes* that occurred within the last 30 days from: <http://gldss7.cr.usgs.gov/neis/qed/qed.html>. This site from the United States Geological Survey shows a world map with current *earthquakes* from the last 8-30 days. Students may be shocked to see that there is so much *earthquake* activity going on all the time. Explain that sometimes the *earthquakes* are so weak we can't feel them.

6) Tell students that the strength of an *earthquake* is measured on a *Richter scale*. This numerical value tells scientists what the magnitude of the *earthquake* is. The magnitude is related to the amount of energy being released at the epicenter (source of the *earthquake*). The weak *earthquakes* have a lower number on the *Richter scale*, while the *earthquakes* we can feel have a higher number on the *Richter scale*. In general, the stronger the *earthquake*, the more damage it can cause. Sometimes, *earthquakes* have even produced cracks in the earth, called *faults*.

7) *Earthquakes* change the landscape quickly because they can destroy land and property as the *earthquake* is occurring. This can happen in a matter of seconds. The vigorous shaking of the Earth can cause buildings to collapse and the Earth itself to crack. If people are in a building that collapses, it can be very devastating. Fortunately, most

earthquakes are mild and don't cause damage. *Earthquakes* can also loosen land and soil and cause large chunks of land to break off causing a *landslide*. If heavy rainfalls come, they can loosen earth that has already been loosened in an *earthquake* and cause a *mudslide*.

Activity 1: Earthquake Activities

8) To have students see the effects of an *earthquake*. Have students make a city diorama. Using a shoebox, have students make a mini-city. Have students use paper and scissors to make little buildings. They can use glue or tape to secure their buildings in the shoebox. Tell students to be as creative as they want. They may add anything else to their cityscape. Have students then place some pebbles and glitter around the city. After they are done, have them replace the shoebox lid and shake it gently. Have students take off the lid and record what happened. Then, have students put the city "back together" and then replace the lid again. Have students shake it more vigorously and record their findings on the Cityscape worksheet (Lesson #3 Worksheet #2). This activity demonstrates the differences between a weak and a strong *earthquake*. A strong *earthquake* will generate more damage than a weak one.

Activity 2: Where were you October 15, 2006?

9) Have students use the reflection sheet (Lesson #3 Worksheet #1) to think about where they were when the last noticeable *earthquake* hit Hawaii on October 15, 2006. (There have been more recent *earthquakes*, however, they were barely noticeable and students may not have known they occurred). Have students write about where they were when the quake hit, and how they felt.

Activity 3: Tsunami Film Strip

10) Tell students that they will be drawing a film strip demonstrating what happens when a *tsunami* is generated. Give students the *tsunami* cards (Lesson #3 Handout #1). Have them place the events in the correct order. After they are finished, have them glue the cards to a piece of construction paper, in the correct order. Above each card, have students illustrate the "scene." Have students share their film strips. After the last event, have them write another card that tells what might follow the last card. Have them illustrate that event, also. Tell students to keep in mind, we are thinking about how *earthquakes* can change the earth.

ASSESSMENT:

Rubric Assessment for Lesson # 3				
Title: Are You Ready To Rumble- Earthquakes				
Benchmark	Advanced	Proficient	Partially Proficient	Novice
SC 4.8.2 Describe how fast processes sometimes shape and reshape the	Student describes how fast processes sometimes shape and reshape the	Student describes how fast processes sometimes shape and reshape the	Student partially describes how fast processes sometimes shape	Student is starting to describe how fast processes sometimes shape

surface of the Earth	surface of the Earth and gives multiple examples	surface of the Earth	and reshape the surface of the Earth	and reshape the surface of the Earth, however, with inaccuracies
LA 4.1.1 Use new grade-appropriate vocabulary, including homophones and homographs, learned through reading and word study, including root words, affixes, and word origins	Student fluently uses new grade-appropriate vocabulary, including homophones and homographs, learned through reading and word study, including root words, affixes, and word origins	Student uses new grade-appropriate vocabulary, including homophones and homographs, learned through reading and word study, including root words, affixes, and word origins	Student begins to use new grade-appropriate vocabulary, including homophones and homographs, learned through reading and word study, including root words, affixes, and word origins	Student attempts to use new grade-appropriate vocabulary, including homophones and homographs, learned through reading and word study, including root words, affixes, and word origins
LA 4.6.1 Participate in grade-appropriate oral group activities	Student participates in grade-appropriate oral group activities and exhibits superior speaking skills	Student participates in grade-appropriate oral group activities	With encouragement, student participates in grade-appropriate oral group activities	Student rarely participates in grade-appropriate oral group activities

* Have students complete Activity 4: *Tsunami* Film Strip. Check to see that students understand how *tsunamis* are generated and how they affect the landscape.

EXTENDED ACTIVITIES

* Have students use the internet and other sources to find out information about the Nuuanu Pali *landslide* that “tore Oahu apart.”

* Have students graph *earthquake* activity over the last ten years in Hawaii. See if there are any patterns.

* Have students use the computer to answer questions on the *earthquake* worksheet. Have students go to the United States Geological Survey’s Web site: <http://earthquake.usgs.gov/regional/states.php?regionID=11> to answer questions and learn about the history of *earthquakes* in Hawaii. Students will learn that even if an *earthquake* didn’t happen here, it can still have implications for our islands. For example, if an *earthquake* occurred in the middle of the Pacific, we may be affected by a *tsunami*. Have students answer the questions on the worksheet (Lesson #3 Worksheet #3).

RESOURCES:

Web:

Energy Kid’s Page. (2007). Retrieved September 5, 2007, from the US Department of Energy’s Web Site:

<http://www.eia.doe.gov/kids/energyfacts/sources/renewable/geothermal.html>

Hawaii Earthquake Information. (2007). Retrieved September 2, 2007, from the United States Geological Survey's Web site:

<http://earthquake.usgs.gov/regional/states.php?regionID=11>.

Preuss, P. (2007). *Living on the Fault Line*. Retrieved September 5, 2007, from the US Department of Energy's Web Site:

http://www.lbl.gov/Science-Articles/Research-Review/Highlights/1998/EES_fault.html

Recent Earthquakes Last 8-30 Days. (2007). Retrieved September 2, 2007, from the United States Geological Survey's Web site: <http://gldss7.cr.usgs.gov/neis/qed/qed.html>.

Volcanic Hazards Program. (2000). Retrieved September 5, 2007, from the US Geological Survey's Web Site: <http://volcanoes.usgs.gov/Products/Pglossary/fault.html>

Print:

Bramwell, M. (1986). *Volcanoes and Earthquakes*. New York: Franklin Watts.

Clifford, N. (1996). *Incredible Earth*. New York: DK Publishing Book.

Cooper, J. (2002). *Arty Facts: Planet Earth and Art Activities*. New York: Crabtree Publishing, Co.

Dixon, D. (1992). *The Changing Earth*. New York: Thomson Learning.

Fagan, M. (1987). *Science Today: Planet Earth*. New York: Gloucester Press.

Gallant, R. (2003). *Plates: Restless Earth*. New York: Benchmark Books.

Llewellyn, C. (1997). *Our Planet Earth*. New York: Scholastic, Inc.

Lye, K. (1991). *The Earth*. Brookfield: The Millbrook Press.

Morris, N. (1998). *Earthquakes*. New York: Crabtree Publishing, Co.

Silverstein, A., et al. (1998). *Plate Tectonics*. Brookfield: Twenty-First Century Books.

Lesson #3 Worksheet #1

Reflection on the earthquake

Where were you on October 15, 2006? In two paragraphs, write about how you felt when the quake hit. For instance, where were you, what were you feeling? Was your family prepared?

If your family wasn't prepared, how could they prepare for a future earthquake?

Lesson #3 Worksheet #2

Cityscape

After replacing the lid on your city, shake the shoebox gently. Remove the lid. What do you notice about your city?

Put your city back together the way it was before you shook it. Replace the lid. Shake the shoebox more vigorously this time. Remove the lid. What did you notice about your city?

Were there any differences in what happened to your city when you shook it gently versus vigorously?

Earthquake Worksheet
Learning About Earthquakes In Hawaii

1) Go to the following Web site:

<http://earthquake.usgs.gov/regional/states.php?regionID=11>

2) Answer the following questions:

When did the most destructive tsunami hit Hilo?

Where was the earthquake that generated the tsunami?

How many were killed?

In 1837, another great tsunami hit Hilo. Where did the earthquake originate?

When was the largest earthquake in Hawaii?

Describe how many deaths occurred and the impact of this quake.

When was the last earthquake in Hawaii?

Where did it occur, in relation to Hilo?

Write down at least five interesting facts you learned from the site.

Earthquake Worksheet- Teacher Key Learning About Earthquakes In Hawaii

1) Go to the following Web site:

<http://earthquake.usgs.gov/regional/states.php?regionID=11>

2) Answer the following questions:

When did the most destructive tsunami hit Hilo?

April 1, 1946

Where was the earthquake that generated the tsunami?

Aleutian Islands

How many were killed?

173

In 1837, another great tsunami hit Hilo. Where did the earthquake originate?

Chile

When was the largest earthquake in Hawaii?

April 3, 1868

Describe how many deaths occurred and the impact of this quake.

Taken from the website: "The earthquake caused 77 deaths (tsunami, 46; landslide, 31). It knocked almost all wooden houses off their foundations in the Keiawa, Punaluu, and Ninole areas. In those areas, straw houses supported by posts in the ground reportedly were "torn to shreds." At Kau, the more substantial houses and every stone wall were thrown down. At Waiohinu, a large stone church collapsed within 10 seconds of the onset of shaking. The shock "ruined" the few stone buildings in Hilo and shook down almost every wall. Brooks became muddy."

When was the last earthquake in Hawaii?

This answer will change depending on when you do this activity.

Where did it occur, in relation to Hilo?

This answer will change depending on when you do this activity.

Write down at least five interesting facts you learned from the site.

Any number of responses.

Tsunami Event Cards

Cut out the cards. Place these cards in the order of their occurrence. When you are finished, glue or tape the cards in the correct order. Then illustrate the event above the card. When you are finished, write what you think will happen next on the blank card. Illustrate.

Shock waves are sent out from the focus
The wave travels up to 500 mph
Colliding plates create a great deal of pressure and jolt past one another
A wave is generated above the focus
The gigantic wave hits the shoreline
Plates collide at convergent boundaries under the ocean

Tsunami Event Cards- Teacher Key

Students arrange the cards on their paper in this order:

Plates collide at convergent boundaries under the ocean
Colliding plates create a great deal of pressure and jolt past one another
Shock waves are sent out from the focus
A wave is generated above the focus
The wave travels up to 500 mph
The gigantic wave hits the shoreline