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Defining an Earthquake

Earthquake Curriculum, K-6 — Scope and Sequence Chart

Unit I: Defining an Earthquake

Level	Concept	Laboratory	Mathematics	Language Arts	Social Studies	Art
K-2	<p>An earthquake is a sudden, rapid shaking of the Earth caused by the release of energy stored in rocks.</p> <p>Legends are traditional narrative explanations of natural phenomena that evolve when scientific explanations are not available.</p>	<p>Sand and box demonstration of earthquakes</p>		<p>Vocabulary development of earthquake words</p> <p>Original earthquake legends</p>	<p>Effects of earthquakes on model buildings</p> <p>Effect of earthquakes on people</p> <p>Cultures and legend origins</p>	<p>Illustrations of legends</p> <p>Illustrations of Earth's interior</p> <p>Mural making</p>
3-4	<p>An earthquake is a sudden, rapid shaking of the Earth caused by the release of energy stored in rocks.</p> <p>Legends are traditional narrative explanations of natural phenomena which evolve, when scientific explanations are not available.</p> <p>Earthquake energy is released in the forms of waves.</p>	<p>Silicone putty rocks</p> <p>Gelatin simulation of earthquakes</p>		<p>Earthquake legends</p> <p>Paragraph writing</p> <p>Class discussion</p>	<p>Map study of cultures associated with earthquake legends</p> <p>Map study of epicenters</p>	<p>Illustrations of earthquake causes</p> <p>Illustrations of earthquake legends</p>
5-6	<p>Earthquakes result from the build-up and release of energy stored in rocks.</p> <p>Earthquakes occur over much of the world and the United States.</p> <p>Various societies have produced earthquake legends to explain these natural occurrences.</p>	<p>Stick simulation of earthquakes</p> <p>Fault action game</p>	<p>Map scales to measure distances</p>	<p>Vocabulary development of earthquake words</p> <p>Earthquake legends</p> <p>Oral reading and note taking</p>	<p>Map study of earthquake locations</p> <p>Map study of cultures associates with earthquake legends</p> <p>Map study of state locations</p>	<p>Sign making</p> <p>Diagram making</p>

I



Defining an Earthquake

An earthquake is a natural phenomenon like rain. Earthquakes have occurred for billions of years. Descriptions as old as recorded history show the significant effects they have had on people's lives. Long before there were scientific theories for the cause of earthquakes, people around the world created folklore to explain them. In simple terms, earthquakes are caused by the constant motion of Earth's surface. This motion creates buildup and releases energy stored in rocks at and near the Earth's surface. Earthquakes are the sudden, rapid shaking of the Earth as this energy is released.

At half-past two o'clock of a moonlit morning in March, I was awakened by a tremendous earthquake, and though I had never before enjoyed a storm of this sort, the strange, thrilling motion could not be mistaken . . . Both glad and frightened, [I shouted]: "A noble earthquake! A noble earthquake!" feeling sure that I was going to learn something.

John Muir 1872

Defining an Earthquake

An earthquake is a natural occurrence, like rain. Earthquakes affect almost every part of the Earth and like rain they can be either mild or catastrophic. Over the course of geological time, earthquakes, floods, and other natural events have helped to shape the surface of our planet.

An earthquake may last only a few seconds, but the processes that cause earthquakes have operated within the Earth for millions and millions of years. Until very recently, the cause of earthquakes was an unsolved mystery. It was the subject of fanciful folklore and equally fanciful learned speculation by peoples throughout the world.

In a legend from Siberian Kamchatka, a god named Tuli drives an Earth-laden sled pulled by flea-infested dogs. When the dogs stop to scratch, the Earth shakes.

Some say the Earth was fevrous [feverish] and did shake.
Shakespeare, Macbeth, III

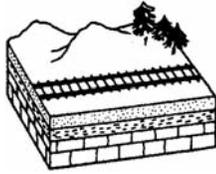
In the mid-1960s, many scientific observations and explanations of earthquakes came together in the theory of plate tectonics. We'll be exploring that subject in later units. In this unit we consider both scientific and popular explanations for the phenomenon and look at the patterns of earthquake occurrence worldwide.

An Earthquake Is . . .

An earthquake is a sudden, rapid shaking of the Earth caused by the release of energy stored in rocks. This is a brief definition which students of all ages can master. A full definition of the term, however, would need to include a good deal more information.

Students may be surprised that we speak of rocks and rock layers, because in many places the rock material of the Earth's crust is covered by accumulations of sand or soil. Remind them that even beneath the sediment in river valleys, plains, and beach areas, some kind of rock is always present.





Earthquake shaking may cause loss of life and destruction of property. In a strong earthquake the ground shakes violently. Buildings may fall or sink into the soil. Rocks and soil may move downhill at a rapid rate. Such landslides can bury houses and people.

Folklore and Scientific Theory

Because strong earthquakes have such disastrous effects, it is not surprising that people have always looked for ways to explain their origin. We find many nonscientific explanations of earthquakes in the folklore of civilizations around the world. We call these traditional narratives earthquake *legends*. Some of them are still being told today.

What we have learned in recent years, however, largely from the study of earthquakes, is that the Earth around us is not static, like a stage set for a play. The Earth's rock layer is broken into large pieces. These pieces are in slow but constant motion. They may slide by smoothly and almost imperceptibly.

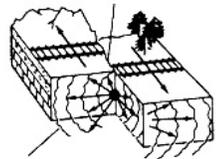
From time to time, the pieces may lock together, and energy that accumulates between the pieces may be suddenly released. This sudden release of energy, like the snapping of a rubber band that has been stretched too far, is what we call *elastic rebound*. Energy is released and travels through the Earth in the form of waves. People on the surface of the Earth experience an earthquake.

Pressure Direction

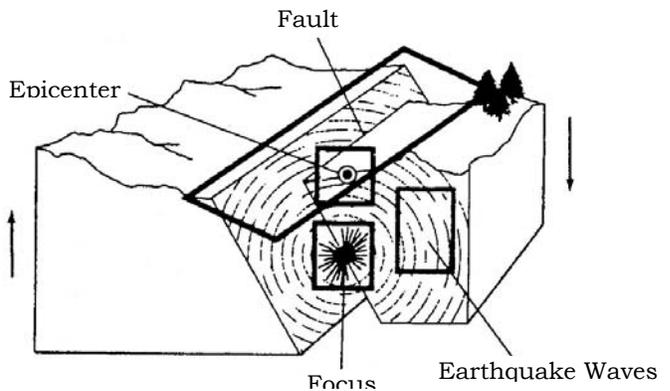


Deformed Rocks

Fault



Earthquake Waves



Earthquake Epicenters

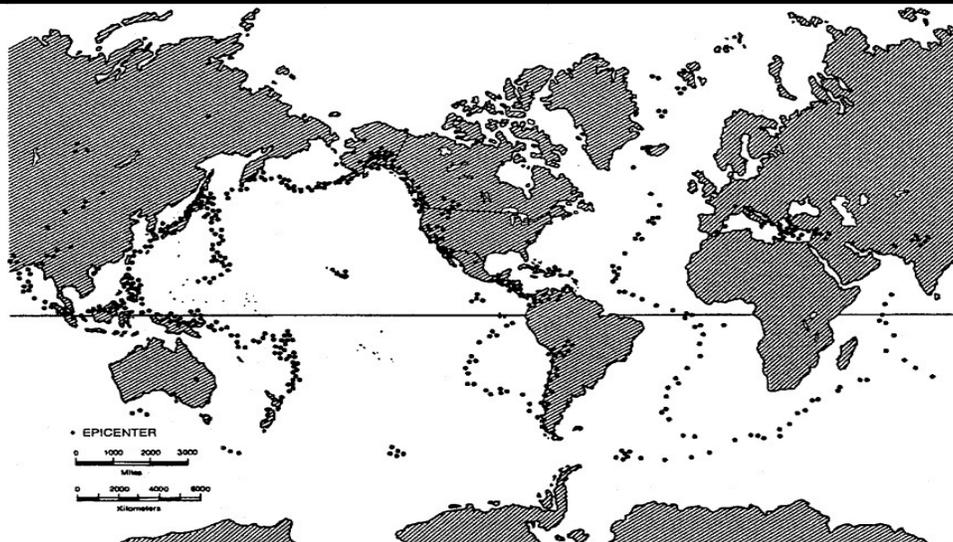
The *epicenter* of an earthquake is the place on the Earth's surface directly above the focus (or *hypocenter*), the place inside the Earth where the quake originates. Earthquake foci are usually somewhere between the surface and 100 km in depth. In some areas, however, foci may be as deep as 700 km.

Even a glance at an earthquake epicenter map shows that most earthquakes have occurred in certain well-defined regions of the Earth. Because these regions tend to be relatively long and narrow, they are sometimes referred to as earthquake *belts*.

One large belt of epicenters runs through the Mediterranean Sea, Asia Minor, the Himalayan mountains, and into the eastern Indian Ocean. A second large belt runs northward through the western Pacific Ocean, the Japanese islands, the Aleutian islands, and the west coasts of North and South America. The longest belt of earthquake epicenters runs through the central regions of most ocean basins. The world epicenter map also shows some shorter belts of epicenters.

Chances are, even if your school is far from any earthquake epicenter, your students already have some ideas about earthquakes and what causes them. In the lessons that follow, you will invite them to tell you what they think.

Master 7, World Map with Epicenters. The dots represent earthquakes with magnitudes ≥ 5.0 recorded from 1980-1990 by the National Earthquake Information Center, USGS.



What Is an Earthquake?

Content Concepts

1. An earthquake is a sudden, rapid shaking of the Earth caused by the release of energy stored in rocks.
2. Legends are traditional narrative explanations of natural phenomena that evolve when scientific explanations are not available.

Vocabulary

earthquake
legends

Objectives

Students will

- describe personal experiences with earthquakes.
- construct an earthquake model.
- observe effects of a simulated earthquake.
- define the term *legend*, and listen to a legend.
- suggest possible causes of earthquakes.
- write and illustrate original legends.
- draw pictures to illustrate their ideas about the Earth's interior.

Assessment

Restate The Turtle Tale. Draw or tell three imaginative, non-scientific explanations for Earth movement.

Learning Links

Language Arts: Writing a description of a demonstration (older students), sharing ideas about the possible causes of earthquakes, building vocabulary, listening to a legend, creating an original legend

Art: Illustrating the legends, expressing ideas about the Earth's interior in drawing, contributing to a mural

Social Studies: Observing the effects of a simulated earthquake on model buildings, predicting the effects on people's lives, discussing a Native American legend, locating San Gabriel on a U.S. map

Activity One: Tremble Here, Tremble There

Materials for the teacher

- A small table or desk that moves easily

Materials for each small group of students

- A shallow box partially filled with sand or soil
- An assortment of paper plates, cups, and small boxes that can be stacked to represent a building.

Procedure

1. Introduce the topic with a class discussion based on the following questions:

What does the word *quake* mean?

What do we mean when we say people are “quaking in their boots”? (Invite students to imitate a person trembling.)

Have you ever been on a bridge when it shook from heavy traffic, or near the railroad tracks when a train passed over? (Invite students to demonstrate shaking and vibrating.) What do you suppose is happening to the Earth when there is an earthquake?

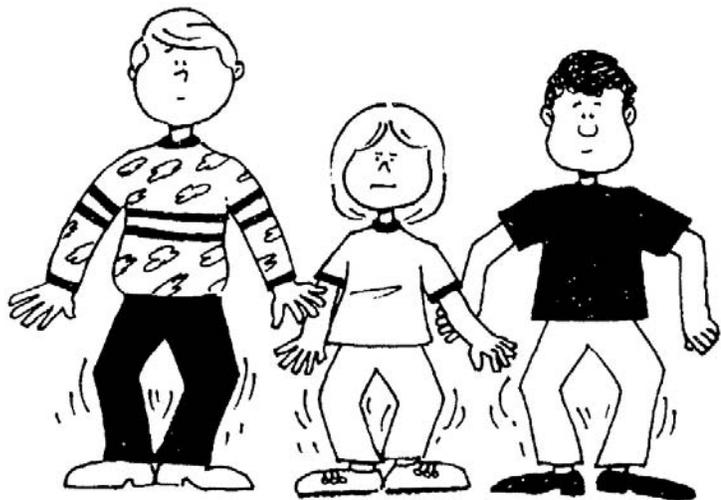
Has anyone here ever felt an earthquake? (Allow students time to express their observations and feelings.)

earth • quake

An earthquake is a sudden, rapid shaking of the Earth caused by the release of energy stored in rocks.

leg • ends

Legends are traditional narrative explanations of natural phenomena that evolve when scientific explanations are not available.



2. Tell students they are going to make a model to demonstrate what happens during an earthquake. Follow these steps:

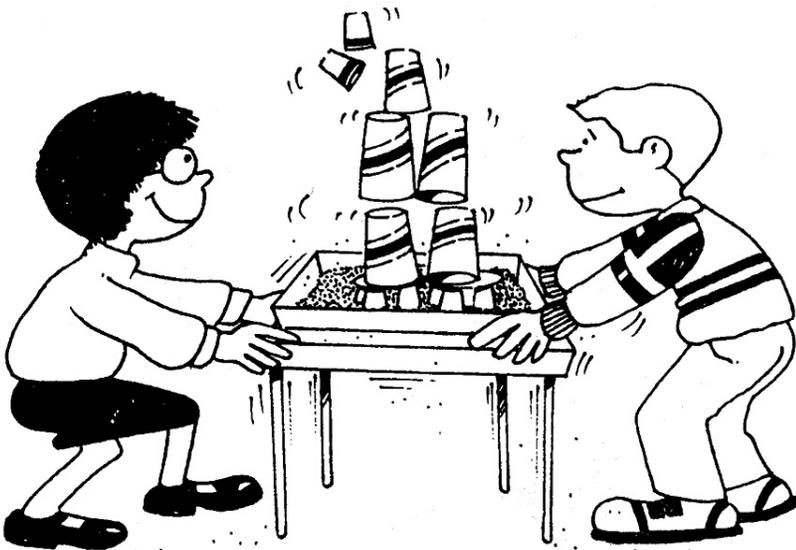
- a. Invite a small group of students to pile plates, cups, and small boxes on top of each other in the filled box to form a tall structure. (Either have enough materials for each group to construct one model, or have the groups take turns.)
- b. Place the large box on the cart, table, or desk.
- c. Shake the cart, table, or desk until the structure topples.
- d. Ask the students to comment on what they see.

What does the sand or soil represent? (the Earth)

What do the plates, cups, and, boxes represent? (a tall building)

What moves? (the Earth and the building)

What happens to the building? (various degrees of damage)



Children will enjoy simulating various levels of force and observing the results.

Activity Two: Tremors and Turtles

Materials for the teacher

- Master 1a, U.S. Map
- Master 2, The Turtle Tale

Materials for each student

- 2 small (6") paper plates
- 1 straw
- Green construction paper
- Handout from Master 3, Turtle Tale Pop-Up Puppet
- Scissors
- Markers or crayons
- Stapler

Teacher Take Note: See the Appendix, Earthquake Legends, for more tremor tales from around the world.

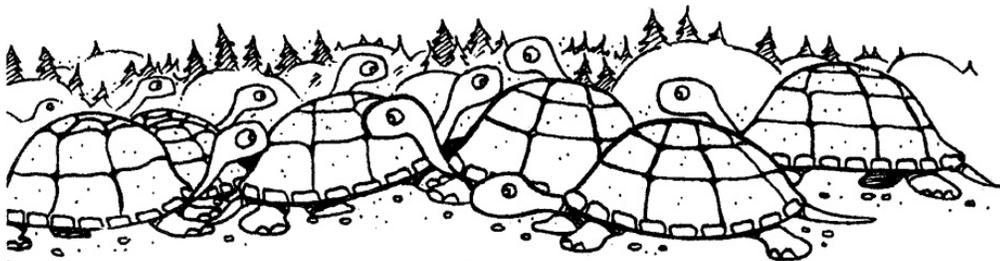
Procedure

1. Discuss the origin of legends.

How can we understand about earthquakes? (from science)

Yes, but earthquakes have been happening for a long time, and we have only been studying them with scientific instruments for a short time. How do you suppose people explained them before that? (with stories)

These stories are called legends.





Master 1a, U.S. Map. San Gabriel is marked with an asterisk (*)

Teacher Take Note: Encourage older students to design their own puppets. Younger students may enjoy the turtle dot-to-dot exercise. (Master 4)

2. Point out the San Gabriel Valley on a U.S. map. (Indicate the southwestern part of California, in the neighborhood of Los Angeles—see map.)
3. Introduce the story on Master 2, *The Turtle Tale*, and read it aloud. This is a story that was told by a group of Native Americans who lived where earthquakes are common, in the San Gabriel Valley. People call them the *Gabrielinos* (Ga • bree • uh • leé • nos).

4. Discuss the story.

Did you enjoy the story? Why or why not?

Do you think the story is true? Why or why not? (Students will give a variety of reasons why it is not: Turtles are not that big. Turtles are not that strong. Turtles can't talk.)

Why do you think the Indians developed this story? (When an earthquake or any other frightening event occurs, people want to understand what causes it. Understanding helps them to be less afraid.)

Have you ever asked an older person to explain something that frightened you, and felt better afterwards?

5. Have students make a *Turtle Tale Pop-Up Puppet*. Distribute Master 3 (pattern) to students and give these instructions:

Staple plates together top to top creating a rounded shell for the turtle.

Copy pattern onto green construction paper.

Cut out 4 feet, 1 head, and 1 tail.

Attach feet onto shell (paper plates).

Staple tail to one end of the straw and the head to the other.

Slip straw between plates at a space between staples.

Decorate the shell.

Pull the tail to make the head go into the shell. Push the tail to make it come out again.

6. Have students act out the legend of the *Turtle Tale* with their puppets. You will need seven students to portray the turtles and one for the Great Spirit. Students can mime the action and dialogue as the teacher reads aloud.

Activity Three: Earth Mural

Materials for the teacher

- A large roll of paper for the mural

Materials for each small group of students

- Drawing paper and crayons or oil pastels
- Scissors

Procedure

1. Ask each student to draw a large circle representing the Earth and draw a picture of what there might be inside to make it move. Help students dictate or write explanations that match their drawings.
2. Create a class mural by directing the students to cut out their drawings and paste them to a large piece of paper. The explanations students have written or dictated may be displayed beside the drawings.
3. Share all the student stories and the legends. Accept ideas without evaluation. End the lesson without providing any further information as to the actual causes of earthquakes. (Direct curious students to children's encyclopedias and other classroom or library reference materials. When the discussion resumes in the next lesson, you will find that students have gained some information on their own.

Extensions

1. Ask students to create their own legends to explain earthquakes. Have them dictate, draw, or write their stories.
2. Act out the original legends with paper bag puppets. Provide lunch bags and art materials. Give the students time to make their puppets and rehearse before the final presentation.
3. Ask the children to describe an imaginary journey to the center of the Earth. What might they find there that could cause earthquakes?

One group of first graders made these drawings of the Earth's insides.

