

# People Explain Earthquakes

## Vocabulary

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earthquake  
legend  
culture

## Learning Links

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**Language Arts:** Class discussion, writing expository paragraphs, sharing ideas

**Social Studies:** Locating countries on the world map

**Art:** Illustrating students' earthquake theories, illustrating legends

## Content Concepts

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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.
3. Earthquake energy is released in the form of waves.

## Objectives

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Students will

- describe personal experiences with earthquakes.
- write and illustrate a paragraph about what they think causes earthquakes.
- read and illustrate earthquake legends.
- locate the cultures that developed the various legends on a world map.
- compare these locations to the major areas of earthquake activity around the world.
- state what scientists now believe is the cause of earthquakes.
- observe the effects of a simulated earthquake.

## Assessment

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Explain or draw a picture of what scientists believe is the cause of earthquakes.

## **Activity One: Earthquake Experiences**

### **Materials for the teacher**

- Magazine or newspaper accounts of earthquakes, or books, slides, movies, and other media dealing with the subject

### **Materials for the students**

- Drawing paper
- Crayons or markers
- Tape

### **Procedure**

1. Begin a discussion by asking students what they think an earthquake is. List responses on the board.
2. Ask if any of your students has ever experienced an earthquake. Invite those who have to share their experiences with the class.
3. If the students do not have much personal experience to draw on, use some of the resources suggested above to provide a basis for the unit. You may also want to invite someone who has experienced an earthquake to visit the class.
4. Distribute paper and art supplies. Ask the students to make drawings illustrating what they think causes earthquakes. They may write paragraphs to accompany the pictures and combine them as a display for the wall or bulletin board. Volunteers can present their ideas to the class. Make no comments about the correctness of their ideas at this point.

## **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 which evolve when scientific explanations are not available.

## **cul • ture**

A culture is the special way of life common to a group of people.



**Teacher Take Note:** Some of these legends come from parts of the world where quakes do not occur frequently. An earthquake is a highly dramatic, memorable event. Some cultures may have borrowed oral traditions based on events outside their own geographic region. Others may have carried legends with them as they migrated from one part of the globe to another. Be prepared to find a less than exact correlation between legends and earthquake activity.

## Activity Two: Earthquake Legends

### Materials for the teacher

- Large wall map of the world, or transparency made from Master 5, World Map
- Tape or pins
- Colored yarn
- Transparency made from Master 6, World Map with Legend Sites
- Transparency made from Master 7, World Map with Epicenters
- Overhead projector

### Materials for each student

- Booklet of earthquake legends (See Appendix)
- Large sheets of drawing paper
- Crayons or markers

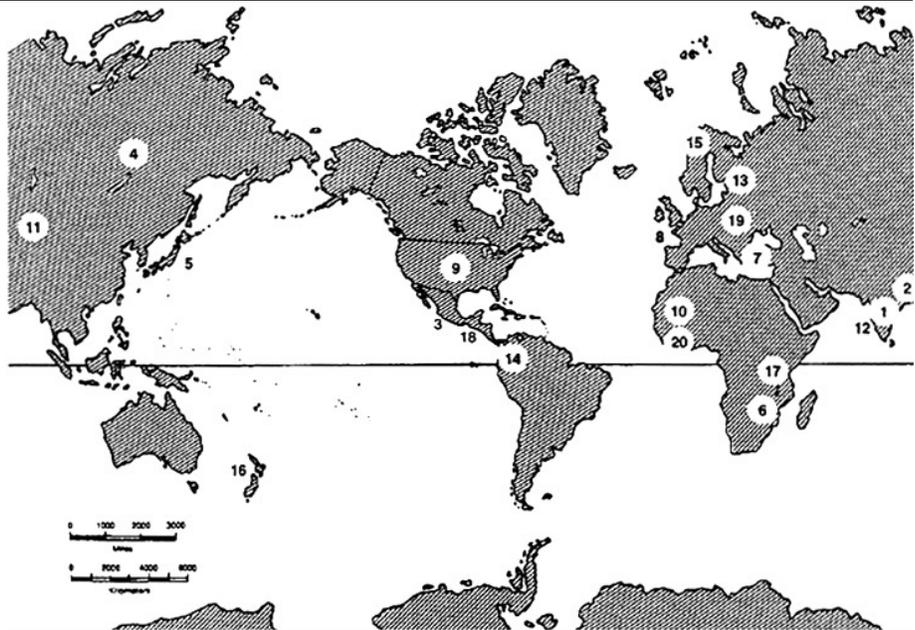
### Procedure

1. Explain that earthquakes have been happening on Earth for millions of years. Scientists have understood what causes them for less than 50 years. People who experienced earthquakes developed traditional explanations that suited their *culture*, or way of life. We call these explanations *legends*.

Master 6, World Map with Legend Sites

#### Earthquake Legend Sites Key

1. India
2. Assam, between Bangladesh and China
3. Mexico
4. Siberia
5. Japan
6. Mozambique
7. Greece
8. Belgium
9. Tennessee USA
10. West Africa
11. Mongolia
12. India
13. Latvia
14. Colombia
15. Scandinavia
16. New Zealand
17. East Africa
18. Central America
19. Romania
20. West Africa

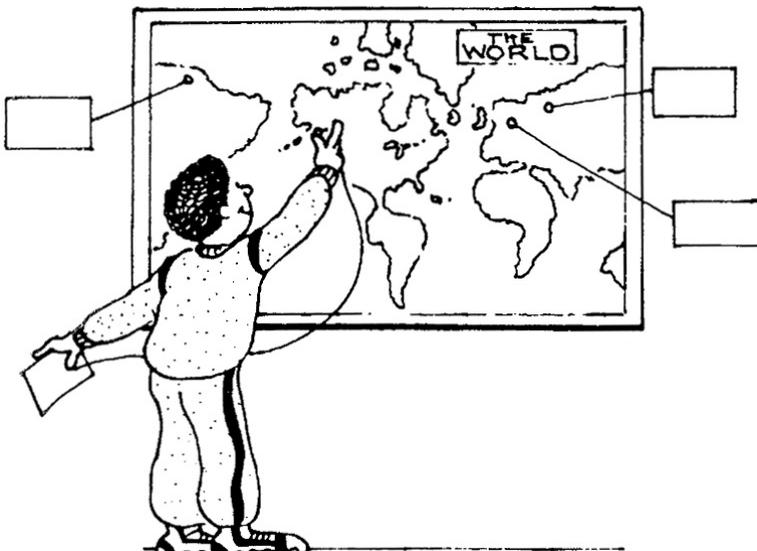


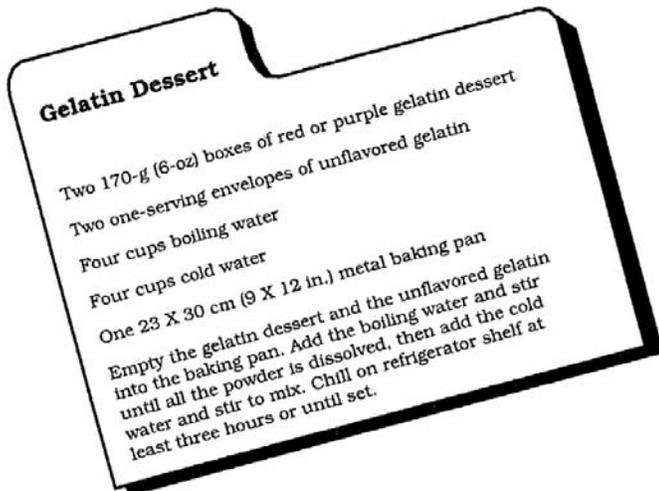
2. Distribute art materials and copies of the legends to every student. Divide the students into groups and have each group illustrate one of the legends. Label each illustration with the name of the culture or the region of the world it comes from.
3. On a world map, locate the region where each legend originated. (See Master 6. How you approach this part of the activity depends on your students' geography background.)
4. Make a wall display by having students place their illustrations on the wall surrounding the world map. Use the yarn and pins or tape to connect each illustration of a legend to the appropriate spot on the map.
5. Ask each group to read or recount their legend, and tell why they think it does or does not explain earthquakes. You may need to start the groups off by asking such questions as these, for the first story:
  - Are elephants big enough to hold up the world?
  - Could an elephant stand on a turtle without crushing it?
  - Did the early Hindus imagine ordinary animals in this story, or magical ones?
  - Do you think there are any such magical animals?
6. Project the transparency of Master 7, World Map with Epicenters. Explain that each dot shows a place where an earthquake has occurred. You may want to highlight the areas of greatest earthquake activity. Ask students if they can see a relationship between these areas and the places where the legends originated.

**Teacher Take Note:** You may want to read all the legends with the students before they begin to draw.

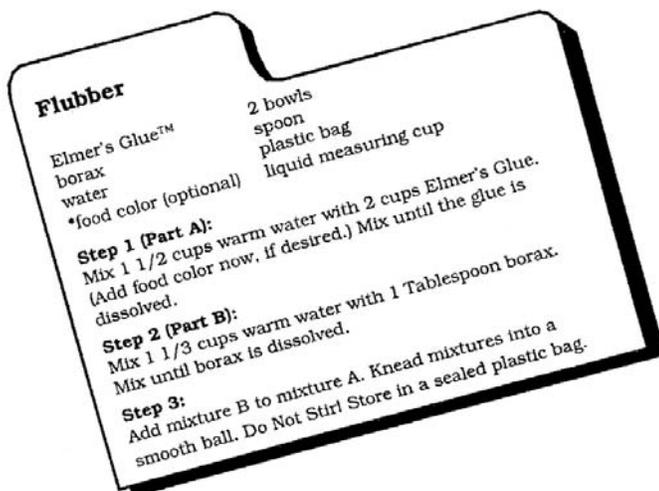
### **Legend Book Assembly**

Copy the pages (each one has two legends) for the legend book in sequence. Be sure to copy page 2 on the back of the cover page. Repeat this process for the rest of the pages. Fold and staple in the center to form a booklet.





**Teacher Take Note:** This recipe has been carefully tested. To transmit waves that can be seen easily, the pan *must* be metal, and it *must* be full nearly to the top with the gelatin mixture.



## Activity Three: Tasty Quake

### Materials for the teacher

- One pan of prepared gelatin dessert (see recipe)
- A fist-sized rock
- Silicone putty or “flubber” (see recipe)
- 25 coffee stirrers — 5" (13 cm) plastic
- Scissors
- Ruler

### Procedure

1. Prepare gelatin dessert in advance and refrigerate. These ingredients will make one pan. Prepare more if you wish to have several small groups performing the demonstration simultaneously.
2. Write the definition of an earthquake on the board.
3. Explain that under the soil there are rock layers. These layers are under stress because of activity within the Earth.
4. Explain that when these rocks are under extreme stress they react more like a plastic material, such as silicone putty, than like the hard rock we see above the ground. (Show rock and putty.)
5. Demonstrate with silicone putty (or flubber), or distribute several lumps so that each small group can do the activity for themselves. (The putty will be difficult to break if it has been warmed by too much handling, so work quickly.)

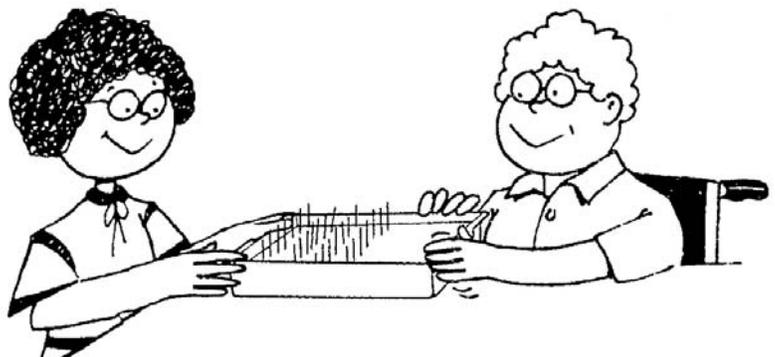
**Teacher Take Note:** To get the best results follow the instructions for mixing ingredients in two separate bowls before combining all ingredients. Students should not eat the flubber. Students should wash their hands after handling the mixture.



- a. First, stretch the putty slowly to show how rocks react to slow twisting and pulling.
  - b. Next, shape it back into a ball and give it a sharp tug with both hands. The putty will snap into two pieces.
  - c. Explain that this reaction is similar to what happens during an earthquake.
- 6.** Explain that when rocks break in this sudden way energy is released in the form of waves. We can simulate this release of energy by watching what happens to a pan of gelatin.
  - 7.** Gently tap the side of the pan of gelatin, while holding the pan firmly with the other hand. Students should be able to see the waves traveling through the gelatin. Compare the gelatin to the ground, the tap of your hand to the rock breaking, and the waves in the gelatin to earthquake waves.
  - 8.** Ask the students to predict what happens when you tap the pan with more force. Tap the pan harder. Is their prediction confirmed? Repeat these two steps several times, and be sure that all the students have a chance to see the waves.
  - 9.** Coffee stirrers can be used to further enhance student observation of wave action. In the gelatin, insert to the bottom of the pan, four rows of stirrers parallel to the bottom of the pan. (Place each row approximately 1.5" (4 cm) apart. Place each stirrer approximately 1.25" (3 cm) apart.)
  - 10.** Repeat steps 7 and 8 above (tap pan at side opposite the stirrers).
  - 11.** Ask students to compare their observations of waves in gelatin with and without stirrers. (The stirrers magnify the wave action, allowing greater visibility.) Discuss possible results of wave action on buildings (point out that stirrers could represent buildings). Ask how stirrers reacted to different amounts of force used in tapping the pan.

## Extensions

- 1.** Students could act out the legends with a few simple props.
- 2.** Students could survey other students in the school to learn what they think causes earthquakes. Responses can be tabulated on the board or on butcher paper taped to the wall and become the basis for a class discussion.
- 3.** In an area where earthquakes do not occur frequently, students could survey adults in the community to find out how many of them have experienced earthquakes. Small groups could divide responsibility for a set number of interviews such as ten per group and graph their results. No two students may interview the same person.
- 4.** Instead of illustrating the legends on large sheets of paper, students may draw a small symbol for each legend, cut it out, and pin it directly onto a large wall map at the correct location. The Japanese legend, for example, could be represented by a fish.



Tap on this end



# Energy Waves Cause Earthquakes

## Vocabulary

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earthquake

legend

stored energy (potential energy)

earthquake waves (seismic waves)

fault

fault creep

focus

epicenter

## Learning Links

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**Language Arts:** Discussing, oral reading, note taking, following directions

**Social Studies:** Map reading, correlating different types of maps, discussing effects and explanations of earthquakes in past and present societies

**Math:** Using map scale to measure distances

**Art:** Creating signs, illustrating activity

## Content Concepts

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1. Earthquakes result from the buildup and release of energy stored in rocks.
2. Earthquakes occur over much of the world, including the United States.
3. Various societies have produced earthquake legends to explain these natural occurrences.

## Objectives

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Students will

- watch one demonstration and participate in one activity on elastic rebound, and apply the principle to earthquake activity.
- demonstrate the phenomenon of fault creep, and distinguish it from earthquake activity.
- list some events that occur during an earthquake.
- locate their own state on an outline map of the United States.
- determine from study of epicenter maps if their local area and state have experienced earthquakes.
- read and discuss earthquake legends.
- locate the place where each legend originated on an outline map of the world.

## Assessment

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Describe (write and/or draw) an event which releases energy and relate the results of that energy release.

## Activity One: A Wet Wave Experience

### Materials for the teacher

- Transparency made from Master 8, Elastic Rebound
- Overhead projector
- Strip of 1/16" wood lath the size of a ruler, or a 1/4" dried stick about 1' (30 cm) long.
- Sink or basin large enough to hold wood
- Water to fill basin
- Goggle

### Procedure

1. Gather students around sink or basin filled almost to the top with water.
2. Hold the wood completely under water. With one hand on each end, bend it slowly until it breaks.
3. Ask students to describe what they see: jerky movement of the water and waves radiating out from the breaking point.
4. Explain that energy was transferred to the stick by the hand movements, stored as potential energy until the stick broke, and then transferred to the water. This concept of buildup and release of energy in rocks is called elastic rebound theory.
5. Direct students to make a drawing of the demonstration in their notebooks.
6. Ask students to explain how the demonstration relates to an earthquake.
7. Project transparency of Master 8, Elastic Rebound, and use it to illustrate that when pressure from within the Earth is exerted on rocks, they bend and store energy until they reach a certain point, like the wood.

The stored or potential energy is released, in the form of waves, in an event we call an earthquake. The breaking point is the focus of the earthquake. Help students to relate this explanation to the demonstration.

## fo • cus

The focus is the place where an earthquake starts.

## ep • i • cen • ter

The epicenter is the point on the Earth's surface directly above the focus.

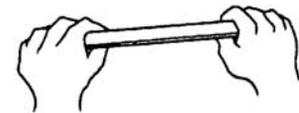
## fault

A fault is a crack in rock or soil along which earthquake movement has taken place.

## earth • quake waves

Earthquake waves, or seismic waves, are waves caused by the release of energy in the Earth's rocks during an earthquake.

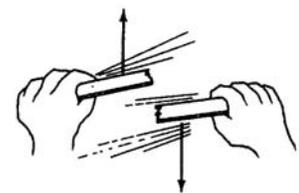
### Elastic Rebound



Original position



Buildup of potential energy



Breaking stuck produces energy release

## Activity Two: It's Your Fault

### Materials for the teacher

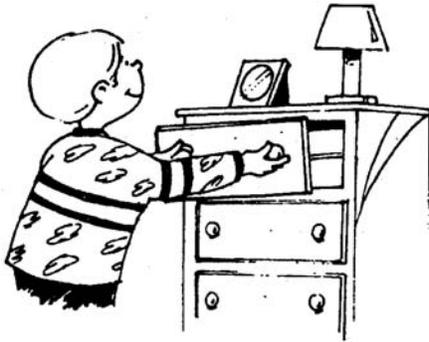
- Transparency made from Master 9, Dresser Drawers
- Transparency made from Master 10a, Earthquake Terms
- Overhead projector

### Materials for each student

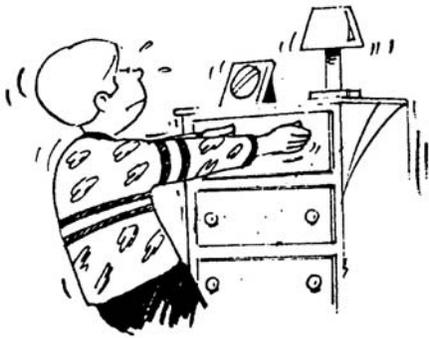
- A sign saying either Block A or Block B (Students can make them and letter them neatly.)
- String or tape for affixing sign

### Procedure

1. Project the transparency made from Master 9, and explain that the pieces of Earth's crust often move past each other as smoothly as our dresser drawers move. Project Master 10a, and point out the fault on the Earth's surface.
2. Label the area to the left of the fault Block A and that to its right, Block B. Explain to students that they are going to demonstrate what happens when pieces of the Earth's crust move.
3. Take the students to a location in or outside the classroom where they will not hit anything but the floor if they fall.



Smooth surface slides easily.



A sticky drawer opens with a jerky movement.

4. Ask them to form into groups of 8 to 10 students, and divide each group into equal halves. (The teacher can participate if necessary to even the groups.)
5. Line up two groups of students facing each other, and explain that each line represents a block of Earth. The area between the two lines represents a fault.
6. Students should stretch out their arms, from both sides of the “fault,” so that each is lightly touching the palms of a student on the other side.
7. Instruct students on both sides of each fault to shuffle smoothly to the students’ right, keeping their palms extended. (The two lines will move in opposite directions, and students will slowly change partners.) Explain that this simulates *fault creep* movement.
8. Line the groups up as before, but this time have them lock fingers across the fault. Again instruct them to move to the right by slow steps, but keep them moving past the point where they can hold on easily. Just before they have to let go or fall, call out “earthquake!” Ask students to drop hands and stand up straight. The sudden release of energy should cause them to stumble and fall into one another. Explain that this activity simulates an earthquake.
9. Compare and contrast the two events in a class discussion, referring to the Dresser Drawers (Master 9) and Earthquake Terms (Master 10a) transparencies. Be sure that students understand the difference between the smooth movement that simulated fault creep and the buildup and sudden release of stress that caused them to stumble in the second demonstration. According to the theory of elastic rebound, it is this buildup and release of stress that causes earthquakes.

## Activity Three: Visual Vocabulary

### Materials for the teacher

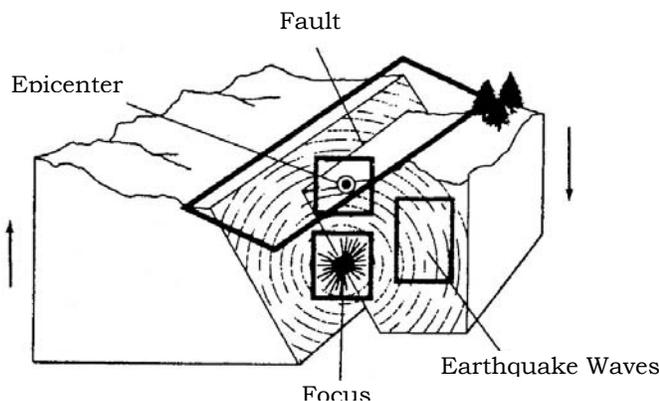
- Movie clip, video clip, slides, filmstrip, or written eyewitness account(s) of earthquakes
- Transparency made from Master 10a, Earthquake Terms
- Overhead projector

### Materials for each student

- Student handout made from Master 10b, Earthquake Terms Worksheet
- Colored pencils

## Procedure

1. Ask any class members who have experienced an earthquake to describe that event to the class.
2. Use one of the media listed above (movie clip, video, etc.) to give the class some common vicarious earthquake experiences.
3. Brainstorm to create a class list of things that happen during an earthquake (rumbling noises, swaying trees, etc.) on the board or an overhead.
4. Project Master 10a, and go over the definitions of *focus*, *epicenter*, *fault*, and *earthquake waves*. Instruct students to fill in the definitions on Master 10b, Earthquake Terms Worksheet, then shade over each one in a different color: the first in red, the second in blue, the third in yellow, and the fourth in green. Finally, ask them to color the part of the diagram that each definition refers to in the same color as the definition.



Master 10a. earthquake terms.

## Activity Four: Local Legends

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### Materials for the teacher

- Standard classroom wall map of the world, or a transparency made from Master 5, World Map
- Transparency of Master 11, U.S. Map with Epicenters
- Transparency made from Master 7, World Map with Epicenters
- Booklet of earthquake legends (See Appendix.)
- Optional: Epicenter map of your state or area (obtain from state geological survey, U.S. Geological Survey or local college geology department)

### Materials for each student

- Booklet of legends
- Worksheets made from Master 11, U.S. Map with Epicenters

## Procedure

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1. Using transparencies and/or student copies of the U.S. Map with Epicenters. Master 11, ask students these questions:

According to this map, which of the states experience a lot of earthquakes?

Which states experience very few or no earthquakes?

Where is our state on this map?

According to the map, does our state experience a small, medium, or large number of earthquakes?

People in states without epicenters, as shown on this map, may still experience earthquakes. How can this be? (Both seismographs and the human senses can register the effects of distant earthquakes, especially large ones. Also, this map only records quakes over a certain intensity. Some states may have quakes below those levels.)

2. Show students how to use the map scale on the U.S. Map with Epicenters to measure the distance from where they live to the nearest epicenter on the map. Use a local or state map if available.

## Extensions

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1. If you live in an area that has ever been affected by an earthquake, check your local library for microfilm copies of old newspapers describing the event. On August 31, 1886, for example, the effects of the Charleston, South Carolina earthquake were felt in most of the states east of the Mississippi and south of New York state.
2. Current documentation on seismic activity can be obtained through the Internet. See References for Internet sites in the Appendix.

**Teacher Take Note:** The terms *intensity* and *magnitude* will be discussed in later chapters.

3. Write the definition of *legend* on the board, and invite students to recount some legends they may have heard.
4. Have students read some of the earthquake legends out loud in class. Locate the origin of each on the world map before moving on the next.
5. Project the transparency of Master 7, World Map with Epicenters, and ask students if they see any correlation between the origins of the legends and the density of earthquake epicenters. (See Unit I, Level 2, Activity Two.)
6. Discuss with students:

Why did these legends develop? (Emphasize that they were creative attempts to explain frightening and puzzling natural occurrences.)

What real facts do these legends contain or reflect? (Siberia: that human beings and animals are interdependent; New Zealand: that the Earth is like a living organism; Romania: that human decency upholds the social world; Mexico: that the evil in the world is hard to understand; etc.)

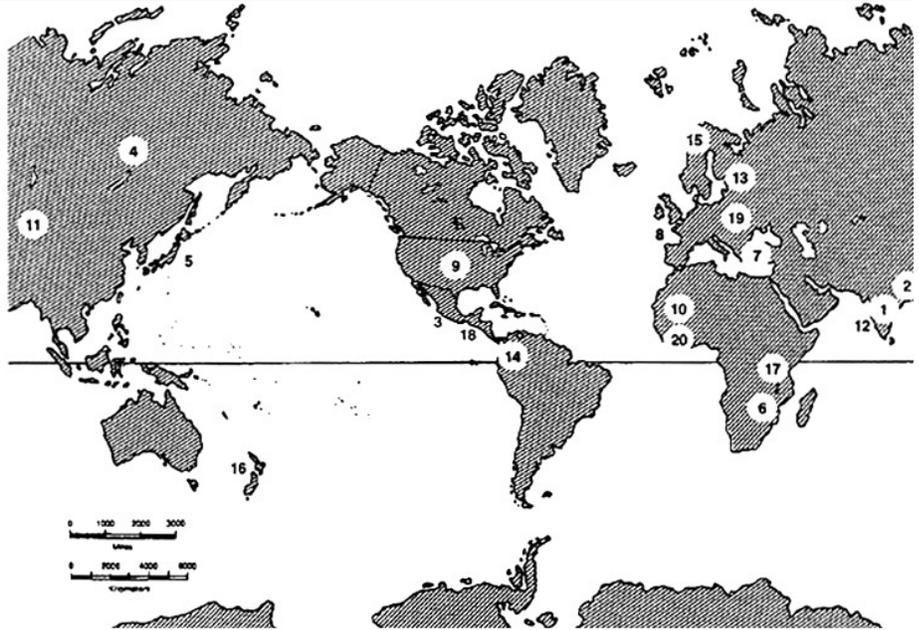
## leg • ends

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

Master 6, World Map with Legend Sites

### Earthquake Legend Sites Key

1. India
2. Assam, between Bangladesh and China
3. Mexico
4. Siberia
5. Japan
6. Mozambique
7. Greece
8. Belgium
9. Tennessee USA
10. West Africa
11. Mongolia
12. India
13. Latvia
14. Colombia
15. Scandinavia
16. New Zealand
17. East Africa
18. Central America
19. Romania
20. West Africa



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# Unit I. Defining an Earthquake

## Materials List

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### Grades K-2

audiovisual cart on wheels  
shallow box  
sand or soil  
paper plates and cups  
small boxes  
green construction paper  
straws  
stapler  
writing paper  
pencil  
mural paper  
drawing paper  
crayons  
oil pastels  
scissors

### Grades 3-4

drawing paper  
crayons  
markers  
tape  
straight pins  
colored yarn  
fist-sized rock  
Silly Putty™  
red or purple gelatin  
unflavored gelatin  
boiling water  
metal baking pan  
overhead projector  
coffee stirring sticks

### Grades 5-6

wood lath or dried stick  
large bowl  
sink or basin  
goggles  
colored pencils  
string or tape  
overhead projector  
paper clips