Thought-provoking discussions provide a good way to assess the overall depth of student understanding. The following are some suggested discussion topics.

- Why do you think that volcanoes and earthquakes often occur in the same areas of the world? What do volcanoes and earthquakes have in common?
- Imagine that two different cities have earthquakes of similar strength. One city has a great deal more damage than the other. Consider some possible reasons for this difference. What changes could these cities implement to reduce earthquake damage in the future?
- Discuss what safety measures students should take if an earthquake occurs.

Follow-up Activities

- Students can create their own earthquake simulator or "shake table" to test whether or not a structure is earthquake-proof. First, fill the lid of a shoebox or other small cardboard box with marbles. Then rest a piece of cardboard that fits within this box over the marbles to make the shake table. Students can build structures in small groups to test on the earthquake simulator, using small stirring straws and miniature marshmallows. Once the structures are complete, students can place their structure on the cardboard insert and shake the lid to make the marbles move. Students can vary the amount of time and strength of shaking. Have students compare their structures and the degree to which they were earthquake-proof.
- Invite an architect or engineer into class as a resource person who can talk about how earthquake-resistant construction is designed and tested.
- Conduct a class research project on famous earthquakes. Each student can select and research a famous earthquake, including the location, strength and effects on the surrounding area. Students can share their information with the class and plot these famous earthquakes on a world map.

Suggested Internet Resources

Periodically, Internet Resources are updated on our web site at www.libraryvideo.com

- **www.exploratorium.edu/faultline/index.html**
  The Exploratorium offers this Web page called "Life Along the Faultline" that presents features about California earthquakes, including the stories of survivors, historical data from past earthquakes and engaging student activities.
- **pubs.usgs.gov/gip/earthq1/**
  This online publication from the U.S. Geological Survey provides information about the science and history of earthquakes. This site also includes a description of the processes of measuring and predicting earthquakes. Helpful images and graphics are provided.

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- **whyfiles.org/094quake/3.html**
  This page from the "Why Files," sponsored by the University of Wisconsin, describes the theory of continental drift, and links the movement of plates with earthquakes. Advancements in architecture and engineering for the creation of earthquake-safe buildings are also addressed.

Suggested Print Resources

- Gallant Roy A. *Dance of the Continents.* Benchmark Books, New York, NY; 1999.
- Grace, Catherine. *Forces of Nature.* National Geographic, Washington, DC; 2004.
- Moores, Eldridge M. *Volcanoes and Earthquakes.* Time-Life Books, Alexandria, VA; 1995.
- Sattler, Helen Roney. *Our Patchwork Planet: The Story of Plate Tectonics.* Lothrop, Lee & Shepard Books, New York, NY; 1995.
- Strain Trueit, Trudi. *Earthquakes.* Franklin Watts, Danbury, CT; 2003.

TEACHER'S GUIDE CONSULTANT

Conrad M. Follmer

25 years as a K-5 Science & Math Coordinator for a Pennsylvania public school system, currently an independent consultant to elementary schools.

TITLES

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- FOSSIL FUELS
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Earth Science IN ACTION™

Earthquakes

Grades 5–8

Students in grade 5-8 dassrooms possess a wide range of background knowledge. Student response to this video program is sure to be varied, so the teachers at these grades need all the help they can get! This guide has been designed to help the 5-8 science teacher by providing a brief synopsis of the program, previewing and follow-up questions, activities, vocabulary and additional resources.

Before Viewing: Extensive research tells how important it is for the teacher to discover what the students know — or think they know — about a topic, before actually starting a new unit. Therefore, after prompting discussion with the pre-viewing questions, lead your class to create an "Everything We Think We Know About…" list. You may also wish to preview key vocabulary words, and have students raise additional questions they hope will be answered.

After Viewing: Have your students share video excerpts that fascinated or surprised them, then challenge your students to prove or disprove the accuracy of the facts they put on their "Everything We Think We Know About…" list. Discuss what else they learned and use the follow-up questions and activities to inspire further discussion. Encourage students to research the topic further with the Internet and reading resources provided.

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Program Summary

An earthquake is the shaking that results from the sudden movement of rocks deep underground in the Earth. Movements in the mantle, or molten rock layer of the Earth, put pressure on the surface or crust, causing it to bend, buckle, stretch and even break. Over the course of millions of years, the Earth's crust has broken into large pieces called plates that are still in motion. These plates constantly push against or across each other, causing different types of stress in the crust. Compression causes the squeezing of plates together. Tension pulls plates apart from each other. Shearing tears the crust, as plates slide or rub against each other in opposite directions. These stresses cause more than 150,000 earthquakes per year, most of which people do not even feel.

When plates move, it is usually along a zone of weakness called a fault line, which can stretch for thousands of miles, like the San Andreas Fault in California. There are three types of faults. A normal fault, usually caused by tension, occurs when one side (hanging wall) drops down from the opposite wall (footwall). A reverse fault, usually caused by compression, occurs when the hanging wall is raised above the footwall. A lateral fault, usually caused by shearing, occurs when the two walls grind against each other. This movement or breaking of the Earth's crust is called a rupture. The exact point deep underground where the rupture occurs is called the hypocenter or focus of the earthquake. The area on the surface directly above the hypocenter is called the epicenter. When an earthquake occurs, energy waves called seismic waves are sent out in all directions from the hypocenter, like ripples in a pond. It is this energy ripple that causes damage to land and buildings during an earthquake. If an earthquake occurs on the ocean floor, the seismic waves can cause a tsunami that can bring great destruction to coastal areas nearby.

The scientists who study earthquakes, known as seismologists, measure the size and energy of earthquakes using the Richter scale. A seismograph is the name of the instrument that measures the Earth's movements and determines the scale of the earthquake. Although seismologists cannot yet accurately predict earthquakes, they have identified indications that reveal impending earthquakes, such as counting and measuring aftershocks.

Vocabulary

The following words are included for teacher reference or for use with students. They are listed in the order in which they appear in the video.

earthquake — The shaking of the Earth's crust, resulting from stresses that cause the sudden movement of rocks deep underground.

crust — The surface layer of the Earth, varying in thickness from around 5 kilometers under the ocean to over 30 kilometers under the continents. The crust is cracked into rigid rock plates.

mantle — The largest layer of the Earth located directly under the crust, composed of very hot, dense, flowing rock.

inner core — The solid center of the Earth made of extremely hot metal under great pressure.

outer core — The layer of the Earth surrounding the inner core made of very hot liquid metal.

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plates — Solid rock pieces that make up the crust of the Earth's surface. Plate margins are areas where the crust is being formed or destroyed. These plates float on the mantle.

Pangaea — A giant continent that is thought to have existed about 300 million years ago and consisted of all of the present-day continents.

compression — The stress to the Earth's crust caused when plates are squeezed together.

tension — The stress to the Earth's crust caused when plates are pulled apart.

shearing — The stress caused when plates rub against each other in opposite directions, tearing the Earth's crust.

fault — A zone of weakness in the Earth's crust where it has cracked or is ready to crack. There are three types of faults: normal, reverse and lateral.

normal fault — The type of crack in the Earth's crust that occurs when plates pull apart, causing the rock above the fault to drop beneath the rock below the fault.

reverse fault — The type of crack in the Earth's crust that occurs when plates push together, causing the rock above the fault to move up relative to the rock below the fault.

lateral fault — The type of crack in the Earth's crust that occurs when plates rub against each other in opposite directions, moving the blocks of rock horizontally.

folds — A bend in the rock of the Earth's crust caused when plates press together.

monocline — A fold in the Earth's crust that is high on one side.

anticline — A fold in the Earth's crust that is high in the middle.

syncline — A fold in the Earth's crust that is low in the middle.

rupture — The breaking of rocks along a fault line as the result of an earthquake. On the surface of the Earth, slides, scarps and fissures show as a result of a rupture. Ruptures can also occur deep underground.

hypocenter — Also called the focus, the exact point within the crust where a rupture occurs.

epicenter — The location on the surface of the Earth immediately above the hypocenter of the earthquake.

tsunami — A giant wave caused by an earthquake on the ocean floor. These waves can reach 500 miles per hour and 100 feet high.

seismic waves — The energy waves sent out through the Earth from the hypocenter of an earthquake.

earthquake simulator — A device used by architects and engineers to test the ability of scale models of buildings to withstand earthquake damage.

seismologist — A scientist who studies earthquakes.

Richter scale — The scale developed by Dr. Charles Richter in 1935 to measure the relative size of earthquakes.

seismograph — An instrument that is used to record the motion of the ground during an earthquake.

aftershocks — The many smaller quakes that follow a large earthquake.

Pre-viewing Discussion

Before students generate their list of "Everything We Think We Know About…" for this topic, stimulate and focus their thinking by raising these questions so that their list will better reflect the key ideas in this show:

- What are earthquakes? What causes them?
- How do earthquakes affect the Earth and its inhabitants?
- How are earthquakes measured and predicted?

After the class has completed their "Everything We Think We Know About…" list, ask them what other questions they have that they hope will be answered during this program. Have students listen closely to learn if everything on their class list is accurate and to hear if any of their own questions are answered.

Focus Questions

1. Describe the layers of the Earth's crust and their characteristics (core, crust, mantle).
2. What is the relationship between the Earth's mantle and crust?
3. What are plates? Why are the edges of plates so important to the cause and location of earthquakes?
4. Describe the three different types of stress caused by the movement of Earth's plates.
5. What is a fault? Explain the characteristics of the three types of faults.
6. Which kind of stress causes each type of fault?
7. What are folds? Describe the three types of folds.
8. Explain these terms and how they interrelate: rupture, hypocenter and epicenter.
9. What is a tsunami?
10. How do undersea earthquakes cause tsunamis?
11. What are seismic waves?
12. Why are earthquake simulators useful tools?
13. How are earthquakes measured and predicted?
14. What is the Richter scale? How is it designed?
15. What instrument measures the size of an earthquake?
16. How do seismologists predict that a major earthquake is coming?

Follow-up Discussion

Research indicates that students will retain their previous misconceptions about a topic, in preference to new information, until they actively recognize and correct their own errors. Therefore, it is important to have your students re-examine the facts/beliefs they put on their "Everything We Think We Know About…" list. It might also be helpful to review the list by marking each entry with a "+" or "-" to show which facts were correct and which were incorrect.

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