

## Earthquakes: Breaking New Ground

Watch it online at <http://www.kqed.org/quest/television/view/570>

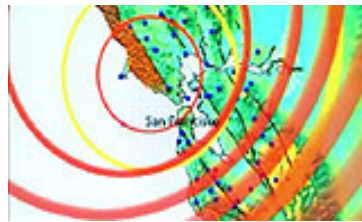
TV story length 8:48 minutes

### QUEST SUBJECTS

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| <p><b>Life Science</b></p> <p><b>Earth Science</b></p> <p><b>Physical Science</b></p> | <p>Biology<br/>Health<br/>Environment</p> <p><b>Geology</b><br/>Weather<br/>Astronomy</p> <p>Physics<br/>Chemistry<br/>Engineering</p> |
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### PROGRAM NOTES

Earthquakes have always surprised us, but maybe they won't in the future. What if scientists could read the warning signs and predict major earthquakes before they struck? The United States Geological Survey (USGS) and Bay Area scientists are studying large fault lines in California in order to create such earthquake warning systems. The goal is to help avoid the potential damage and loss of life when -- not if -- the next "big one" hits.



In this segment you will find...

- diagrams of plate tectonics.
- a look at the SAFOD earthquake study in Parkfield.
- information about the ELARMS earthquake alarm system and how it might help people in earthquake-prone areas.

### CA SCIENCE STANDARDS

#### Grade 6

##### Earth Sciences

1. Plate tectonics accounts for important features of Earth's surface and major geologic events. (d, e, g)
2. Topography is reshaped by the weathering of rock and soil and by the transportation and deposition of sediment. (d)

### TOPIC BACKGROUND

Earthquakes are natural disasters caused by forces deep in the earth that are continuously changing the earth's surface. A sudden release of the pressure that builds from these forces results in an earthquake, and earth's crust rapidly shakes or rolls.

The earth's lithosphere -- the crust and the rigid, uppermost part of the mantle -- is broken up into seven huge tectonic plates and dozens of smaller ones. These plates are constantly moving, slowly shifting against one another at their boundaries. As the plates move, friction builds and the plates get stuck along the edges of the crust, creating stress. When the stress reaches a certain point, a fault (the edge of a plate or a crack in earth's crust) slips. The released energy moves in seismic waves through the crust and causes the ground to shake -- what we feel as an earthquake.

There are three types of plate boundaries: spreading zones, subduction zones and transform faults. Spreading zones occur when hot, molten rock rises and pushes two plates apart, creating new rock material at the edges. Subduction zones occur where the edge of one plate overlaps the edge of another, pushing the lower plate down onto the mantle, where the edges melt. Transform faults occur where two plates slide past one another horizontally, creating friction and tension at the edges.

There are two tectonic plates in California: the Pacific Plate and the North American Plate. The Pacific Plate primarily makes up the floor of the Pacific Ocean and the coastal part of California. The North American Plate is made up of most of the continent of North America and a portion of the floor of the Atlantic Ocean. The plates move very slowly. The Pacific Plate slides northwest past the North American Plate at about two inches per year. At a total length of more than 650 miles and a depth of 10 miles in some areas, the San Andreas Fault (a transform fault) is the primary boundary between the North American and Pacific Plates. The San Andreas Fault zone also includes other, smaller boundaries, such as the Hayward Fault in Northern California and the San Jacinto Fault in Southern California.

## Media Enhance Education

Video and audio can be powerful tools for meaningful learning. It all depends on you, the educator. The key to using media effectively is preparation. Make the most of learning opportunities by encouraging students to become active viewers and listeners. Pick and choose from the suggested questions and activities to offer an engaging media experience.

## Questioning

Oftentimes, teachers and students become frustrated during a media segment when students can't find the answers to a long list of questions. Provide a limited number of questions or topics for students. This focuses their attention during a media segment, helps to keep them engaged and generally results in higher quality answers. QUEST Ed. has provided a number of options for focus questions ranging from fact based to opinions, as well as "big picture" ideas.

## PRE-VIEWING

- What is an earthquake?
- Have you ever felt an earthquake? If so, what was it like?
- What is the relationship between plate tectonics and earthquakes?
- Why would it be useful to be able to predict earthquakes?

## VIEWING FOCUS

NOTE: You may choose to watch the television segment twice with your students: once to elicit emotional responses and get an overview of the topic and again to focus on facts and draw out opinions.

- How and where do earthquakes occur?
- Why do so many earthquakes occur in the Bay Area?
- Describe the SAFOD experiment. Why is it important?
- What makes the Hayward Fault so potentially dangerous?

## POST-VIEWING – Links to activities mentioned here can be found on the following page.

- **Review** students' answers to the Viewing Focus Questions.
- **Read** about how earthquakes shape the Bay Area online at [http://www.baynature.com/v06n02/v06n02s\\_main.html](http://www.baynature.com/v06n02/v06n02s_main.html).
- **Write** an opinion piece about earthquake prediction. Should money and time be spent on earthquake prediction experiments? Why or why not?
- **View** earthquake intensity maps of different Bay Area locations online at <http://www.abag.ca.gov/bayarea/eqmaps/pickfault.html>.

“Every time there’s an earthquake, we still learn a great deal. So we need to always look for new ways to use this information, to use this technology around us to mitigate these future earthquakes.”

-- Richard M. Allen, professor of geophysics, UC Berkeley

## LESSON PLANS / ACTIVITIES



### **Faultline, Seismic Science at the Epicenter** The Exploratorium

<http://www.exploratorium.edu/faultline/index.html>

- This Web site has a collection of information, images and activities about earthquakes and plate tectonics.



### **Earthquake Topics -- Lessons Online** USGS

<http://earthquake.usgs.gov/learning/topics/index.php?topicID=56&topic=Lessons+online>

- This site has a comprehensive selection of earthquake-related lesson plans and activities.

## WEB SITES

### **The Restless Planet – Earthquakes** PBS Online

<http://www.pbs.org/wnet/savageearth/earthquakes/>

- This companion Web site to the **Savage Earth** series features a main article, sidebar information and animated graphics about earthquakes and plate tectonics.



### **Earthquakes for Kids** USGS

<http://earthquake.usgs.gov/learning/kids/>

- This educational site features games, puzzles, pictures, activities and information about earthquakes.

### **Earthquake!** National Geographic

<http://www.nationalgeographic.com/ngkids/0403/>

- This interactive **Kids Magazine** Web site has stories about earthquakes, as well as maps and information about where and how earthquakes occur.

## ARTICLES / READING

### “San Andreas ‘Fully Loaded’ for Major Quake” (6/21/06)

[http://www.livescience.com/environment/060621\\_san\\_andreas.html](http://www.livescience.com/environment/060621_san_andreas.html)

- **LiveScience** article discusses the potential for a major earthquake along the San Andreas Fault.

### “Can Satellites Aid Earthquake Predictions?” (7/20/04)

[http://news.nationalgeographic.com/news/2004/07/0720\\_040720\\_earthquake.html](http://news.nationalgeographic.com/news/2004/07/0720_040720_earthquake.html)







- **National Geographic News** article describes the Global Earthquake Satellite System and its potential use in earthquake prediction.

Look for the



indicating resources from QUEST partner organizations

# QUEST QUAD

<b>FIELD NOTES</b> 	<b>FIELD TRIP</b> 
<p><b>Go outside and ...</b></p> <ul style="list-style-type: none"> <li>⦿ Look around your neighborhood           <ul style="list-style-type: none"> <li>• Which buildings, structures and environments do you think a major earthquake would affect the most? Why?</li> </ul> </li> <li>⦿ Think about what you know about how earthquakes affect the geography of an area           <ul style="list-style-type: none"> <li>• How do you think past earthquakes helped create or change the shape of the land in your neighborhood?</li> <li>• If a major earthquake struck tomorrow, how do you think it would change the topography in your neighborhood?</li> </ul> </li> </ul>	<p><b>Visit ...</b></p> <ul style="list-style-type: none"> <li>⦿ Lawrence Hall of Science Outdoor Science Park: “Forces That Shape the Bay”           <ul style="list-style-type: none"> <li>• Ride earthquake simulators.</li> <li>• See how the Bay Area has been shaped over time.</li> </ul> </li> <li>⦿ Point Reyes Earthquake Trail           <ul style="list-style-type: none"> <li>• Walk the half-mile loop trail along the San Andreas Fault.</li> <li>• Record any evidence of plate movement you find along the trail.</li> </ul> </li> </ul> 
<b>FIELD RESEARCH</b> 	<b>FIELD TEST</b> 
<p><b>Find out more about...</b></p> <ul style="list-style-type: none"> <li>⦿ Plate tectonics           <ul style="list-style-type: none"> <li>• Research where the major plates are located and how plate movement has affected the geography in plate boundary regions like the Bay Area.</li> </ul> </li> <li>⦿ Fault lines           <ul style="list-style-type: none"> <li>• Describe the four basic types of faults.</li> <li>• How are they different from one another?</li> </ul> </li> </ul>	<p><b>Experiment with...</b></p> <ul style="list-style-type: none"> <li>⦿ Building an earthquake-proof structure           <ul style="list-style-type: none"> <li>• Use plastic straws, tongue depressors, tape, pins and any other similar materials to build a structure on top of a cookie sheet.</li> <li>• Shake the edges of the cookie sheet. Did your structure collapse?</li> <li>• Think about how to make your structure stronger and try again!</li> </ul> </li> <li>⦿ Simulating plate motion           <ul style="list-style-type: none"> <li>• Visit <a href="http://www.thetech.org/exhibits_events/online/quakes/plates/tectonics.html">www.thetech.org/exhibits_events/online/quakes/plates/tectonics.html</a> and use hand motions to simulate divergent, convergent and transformational motion.</li> </ul> </li> </ul> 

## VISIT OUR PARTNERS

The Bay Institute  
[www.bay.org](http://www.bay.org)

California Academy of Sciences  
[www.calacademy.org](http://www.calacademy.org)

Chabot Space and Science Center  
[www.chabotspace.org](http://www.chabotspace.org)

East Bay Regional Park District  
[www.ebparks.org](http://www.ebparks.org)

Exploratorium  
[www.exploratorium.edu](http://www.exploratorium.edu)

Girl Scouts of San Francisco Bay Area  
[www.girlscoutsbayarea.org](http://www.girlscoutsbayarea.org)

Golden Gate National Parks Conservancy  
[www.parksconservancy.org](http://www.parksconservancy.org)

Lawrence Berkeley National Laboratory  
[www.lbl.gov](http://www.lbl.gov)

Lawrence Hall of Science  
[www.lawrencehallofscience.org](http://www.lawrencehallofscience.org)

Oakland Zoo  
[www.oaklandzoo.org](http://www.oaklandzoo.org)

The Tech Museum of Innovation  
[www.techmuseum.org](http://www.techmuseum.org)

UC Berkeley Natural History Museums  
<http://bnhm.berkeley.edu/>

## OTHER WAYS TO PARTICIPATE IN QUEST



### LOG ON

[kqed.org/quest](http://kqed.org/quest)



### LISTEN

**KQED 88.5 FM San Francisco &  
89.3 FM Sacramento  
Fridays at 6:30am and 8:30am**



### WATCH

**KQED Channel 9  
Tuesdays at 7:30pm**

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