The Great California ShakeOut

The purpose of the ShakeOut is not only to practice the Drop, Cover, and Hold On procedure, but also to promote a general understanding of earthquake science and why it is particularly important to be knowledgeable about it in California. While the potential earthquake hazards that surround us vary by location, everywhere in California is considered at high risk compared to the rest of the country because of our location at the boundary of two tectonic plates. We live in earthquake country.

EARTH SCIENCE ACTIVITY: Finding Plates by Plotting Quakes

BACKGROUND:

The theory of plate tectonics is an important foundation for earthquake science education. It is the motion of the tectonic plates that make up the Earth's crust that causes the build-up of energy which, upon release, leads to the earthquakes we experience. Longer periods of energy build-up can cause larger ruptures that have the potential to devastate densely-populated areas, particularly in California since several of our major cities are located on or near the boundary between the North American plate and the Pacific plate. Since we have rooted ourselves in earthquake country, we experience earthquakes much more frequently than other states, and thus our earthquake hazard risk is also increased. Having a better understanding of plate tectonics can help us better realize the risks we are living with as residents of California and allow us to make more informed decisions regarding what we need to do to be earthquake ready.

ACTIVITY:

Set-Up

Make enough copies of the dotted Xpeditions map to distribute one to each of your students. For older students, also prepare photocopies of the list of earthquakes. For younger students, the earthquakes are best read out loud and marked together as a class. Students may want to have a highlighter or crayon for the final segment of the activity.

Procedure

1. Distribute the materials to your students.
2. For older students: Have them use the coordinates given by the latitudes and longitudes of each earthquake to plot them onto their maps. Instruct them to draw a point where each earthquake is located, and label it with its magnitude (ex: • 6.5). For younger students: Read through the list slowly and teach them how to use coordinates to plot points. Have them label each earthquake location on their maps.
3. Let the students plot as many of the coordinates as possible given the time allotted for the activity; the more points graphed, the more effective the message will be.
4. Once the students are done plotting earthquakes, instruct them to connect the black dots – both the alphabetical (A-Q) and numeric (1-26), in order – and to trace over the dotted lines as well. The resulting image is a worldwide plate tectonics map.
5. Explain to the students that most of their plotted earthquakes fall along, or near, the lines which represent plate boundaries, because earthquake occur along faults.

CONTENT:

As early as the 1920s, scientists noted that earthquakes were not a universally occurring natural phenomenon, but were concentrated in very specific narrow zones. These zones were determined to be the boundary areas between tectonic plates. A tectonic plate (also called 'lithospheric plate') is a massive, irregularly shaped slab of solid rock, generally composed of both continental and oceanic lithosphere, upon which the oceans and continents lie. Plate size can vary greatly, from a few hundred to thousands of kilometers across. Plate thickness also varies greatly, ranging from less than 15 km for young oceanic lithosphere to about 200 km or more for ancient continental lithosphere.

Like many features on the Earth's surface, plates change over time. The theory of plate tectonics states that the Earth's outermost layer is fragmented into a dozen or more large and small plates that are moving relative to one another as they ride atop hotter, more mobile material. Most movement, which causes either creep (slow, steady motion along fault segments) or the build-up of stress that leads to sizeable earthquakes, occurs along plate boundaries. Locked segments of a fault store a tremendous amount of energy that can build up for decades, or even centuries, before being unleashed in devastating earthquakes.

Knowledge about plate tectonics is particularly important in California because of the sizeable earthquake risk that exists due to the state's location atop the boundary between the Pacific Plate and the North American Plate. The build-up of stress at certain points along this boundary occurs as the two plates shift slowly, but steadily, past each other at millimeters per year. Eventually, enough stress is caught at certain fault segments of the boundary that it gets released in the form of energy waves that cause the ground to shake.

There are four types of plate boundaries:

Divergent boundaries: where new crust is generated as the plates pull away from each other.

Convergent boundaries: where crust is destroyed as one plate dives under another.

Transform boundaries: where crust is neither produced nor destroyed as the plates slide horizontally past each other.

Plate boundary zones: broad belts in which boundaries are not well defined and the effects of plate interaction are unclear.

Information from *This Dynamic Earth: the Story of Plate Tectonics* by W. Jacquelyne Kious and Robert I. Tilling, distributed by U.S. Department of the Interior / U.S. Geological Survey