

Activity Overview

In this activity students examine and describe the distribution of earthquakes at global, regional, and local scales. They correlate faults with earthquakes and data on past earthquakes in their community to prepare for future events.

At the conclusion of **Activity 4**, students should be able to explain the global distribution of earthquakes and relate earthquakes to other features such as volcanoes and major faults. They should be able to describe the past earthquake history of their community and region and use this information to estimate the risk of future earthquakes. Each student group should be able to describe the earthquake history of their community as part of their **Chapter Challenge** project. Content reading looks at the global distribution of earthquakes and notes that earthquakes occur at plate boundaries. The concept of “risk” is addressed and earthquake risks in the United States are examined.

Preparation and Materials Needed

Little preparation is needed for this activity. The students will need access to the *This Dynamic Planet* map and the Internet. A state geologic map is useful, and time might be saved if you locate one prior to the activity. An AAPG geologic highway map can also be used. To obtain geologic maps visit the *EarthComm* web site for a list of helpful resources.

Materials

- U.S. Geological Survey map: *This Dynamic Planet* (or copy of map on page 150 provided as a **Blackline Master Earthquakes 4.1**)
- World map (see **Blackline Master Earthquakes 1.1**)
- Geologic map of your state (with latitude and longitude marked)
- Geologic map of your region (with latitude and longitude marked)

Think about It

Student Conceptions

Students who have completed the activities in **Chapter 2** (Plate Tectonics) may have a sense of the distribution of earthquakes around the world. If an earthquake has not occurred while the students have lived in their community, they are likely to think that one will never occur. They may be surprised after completing this activity!

Answer for the Teacher Only

Earthquakes tend to occur along well-defined belts, most prominently in ocean basins and along the edges of continents around the Pacific basin.

As a minimum, students should note any nearby earthquakes and the closest linear belt of earthquakes.

Assessment Tool**Think about It Evaluation Sheet**

The **Think about It Evaluation Sheet** can be used to assess the extent to which students have met the basic expectations for the warm-up activity.

Investigate

Circulate from group to group asking questions that help the students better understand the distribution of earthquakes.

1. a) Broad belts, curved zones.
 - b) Along the edges of some continents; volcanoes, oceanic trenches.
 - c) Earthquake zones are narrow in oceans, and a bit wider along the edges of continents. In the Pacific, they are along the edges of continents, but from Europe to Asia they are in a broad zone. Most of the earthquakes in the narrow oceanic belts have depths of less than 60 km. Along the edges of continents, the earthquakes closest to the ocean basin are shallow (less than 60 km), but the earthquakes increase in depth toward the continent. This is very apparent for Japan and South America on the *This Dynamic Planet* map.

Teaching Tip

The map on page 150 of the Student Book is available as **Blackline Master Earthquakes 4.1**.

2. a) Lines, broad zones, scattered.
- b) For most, yes, especially the San Andreas Fault and the Banning Fault.
- c) Yes; see north of the Garlock Fault or in central or northern California.

For Questions 3 and 4, students explore web sites with the goal of generating a map that shows notable earthquakes of the world on the world map, important earthquakes of the United States and Canada, or earthquakes that have occurred within 200–500 km of their community.

Have the groups share their information with the class.

- How do the community maps fit into the patterns for the continent?
- How do the continental patterns fit within the global pattern?

Comparing the earthquakes to the geologic map can be challenging. Review the comments in **Background Information** and remember, especially in the eastern states, that active faults may not reach the surface.

Assessment Tool

Investigate Notebook Entry-Evaluation Sheet

The **Investigate Notebook Entry-Evaluation Sheet** is designed to help students get a sense of the expectations for *EarthComm* notebook entries.

3. Student maps and responses will vary depending on how students choose to define “notable earthquakes.” You may want to, as a class, come up with a criteria for distinguishing a notable earthquake.
4. Responses will vary depending on the geology of your community. The *EarthComm* web site www.agiweb.org/earthcomm contains a list of resources to help you to obtain geologic maps of your state and region, as well as information on how to read and interpret geologic maps. You may need to review this with students, because it is likely that this will be their first experience with geologic maps.

Reflecting on the Activity and the Challenge

This is an opportunity to note the observations the students should have made. They have recognized global patterns in earthquake distribution. They have identified areas in the United States where earthquakes are common. The students should be aware of the frequency, location, and size of earthquakes in their community or region. The information can be used as guidelines to future activity and used to tell citizens what they need to prepare for.

Digging Deeper

Assign the reading for homework. The questions in **Check Your Understanding** on page 154 can be provided as a homework assignment.

Assessment Tool

Check Your Understanding Notebook Entry-Evaluation Sheet

This evaluation sheet is used to help you evaluate the extent to which students understand the key concepts explored in the activity and explained in the **Digging Deeper** reading section.

Check Your Understanding

1. The pattern of earthquakes associated with ocean trenches, by which the earthquakes fall closely on a sloping surface that extends downward at some angle from the trench, is strong evidence for subduction of one lithospheric plate beneath another.
2. Earthquake risk is highest in subduction zones and in continent–continent collision zones.

Teaching Tip

Use the **Blackline Master** of the earthquake risk map of the United States (**Blackline Master Earthquakes 4.2**) to make copies for the students. Have the students plot earthquake data onto the map. Do earthquakes ever occur in areas which have a low hazard?

Understanding and Applying What You Have Learned

1. a) In 1886, in Charleston, South Carolina.
 - b) As time passes, people tend to think of a hazard less frequently. People tend to assume that earthquakes no longer pose a risk or that they will not occur in their lifetime.
 - c) Much greater.
 - d) Apparently yes; on the basis of 50-year intervals starting in 1800, the number of large earthquakes has increased from one every 50 years to 10 between 1950 and the present.
 - e) No. The number of deaths would be greater because the population of the area has grown significantly.
 - f) One possible explanation is that in the 1700s, earthquake observation was not as intense and equipment was not as sensitive.

2.
 - a) No; exceptions are southern California, and the broad zone from southeast Asia to Europe.
 - b) Yes. Nearly all the earthquakes along the edges of the continents are associated with volcanoes.
 - c) No. Volcanoes in ocean basins are not shown. Many of these volcanoes have only recently been discovered. Hundreds if not thousands of submarine (underwater) volcanoes will be discovered and mapped in the future. Nearly all of these volcanoes will correspond to the location of the earthquakes.
 - d) Areas of greatest risk (32%+ g) are on the edge of the continent in California. Areas with the high risk (24%–32% g) parallel the edge of the continent from California to Washington. Much larger areas in the western states (closer to the edge of the continent) are at higher risk than the eastern states.
3. Earthquakes do not occur at regular intervals, so no predictions can be made. Also, many people have never felt an earthquake and think it is unlikely that one will strike their homes. Therefore, it may be difficult to get the public to take earthquake preparation seriously.

Preparing for the Chapter Challenge

This background summary can provide an introduction to the students' final brochures. Encourage students to prepare graphics to support their reasoning. The *EarthComm* web site provides many helpful links if students want to further research the earthquake history of their area. The web sites include both statistical data and colorful maps and charts which can be incorporated into the final brochures.

Inquiring Further

1. Earthquakes of magnitude 7 or greater
 - a) 40.
 - b) 20.
 - c) There seems to be an increase in the number of large earthquakes from the 1920s to the 1950s. There seems to be a steady decrease from about the 1970s to the present.
 - d) Maybe the rate of buildup of stress. This is related to plate tectonics. The *EarthComm* web site www.agiweb.org/earthcomm provides links for students to research earthquake history in the United States.