

Earthquakes



Earthquakes can damage buildings.

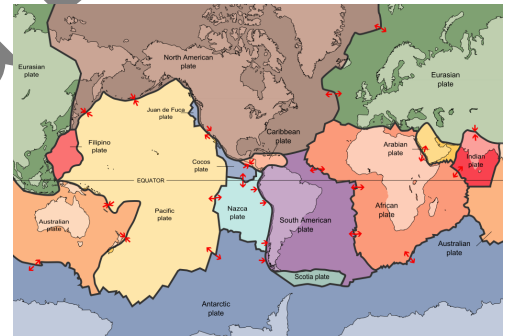
What is an Earthquake?

During an earthquake, the ground shakes, sometimes severely. In strong earthquakes, buildings can be damaged or destroyed, and the ground itself can split. Earthquakes often involve a few different phases. In some cases, there are **foreshocks**, or minor shaking prior to a larger earthquake. Foreshocks cannot be identified as foreshocks until the main quake arrives. The

main, and largest, earthquake in the sequence is called the **mainshock**. Finally, **aftershocks** always follow the mainshock. Aftershocks are small, like foreshocks, and occur in the same place as the mainshock. If a mainshock is strong enough, aftershocks can last up to years afterwards.

What Causes Earthquakes?

Earth's surface, called the crust, is like a puzzle. Each piece is called a **tectonic plate**. The plates compose the **lithosphere**. Plate edges, where they contact each other, are called **plate boundaries**. Along the boundaries are **faults**, or cracks in the crust between masses of rock. Tectonic plates constantly move past one another at these boundaries. They move along on top of the **asthenosphere**, part of the **mantle**, a partially molten layer of Earth just beneath the lithosphere. Earthquakes occur when plates slide past one another, the edges become stuck for a time, and suddenly slip. The movement of the plate generates a lot of energy that is stored while the edges are stuck. When they slip, breaking apart, that stored-up energy is released as an **earthquake**.



There are 12 major tectonic plates on Earth.

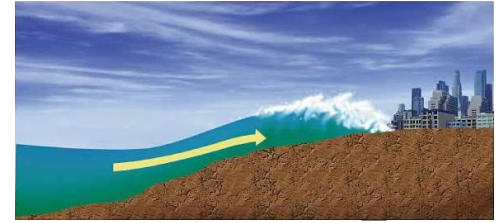
The energy is released as a wave, with the rock masses first being pushed out from the fault and then springing back in in succession. This pattern is called a **seismic wave** and moves much like any other wave (e.g. light, sound). Fittingly, the scientists who study earthquakes are called **seismologists**. Seismic waves radiate out from the point of energy release much like ripples in a pond. This point lies within the crust and is called the **focus**. On the surface, the location directly above the focus is called the **epicenter**. Earthquakes feel strongest



Seismic waves radiate out from the focus.

at the epicenter, becoming progressively weaker with distance.

When earthquakes happen at land-based faults, they can cause severe damage due to the shaking alone. However, if an earthquake occurs at sea, it can generate a **tsunami**. Tsunamis are giant, fast-moving waves that can cause massive amounts of destruction when they reach land.



Earthquakes at sea can cause tsunamis.

How are Earthquakes Measured?

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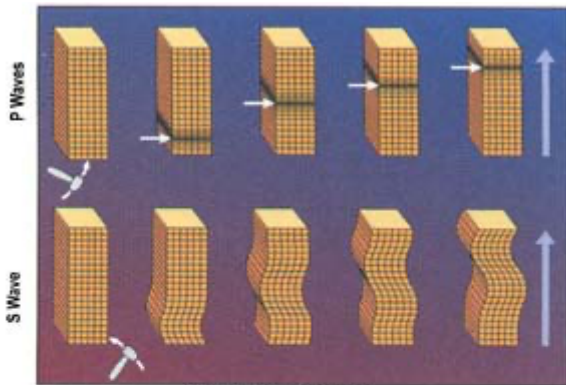
printed out) is called a **seismogram**. Wave amplitudes range widely, so magnitude is often measured as the logarithm (base ten) of the greatest-amplitude wave measured by a seismograph. In this measuring scheme, magnitude can range from less than 1 to greater than 8 (some negatives have been recorded). The scale of earthquake magnitude is called the **Richter scale** after Charles F. Richter, who developed it in 1935. Earthquakes of less than one up to 2.9 are considered micro earthquakes, while earthquakes of 8 or greater are termed great earthquakes. Micro earthquakes are quite common, happening over 100,000 times per year, and usually imperceptible to people. Great earthquakes, on the other hand, are extremely rare, less than 3 occur per year, and result in massive destruction and loss of life spreading over a large area.

Intensity refers to the strength of the shaking caused by an earthquake. It is generally measured in acceleration and velocity of ground motion. North American seismologists

employ the **modified Mercalli scale**, developed in 1931. It is written in Roman numerals and ranges from I (not felt) to XII (severe damage). Other parts of the world use other, similar, scales. Such intensity scales tend to be more qualitative in comparison to the Richter scale, which is purely quantitative.

How Do Seismologists Find the Epicenter?

Not only can seismologists measure the magnitude and intensity of an earthquake, but they can further pinpoint where the earthquake occurred.



P waves are compressional and S waves are shear waves.

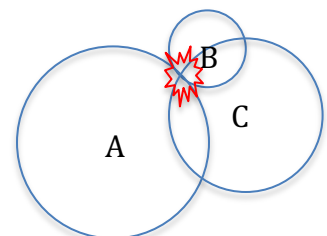
The first step is to determine how far away the epicenter is from the recording station. Seismologists do this by measuring the difference between the arrival time of two types of seismic waves: **P waves** and **S waves**. A seismograph measures both waves to determine magnitude. P waves are compressional waves, the pushing out and springing back of rock masses mentioned above. S waves, on the other hand, are shear

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Next, distance information from two other recording stations must be gathered. Seismologists then add two more circles to their map. Where these circles intersect is the epicenter. For example, say recording station A measures a distance of 100 miles from their location to the epicenter, recording station B measures 40 miles, and recording station C measures 80 miles. If circles with radii of each of these distances are drawn with the respective recording station in the center, they will intersect at the epicenter of the earthquake. This process is called **triangulation**, since three stations are required.



Triangulation uses three distance measurements to find the epicenter of an earthquake.

Reading Comprehension Questions:

1. What
2. What is the sequence in which an earthquake occurs and which phase only occurs sometimes?
3. What
4. What causes an earthquake?
5. What
6. What are the
7. What is a tsunami?
8. What
9. What are the two metrics for measuring earthquakes? Explain.
10. What is the difference
11. How do

Extension Questions

12. Have there been earthquakes in your home state or country? If so, when was the last one? What was its measurement on the Richter and/or Mercalli scales?
13. On a map,
14. Create an

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TWF READING

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