

Student Page 2.2A: Earthquake Basics

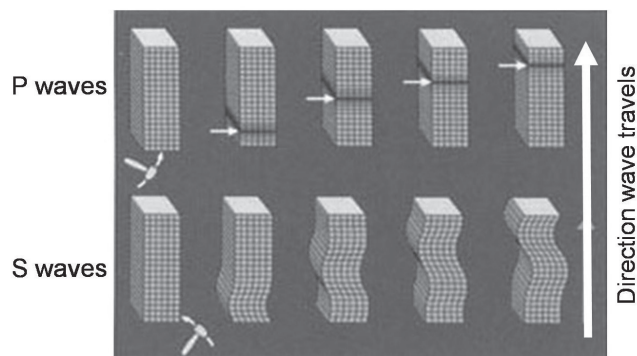
What is an earthquake?

An earthquake is the name for an event where the ground shakes and the earth moves. Earthquakes happen naturally all over the world. They usually happen suddenly, with no warning.

What happens during an earthquake?

When an earthquake occurs, the ground shakes, or vibrates. These vibrations can destroy buildings, roads, and cause other damage like you have probably seen in photographs or on video. Scientists call the vibrations **seismic waves**.

Earthquakes create two kinds of seismic waves. There are primary waves and secondary waves. Scientists often refer to them as P and S waves. These waves both travel away from the center of an earthquake, called the focus. However, they move in two different ways. P waves push and pull the earth in the same direction they are moving. S waves move the earth up and down or side to side. The picture below shows the idea by using a hammer to represent how the wave begins.

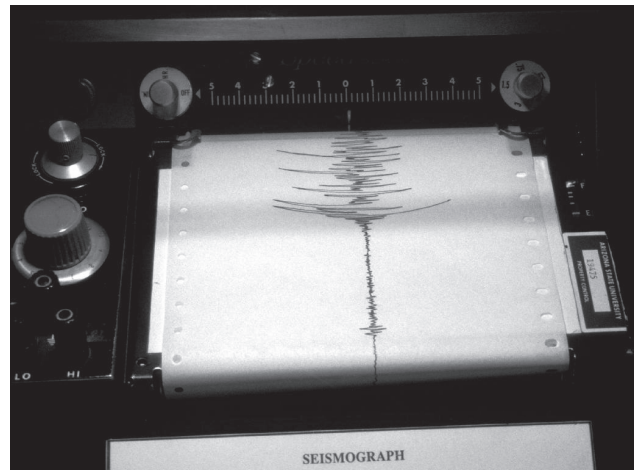


[Illustration adapted from USGS Earthquake Hazards Program.]

P waves travel faster than S waves. They reach a given point first. This is why they are called primary waves. S waves always arrive a little bit later.

How do scientists measure earthquakes?

To measure earthquakes, one of the tools scientists use is a seismometer. **Seismometers** measure seismic waves. Seismometers are measuring seismic waves right now all around the world! When a seismic wave shakes the ground, seismometers record the amount of shaking. Older seismometers mark the vibrations on a long roll of paper. They use a pen attached to the end of a small needle. The vibrations make the needle (and the pen) go back and forth across the paper. The measurement on the paper is a **seismogram**. Modern seismometers create seismograms using computers.



Seismometer recording an earthquake. [Image courtesy Oklahoma University, photo by Albert Copley. Image source: Earth Science World ImageBank]

Since P & S waves move at different speeds, the recording station (seismometer) always records a P wave first. A seismometer records S waves a little bit later. The more time between the two waves, the further away the recording station is from the epicenter. The epicenter is the point on the surface of the earth directly above the source of the earthquake, or focus. By measuring P and S waves with seismometers, scientists can learn where and when earthquakes happen. They can also learn about the structure of Earth.

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How big is an earthquake?

Have you ever heard someone talk about an earthquake by number? Scientists measure how big an earthquake is and use numbers to compare the sizes of different quakes. The size is called the **magnitude** (M) of the quake. An earthquake with larger magnitude is more energetic. Larger earthquakes release more energy and last longer, too.

Scientists use magnitude numbers to compare quakes. If two quakes have the same magnitude, they release the same amount of energy. An M6.7 earthquake is M6.7 no matter where you are. What about an M3 compared to an M2? The M3 is one unit of magnitude bigger than the M2. For each unit the magnitude increases, the energy released by the quake increases 32 times! For example,

an M3 is 32 times more energetic than an M2! Magnitude also tells scientists about how much the ground shakes. For every unit the magnitude increases, the ground shakes 10 times harder. For example, an M3 shakes the ground 10 times harder than an M2. Scientists call this earthquake rating system the Moment Magnitude Scale.

How much shaking you actually feel in an earthquake is called the **intensity**. Unlike magnitude, the intensity of an earthquake changes from place to place. It depends on how far you are from the center of the earthquake. It also depends on what kind of ground you are standing on. Why is this way of measuring earthquakes less consistent than magnitude?

Student Page 2.2B: Your Own P and S Waves

S Waves

You can make your own P and S waves by using a simple toy. Take the Slinky™ that your teacher provides. Hold onto one end while a partner holds onto the other end. Stretch it out. Then, shake one end up and down (or side to side) so that a small wave travels along the Slinky™. This wave is just like an S wave. The coils move up and down (or side to side) as the wave moves from one end to the other.

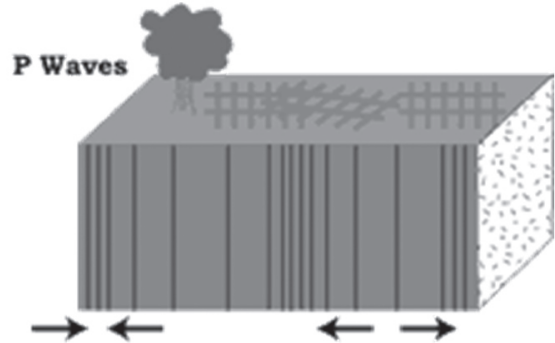


[Figure courtesy USGS]

P Waves

Now try to model a P wave. A P wave moves objects in the same direction that it travels.

Try to create a P wave using the Slinky™. In what directions do you have to move one end of the Slinky™ to create P waves?



[Figure courtesy USGS]

In your Science Notebook, draw a simple picture or write a few sentences to describe how you modeled P and S waves with the Slinky™.