Getting to Know: How We Study the Interior of the Earth

In January 2010, a devastating Earthquake struck the island nation of Haiti. More than 220,000 people lost their lives, and more than a million people were left homeless. The energy from the earthquake was detected in locations of Earth's crust around the entire world. Most earthquakes, however, are much smaller than the one that struck Haiti. Minor earthquakes occur frequently, and they tell geologists a lot about the interior of Earth.

During an earthquake, *seismic waves* carry energy along Earth's surface and through the planet's interior. Breaks and slips between rocks in Earth's crust cause the energy to radiate outward in all directions. A geologist studies these movements to determine how, when, and where earthquakes form. This specialized area of geology is called *seismology*.

An earthquake in 2010 devastated homes in the nation of Haiti. (Photo from US Geological Survey)

Are there different types of seismic waves?

There are several types of seismic waves. *Compression* or *P waves* travel through the Earth's crust as if it were a spring, pushing energy forward through the rock material so that the crust also moves forward and then springs back into place. *Transverse* (shear) or *S waves* move energy at right angles to the direction of the crust's movement, which can create an up-and-down motion. P Waves are the first seismic waves to be detected after an earthquake because they move twice as fast as S waves. By analyzing the difference in arrival times of P waves and S waves, scientists can determine how far away an earthquake's epicenter is.

How does seismology teach us about Earth's layers?

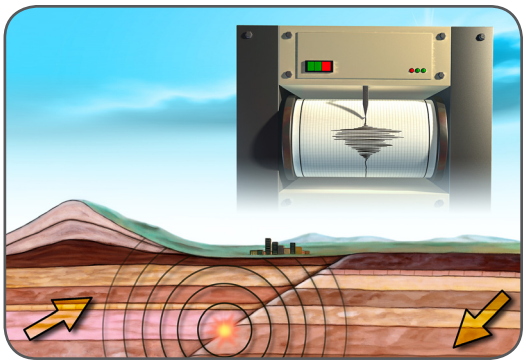
Earthquake waves help scientists study Earth's interior. P waves travel through both liquid and solid material, while S waves cannot travel through liquids. Because S waves do not travel through Earth's outer core, scientists have determined that the outer core is liquid.

Misconception : ***Can we study Earth's core by drilling into it, or by analyzing lava?***

We do not have the technology to drill into Earth's core. The distance is far too great, and the intense heat would melt any drill bits that we could build. Analyzing lava also does not help us learn about Earth's core because lava does not come from the core. Lava comes from pockets of magma in Earth's crust or upper mantle. Seismic waves have provided the most valuable evidence of Earth's interior structure and composition.

How is seismic energy measured?

A *seismograph* is a specialized tool used to record seismic energy. When the ground shakes, the seismograph records the motion. The magnitude and intensity of the seismic energy is recorded and classified according to various scales. The most commonly used scale to describe earthquakes is called the *moment magnitude scale*. The moment magnitude scale is logarithmic—for every increase of one in the scale, an earthquake releases 10 times more energy. This means that an earthquake that measures 4.8 on the moment magnitude scale released ten times more energy than a 3.8 earthquake. Likewise, a 5.8 earthquake releases 100 times more energy than a 3.8 earthquake.



Seismic energy released along a fault, or crack in Earth's crust, travels throughout Earth. Seismograph stations located worldwide detect seismic waves.

Can earthquakes be predicted?

Earthquakes cannot be predicted. Scientists analyze recent or past events to determine the likelihood of a future earthquake. For example, if few large earthquakes have occurred in an active fault area in recent times, scientists may conclude that an earthquake is more likely to occur in the future because pressure is likely building. However, it is impossible to reliably determine when or where the next earthquake will occur.

Although catastrophic earthquakes are a concern for some people, especially those living along major fault lines, they can also help us learn about the interior of our planet. As scientists continue to study earthquakes, they will learn more and more about the structure of Earth's interior.