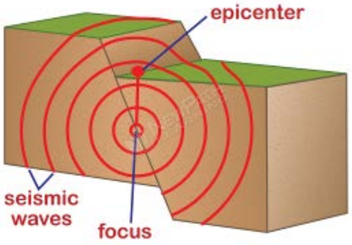
EARTHQUAKES

The theory of plate tectonics describes the movement of the plates of the lithosphere relative to each other. This movement creates forces that push and pull on the crust. Crustal rock can absorb and store energy, but only so much. There is a point at which the stress is more than the rock can hold and the rock breaks. When the rock breaks, the stored energy is released and this energy travels through the Earth. This sudden release of energy created when rocks break is called an **earthquake**.



The point in the crust where the rock first breaks to create an
earthquak directly
above the **enter.**
Following a quakes
that occur **ocks** are
smaller in

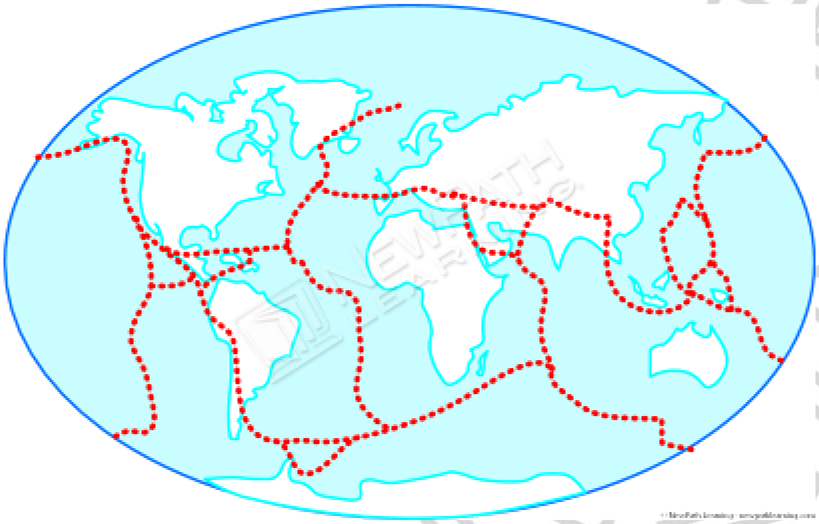
What do we call the point in the Earth's crust where the rock first breaks to create an earthquake?

Types of Stress Acting on Rocks

Stresses are created whenever one mass of rock moves relative to another. When two tectonic plates are pushing toward each other, **compressional stress** deforms and breaks the rocks. Folded mountains are a typical result of compressional stress. When two plates are moving away from each other, **tensional stress** is created which creates **faults** that allow blocks of crust to move down relative to one another. Plates can also slide past one another. This creates **transform faults,** which also creates stress on both plates.

Lesson Checkpoint:
Name and describe one type of stress on the rock and plates of the Earth.

Faults



When rocks break and there is movement on a plane (that is, a surface), the surface formed by the plane is called a **fault**. When a fault forms, one block is above the fault and the other is below the fault. The block above the fault is called the **hanging wall**. The block below the

- When t a **reverse** **fault** is
- A rever e is called a **thrus**
- When t ll, a **normal**
- When two blocks slide past one another, a **transform fault** is formed.

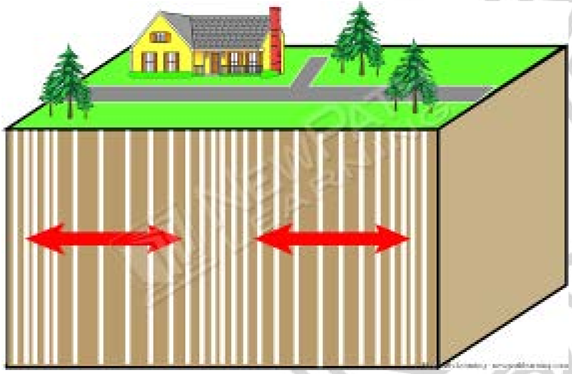
Lesson Checkpoint:
What are the two parts of a fault?

Types of Seismic Waves

When rock breaks, the energy that was stored in the rock is released in a single, massive event. The energy travels through the Earth, rolling and shaking the crust. This event is known as an **earthquake**. The energy is released in the form of energy waves.

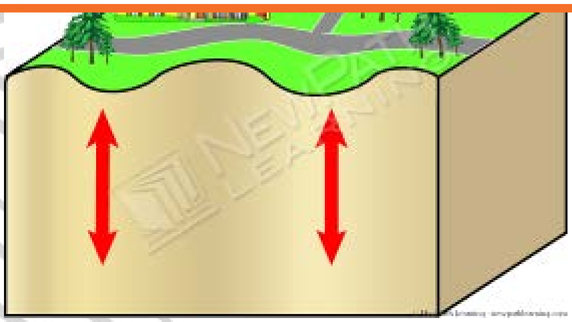
There are **three different types** of energy waves (**seismic waves**) released by an earthquake.

- **P-waves** or **primary waves** are the first energy waves released. They are the fastest of the seismic waves and can travel through solids, liquids, and gases. Because they are the fastest seismic waves, they are the first waves to be measured by a **seismograph**. P-waves are pulse waves that move rock back and forth, first compressing then stretching the rock.



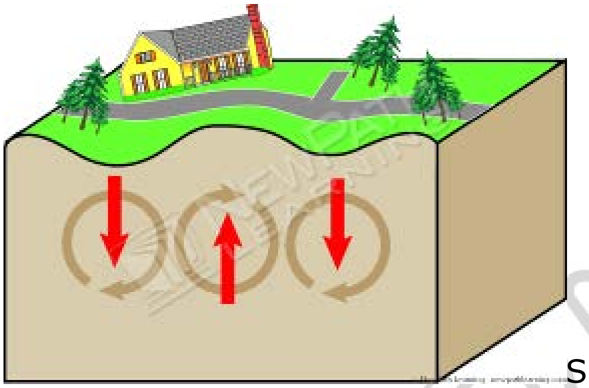
P-waves

- **S-wav** aves
  created ves and
  therefo aves are
  also cal ern
  through



- S-waves can travel through solids, but they cannot travel through liquids. The disappearance of S-waves at the outer crust/mantle boundary is what indicates the outer core is liquid.

- The slowest and most destructive seismic waves created by an earthquake are called **surface waves**. Surface waves travel along the surface of the Earth's crust in a circular motion. They are the most destructive of the seismic waves because they shake the surface of the Earth up and down.

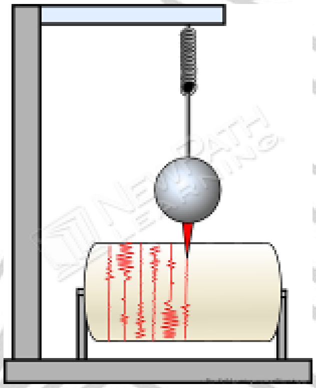


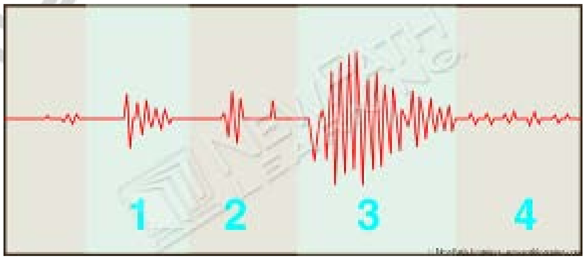
Surface waves

Lesson Checkpoint:
Which type of seismic wave is the most destructive?

How Are Earthquakes Measured?

Earthquakes are measured by machines called **seismographs**. The
different s er or
drum (or a The first
up tick on The next
significant nificant
and drama ismogram
also recor nowing
the differe can be
used to ca ocation of
the earthquake's epicenter.





Readings from three different seismographs are needed to determine the epicenter of an earthquake. The information from the seismogram can determine the distance from the seismograph to the epicenter, but it can't determine the direction. The intersection of three circles, representing three distances from the epicenter to the seismograph stations, can determine the location of the epicenter.

The strength of an earthquake is recorded on a scale from 1 to 10, where 1 is the mildest and 10 the strongest and most destructive. This measurement scale was developed in 1935 by Charles Richter and Beno Gutenberg and is called the **Richter Scale**. It is a base 10 logarithmic scale. Consequently, a magnitude 5 earthquake is over 900 times more powerful than a magnitude 3 earthquake.

Lesson Checkpoint:
Readings from how many different seismographs are needed to find the epicenter of an earthquake?

Earthquake Damage and Safety

Damage to buildings, structures, and infrastructure is caused by the rolling surface waves. The damage seen here in the famous
magnitude tly from
the earthq as due
more to th o firemen
could not f dern
engineerin ke
damage.

Surface wa the
ground moves, buildings twist and deform and fall over: the earthquake shakes the "feet" out from under them. Construction engineers are using advanced techniques to minimize, and hopefully eliminate, such structural damage caused by earthquakes. This not only reduces damage and the costs related to that damage, but more importantly it reduces the chances of injury and death.

For example, engineers have constructed buildings that are attached to the ground with shock absorbers that are made out of rubber and steel. The shock absorbers take the energy of the earthquake and limit the amount that actually shakes the building.

People who live in earthquake-prone areas need to learn to take precautions and make safe decisions during an earthquake. Those who are outside must stay outside, away from buildings and structures. Those who are inside are advised to stand in doorways or crouch under a table in the middle of a room (that is, away from the walls) to avoid injury from falling ceiling and wall material.