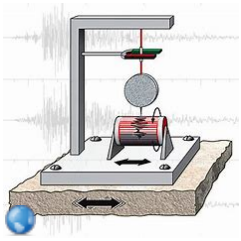
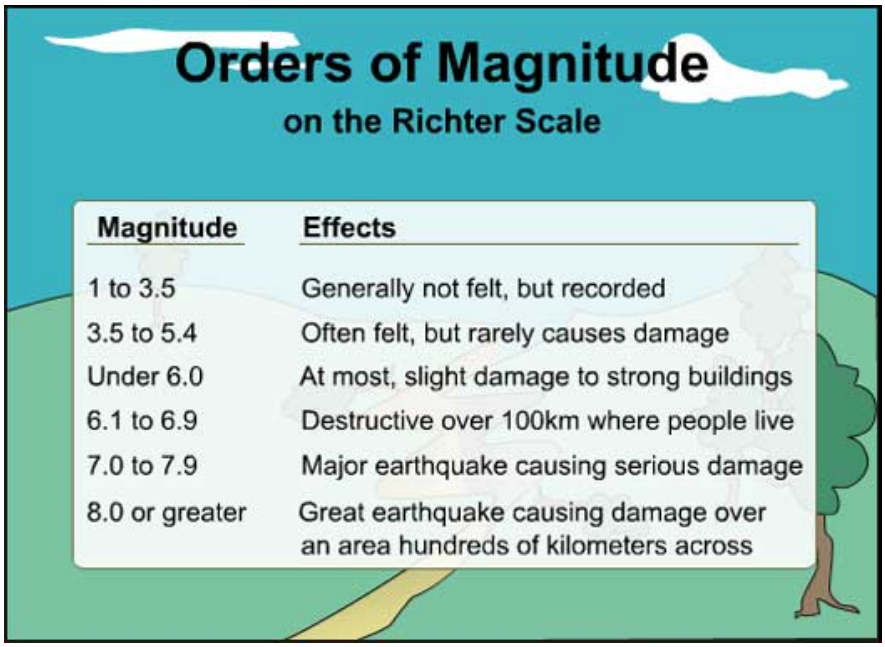
Earthquake is a disturbance and movement of Earth's crust due to a build-up of stress.

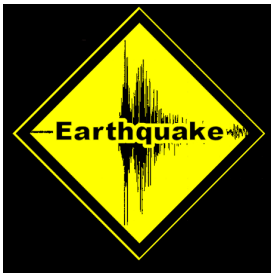
seismograph - a sensitive machine that is attached to bedrock in order to measure the strength of earthquakes.



richter scale - a scale on which the magnitude, strength, of an earthquake is measured.

magnitude - the size





Earthquakes

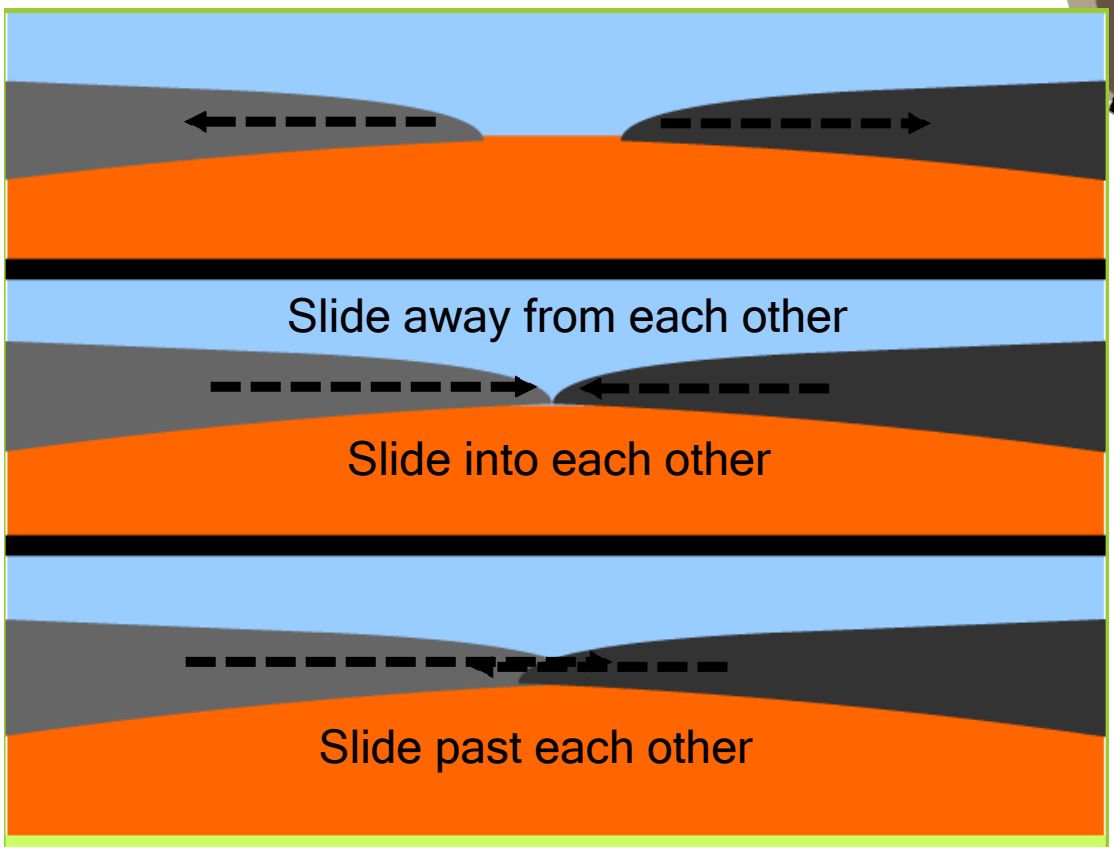
Earthquake is a disturbance and movement of Earth's crust due to a build-up of stress.

It is the shaking of the Earth
Measured using a seismograph
The Richter Scale measures the strength of the Earthquake.

311-4 https://www.youtube.com/watch?v=kwfNGatxUJI

They are the result of energy released from forces built up due to plate tectonics in Earth's crust

When this energy is released, it travels in seismic waves

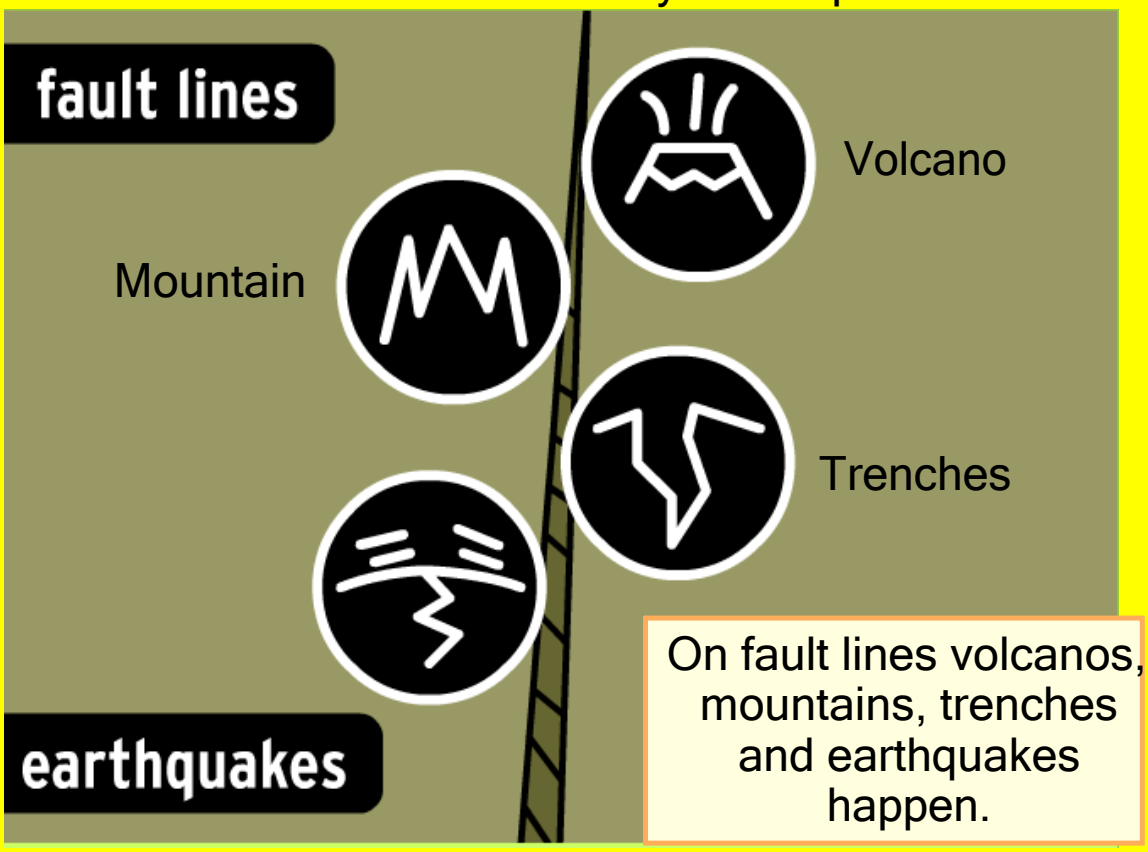


Earth Crust - (Pt 5 Earthquakes)

https://www.youtube.com/watch?v=M5xDi_CT3H0

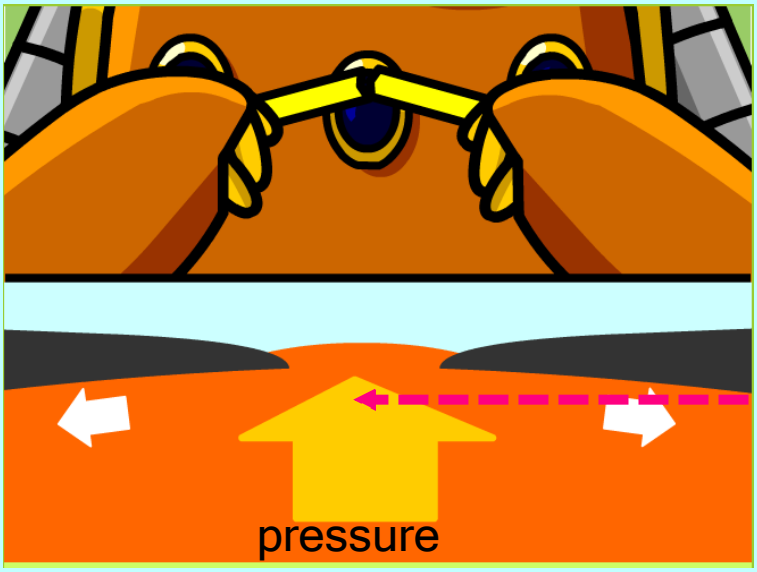
Fault Lines

Fault lines are the active boundry where plates meet.



How Does all of this Relate to Earthquakes?

Release of Pressure

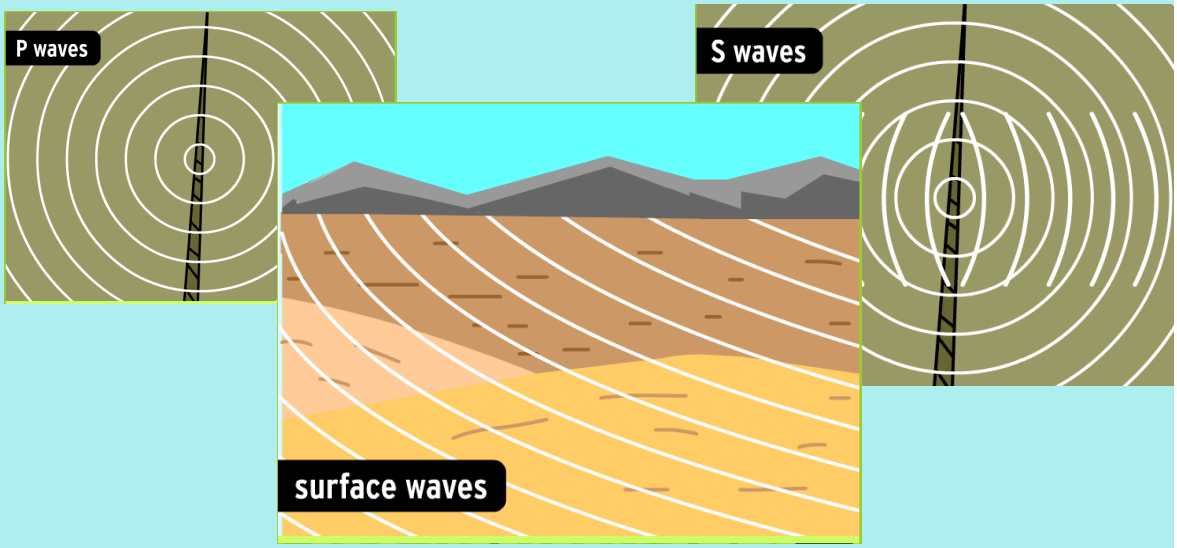


An earthquake arises from pressure on the rocks.

Moving rocks create pressure, an earthquake is the release of the pressure.

An Earthquake acts like a pencil breaking... as the you apply pressure to the pencil eventually enough pressure will snap the pencil in half.
An Earthquake is the same, you feel the shake on earth when the pressure moves the rock

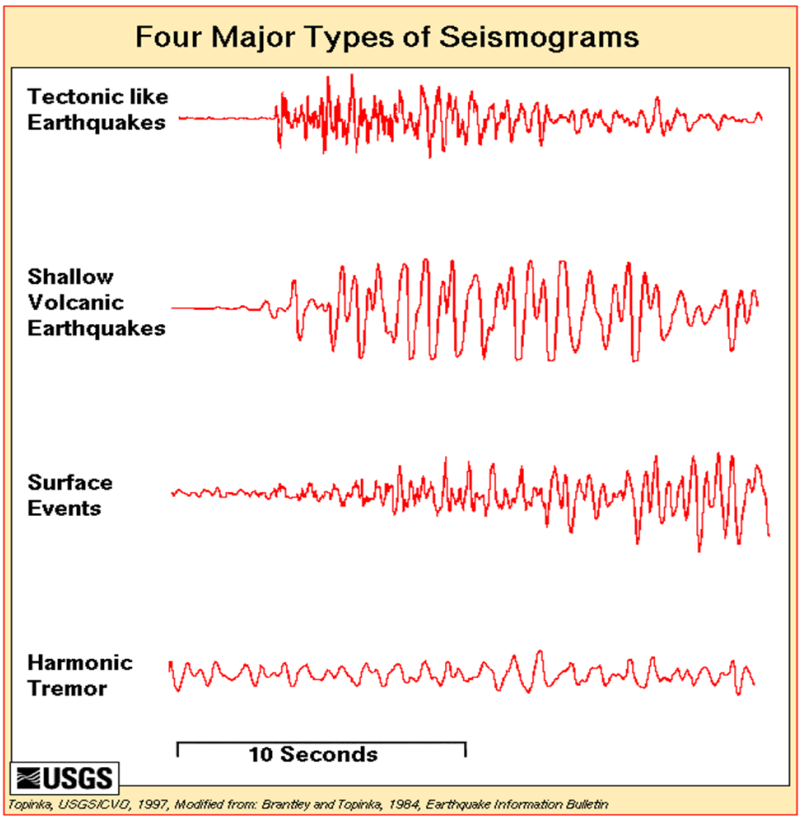
Seismic Waves



The rumbling of the earth is an earthquake - an earthquake is a result of a release of pressure. When the pressure is released Seismic waves are the result. The seismic waves are the energy waves that travel outwards from the source of the earthquake.

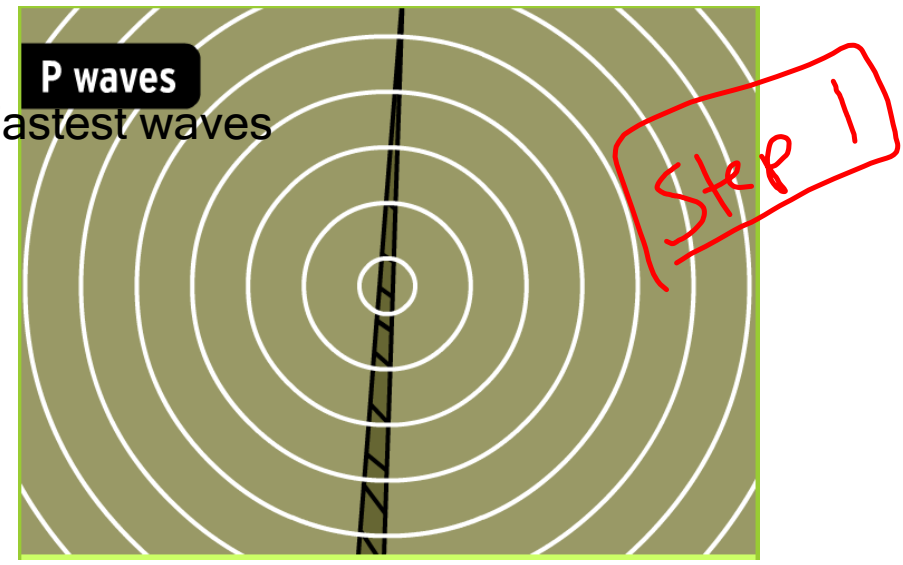
Aftershocks are little earthquakes that are experienced after the first shock.

Earth Crust - (Pt 5 Earthquakes)



P Waves

Primary waves - first to be detected. They can move through liquid and solid rock. They travel the fastest. (Like the compression of a Slinky)(Warns people earthquake is beginning)



Fastest waves

https://www.youtube.com/watch?v=wDfIgoXaXis

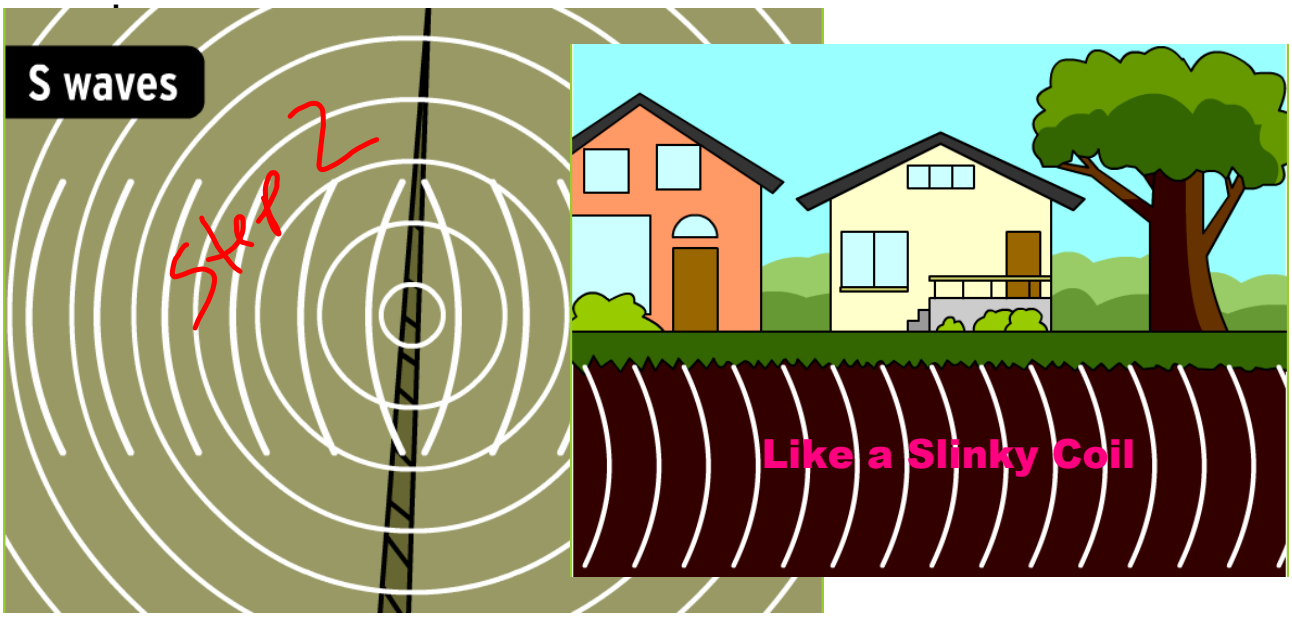
https://www.youtube.com/watch?v=ciE1LS3hLmY

https://www.youtube.com/watch?v=H8xg--5GOQg

S Waves

Secondary waves - travel at right angles to the direction of movement - they cut the rock. (LIKE the Side to side movement of a slinky)

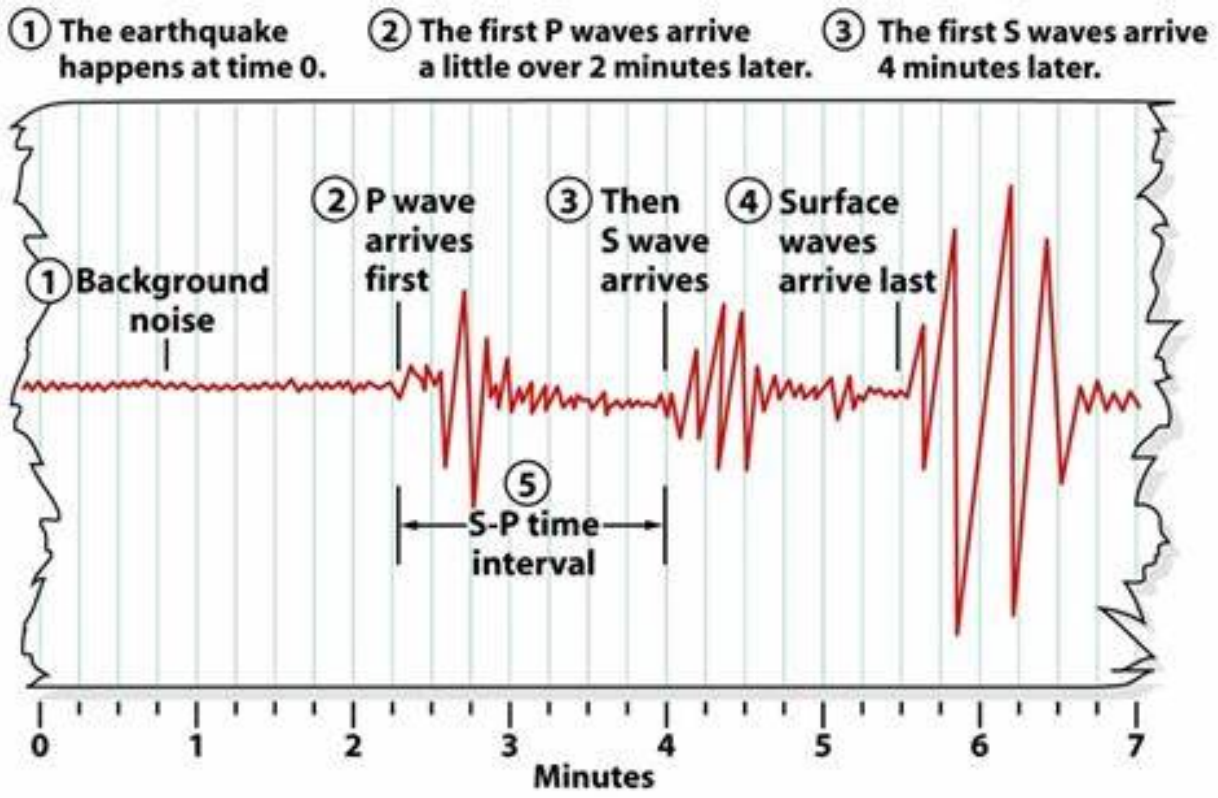
They cannot travel through liquid rock, but they are more dangerous because they travel in vertical and horizontal



Surface Waves

Slowest waves, they travel through the surface of the ground. Their rolling motion is what breaks up roads and crumbles buildings.

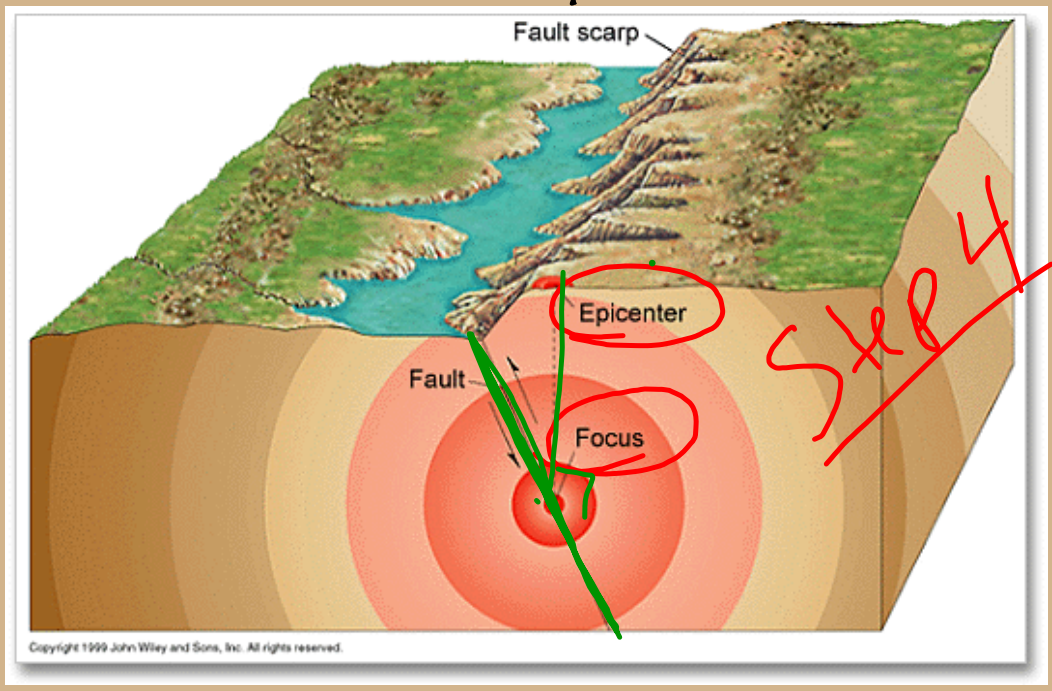
Earth Crust - (Pt 5 Earthquakes)



4 The surface waves, which travel the long way around Earth's surface, arrive last.

5 The S-P interval, here slightly less than 2 minutes, tells the seismologist how far away the earthquake was.

Focus and Epicenter

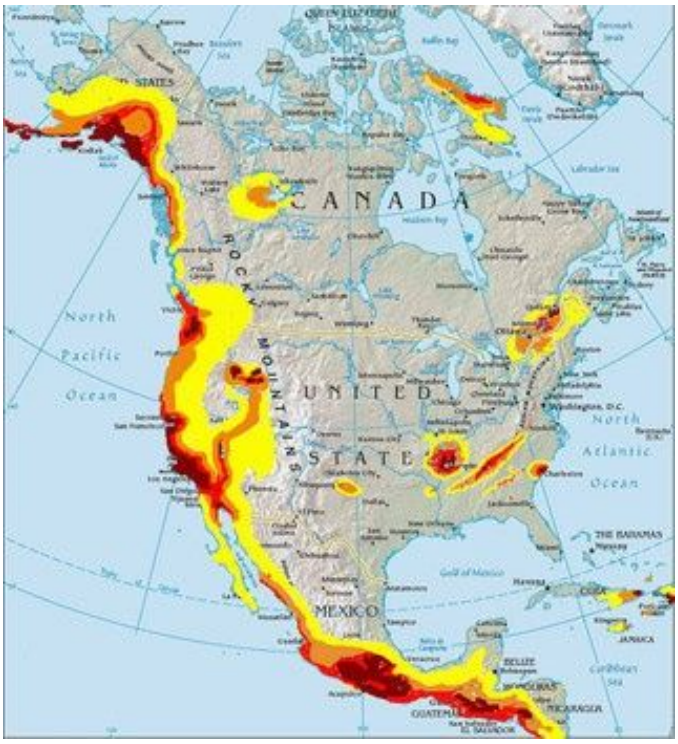


https://www.youtube.com/watch?v=7NqmHtljCJ0

Focus-is the place deep in the Earth's crust where the earthquake begins. The primary and secondary waves come from the focus of the earthquake.

The surface location directly above the focus is called the **epicenter**. Surface waves travel out from the epicenter.

Earth Crust - (Pt 5 Earthquakes)



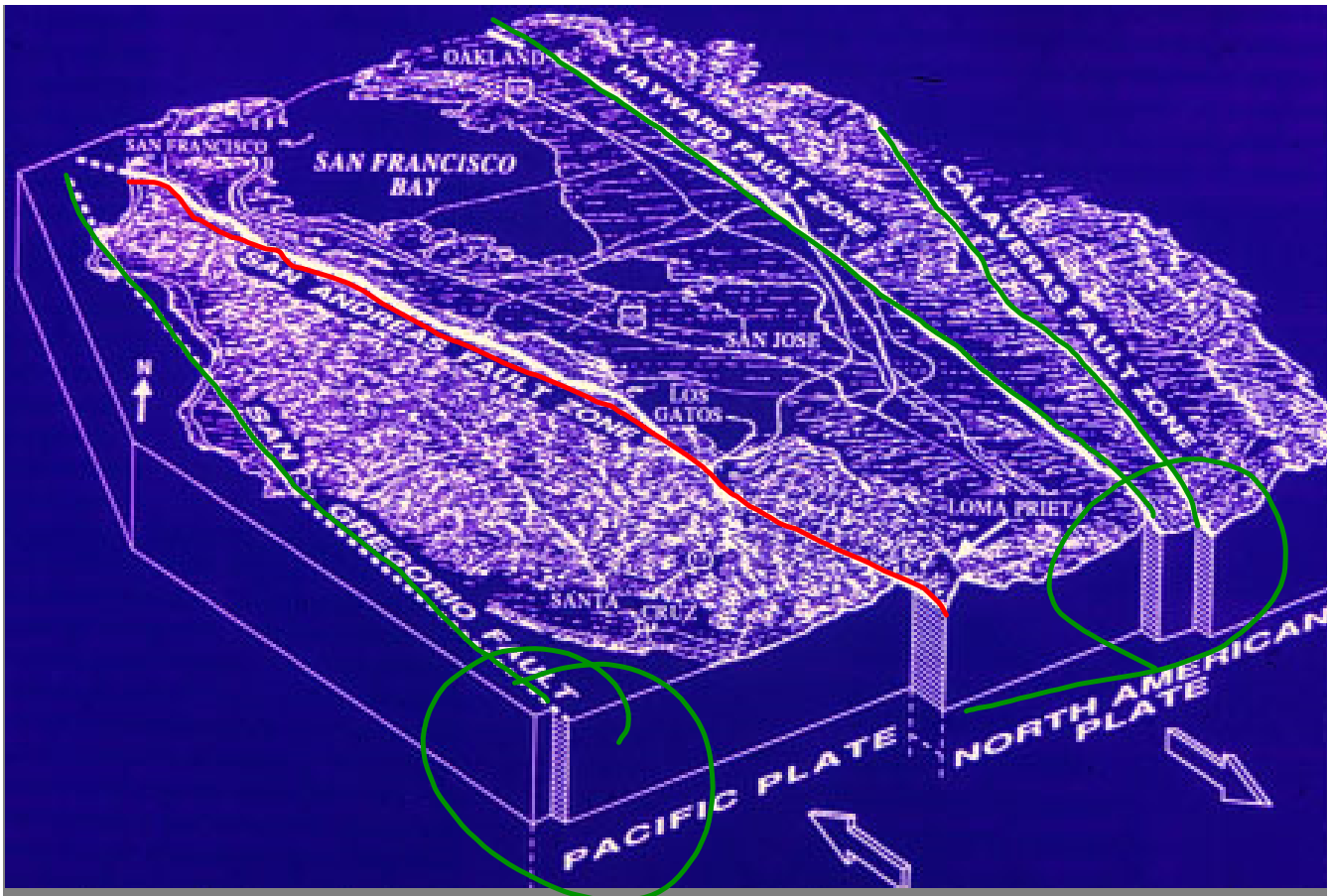
These are the earthquake zones in North America.

Since the 1900, about 5000 (greater than 3.0 magnitude) earthquakes have been recorded in Canada, USA and Mexico. Fewer than 20 were a magnitude of 8 or greater.

https://earthquakescanada.nrcan.gc.ca/recent/2020/index-en.php

The earliest recorded earthquake in Canada took place on 5 February 1663. Occurring in the Charlevoix–Kamouraska region in Québec, at a probable magnitude of 7, the earthquake was felt over much of eastern North America. It also prompted landslides along the St. Maurice, Batiscan and St. Lawrence rivers.

Earth Crust - (Pt 5 Earthquakes)



http://emerald.ucsc.edu/~es10/fieldtripEarthQ/location3.html

Local Earthquakes?

Usually minor in our region. They occur due to the movement along local faults on the floor of the Atlantic Ocean.

https://earthquaketrack.com/r/new-brunswick-canada/recent

Types of Rock Movement in Earthquakes

As you learned in Chapter 10, the rock in Earth's crust is under pressure all the time from tremendous forces. (You will learn more about these forces in Chapter 12.) The pressure keeps the rock in constant movement. Seismologists have identified three basic kinds of ground movement that cause earthquakes (see Figure 11.7).

- Type 1: Two enormous rock surfaces are pushing together.
- Type 2: Two enormous rock surfaces are pulling apart.
- Type 3: Two enormous rock surfaces are sliding past each other.

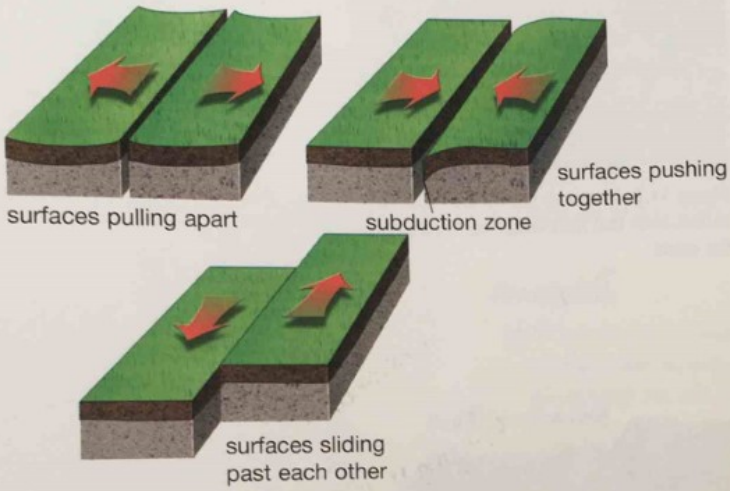


Figure 11.7

Pause & Reflect

Design Your Own

With a partner, think of some materials you could use to demonstrate types of rock movement in earthquakes. Be ready to demonstrate the various types of movement to your classmates.

Rocks That Push Together

In places where the rock surfaces push together, tremendous pressure can bend them into folds. Sometimes one piece of rock will get pushed under the other and dip deep into Earth. This is referred to as a **subduction zone.**

Scientists can tell what kind of rock movement is occurring in an area by measuring the depth of the focus of each earthquake. The deepest earthquakes are usually caused by rocks that have been pushed together, forming a subduction zone. One of the deepest subduction zones in the world is in the Pacific Ocean, in the Marianas Trench off the coast of Japan.

Rocks That Pull Apart

Earthquakes that are caused by rock surfaces pulling apart are very shallow earthquakes. The rocks pull apart when hot magma beneath Earth's crust bubbles upward to a small opening. As pressure increases, the rocks pull apart. Most of these shallow earthquakes happen on the sea floor and cause little damage. The island called Iceland in the North Atlantic Ocean experiences many shallow earthquakes. It has huge cracks on its surface where the rocks have pulled apart.

Earth Crust - (Pt 5 Earthquakes)

Rocks That Slide Past Each Other

In 1965 a Canadian, Tuzo Wilson, was the first person to identify the type of earthquake that is caused when rock surfaces slide past each other and lock in place until the pressure becomes too great. When the rocks shift, an earthquake happens. The area where the rocks break and move is called a **fault.** The best-known example of this type of fault is the San Andreas Fault in California. Look back at the map in Figure 11.6 to see how earthquake activity in the area around the San Andreas Fault compares with activity in other parts of the world.

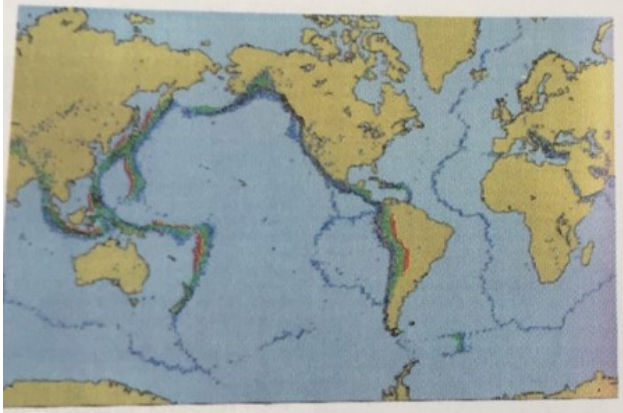
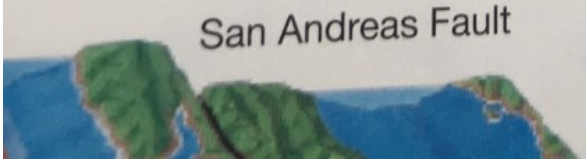
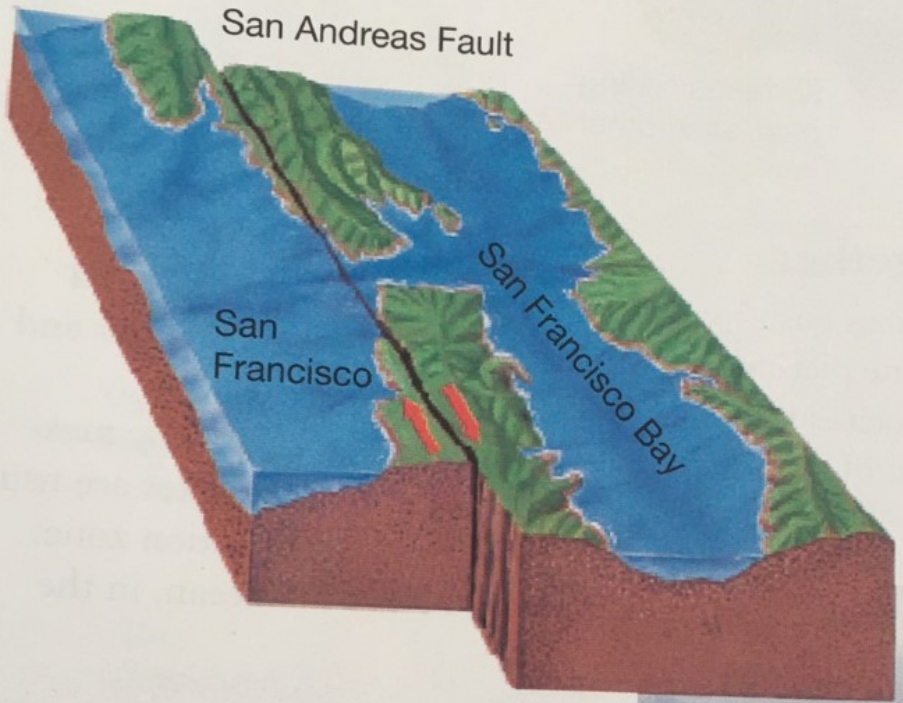


Figure 11.8 This map shows the depth of earthquakes that have occurred throughout the world.



Earth Crust - (Pt 5 Earthquakes)



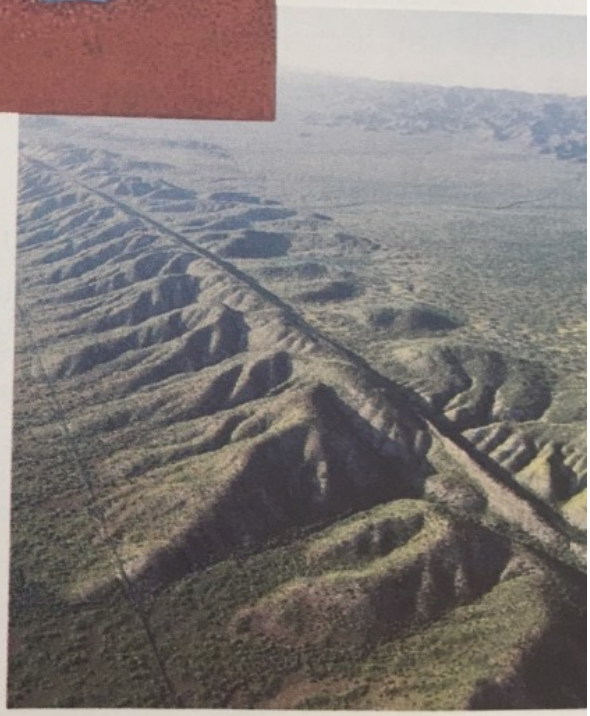


Figure 11.9 The San Andreas Fault is a well-known fault that is so large, it is visible from the air. The photograph on the right shows an aerial view of the fault, and the diagram above shows the movement of the rock surfaces that make up the fault.

Effects of Earthquakes on People

People who live in earthquake zones learn how to prepare for earthquakes. As you know, schools have earthquake drills just like fire drills. In many homes, people attach the furniture to the walls so that it won't shift or fall over during an earthquake. They store heavier items near the floor on shelves.

Buildings and roads are constructed differently in areas that experience many earthquakes. Engineers try to make them earthquake-resistant — able to withstand the shaking of the ground that occurs during an earthquake. Rigid structures made of bricks or solid concrete break during an earthquake because they have very little flexibility. Buildings made of steel, wood, and reinforced concrete can bend a little without breaking. (You will learn more about reinforced concrete in Unit 5.)

Figure 11.10 This office building in Vancouver is specially built so that it will not collapse in an earthquake. The floors are suspended from the central core of the building by huge cables that are visible at the top. What do you think will happen to this building when the ground moves in an earthquake?

Figure 11.11 Part of this freeway collapsed during an earthquake near San Francisco. Part of it did not collapse because the concrete pillars had been reinforced to withstand a earthquake.

ool
ools

his system of lasers monitors movement along the San ndreas Fault. A series of 18 reflectors are positioned veral kilometres away from the laser station. If a reflector's sition changes, the change is measured. Movements of s than 1 mm along the fault can be detected.

At Home ACTIVITY

Be Prepared!

Think about how you might prepare for an earthquake in your own home.

What to Do

Consider what changes might be necessary i your bedroom to prevent you from being injured if an earthquake happened while you were sleeping. For example, are there shelve with heavy objects at the top?

Think about the items you might need in an emergency kit after an earthquake. How lon might you need them? Where could you sto your emergency kit?

Make a list of changes to your bedroom an another list of items for your emergency kit. Compare your lists with

Earth Crust - (Pt 5 Earthquakes)

Figure 11.12 The building on the left is in the process of falling over during an earthquake in Mexico. The sediment underneath it is acting like quicksand.

Figure 11.13 Some earthquakes happen under the sea, causing huge waves called tsunamis. Tsunamis are common along Japan's coastline. This painting by artist Katsushika Hokusai shows a huge ocean wave near Japan, with Mount Fuji in the background. Tsunami is a Japanese word meaning "harbour wave."

Liquefaction

One of the most damaging earthquakes happened about 350 km east of Mexico City in 1985. When the shock waves reached the city, their size was increased by the soft sediments of the ancient lake bed on which the city is built. The sandy base turned into quicksand, and many buildings fell over (see Figure 11.12). The process of changing into a liquid-like substance such as quicksand is called **liquefaction**. The official number of deaths caused by this earthquake was over 5000.

INTERNET CONNECT

www.school.mcgrawhill.ca/resources/

Find out about the tsunami that struck Port Alberni, B.C., in March 1964 by going to the above web site. Go to **Science Resources**, then to **SCIENCEPOWER 7** t know where to go next. Write a short story, a poem such as a haiku, or a script, as though you were one of the people whose account you have just read.

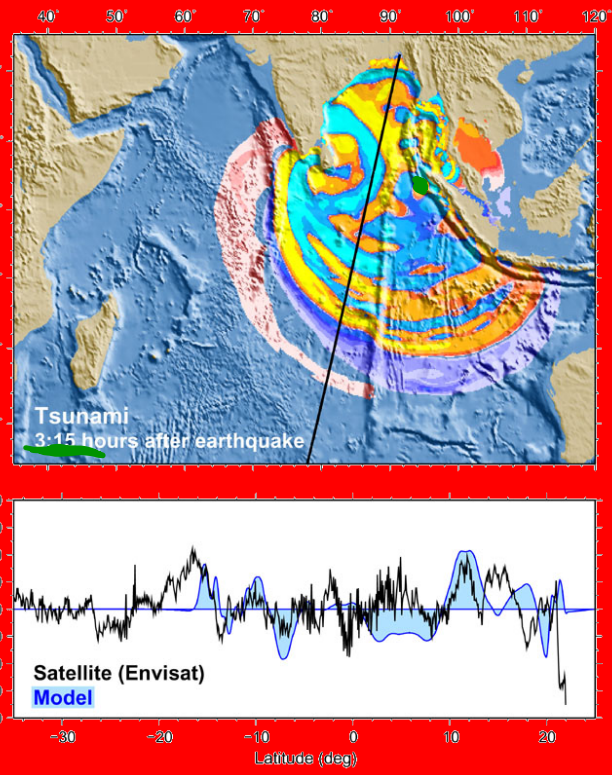
Check Your Understanding

1. (a) Name the instrument that *measures* earthquakes, and explain how it works.
   (b) Name an instrument that *detects* earthquakes, and explain how it works.
2. Explain why three seismographs are required to locate an epicentre.
3. Where do earthquakes usually occur in Canada?
4. Imagine waking up in the middle of the night to find an earthquake occurring. When the shaking stops, you get out of bed to check on the rest of your family. Everyone is fine, but you notice cracks in the walls of your home. Should you stay inside or leave? Explain.
5. **Thinking Critically** What kinds of structures might suffer the least damage during an earthquake? Write your ideas, and then share them with a classmate. Check your ideas by looking at books or using the Internet.

Earth Crust - (Pt 5 Earthquakes)

Tsunami and Liquification

https://www.youtube.com/watch?v=OQ3oXIjPmaE



Liquification - means turning into liquids - like quicksand

https://www.youtube.com/watch?v=Z-2khcTHIgs

https://www.youtube.com/watch?v=4d-EYIZAqXc