MEGA MOLECULES

If I am a seismologist…
I measure the vibrations on the Earth's surface
to find the location of earthquakes.

Experiment 9
Earthquake

You will need the measuring tape (G), spring (J), and a phone with a stopwatch.

Things To Know:

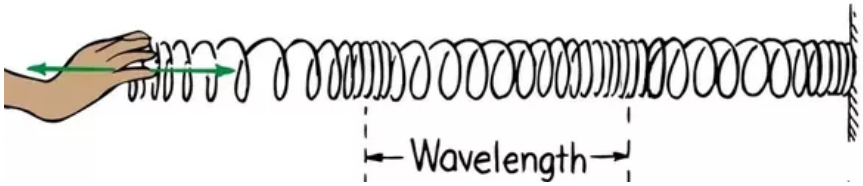
Earthquakes occur along faults and produce seismic waves that radiate out in all directions from the original location. Seismic waves are waves of energy that travel within the earth or along its surface. Seismometers are instruments that measure the motion of the ground caused by seismic waves. There are three basic types of seismic waves: P waves, S waves, and surface waves. P waves are known as primary waves because they are the fastest of the earthquake waves, arriving first at distant points. The vibrating materials move back and forth along the same direction in which the wave is traveling. S-waves, secondary waves, are transverse waves. Transverse waves move side to side. Transverse waves can move through solid rock, but cannot move through liquid or gas. Surface waves move slower than the other two types of waves and cause most of the damage during an earthquake.

What To Do:

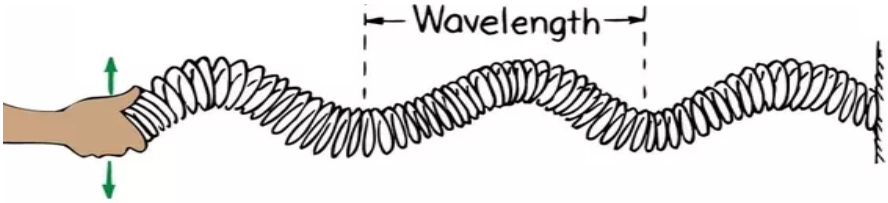
1. The spring will simulate seismic waves passing through the Earth. Lay the spring on the floor. Stretch the spring about 1 meter. (Caution: A stretched spring has potential energy and can cause injury if you or your partner suddenly let go of the spring. Hold tightly to the

spring. Do not stretch the spring more than the length of the measuring tape, 1.5 m)

2. Make a P-wave by pushing your hand forward and then pulling your hand backward. Notice that a wave travels along the spring from you to your partner and back again.



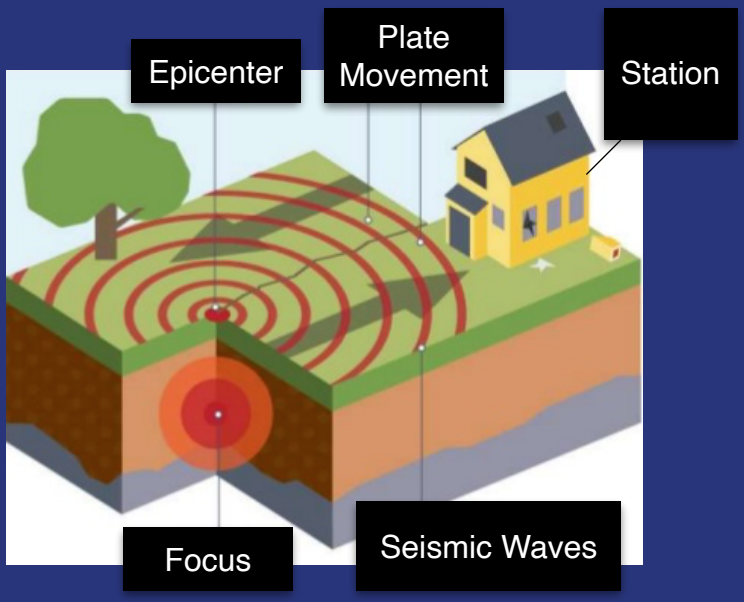
3. Make a S-wave by moving your hand from side to side.



The Epicenter!

The earthquake's epicenter is a point on the earth's surface directly above the location of the focus where plate movement begins and seismic waves radiate outward in all directions.

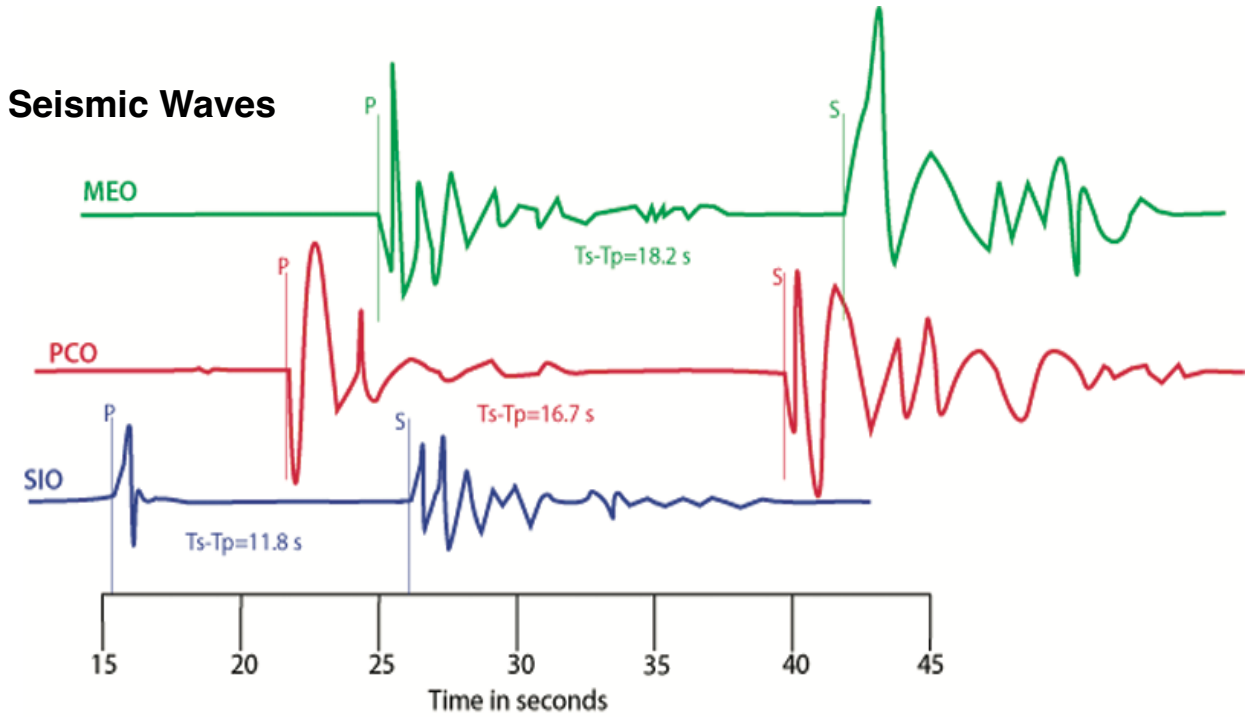
Seismologists use the time interval between the arrival of the P and S waves (the S-P interval) on the seismograms from at least three different stations to locate the epicenter of the earthquake.



4. The graph below shows the seismic waves produced by an Oklahoma earthquake as recorded by three separate seismograph stations. You can locate the seismograph stations on the Map of Oklahoma on the following page.

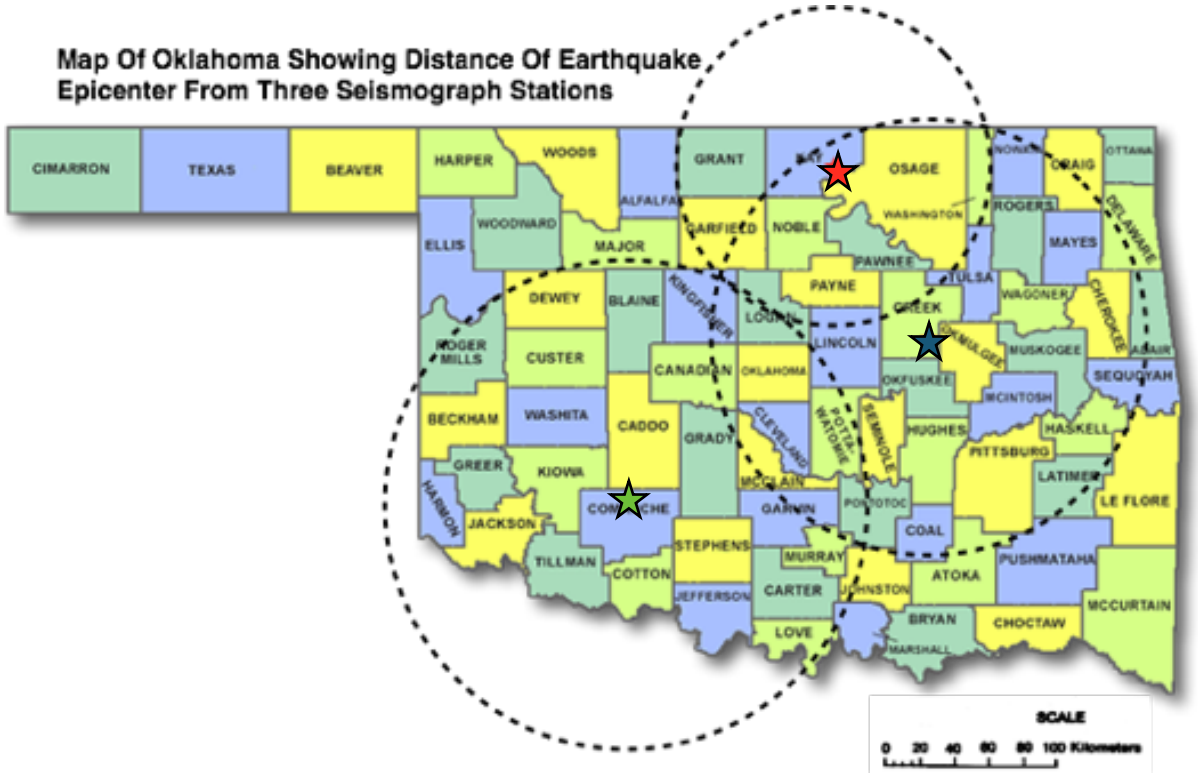
★MEO, Meers Seismograph Station in Commanche County, Oklahoma
★PCO, Ponca City Seismograph Station in Kay County, Oklahoma
★SLO, Slick Seismograph Station in Creek County, Oklahoma

The amplitude of a wave is the height of the wave measured from the original straight line. A wave with more energy has a higher amplitude. The seismograph station with the greatest amplitude is closest to the epicenter of the earthquake. Answer questions #1-3 on the student sheet.



5. You can use the differences between the arrival times of the S and P waves (T_s-T_p) to find out how far the earthquake is from a seismograph station. A number of factors affect the speed of earthquake waves. To find the distances for this earthquake, multiply the T_s-T_p time interval by 8.0 kilometers per second, abbreviated km/s. Complete the table on the student sheet.

6. The radius of each circle on the map of Oklahoma below represents the distances you calculated. The location where all three circles overlap (or nearly overlap) is the location where the earthquake occurred. Record the location of the epicenter of the earthquake.



Challenge: The speed of P and S waves is related to the density of the rock through which they travel. As the porosity of the rock increases, the speed decreases. For example, a S wave travels about 3.0 km/s in granite and about 1.3 km/s in sandstone. Perform an experiment to change the speed of a single wave pulse on the spring. Remember to lay the spring on the floor. Stretch the spring 0.5 m, 1.0 m, and 1.5 m. Do not stretch the spring more than the length of the measuring tape, 1.5 meters. When does the wave appear to move the fastest?

Top View

MEGA MOLECULES

Name _____ Date _____

Experiment 9: Earthquake

1. What is a seismic wave?

2. Describe the similarities and differences between a P-wave and a S-wave on the spring.

3. Which seismograph station is closest to the epicenter of the earthquake?

4. To find the distances for this earthquake, multiply the Ts-Tp time interval by 8.0 km/s. Write the distances in the table below.

Station	Location	Ts-Tp seconds (s)	Distance kilometers (km)
MEO ★ Meers Seismograph Station	Comanche County, OK	18.2	
PCO ★ Ponca City Seismograph Station	Kay County, OK	16.7	
SIO ★ Slick Seismograph Station	Creek County, OK	11.8	

5. Use the map of Oklahoma below to determine the county where the epicenter of the earthquake was located?