Unit: Dynamic Earth/Plate Tectonics: Earthquakes

Name: Key Block:

**How is an earthquake generated?**

1.) As plates collide, diverge, or scrape past one another, Stress builds up within the crust.

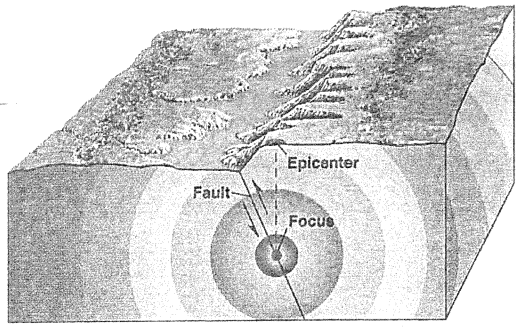
2.) Eventually, the rock cannot stretch any further, and breaks or slips along a fault.

3.) The shock of the slip within the crust releases energy in the form of Seismic Waves.

**Terminology:**

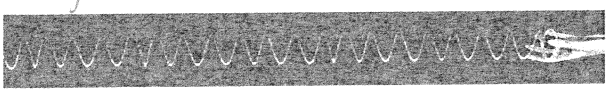
A.) Focus: The point of slip/rupture away from fault

B.) Epicenter: The point on the earth's surface directly above the focus




**Types of Seismic Waves:**

1.) P-Waves (primary): Arrive first and are compression or "push/pull" waves. They travel the fastest and through all mediums (Solid + liquid)



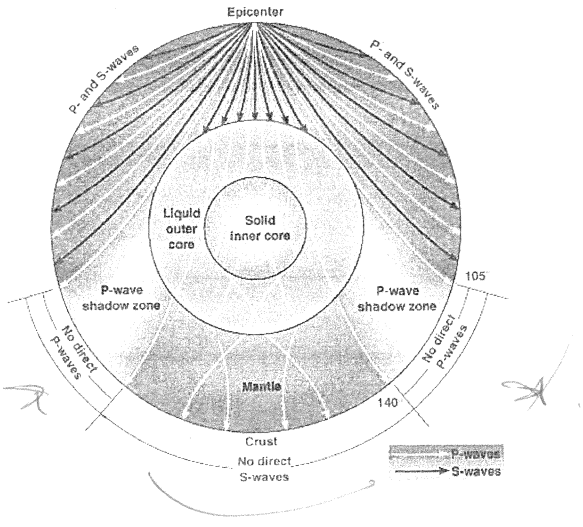
2.) S- Waves (secondary): Arrive second and are transverse, moving side to side like a wave in a rope and only through Solid layers.

**Shadow Zones:**

P waves will travel through all layers of the earth, but refract when entering different substances. The bending of P-waves when they reach the core causes a P-wave Shadow zone.

S-Waves will not travel through the Outer Core at all causing a larger S-Wave shadow zone.

This means that seismic stations at these locations will not record the seismic waves given off by the earthquake.




**Using the Reference table to determine travel times of P and S waves**

Looking at pg 11 of the Reference table, we can determine how long it will take P and S waves to reach a seismic station at a given distance from an epicenter.

The Relationship using pg. 11: Which could color? A squiggle B squiggle

1.) As the distance from the epicenter increases, the travel time of both the P and S waves increases.

2.) As the distance from the epicenter increases, the lag time, or "S-P time interval," will also increase. This is because both waves do not travel at the same speed. (Think of this like the mile run. Everyone starts at the same time and at the same point, but as time progresses, everyone will get further away from one another as we travel at different speeds).

Example Problems:

1.) How long will it take a P and S wave to reach a seismic station 4,200 km (4.2 x 10^3) away from the epicenter?
   a. P wave: 7 min 20 (s)
   b. S Wave: 13 min 10 (s)
   c. What is the lag-time, or S-P time interval between them? *(Use a scrap piece of paper to mark the time interval between them, then drag down to the corner of the Y-axis to get the time interval. You can also find this by subtracting the P travel time from the S travel time)*

$$\begin{array}{r} 13:10 \\ -\ 7:20 \\ \hline 5:50 \end{array}$$ 5 min, 50 (s).

2.) How long will it take a P and S wave to reach a seismic station 7,600 km away from the epicenter?
   a. P wave: 11:00 (11 min 00 s)
   b. S Wave: 20:00
   c. What is the lag-time, or S-P interval between them?

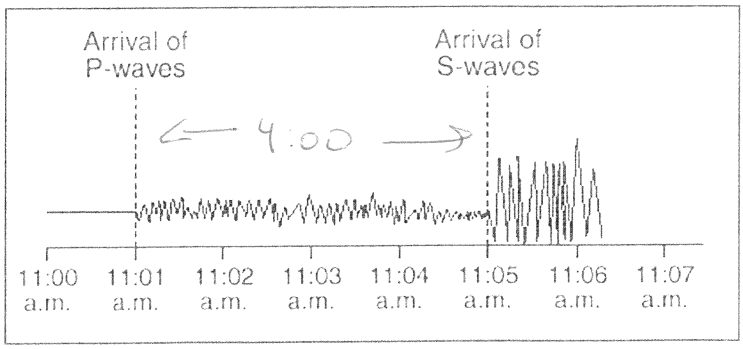
$= 9:00$

time difference between P + S wave = S - P

**Reading a Seismogram**

A seismogram is an image produced by a seismograph which records the arrival and intensity of seismic waves.

**The higher the amplitude of the waves, the stronger the earthquake is.**




Find the **S-P time interval/lag time** using the seismograph depicted to the right (Subtract S-P arrival times!)

$$S\text{-}P = \begin{array}{r} 11:05:00 \\ -\ 11:01:00 \end{array} = 4:00$$

To find the distance to the epicenter:

1.) Find the S-P time interval using the seismogram given.
2.) Mark the S-P time interval on a scrap sheet of paper using the y-axis on pg. 11 of the ESRT
3.) Drag your marked interval between the P and S waves until it matches exactly to where the P and S wave curves are at that given interval. (Always remember to drag your paper to the right as you slide it between waves)
4.) Read the x-axis to get the distance to the epicenter at that location!
   What is the distance to the epicenter for the seismic station above? 2,600 km.