

Tutorial video: <https://www.youtube.com/watch?v=GcqSj43evE0>

**EXAMINING SEISMOGRAMS**

There are three basic types of seismic waves generated by earthquakes: P-waves, S-waves, and Surface waves. P and S-waves are body waves and travel through the interior of the Earth. P-waves have the greatest velocity and reach the seismic station first. S-waves arrive at the seismic station after the P-waves. The amount of time that passes between the P-wave arrival and the S-wave arrival is important in helping seismologists determine the epicenter of the earthquake.

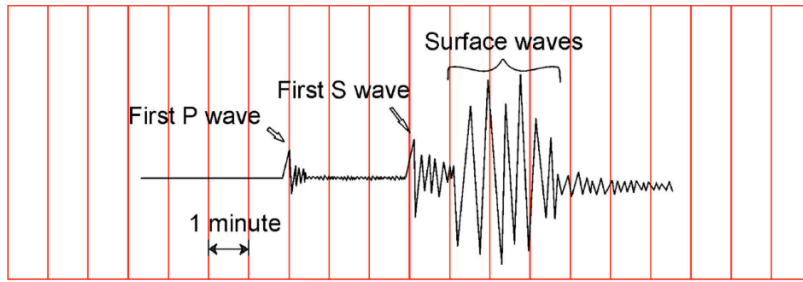
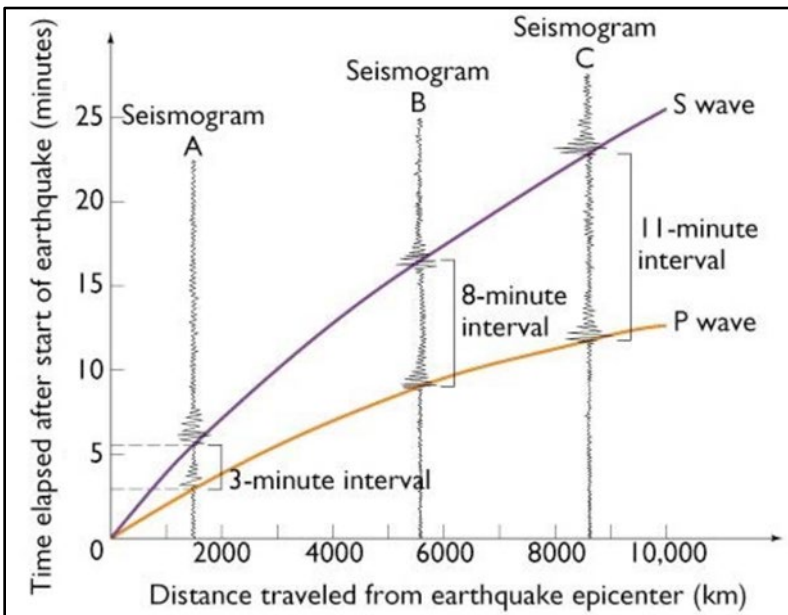


Figure 1. A typical seismogram

1. Looking at the seismogram above, which wave type would do the most damage?
2. Which seismic waves are the fastest? Slowest? (2pts)
3. What was the difference in arrival time between the first P wave and the first S wave?

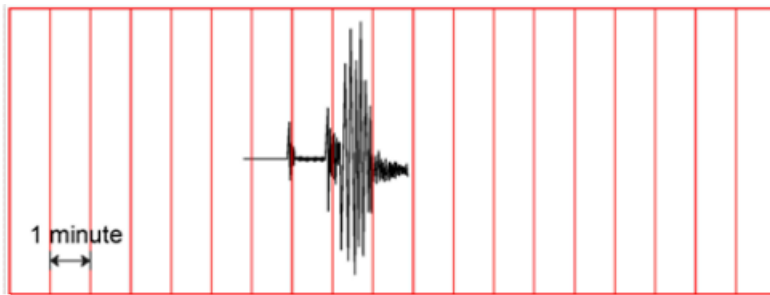
Today we will be using a travel-time graph, where the vertical separation between the P and S curves is equal to the difference in the arrival times between the P-wave and S-wave. The travel time graph is below with seismograms inserted.



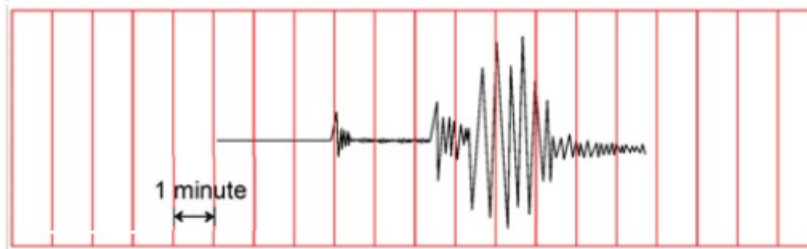
**Seismogram A was recorded in San Jose  
Seismogram B was recorded in Anaheim  
Seismogram C was recorded in Bakersfield**

4. Which city experienced the earthquake waves first? \_\_\_\_\_
5. Which city had the earthquake last? \_\_\_\_\_
6. Which city had the biggest wait between the P waves and the S waves? \_\_\_\_\_
7. How far was San Jose from the epicenter? \_\_\_\_\_

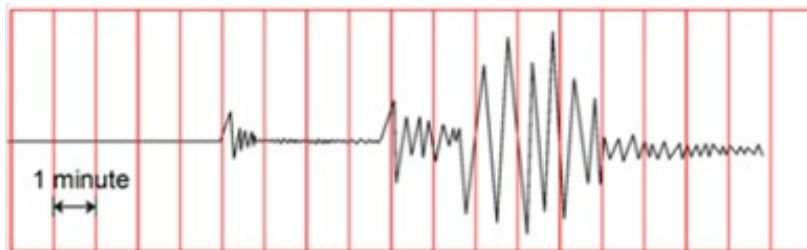
8. **FILL IN:** The farther away the epicenter is, the \_\_\_\_\_ the P and S waves are. The closer you are to the \_\_\_\_\_, the closer the P and S waves are. (2pts)




Station a: St. Louis, Missouri



Station b: Houston, Texas



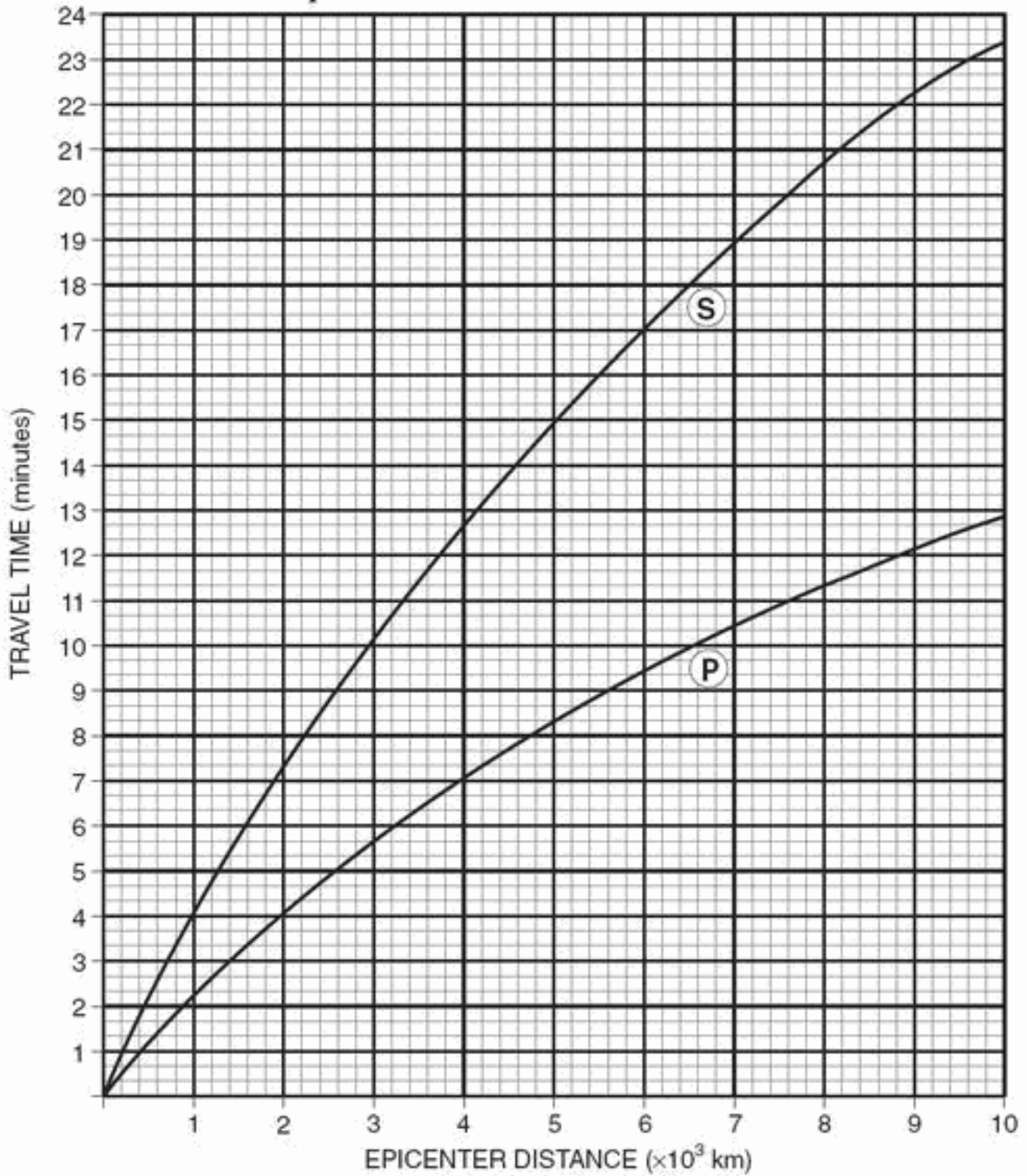
Station c: Los Angeles, California

Study the seismographs above  then fill in the data chart and answer the questions.

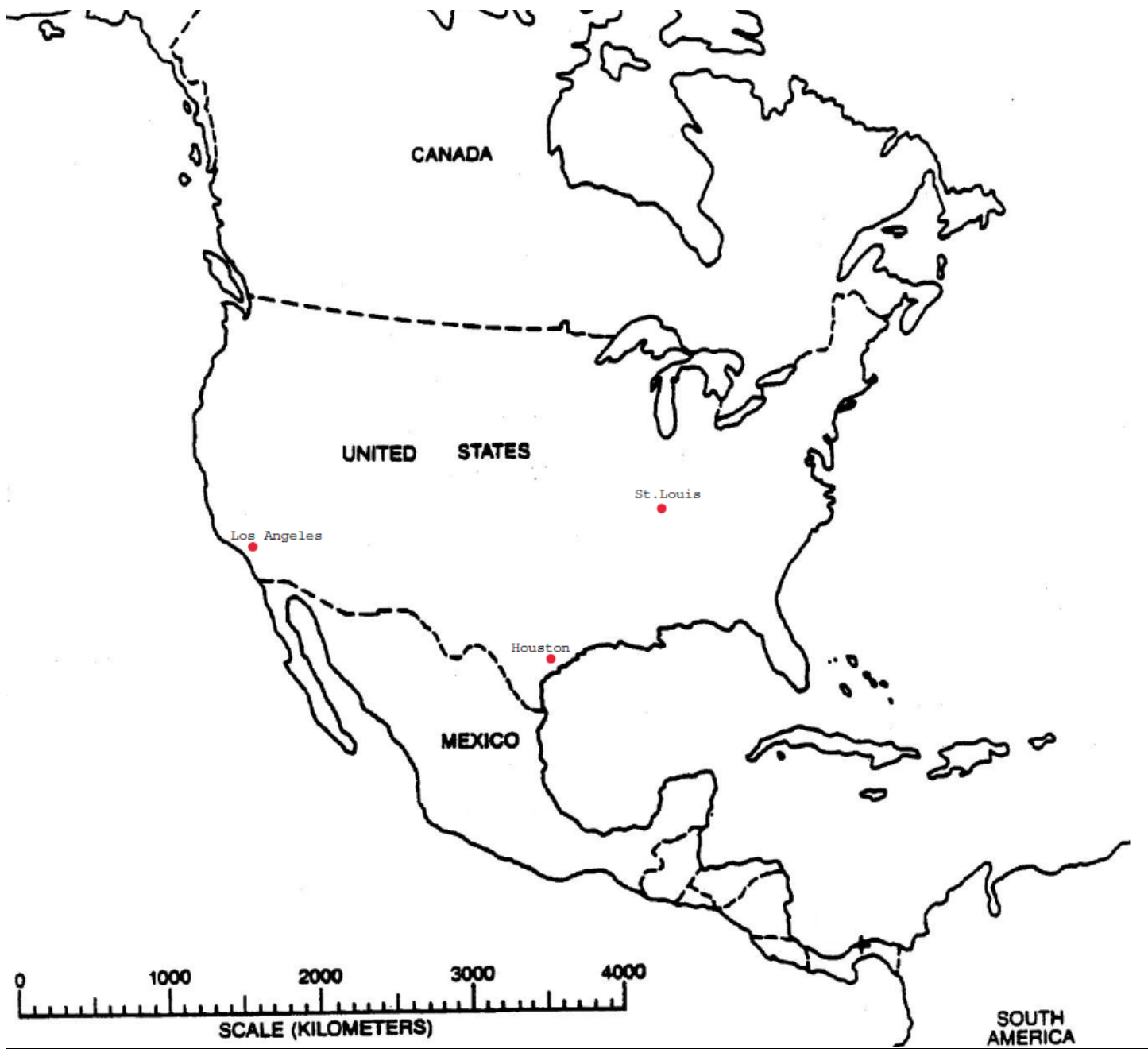
<b>EPICENTER DATA TABLE</b>			
	<b>Los Angeles, CA</b>	<b>St. Louis, MO</b>	<b>Houston, TX</b>
Elapsed time between first P and S waves (round to the nearest whole or ½ minute if necessary)			
Distance from the epicenter in kilometers (this is determined by using the travel time graph on page 3 of this lab)			

To accurately locate an earthquake's epicenter, records from three seismographs are necessary. You are now going to use a compass to draw circles around the cities on the map on page 4. (3pts) The circle represents all the places the earthquake might have occurred. Once you have drawn 3 circles, you will have identified the epicenter. Place a star at the location of the epicenter and label it "epicenter." (1pt)

## Earthquake P-wave and S-wave Travel Time



\*Each box on the Y axis represents 20 seconds. Each box on the X axis represents 200 miles.



**ANALYSIS QUESTIONS:**

9. Did all three of the circles drawn overlap in one spot? \_\_\_\_\_
10. Which of the 3 locations was the earthquake closest to? \_\_\_\_\_
11. Let's say that the seismic station in Los Angeles was malfunctioning. How could a scientist determine the exact location of the earthquake?  
\_\_\_\_\_

*Use the travel time chart on page 3 to answer the rest of the questions*

12. S wave travel time is 4 minutes. How far did the seismic wave travel during this time period?  
\_\_\_\_\_
13. How long does it take a P wave to travel 4000 kilometers? \_\_\_\_\_
14. How far does an S wave travel in 15 minutes and 20 seconds? \_\_\_\_\_
15. If an earthquake's P wave travels 2000 kilometers and arrives at a seismic station at 12:08, what is the origin time of the earthquake? (when did the earthquake start?) \_\_\_\_\_
16. If an Earthquake's P wave travels 4000 kilometers and arrives at 1:00pm. When will the first S wave arrive? \_\_\_\_\_

*Use a sticky note to do the "wedge method" on the next couple of questions.*

P arrival= 3:00 S arrival=3:03 and 20 seconds later

17. What is the lag time? \_\_\_\_\_
18. How far away is the epicenter? \_\_\_\_\_

P arrival= 2:21 S arrival=2:30

19. What is the lag time? \_\_\_\_\_
20. How far away is the epicenter? \_\_\_\_\_