Locating the Epicenter of an Earthquake

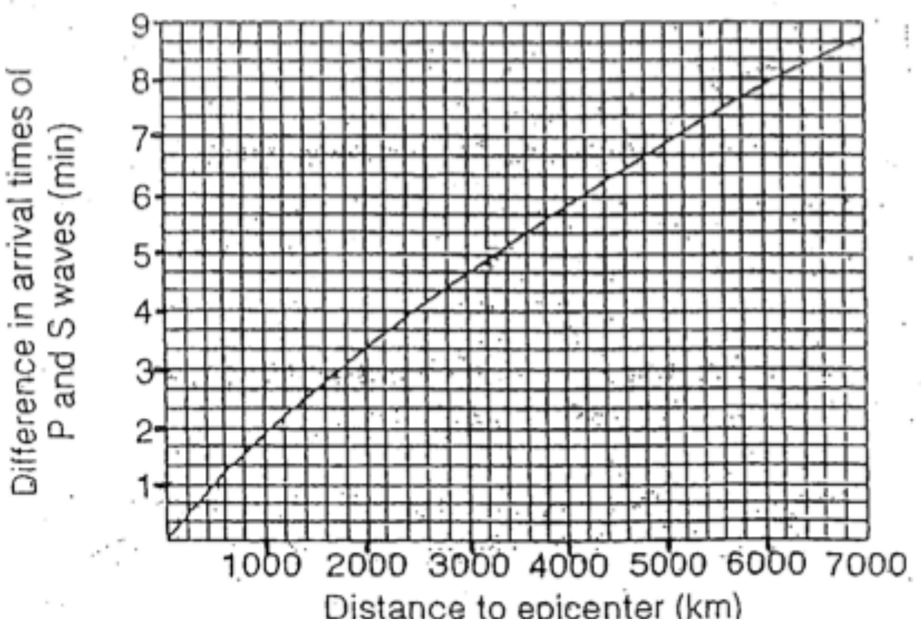
Name: ___________________________

Objective: In this investigation, you will find the location of an earthquake's epicenter by applying a method similar to the one that scientists use.

Background: The **magnitude** of an earthquake is measured by the amount of energy released during an earthquake. The **Richter scale** was invented in the 1930's by Dr. Charles Richter. Think of a seismograph as a kind of sensitive pendulum that records the shaking of the earth. The Richter scale is open-ended, meaning there is no limit to how small or large an earthquake might be. The **epicenter** of an earthquake is usually determined by examining **seismograms** from at least 3 recording stations. From these records, the distance from the epicenter of the earthquake to each of the recording stations can be determined. Circles drawn on a map from each of the seismic stations are then used to locate the epicenter.

Procedure:

1. Use the graph below to complete the following the data table that displays data taken from 3 seismic stations.

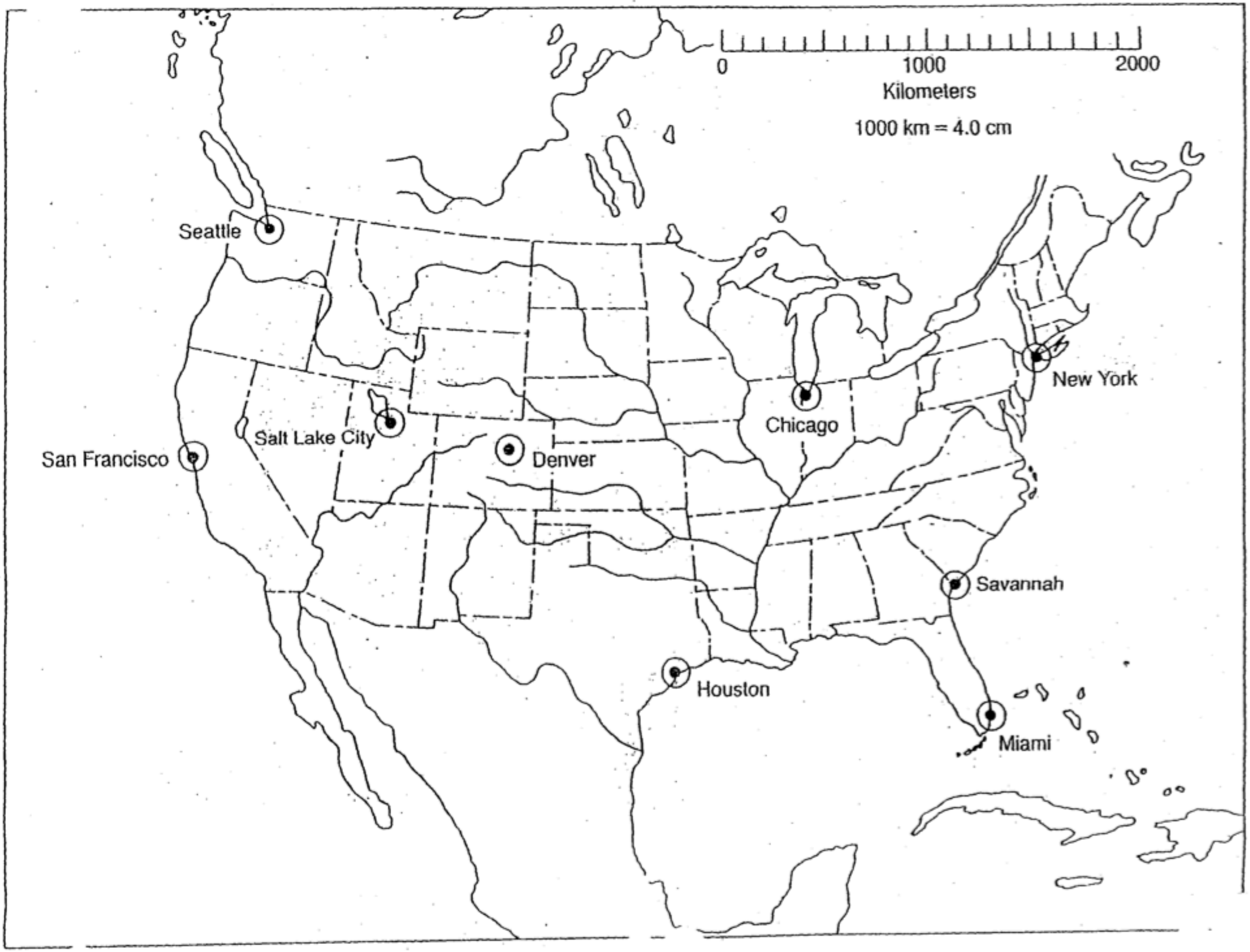


Earthquake 1

	First P Arrival	First S Arrival	Difference in P and S Wave Arrival Times	Distance to Epicenter	P-wave Travel Time	Time of Earthquake
Houston	12:30:15	12:34:15				
Denver	12:30:20	12:32:50				
Seattle	12:31:00	12:33:10				

time of earthquake = arrival time of the first P-wave minus the P-wave travel time

2. Using the distance to epicenter information above, the map & map scale, plot the location of the earthquake. This can be done by drawing circles with the appropriate radius around the cities of record and identifying where the circles intersect. This one intersection will be the location of the epicenter.


0
1000
2000
Kilometers
1000 km = 4.0 cm
Seattle
San Francisco
Salt Lake City
Denver
Chicago
New York
Savannah
Houston
Miami

3. The figure below shows seismograph records made in 3 cities following an earthquake. The traces begin at the left and arrows indicate the arrival of the P waves. Use the time scale provided to find the **lag time** between the P waves and S waves for each city.

Figure 6.2

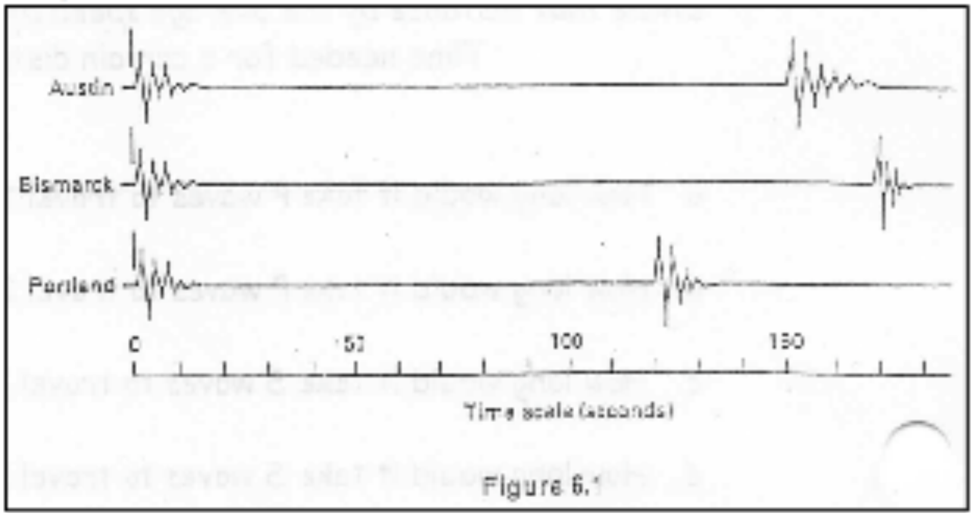


Table 6.1 Epicenter Distances

City	Lag time (seconds)	Distance from city to epicenter
Austin		
Bismarck		
Portland		

Figure 6.1

4. Use the information in the data chart to draw the 3 circles necessary to locate the epicenter of the earthquake on the map to the right.

Conclusion Questions:

1. Describe several differences between P and S waves.

2. What city was closest to the epicenter using the Denver, Houston, and Seattle data?

3. Which of the three cities in the data table would have been aware of the earthquake first?

4. Which city was closest to the epicenter using the Austin, Bismarck, and Portland data?

5. Why is it necessary to have data from at least three recording stations?

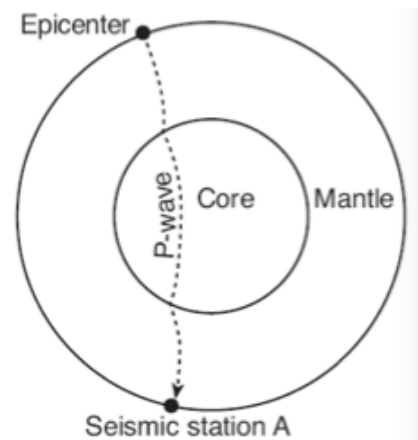
6. Use the US map and the time travel graph from the first data set to answer the following question. Suppose the epicenter of an earthquake is located in San Francisco. What will be the difference in arrival times of P and S waves recorded in New York City? (hint: you will need to know the distance between the two cities)

7. As the distance between an observer and an earthquake decreases, what happens to the difference in arrival times between P and S waves?

8. Why are earthquakes more common on the west coast of the United States than on the east coast?

9. List TWO actions that a homeowner could take to prepare the home or family for the next earthquake.

10. The cross section of Earth at the right shows a P-wave moving away from an earthquake epicenter to sesmic station A. No S-waves arrive directly at seismic station A because
   A. some parts of the core are liquid
   B. S-waves travel too slowly
   C. the distance to seismic station A is too great
   D. seismic station A is located on glacial ice



11. Use the diagram of shadow zones below to EXPLAIN each of the different zones and WHY they occur.