Investigating Earth's Interior

As discussed in class, not all seismic waves travel in the same way. P-waves are compressional waves, and as a result they can travel through any type of matter. But, s-waves are transverse waves. Because of this, s-waves can only travel through solids. Liquids and gases block s-waves. When an earthquake occurs, it's common for the waves to be blocked in certain places. Seismologists call the area of blocked waves a **shadow zone**.

This activity uses that idea! It should help you understand how scientists are able to make conclusions about what lies hundreds or even thousands of miles below our feet.

READ ALL the instructions as you go! They should tell you everything you need to know.

Monitoring Stations

Scientists never work alone. In this activity, you are teamed up with seismologists all around the world to analyze the arrival of seismic waves.

1. Tear off the second page with the model Earth on it and put your name on that sheet.
2. On your blank model Earth, mark and label each of the following seismic monitoring stations. You will be using data from these stations to learn about the inside of the Earth. Station A has already been marked for you at 15°.

A: 15°	B: 40°	C: 80°	D: 115°	E: 145°	F: 160°
G: 195°	H: 225°	I: 265°	J: 300°	K: 315°	L: 340°

S-Wave Data

Your seimologist friends have been monitoring earthquakes and keeping track of what kinds of wave they receive. The rows on this table represent earthquakes they've studied. The epicenters have already been found using the triangulation technique. For each quake, the stations have reported if they detected any s-waves.

- "✓" means they were able to detect s-waves from the earthquake.
- A blank box means they did not detect s-waves. That station is in the quake's shadow zone.

Quake Number	Epicenter Position	Monitoring Station											
		A	B	C	D	E	F	G	H	I	J	K	L
1	185°			✓	✓	✓	✓	✓	✓	✓			
2	90°	✓	✓	✓	✓	✓	✓	✓					✓
3	50°	✓	✓	✓	✓	✓	✓				✓	✓	✓
4	210°				✓	✓	✓	✓	✓	✓	✓	✓	
5	155°			✓	✓	✓	✓	✓	✓	✓			
6	290°	✓	✓					✓	✓	✓	✓	✓	✓
7	230°				✓	✓	✓	✓	✓	✓	✓	✓	✓
8	10°	✓	✓	✓	✓					✓	✓	✓	✓

3. For each earthquake, mark and label the epicenter on your Earth model. The epicenter for Quake 1 is already marked for you at 185°.

4. For every earthquake in the table, draw a straight line from the epicenter to each station that detected s-waves from the quake. FOR EXAMPLE: On the Quake 1 line, s-waves were detected by stations C, D, E, F, G, H, and I. So you should draw straight lines from Quake 1 to those stations.

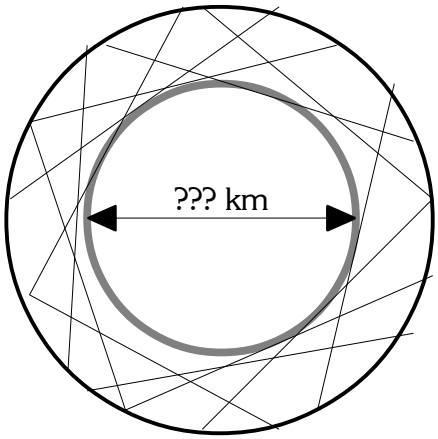
Interpreting the results

Once you've drawn in all the lines for all the quakes, your model might look a bit messy. But hopefully there's a clean area where no s-waves were able to travel.

5. Draw as large of a circle as you can in the blank area of your model Earth. This represents an underground layer of our planet that is a liquid instead of a solid. Hopefully your picture looks a little like the one below.

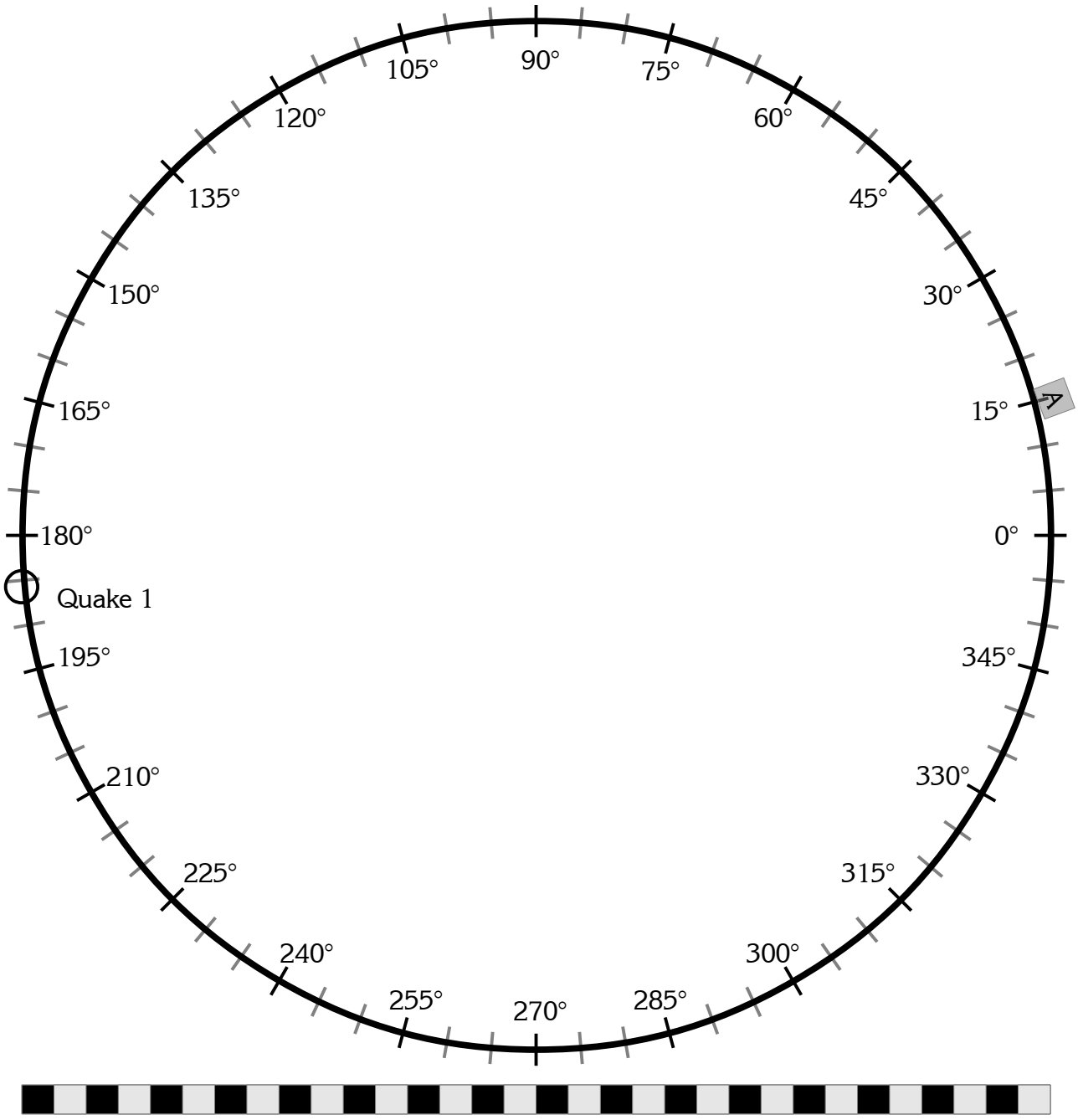
6. Use the scale on your model to make a guess at the size of this liquid section. Measure the whole way across it from one side to the other, then draw an arrow and write in the size like in the example picture below.

7. Finally, turn over your model Earth sheet and answer the questions there!



Name: _____ Period: _____ Date: _____

Model Earth



Scale: Each block on this scale represents 400 km.

<u>Turn over for the questions!!</u>

Questions

8. Take another look at your model and the scale. How many km across is the whole Earth?

9. You've discovered that there is a liquid section of the Earth deep underground. How far down from the surface (the edge of your model) would you have to dig to reach this liquid section?

10. The state of Ohio is 355 km across, but the hole you would need to dig is a lot further than that. How many times bigger than Ohio is your hole going to be?

11. The deepest hole in the world is the Kola Superdeep Borehole in northwestern Russia. The hole is only 9 inches wide, but during the 1970s and 80s, scientists there drilled to a depth of about 12.25 km. (They had to stop because the temperature at the bottom was hot enough to destroy their drill.) To reach the liquid section of the Earth, how many Kola Superdeep Boreholes would you need to pile on top of each other?

12. Transverse waves like s-waves stop as soon as they hit a liquid. Can s-waves tell you what lies DEEPER in the Earth than this liquid section? (Hint: Try making an analogy... light waves are stopped by opaque objects. Can light waves tell you what lies INSIDE an opaque object?)

13. Do you have any guesses about what kind of liquid might be down there?