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Speedy Waves

Mechanical waves (waves that need a medium/matter to travel through) pass through some substances more easily than others. Both sound and earthquakes travel through mechanical waves; P-waves and sound are both longitudinal/compressional waves where the particles hit each other like dominoes, sending the energy through them. Gases, such as air, are rather poor wave transmitters when compared with liquids and solids. Did you know in solid rock, P-waves travel about 5 miles per second!? However, on the west coast of the US where the ground is not as solid that the speed decreases to about 2.8 miles per second? Did you know that sound will travel through water about 4x faster than it travels through air? Did you know that sound travels through steel about 15x faster than it does through air? Today you will compare some substances and rank how they transmit sound, connecting the waves concepts we've learned so far with some new ideas about the Earth.

Part 1 – What do you know about waves?

1. If sound and seismic waves are mechanical waves, what do they need to travel? What kind of energy do they use?

2. What is the vocabulary word that means "the matter a wave travels through?"

3. What are some different ways that waves can travel?

Type of Wave	Describe/Draw an example
Longitudinal/ Compression	
Transverse	* *also, label a wavelength and the amplitude of a transverse wave*

4. What is a way you can remember the difference between these?

Type of Wave	How to remember
Longitudinal/ Compression	
Transverse	

5. How do waves behave?

Wave Behavior	Definition	Example/Sketch
Reflection		
Refraction		

Part 2 – Tuning Forks

You will be using tuning forks, which are specially engineered metal tools to hear specific pitches of sound. Remember that sound is a longitudinal/compressional wave where particles hit each other like dominoes to transfer the energy.

Gas versus Solid

1. Using the **rubber mallet,** hit the tuning fork on one of the prongs. Don't hit it too hard but make sure you hit it enough to vibrate.

2. Keep the tuning fork about 30 centimeters from your ear. Describe the sound.

3. Now put the tuning fork closer to your ear. Describe the sound.

4. Why do you think the tuning fork sounded so differently in step 3 compared to step 2? (hint: think about longitudinal mechanical waves in your answer)

5. Repeat step 2, then, put the bottom of the tuning fork on the table at that same distance WITHOUT touching the prongs and put your ear on the table. Describe the difference.

6. Why did the table sound different than the air?

7. Sketch the atoms to show the relative densities for the table and air.

table  **air** 

8. Explain how you think this concept would affect the speed of earthquake waves if they were to travel from rocky land to liquid. (*hint: which is more dense*?)

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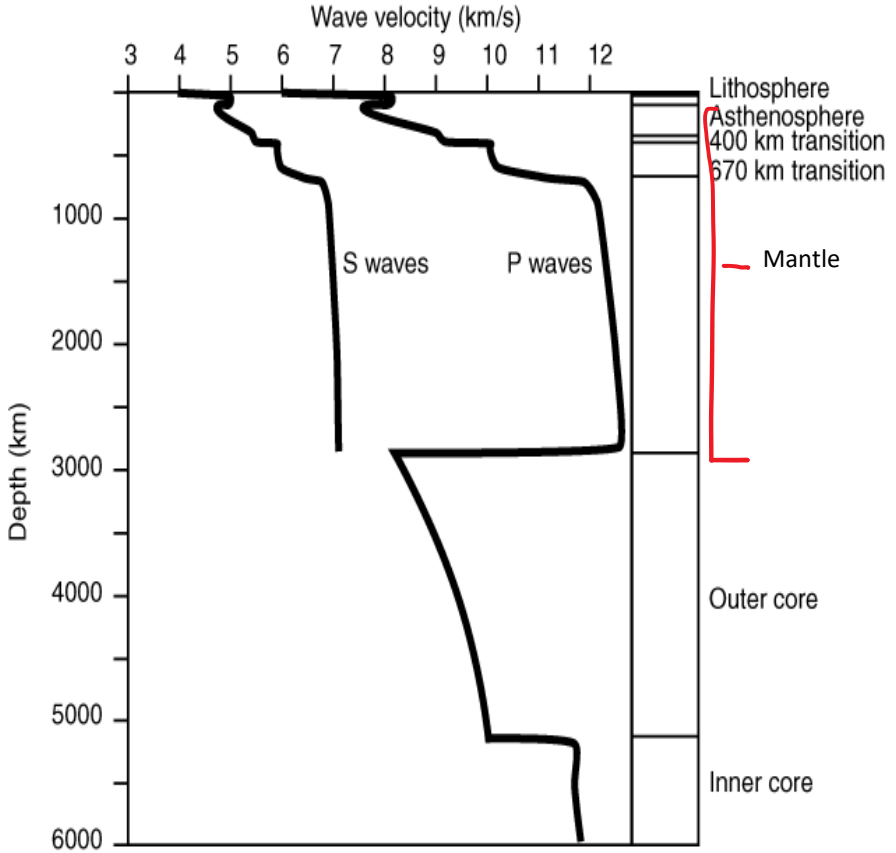
Extending Lab Ideas

1. Summarize the relationship between density of a medium and the speed at which waves travel through it.

Use the graph to answer the following questions:



2a. Which layer is the closest to Earth's surface?

2b. Which is the farthest from Earth's surface?

3. In general, what happens to the velocity/speed of the P- and S-waves from the lithosphere as they travel from the surface of the Earth to a depth of 3000 km?

4. What happens to the S-waves at 3000 km? Why do you think this is?

5. What happens to the P-waves at 3000 km?

6. The velocity of the P-waves gets faster as the waves travel through the outer core and then the velocity jumps to an even faster speed as it enters the inner core. What does this tell you about the density of the layers as they get closer to the center of the Earth?

7. Summarize what state of matter the following layers are, based on the data from the graph.

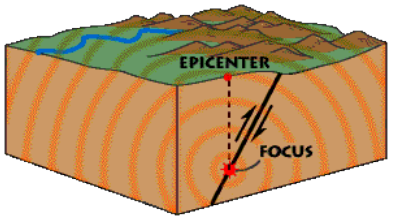
Inner core:
Outer core:

So, What Are These Earthquake Waves Anyway?...

First, the earthquake occurs because tectonic plates move past each other and release energy doing so, creating **seismic waves**.

Focus –

Epicenter –



Then, the energy propagates/radiates/transfers as seismic waves of different types

Body Waves are the seismic waves that travel inside of the Earth

P-waves (primary/pressure waves)

When do they leave the earthquake?

What type of wave are they (longitudinal, transverse, etc.?)

Other info?

S-waves (secondary/shear waves)

When do they leave the earthquake?

What type of wave are they (longitudinal, transverse, etc.?)

Other info?

Surface Waves come next and they are seismic waves that travel on the surface of Earth

When do they leave the earthquake?

What type of wave are they (longitudinal, transverse, etc.?)

Other info?

Sketch some paths of the 3 types of waves through Earth with labels: