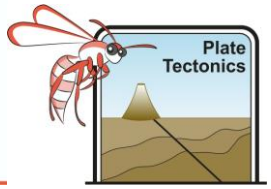
Body Waves (S&P) - Student Activities



Seismic waves are energy waves released during earthquakes. Stress released during tectonic movement builds up until it overcomes limiting friction and is released as a seismic wave. When seismic waves pass through rock, particles are moved to release stress. These shock waves travel in all directions away from the source and are impeded and deflected by the materials they travel through.

There are two kinds of seismic waves:

1. **BODY WAVES (S&P)** are waves that travel through the body of the Earth.

   P waves are compressions that pulse through rock. In most earthquakes the P waves are the first to be felt. Often there is an accompanying sonic boom.

   S waves are also known as secondary, shake or transverse waves. These are transmitted by a sideways or up and down movement. S waves usually arrive a few seconds later than the P waves. They rattle and shake the ground vertically and horizontally but cannot travel through liquids.
   http://www.pbs.org/wnet/savageearth/animations/earthquakes/main.html

2. There are also **surface waves** (Love waves (L) and Rayleigh waves (R)). These travel across the surface of the planet lifting and dropping the earth like ripples across a pond and cause major damage to humans and their property.

For animations of these wave forms visit:
http://www.pbs.org/wnet/savageearth/animations/earthquakes/main.html

AIM **To demonstrate the difference between S and P body waves**

Materials

- Three students
- A piece of chalk or masking tape to mark positions
- A measuring tape or metre ruler
- A long slinkie
- A piece of rope or cord the same length as the partially extended slinkie
- A stopwatch or accurate timepiece

Part A The P wave. COMPRESSION OR PRIMARY WAVES

P waves are compressions that are transmitted through solids, liquids and gasses. P waves are the result of a zone of compressed waves being transferred along the direction of wave travel.
P waves are called primary waves because they are the first to arrive after an earthquake.

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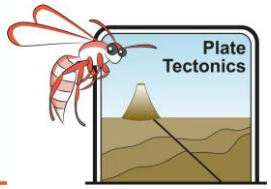

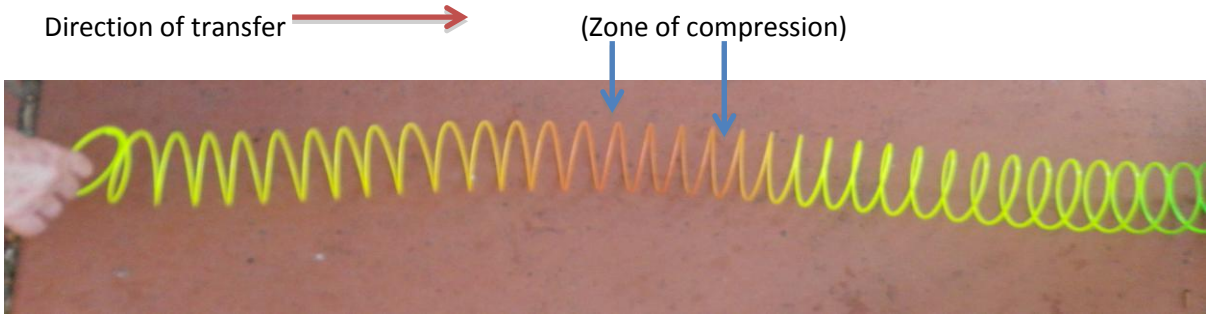

Scientists often trial experiments before formal testing to find out which variables have not been controlled and to work out how the experiment can be improved. These are sometimes called “trial runs” or “dummy” runs.

Trial Run - You will be working in groups of three

1. Bunch a few coils of the slinkie in one student’s hand at one end and let another student extend the slinky.
2. Mark the position of the ends with chalk or masking tape.
3. Measure the length of the slinky
4. Release the bunched coils and observe.
5. Measure the time taken for the compression wave to travel along your slinky

How can this experiment be improved? Share ideas with your group to control variables and make sure the results are accurate and precise

_____

_____

Write your improved experiment below. Carry it out and list your observations

AIM _____

Materials

_____

_____

_____

Method

_____

_____

_____

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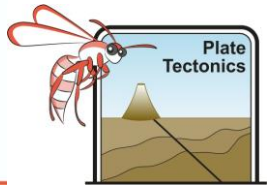

Observations

_____ **Speed = Distance / Time**

_____

_____

Conclusion The speed of the wave was _____

_____

_____

P wave - Student Activity 2

Rules

For each wave pulse:

1. Each student only takes four steps, two to the right and then two to the left before returning to their original position.
2. There are never more than three students bunched up at any time.

Method

1. Students stand about 1 step (30 cm) apart.
2. Someone loudly counts the seconds.
3. On the first second the first student takes one step to their right to join the second student.
4. On the second count both these students take one step to the right to join the third student. This group of three is the compression wave.
5. On the third second the first student starts their return to their original position at one step per second while the remaining pair move one step to the right to join the next student and maintain the compression of three.
6. This pattern continues to the end of the line.
7. Each student returns to their original position after the wave moved on.

→ Direction of wave transmission

1	2	3	4	5	6	7	8
	1+2	3	4	5	6	7	8
		1+2+3	4	5	6	7	8
	1		**2+3+4**	5	6	7	8
1		2		**3+4+5**	6	7	8
1	2		3		**4+5+6**	7	8
1	2	3		4		**5+6+7**	8
1	2	3	4		5		**6+7+8**
1	2	3	4	5		6	7+8
1	2	3	4	5	6	7	8

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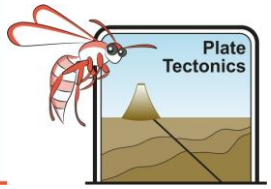

Part B The S wave. Secondary or Shear wave

S waves are slower than P waves and only travel through solids. When an S wave passes, particles move at right angles to the direction of transmission. S waves only travel through solids

AIM **To replicate an S wave and measure its speed of transmission.**

Materials

- Two students
- A piece of rope or cord as long as the extended slinky in the previous experiment
- Something to tie one end of the rope to e.g. a door handle, seat back or fence line

Method

1. Lay the rope straight between the markings of the previous experiment
2. Two students hold the ends firmly
3. One of these students briskly flicks a single vertical wave of rope towards the other end
4. The second student measures time taken for the transmitted S wave to travel the length of the rope
5. Repeat measurements and find the average speed of transmission of S waves.
6. Compare these results with those from the previous (p wave) experiment

Observations on S wave motion

Trial	Time (s)	Distance (m)	Speed (m/s)
1			
2			
3			
		Average	

Discussion

Which wave form travels or is transmitted faster? _____

Describe any difference in mode of transmission between P and S waves that you could see.

_____

_____

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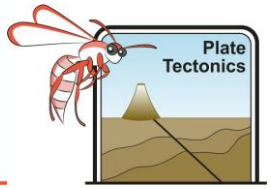

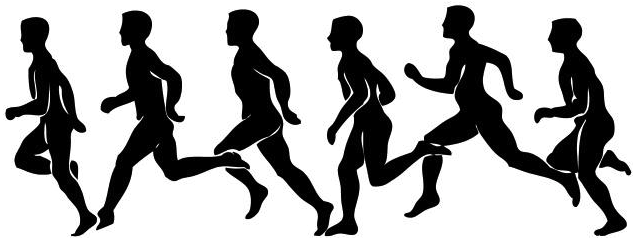

What should you do if you feel a P wave arrive? _____

Information to help you decide what to do during an earthquake

Average speed of teenager running	about 10 to 15km/hour
Average speed of P wave	330 m/s in air
	450m/s in water
	500m/s in rock (granite)
Average speed of S wave	about 60% of P wave
Average speed of Stealth bomber	1,010km per hour
Speed of sound	343.2m/s

Materials

1. Convert the data above to the same units to allow easy comparison.

If you realise a particularly devastating earthquake was about to strike, could you outrun or fly away from it? _____

Why do P waves travel faster in rock than in air (HINT kinetic energy) _____

_____

What should you do if you feel a P wave arrive? _____

_____

S waves can be twice as slow as P waves.

S wave – Student Activity 2

Students can either perform the “Mexican wave” movement beloved by soccer fans by standing up and sitting down one second after the student on their left starts moving. The wave rolls along the line of students.
Seated students can just raise and lower their arms at with a similar one-second delay.

Body Waves (S&P) - Student Activities

Extension

Students can lay both P and S wave experiments side by side. They can estimate which form of wave transmission looks faster by observing which reached the other end first.

Why is this comparison scientifically inaccurate? _____

_____

_____

_____

Information about seismic monitoring in Australia can be found at:
http://www.ga.gov.au/hazards/our-capabilities/monitoring/earthquake-monitoring.html

Seismometers in Schools project at: https://www.facebook.com/ausisnetwork