

Video question script: Wave motion – pupil molecules

Question/Activity	Likely response	Rationale
Using a line of pupils to demonstrate the different ways in which P- and S-waves are transmitted, through the 'Waves in the Earth – pupil molecules' Earthlearningidea		Introduction to seismic waves
Recall for pupils that P-waves pass through solids, liquids and gases, but S-waves pass through solids only Explain that you are going to use a pupil model to simulate this		Concrete preparation: seismic wave reminder
Ask four or five pupils to form a line at the front of the room – with space in front of the first person in the line		
Ask them to represent the molecules in a solid – by putting their hands on the shoulders of the person in front keeping them straight and rigid. Ask them to look ahead and respond to what happens from the person behind them. Choose another responsible person to be the 'mover' or be the 'mover' yourself		
Run 1. Ask the 'mover' to move the last person in the line gently backwards and forwards to simulate a P-wave. Ask what sort of wave is being simulated	• a P-wave	Construction: spotting the patterns
Run 2. Ask the 'mover' to move the last person in the line gently from side to side to simulate an S-wave. Ask what sort of wave is being simulated	• an S-wave	
Then ask them to drop their hands and move closer together so that they are nearly touching one another. Explain that they are now representing a fluid (liquid or gas) – with the molecules not linked to one another. Again they should look ahead and respond to what happens from the person behind them. Tell the 'mover' quietly what to do for the next two runs without the people in the line hearing.		
Run 3. The 'mover' should move the last person in the line from side to side. That movement should have no effect on the others in the line – since the S-wave being simulated cannot pass through fluids. The other pupils will be able to see this, but those in the line will not		
Run 4. The 'mover' should then push the last person in the line (gently) forward, to simulate a P-wave. The pupils will bang into one another in transmitting this P-wave and the person at the front may stagger forward		
Summarise what has been shown by this pupil model – that P-waves are transmitted by solids and fluids, but S-waves are only transmitted by solids.		Bridging: from the pupil model to seismic waves

Notes:

- Who to choose as the 'mover' will depend on the school's policy and your professional judgment about teachers touching pupils. The activity is safer if you control it, but to avoid teachers touching pupils, you will need to select a responsible pupil as the 'mover'.
- This set up can be a little dangerous if a small person in the middle of the line gets squashed or if the person at the front of the line falls over. It is safer if the pupils stand side by side – but not so much fun.
- The activity can be extended by repeating:
 - Run 1 with more relaxed arms. This shows that when the 'solid' is less 'compressible' and 'rigid' the wave moves more slowly – so the velocity of P-waves depends the rigidity and the incompressibility of the solid
 - Run 2 with more relaxed arms. This shows that when the solid is less 'rigid' the S-wave velocity is reduced – so S-wave velocity in solids depends on their rigidity
- Neither of these two extensions relates to the density of the material – since increase in density actually reduces seismic wave velocity. However, the increase in velocity caused by increased rigidity and incompressibility is greater than the reduction caused by density increase, so seismic wave velocities do increase with depth.