Triple Science - Physics

SP4 Knowledge organiser

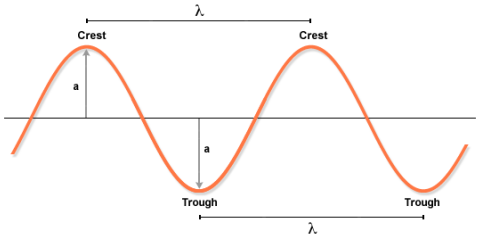
P4: Waves

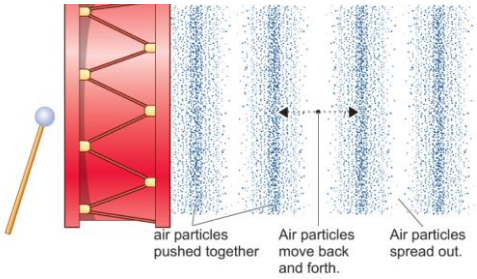
Lesson sequence

1. Waves
2. Wave speed
3. Core practical – investigating waves
4. Refraction
5. Waves crossing boundaries
6. Ears and hearing
7. Ultrasound
8. Infrasound

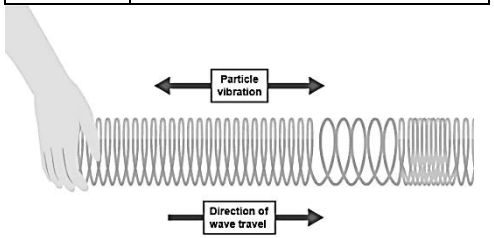
1. Waves	
Waves	Transfer energy without transferring matter.
Oscillate	When particles vibrate backwards and forwards or up and down.
Transverse waves	Waves in which particles oscillate at right angles to the direction of energy movement. E.g. water waves and light waves.
Longitudinal waves	Waves in which particles oscillate parallel to the direction of energy movement. E.g. sound waves.
Medium	The material that waves travel through. Light waves are the only waves that have no medium.
Seismic waves	Waves of vibrating rock caused by earthquakes.
Frequency	The number of waves that pass a point every second.
Hertz	The unit of frequency. 1 Hz = 1 wave per second.
Period	The length of time it takes for a single wave to pass.
Wavelength	The distance in m from the top of one wave to the top of the next.
Amplitude	The maximum distance a particle vibrates away from its resting point,

Velocity	The speed of a wave in m/s.

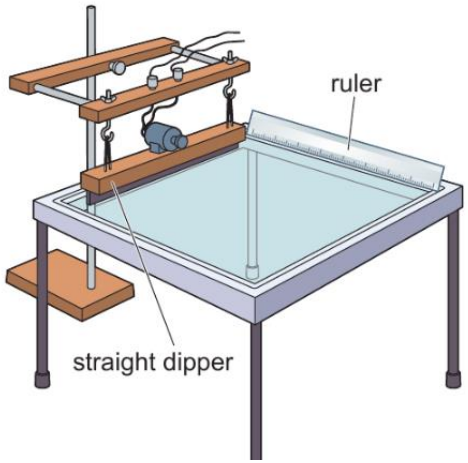




2. Wave speed	
Speed, distance and time	$wave\ speed\ (m/s) = \frac{distance\ (m)}{time\ (s)}$
Speed, frequency and wavelength	$wave\ speed\ \left(\frac{m}{s}\right) = frequency\ (Hz) \times wavelength\ (m)$
Measuring wave speed	Time how long they take to travel a certain distance.
Changing speed	Waves travel at a different speed in a different medium. Light is slower in water than air.

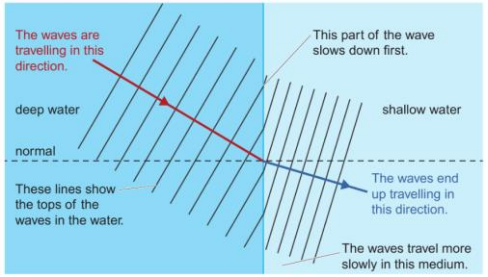


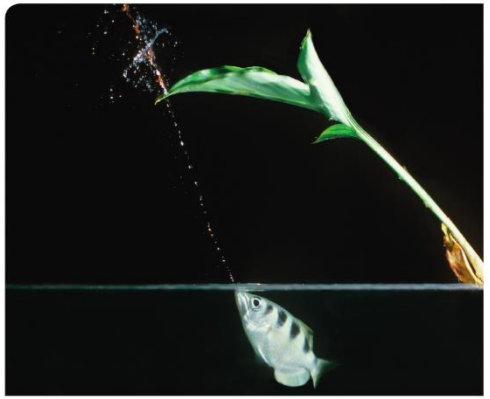
3. Core practical – investigating waves	
Aim	To measure the speed of waves in a liquid and a solid.
Water waves 1	1. Count the number of waves in 10 s and use this to find the frequency. 2. Measure the wavelength with a ruler 3. Wave speed = frequency x wavelength
Water waves 2	1. Time how long a wave takes to pass two points, 0.3 m apart. 2. Wave speed = dist / time
Waves in a solid	1. Hit suspended metal bar with hammer and measure the frequency using an app. 2. Measure the metal bar – double the length gives the wavelength



4. Refraction	
Refraction	Bending of waves when they enter a new medium at an angle.
Interface	The boundary between two media (mediums) such as air and water.

Normal	An imaginary line drawn at 90° to where light hits an interface (boundary).
Travelling from air to glass or water	Light bends towards the normal
Travelling from glass or air to water	Light bends away from the normal.
Explaining refraction	Light waves slow down as they go from air to water. The 'bottom' of the wave hits the water and slows down first, causing refraction.





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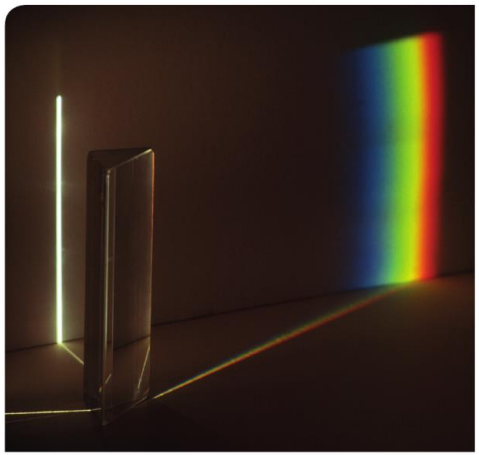
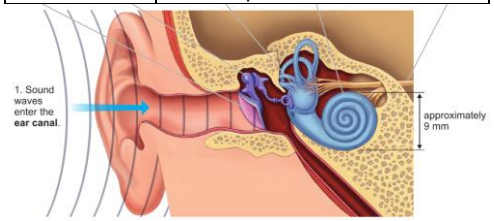
5. Waves crossing boundaries	
Transmitted	The wave passes through the material and is not absorbed or reflected
Absorbed	The wave disappears as the energy it is carrying is transferred to the material
Reflected	The wave 'bounces' off
White light	Light which contain all the wavelengths of the visible spectrum at equal intensity
Echo	A sound wave reflected by a hard surface



6. Ears and hearing	
Pinna	The external part of the ear
Ear canal	A pathway running form the outer ear to middle ear
Ear drum	A thin membrane that vibrates in response to sound waves
Ossicles	Three tiny bones (hammer, anvil and stirrup)
Cochlea	A coiled tube containing liquid which produces nerve impulse in response to sound vibrations

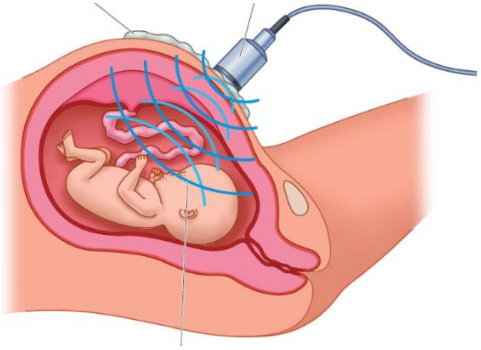
Auditory nerve	A bundle of fibres that carries hearing information between the cochlea and the brain
Frequency	The number of waves passing a point every second
Range of human hearing	20 - 20,000Hz
Neuron	A specialised cell transmitting nerve impulses

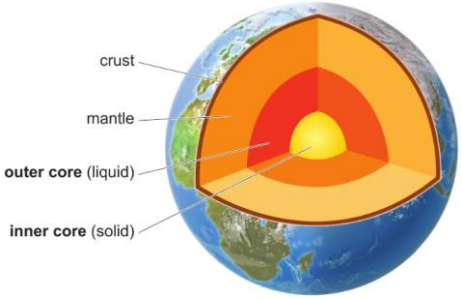


Exam-style question

Describe how sound waves in a fluid are converted to vibrations in a solid. *(2 marks)*

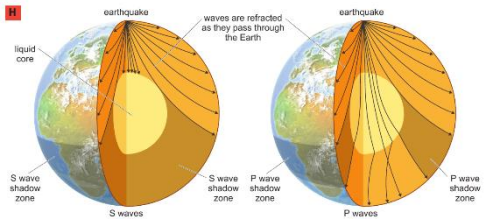
7. Ultrasound	
Ultrasound	Sound or other vibrations having an ultrasonic frequency
Echolocation	The location of objects by reflected sound
Sonar	A system for the detection of objects under water by emitting sound pulses and detecting or measuring their return after being reflected
Ultrasound scan	Uses high-frequency sound waves to create images of the inside of the body.
Wave speed	Wave speed = distance / time Wave speed = m/s Distance = m Time = s





8. Infrasound	
Infrasound	Sound waves with frequencies below the lower limit of human audibility

P waves	One of the two main types of elastic body waves, called seismic eaves. P waves travel faster than s waves
S waves	One of the two main types of elastic body waves, called seismic eaves. S waves travel slower than P waves
Seismometers	A device use for measuring the movement of the Earth
Shadow zone	A large area of the Earth on the opposite side to the earthquake where no S waves are detected.



Exam-style question

a State the meaning of infrasound. *(1 mark)*

b Give one use for it. *(1 mark)*