P6 Waves

What's the science story?

Wave behaviour is common in both natural and man-made systems. Waves carry energy from one place to another and can also carry information. Designing comfortable and safe structures such as bridges, houses and music performance halls requires an understanding of mechanical waves. Modern technologies such as imaging and communication systems show how we can make the most of electromagnetic waves.

Previous knowledge:

KS3

Year 8 – light and sound

KS4

P4 Atomic structure

Next steps…

N/A

Keywords

Wave	Wavelength	Spectrum
Transverse	Frequency	Absorb
Longitudinal	Period	Transmit
Compression	Displacement	Reflect
Rarefaction	Hertz	Refract
Amplitude	Speed	Boundary
Frequency	Transfer	Normal
	Energy	Oscillate
	Ionising	

Working scientifically skills:

WS8: methods
WS10: selecting equipment
WS11: hazards and risk assessments
WS14: drawing graphs
WS16: using an equation
WS18: converting units

Assessments:

End of unit test (summative) (Out of 30)
Exit tickets x 2/3 (formative)

- **ET Transverse and longitudinal**

AQA GCSE Combined Science Trilogy (8464)

Lesson No. and Title	Learning objectives	AQA Specification	Practical equipment
1. Transverse and longitudinal waves	4 – To state examples of waves. 6 – To describe the different between longitudinal and transverse waves. 8 – To compare longitudinal and transverse waves.	Waves may be either transverse or longitudinal. The ripples on a water surface are an example of a transverse wave. Longitudinal waves show areas of compression and rarefaction. Sound waves travelling through air are longitudinal. --- Students should be able to describe the difference between longitudinal and transverse waves. --- Students should be able to describe evidence that, for both ripples on a water surface and sound waves in air, it is the wave and not the water or air itself that travels.	DEMO: Slinky?

2. Properties of waves	4 – To identify amplitude and wavelength from given diagrams. 6 – To calculate the speed of a wave using a given equation.	Students should be able to describe wave motion in terms of their amplitude, wavelength, frequency and period. The amplitude of a wave is the maximum displacement of a point on a wave away from its undisturbed position. The wavelength of a wave is the distance from a point on one wave to the equivalent point on the adjacent wave. The frequency of a wave is the number of waves passing a point each second. --- $period = \frac{1}{frequency}$ $\left[T = \frac{1}{f} \right]$ period, T, in seconds, s frequency, f, in hertz, Hz The wave speed is the speed at which the energy is transferred (or the wave moves) through the medium. All waves obey the wave equation: --- $wave\ speed = frequency \times wavelength$ $[v = f \lambda]$ wave speed, v, in metres per second, m/s frequency, f, in hertz, Hz wavelength, λ, in metres, m	DEMO: Oscilloscope and signal generator

3. RP – Ripple tank	To describe a method to measure the speed of sound waves in air. To describe a method to measure the speed of ripples on a water surface.	Students should be able to: • identify amplitude and wavelength from given diagrams • describe a method to measure the speed of sound waves in air • describe a method to measure the speed of ripples on a water surface. **Required practical activity 20:** make observations to identify the suitability of apparatus to measure the frequency, wavelength and speed of waves in a ripple tank and waves in a solid and take appropriate measurements.	DEMO: Ripple tank
4. Types of electromagnetic waves	4 – To state the components of the electromagnetic spectrum. 6 – To describe each component of the electromagnetic spectrum. 8 – To compare the wavelength and frequency of the different electromagnetic waves.	Electromagnetic waves are transverse waves that transfer energy from the source of the waves to an absorber. Electromagnetic waves form a continuous spectrum and all types of electromagnetic wave travel at the same velocity through a vacuum (space) or air. The waves that form the electromagnetic spectrum are grouped in terms of their wavelength and their frequency. Going from long to short wavelength (or from low to high frequency) the groups are: radio, microwave, infrared, visible light (red to violet), ultraviolet, X-rays and gamma rays. Long wavelength → Short wavelength Radio waves | Microwaves | Infrared | Visible light | Ultraviolet | X-rays | Gamma rays Low frequency → High frequency Our eyes only detect visible light and so detect a limited range of electromagnetic waves. Students should be able to give examples that illustrate the transfer of energy by electromagnetic waves.	•

5. Properties of EM waves 1	4 – To construct ray diagrams to illustrate reflection and refraction of a wave. HT – To explain refraction in terms of velocity. HT – To use wave front diagrams to fully explain refraction.	Students should be able to construct ray diagrams to illustrate the refraction of a wave at the boundary between two different media. (HT only) Different substances may absorb, transmit, refract or reflect electromagnetic waves in ways that vary with wavelength. (HT only) Some effects, for example refraction, are due to the difference in velocity of the waves in different substances. (HT only) Students should be able to use wave front diagrams to explain refraction in terms of the change of speed that happens when a wave travels from one medium to a different medium.	PRAC: Reflection Ray box, silt plate, mirror, protractor, blue tak PRAC: Refraction Ray box, silt plate, Perspex block, protractos
6. RP Infrared and absorption	To investigate how the amount of infrared radiation absorbed or radiated by a surface depends on the nature of that surface.	(HT only) Different substances may absorb, transmit, refract or reflect electromagnetic waves in ways that vary with wavelength. **Required practical activity 21:** investigate how the amount of infrared radiation absorbed or radiated by a surface depends on the nature of that surface.	DEMO: Leslie cube PRAC: Cooling cans Cans painted different colours (white, matt black, shiny silver) kettle, thermometers or data loggers, measuring cylinders, stop watches

7. Properties of EM waves 2	4 – To describe the effects of ultraviolet, x-rays and gamma rays on body tissue. 6 – To draw conclusions from given data about the risks and consequences of exposure to radiation. HT – To explain how radio waves are produced.	(HT only) Radio waves can be produced by oscillations in electrical circuits. (HT only) When radio waves are absorbed they may create an alternating current with the same frequency as the radio wave itself, so radio waves can themselves induce oscillations in an electrical circuit. Changes in atoms and the nuclei of atoms can result in electromagnetic waves being generated or absorbed over a wide frequency range. Gamma rays originate from changes in the nucleus of an atom. --- Ultraviolet waves, X-rays and gamma rays can have hazardous effects on human body tissue. The effects depend on the type of radiation and the size of the dose. Radiation dose (in sieverts) is a measure of the risk of harm resulting from an exposure of the body to the radiation. --- 1000 millisieverts (mSv) = 1 sievert (Sv) Students will not be required to recall the unit of radiation dose. Students should be able to draw conclusions from given data about the risks and consequences of exposure to radiation. Ultraviolet waves can cause skin to age prematurely and increase the risk of skin cancer. X-rays and gamma rays are ionising radiation that can cause the mutation of genes and cancer.	

8. Uses and applications of EM waves	4 – To describe the practical applications of electromagnetic waves. HT – To explain why each type of electromagnetic wave is suitable for its application.	Electromagnetic waves have many practical applications. For example: • radio waves – television and radio • microwaves – satellite communications, cooking food • infrared – electrical heaters, cooking food, infrared cameras • visible light – fibre optic communications • ultraviolet – energy efficient lamps, sun tanning • X-rays and gamma rays – medical imaging and treatments. (HT only) Students should be able to give brief explanations why each type of electromagnetic wave is suitable for the practical application.	