The Sutton Academy

Knowledge Rich Curriculum Plan

SCIENCE- Physics Year 11

Topic: Waves

Lesson/Learning Sequence	Intended Knowledge: *Students will know that…*	Prior Knowledge: *In order to know this, students need to already know that…*	Tiered Vocabulary	Working Scientifically
Lesson: Transverse and Longitudinal Waves	• Students will know that waves are either transverse or longitudinal. • Students will know that waves transfer energy without transferring matter • Students will know that ripples on a water surface and electromagnetic waves are examples of transverse waves • Students will know that sound is an example of a longitudinal wave. • Students will know that in a transverse wave, the oscillations are perpendicular with the direction of energy transfer • Students will know that in a longitudinal wave, the oscillations are parallel with the direction of energy transfer Students will know that longitudinal waves show areas of compression and rarefaction	***Students need to already know that sound and light travel as a wave***	*Tier 2* *perpendicular – at a right angle* *Tier 3* *Oscillations – movement back and forth in a regular rhythm (also known as vibration)* *medium – the substance through which a wave can travel*	
Lesson: Properties of Waves	• Students will know that amplitude is the maximum point of displacement from the equilibrium point on a wave • Students will know that wavelength is the length measured from one point on a wave to the same point on the next wave (e.g. crest to crest) • Students will know that frequency is a measure of the number of waves passing a point each second. • Students will know that the unit of frequency is Hertz, Hz	• ***Students need to already know that the unit of length is metres*** ***Students need to already know that the unit of time is seconds***	*Tier 3* *Wavelength: The distance from one point of a wave to the same point on the next wave (measured in metres, symbol λ)* *Amplitude: distance from maximum displacement to rest (symbol a)* *Frequency: The number of waves each second (measured in Hz, symbol f)*	*Using formula from the equation sheet*

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	• Students will know that the period is the time taken for one complete wave. • Students will know how to apply the equation: period = 1 ÷ frequency			
Lesson: Wave speed	• Students will know that the equation for calculating wave speed is: wave speed = frequency x wavelength • Students will know that v is the symbol for wave speed • Students will know that f is the symbol for frequency • Students will know that λ is the symbol for wavelength • Students will know how to describe a method to measure the speed of a wave in air • Students will know how to describe a method to measure the speed of ripples on a water surface • TRIPLE ONLY: Students will know how to show that changes in velocity, frequency and wavelength are inter-related Students will know how to use the wave speed equation to calculate wave speed, frequency and wavelength	***Students need to already know that the unit of speed is m/s***		*Using formula from the equation sheet*
Lesson: Ripple Tank Required Practical	• Students will know how to describe how to take the measurements required to measure wave speed	***Students should already know that wave speed = frequency x wavelength***		*Taking measurements: time, wavelength, frequency* *Considering accuracy* *Calculating mean from multiple sets of data* *Further calculations*

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Lesson: Standing Wave Required Practical	• Students will know how to describe how to take the measurements required to measure wave speed	***Students should already know that wave speed = frequency x wavelength***		*Taking measurements: time, wavelength, frequency* *Considering accuracy* *Calculating mean from multiple sets of data* *Further calculations*
Lesson: Electromagnetic Waves	• Students will know that electromagnetic waves are transverse waves. • Students will know that electromagnetic waves transfer energy from the source of the waves to an absorber • Students will know that electromagnetic waves form a continuous spectrum. • Students will know that all types of electromagnetic wave travel at the same velocity through a vacuum or air. • Students will know the order of the electromagnetic spectrum, from longest wavelength to shortest wavelength, is: • radio waves, microwaves, infrared, visible light, ultraviolet, X-rays, gamma rays. • Students will know that our eyes only detect a limited range of electromagnetic waves (the visible light region) Students will know how to give examples that show the transfer of energy by electromagnetic waves.	***Students need to already know that oscillations in transverse waves are perpendicular to the direction of energy transfer.***	*Tier 3* *Vacuum – A space devoid of matter*	
Lesson: Properties of Electromagnetic Waves	• Students will know that different substances can absorb, transmit, refract or reflect electromagnetic waves	• ***Students need to already know that electromagnetic waves are transverse wave***	*Tier 3* *Transmit – pass through* *Absorb – Take in*	

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	• Students will know that the ability of a substance to absorb, transmit, refract or reflect electromagnetic wave is dependent on the wavelength of the wave • Students will know that refraction is due to the difference in velocity of waves in different substances • Students will know that wave front diagrams can be used to explain refraction • Students will know that dark materials are more likely to absorb infrared radiation, whilst lighter/ shinier materials are more likely to reflect infrared radiation • Students will know that radio waves are produced by oscillations in electrical circuits • Students will know that when radio waves are absorbed they can create an alternating current with the same frequency as the radio wave itself. • Students will know that radio waves can induce oscillations in electrical circuit • Students will know that changes in atoms and the nuclei of atoms can result in electromagnetic waves being generated or absorbed • Students will know that gamma rays originate from changes in the nucleus of an atom • Students will know that ultraviolet, X-rays and gamma rays can have hazardous effects on human body tissue	***Students need to already know how to represent waves using ray diagrams***	*Refraction – bending of waves due to a change in speed*	

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	• Students will know that hazardous effects felt on human body tissue depends on the type of radiation and the size of the dose • Students will know that ultraviolet can cause skin to prematurely age and increases the risk of skin cancer • Students will know that X-rays and gamma rays are ionising • Students will know that X-rays and gamma rays can cause the mutation of genes and cancer • Students will know how to construct ray diagrams to illustrate the refraction of a wave at a boundary Students will know how to practically measure the amount of infrared radiation absorbed or radiated by a surface			
Lesson: Uses of electromagnetic waves	• Students will know that radio waves are used in television and radio • Students will know that microwaves are used in satellite communications and cooking food • Students will know that infrared is used in electrical heaters, cooking food and infrared cameras • Students will know that visible light is used in fibre optic communications • Students will know that ultraviolet is used in energy efficient lamps and sun tanning • Students will know that X-rays and gamma rays are used in medical imaging and treatments Students will know how to explain why different types of electromagnetic waves are suitable for their use	*Students need to already know that the electromagnetic spectrum consists of radio waves, microwaves, infrared, visible light, ultraviolet, X-rays, gamma rays*		

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Lesson: Infrared Required Practical	• Students will know how to investigate factors that affect infrared emission	*Students need to already know that infrared waves are associated with temperature*		*Working safely* *Taking measurements: temperature, IR emission* *Considering accuracy and reliability* *Evaluating a method*
Lesson: TRIPLE ONLY: Reflection of Waves	• Students will know that waves can be reflected at the boundary between two different materials • Students will know that waves can be absorbed or transmitted at the boundary between two different materials • Students will know how to construct ray diagrams to illustrate the reflection of a wave at a surface • Students will know that the material interface is the point where two different materials meet • Students will know how to describe the effects of reflection, transmission and absorption of waves at material interfaces Students will know how to investigate the reflection of light by different types of surface and the refraction of light by different surfaces	• ***Students need to already know that waves transfer energy without transferring matter*** ***Students need to already know that light travels as a transverse wave***	*Tier 3* *Normal – A line drawn at 90º*	
Lesson: TRIPLE ONLY: reflection practical	• Students will know how to investigate the reflection of light	• ***Students need to already know that waves reflect***		
Lesson: TRIPLE ONLY: refraction practical	• Students will know how to investigate refraction of light	• ***Students will need to already know that refraction is the bending of waves towards or away from the normal***		

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Lesson: TRIPLE ONLY: Sound waves	• Students will know that sound wave travel through solids causing vibrations in the solid • Students will know that within the ear, sound waves cause the ear drum and other parts to vibrate. These vibrations cause the sensation of sound • Students will know that the conversion of sound waves to vibrations of solids work over a limited frequency range, limiting human hearing. • Students will know that the range of normal human hearing is from 20 Hz to 20 kHz Students will know how to describe processes which convert wave disturbances between sound waves and vibrations in solids.	***Students need to know that sound travels as a longitudinal wave.***	*Tier 3* *Ossicles – Bones that are found in the ear*	
Lesson: TRIPLE ONLY: Using waves for detection and exploration	• Students will know that ultrasound waves have a frequency higher than the upper limit for human hearing • Students will know that ultrasound waves are partially reflected when they meet a boundary between two media. The time taken for the reflections to reach a detector can be used to determine how far away the boundary is. • Students will know that ultrasound can be used in both medical and industrial imaging. • Students will know that seismic waves are waves produced by earthquakes. • Students will know that P-waves are longitudinal seismic waves. P-waves	***Students need to already know that waves are either longitudinal or transverse.***	*Tier 3* *Seismic waves – A wave produced by an earthquake*	

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	travel at different speeds through solids and liquids. • Students will know that S-waves are transverse seismic waves. S-waves cannot travel through a liquid. • Students will know that P-waves and S-waves provide evidence for the structure and size of the Earth's core. • Students will know that echo sounding is a process used to detect objects in deep water and measure water depth. Echo sounding uses high frequency sound waves. Students will know how to explain the evidence provided by seismic waves.			
Lesson: Visible Light (TRIPLE ONLY)	• Students will know that visible light contains different colours • Students will know that each colour within the visible light spectrum has its own narrow band of wavelength and frequency • Students will know that specular reflection is reflection from a smooth surface in a single direction • Students will know that diffuse reflection is reflection from a rough surface that causes scattering • Students will know that colour filters work by absorbing certain wavelengths and transmitting other wavelengths • Students will know that the colour of an opaque object is determined by which wavelengths of light are more strongly reflected. • Students will know that any wavelengths that aren't reflected are absorbed.	*Students should already know that waves can be reflected, refracted, transmitted or absorbed* *Students should already know that transparent objects allow light to pass through* *Students should already know that opaque objects don't allow light to pass through*		

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	• Students will know that if all wavelengths of visible light are reflected equally then the object appears black. • Students will know that if all wavelengths of visible light are absorbed then the object appears black. • Students will know that objects that transmit light are either transparent or translucent • Students will know how to explain the colour of an object using absorption, transmission and reflection of different wavelengths • Students will know how to explain the effect of viewing objects through filters • Students will know how to explain why an opaque object has a particular colour.			
Lesson: Lenses (TRIPLE ONLY)	• Students will know that a lens forms an image by refracting light • Students will know that in convex lenses, parallel rays of light are brought to a focus at the principal focus • Students ill know that the distance from the lens to the principal focus is called the focal length • Students will know that images produced by convex lenses can either be real or virtual • Students will know that images produced by concave lenses are always virtual	• ***Students need to already know that length can be measured in cm or mm*** ***Students need to already know how to convert between cm, mm and m***	*Tier 3* *Focal length: the distance from the lens to the principal focus*	

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	• Students will know that a real image is an image that can be projected onto a screen • Students will know that a virtual image is an image that appears to come from behind the lens • Students will know how to represent convex and concave lenses in ray diagrams. • Students will know how to construct ray diagrams to illustrate the similarities and differences between convex and concave lenses Students will know how you use the magnification equation to calculate the magnification of an image produced by a lens.			
Lesson: **Black Body Radiation (TRIPLE ONLY)**	• Students will know that objects emit and absorb infrared radiation • Students will know that the hotter the body, the more infrared radiation it radiates • Students will know that a perfect black body is an object that absorbs all of the radiation incident on it. • Students will know that a black body does not reflect or transmit any radiation. • Students will know that a perfect black body would be the best possible emitter. • Students will know that the intensity and wavelength distribution of any emission depends on the temperature of the body. • Students will know that a body at constant temperature is absorbing and emitting radiation at the same rate	***Students need to already know that infrared radiation is emitted out of hot objects.***	*Tier 3* *Perfect Black Body – A material that absorbs and emits all radiation incident on it*	

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	• Students will know that the temperature of a body increases when the body absorbs radiation faster than it emits • Students will know that the temperature of the Earth depends on the rates of absorption, emission of radiation and the reflection of radiation into space • Students will know how to explain the changes of temperature of a body. Students will know how to use information to show how radiation affects the temperature of Earth's surface			