

TITLE: 8C Waves

Unit Overview (Linked to the KS3 Programme of Study)

In this topic, students will develop their understanding of waves as a way of transferring energy and information. Students will learn about the similarities and differences between transverse and longitudinal waves, how sound is produced and transmitted, and how properties such as amplitude and frequency affect what we hear. Students will explore how light behaves when it is reflected and refracted, how images are formed by mirrors and lenses, and how the eye detects light to produce vision. Students will also study the electromagnetic spectrum, including the uses of different types of electromagnetic radiation and their effects on living cells. Throughout the topic, students will use scientific models, diagrams and mathematical relationships to explain wave behaviour and apply their understanding to real-world technologies and everyday experiences.

Prior Learning (KS2)

Students have learnt previously about light and sound. This has involved recognising that light travels in straight lines, explaining how objects are seen because they emit or reflect light into the eye, and using ray models to explain shadows and visibility. Students have also learnt that sounds are produced by vibrations and that these vibrations travel through materials to reach the ear. Through practical investigations, students have used observations and evidence to explain everyday phenomena involving light and sound. This prior learning provides the foundation for understanding how waves transfer energy, how sound and light behave, how images are formed, and how different regions of the electromagnetic spectrum are used in everyday life.

Future Learning (KS4)

At GCSE, students will build on their knowledge of sound waves, light waves and the electromagnetic spectrum by studying wave behaviour in greater depth. Students will learn how waves transfer energy and information, apply mathematical relationships involving wave speed, frequency and wavelength, and investigate how wave properties can be measured and analysed. Students will develop a deeper understanding of reflection, refraction and wave interactions, and explore the uses, risks and applications of different regions of the electromagnetic spectrum in communication, medicine and technology. Students will also use scientific models, experimental evidence and calculations to explain wave behaviour and evaluate how waves are used in natural and engineered systems.

Misconceptions

Misconceptions – 8C Waves

8C.01 Modelling Waves

- Waves transfer matter rather than energy.
- Sound and light waves are the same type of wave.
- Particles travel along with the wave.
- Waves disappear after they overlap (superpose).
- Transverse and longitudinal waves differ only in speed.

8C.02 Sound Waves

- Sound can travel through a vacuum.
- Sound waves are transverse waves.
- Air creates sound rather than transmitting it.
- Particles travel from the source to the listener.

- Sound travels at the same speed through all materials.

8C.03 Loudness and Amplitude

- Amplitude and frequency are the same thing.
- Loud sounds travel faster than quiet sounds.
- Echoes occur because sound is absorbed.
- Soft materials reflect sound better than hard materials.
- Oscilloscope traces show pitch rather than amplitude.

8C.04 Frequency and Pitch

- Frequency and loudness are the same thing.
- A larger amplitude means a higher pitch.
- Frequency is measured in seconds.
- Higher frequency waves travel faster.
- Pitch depends on amplitude rather than frequency.

8C.05 Light

- Light requires a medium to travel.
- Sound and light waves behave in exactly the same way.
- Light travels infinitely fast.
- Light and sound travel at the same speed.
- All waves require particles to transfer energy.

8C.06 Reflection

- Light stops when it reaches a mirror.
- Images form on the surface of the mirror.
- Reflection changes the speed of light.
- Virtual images are physically present behind the mirror.
- Incident and reflected rays can have different angles without following a rule.

8C.07 Refraction

- Reflection and refraction are the same process.
- Light bends because it hits the surface.
- Refraction occurs without a change in speed.
- Light always bends towards the normal.
- Lenses create light rather than changing its direction.

8C.08 The Eye and Vision

- The eye sends images directly to the brain without processing.
- The retina and optic nerve perform the same function.
- All vision defects are corrected using the same lens.
- The lens produces light.
- Images can form clearly anywhere inside the eye.

8C.09 The Electromagnetic Spectrum

- Visible light is the only form of light.
- All electromagnetic waves are equally dangerous.
- Frequency and speed are the same thing.
- Microwaves are always harmful.
- Higher-frequency electromagnetic waves generally carry no more energy than lower-frequency waves.

Topic-Wide Misconceptions

- All waves require a medium.
- All waves are longitudinal.
- Wave properties (amplitude, frequency and wavelength) are unrelated.
- Wave models are exact representations rather than simplified scientific models.
- Light, sound and electromagnetic waves behave in exactly the same way in all situations.

Practical Requisitions

Mastery (HPA)

Students explain and justify scientific ideas about waves using evidence, mathematical relationships and scientific models. They apply their knowledge of wave behaviour to unfamiliar situations, analyse how wave properties such as amplitude and frequency affect observations, and evaluate the strengths and limitations of wave models. Students use ray diagrams to explain reflection, refraction and image formation, interpret data from wave diagrams and oscilloscopes, and make links between wave properties, energy transfer and real-world applications. They also evaluate the benefits and risks of different regions of the electromagnetic spectrum and use scientific evidence to explain how waves are used in communication, medicine and modern technology.

8C.01 Modelling Waves		HPA Challenge	Skills	EEF Recommendations
Learning Objectives	- Compare transverse and longitudinal waves - Explain wave behaviour using the wave model - Describe what happens when waves superpose	Analyse the similarities and differences between transverse and longitudinal waves.	Working Scientifically WS 1.1 (Development of Scientific Thinking) Understand how scientific models help explain invisible processes. WS 1.2 (Models) Use wave models to explain wave behaviour. WS 3.6 (Explain using Evidence) Explain observations using scientific models and vocabulary. WS 4.1 (Scientific Vocabulary) Use terms such as longitudinal, transverse, oscillation and superposition accurately.	EEF 4 (Memory): Retrieve prior learning about light and sound from KS2. EEF 3 (Modelling): Model wave behaviour using diagrams, ropes and slinkies. EEF 6 (Language): Explicit teaching of specialist wave vocabulary. EEF 7 (Feedback): Feedback used to improve explanations of wave behaviour and scientific
Do Now (5 mins)	Purpose Retrieve prior learning about light and sound. Suggested Structure (teacher adapts) - What is a wave? - How does light travel? - How is sound produced? Diamond (Challenge) - What do light and sound have in common? Teacher Uses Responses To - Assess prior understanding of waves. - Identify misconceptions about sound and light. - Introduce the idea that both are examples of wave behaviour.	Apply the wave model to explain unfamiliar wave phenomena. Evaluate the usefulness of wave models in explaining how energy is transferred.	Maths Skills 1c (Comparisons) Compare properties of different wave types. 2c (Patterns and Relationships) Identify common behaviours across wave types.	
Hook / Intro (5 mins)	Introduce Key Idea “Waves allow energy to move from one place to another without transferring matter.” Suggested Strategy Demonstrate: - A rope wave. - A slinky spring wave. Ask: - What is moving? - Does the rope travel across the room? - How is energy being transferred? Pedagogical Rationale Introduces the central idea that waves transfer energy but not matter.			
Direct Teaching: Cell Structure (10 – 15 mins)	Content: What is a Wave? Introduce: Wave A disturbance that transfers energy from one place to another. Key Idea			

Waves transfer energy but not matter. Transverse Waves Introduce: Transverse Wave • Oscillations are perpendicular to the direction of energy transfer. Examples: • Light waves • Water waves (surface model) Key Features: • Crest • Trough Longitudinal Waves Introduce: Longitudinal Wave • Oscillations are parallel to the direction of energy transfer. Examples: • Sound waves Key Features: • Compression • Rarefaction Wave Behaviour Explain: All waves: • Transfer energy. • Can be represented using models. • Show repeating oscillations. Superposition Introduce: Superposition • When two waves overlap. Explain: • Waves combine temporarily.			
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	• A larger wave may form. • Afterwards the original waves continue unchanged. Keep explanation qualitative at KS3 level. Teacher Modelling (EEF 3) Model wave diagrams. Compare: Transverse Wave Longitudinal Wave Model explanation: “The particles move differently, but both waves transfer energy.” Check for Understanding (Hinge Point) • What is a wave? • Which type of wave is sound? • Which type of wave is light? • What is a compression? • What happens when waves superpose? Mini whiteboards / cold calling			
Guided Practice (10 mins)	Task Type Supported classification and comparison. Pupils • Identify transverse and longitudinal waves from diagrams. • Label wave diagrams. • Match wave types to examples. Teacher Role • Model first examples. • Reinforce vocabulary. • Correct misconceptions immediately.			
Main Task (20 mins)	Core Task Pupils: • Compare transverse and longitudinal waves. • Explain wave behaviour using scientific vocabulary. • Describe what happens during superposition.			

	• Apply understanding to real-world examples. Suggested Activities • Venn diagram comparison. • Wave sorting activity. • Labelled diagram task. • Structured explanation questions. Teacher Flexibility Teachers select format based on class need: • Practical rope and slinky activity. • Diagram interpretation task. • Card sort activity. • Written comparison activity. Success Criteria • Define a wave accurately. • Distinguish between transverse and longitudinal waves. • Explain how waves transfer energy. • Describe superposition. • Use scientific vocabulary accurately. Adaptation Prompts If pupils struggle • Use physical demonstrations. • Provide labelled diagrams. • Use matching activities. If secure • Apply wave models to unfamiliar situations. • Compare wave behaviours in different contexts. • Explain limitations of simple wave models. •			
Support / Diamond (challenge)	Support • Labelled wave diagrams. • Vocabulary mat. • Comparison table scaffold. Example sentence starters: “A transverse wave differs from a longitudinal wave because _____.” “Waves transfer _____ but not _____.” Diamond (Challenge)			

	- Explain why sound and light are classified differently. - Analyse wave behaviour in unfamiliar examples. - Evaluate how useful wave models are for explaining observations.			
Common misconceptions	- Waves transfer matter rather than energy. - Sound waves are transverse waves. - Light waves are longitudinal waves. - Particles travel with the wave. - Waves stop existing after superposition.			
Assessment (5 mins)	Formative and Summary Quick Check Options - Define a wave. - Identify the type of wave shown. - Explain the difference between transverse and longitudinal waves. - Describe what happens during superposition. Diagnostic Focus Can pupils: - Identify wave types? - Explain energy transfer? - Describe superposition? - Use correct scientific vocabulary?			
Exit ticket (5 mins)	Purpose Inform planning for 8C.02 Sound Waves Example Questions - What is a wave? - Which type of wave is sound? - What is the difference between transverse and longitudinal waves? Teacher uses responses to identify misconceptions before introducing sound waves in detail.			
Adaptive teaching	- Retrieval links KS2 light and sound learning to wave theory. - Hinge questions identify misconceptions early. - Physical demonstrations support visualisation. - Vocabulary is explicitly taught and revisited. - Challenge develops deeper conceptual understanding.			

	Exit ticket informs progression to sound waves.			
British Values	Individual Liberty - Students independently apply scientific models to explain wave behaviour. Democracy - Students discuss and justify explanations of wave behaviour using scientific evidence.			
Teacher Notes for MTP adaptations				

8C.02 Sound Waves		HPA Challenge	Skills	EEF Recommendations
Leaning Objectives	- Describe how sound is produced and transmitted - Recall the speed of sound and identify the substances through which sound can travel - Explain observations involving the transmission of sound	Analyse why sound travels at different speeds through different materials.	Working Scientifically WS 1.1 (Development of Scientific Thinking) Apply particle theory to explain sound transmission. WS 1.2 (Models) Use wave and particle models to explain observations. WS 3.6 (Explain using Evidence) Explain sound transmission using scientific reasoning. WS 4.1 (Scientific Vocabulary) Use terms such as vibration, medium, sound wave, compression and vacuum accurately. Maths Skills 1c (Comparisons) Compare speed of sound in different media. 2c (Patterns and Relationships) Identify relationships between particle arrangement and sound transmission.	EEF 4 (Memory): Retrieve prior learning from 8C.01 and 7B Particle Theory. EEF 3 (Modelling): Model sound transmission using particle diagrams and slinky demonstrations. EEF 6 (Language): Explicit teaching of sound-wave vocabulary. EEF 7 (Feedback): Feedback used to improve scientific explanations and application of particle theory.
Do Now (5 mins)	Purpose Retrieve prior learning about waves and particle theory. Suggested Structure (teacher adapts) - What is a wave? - What is a longitudinal wave? - What does a wave transfer? Diamond (Challenge) - Why can you hear someone speaking through a wall but not in space? Teacher Uses Responses To - Assess understanding of wave types. - Identify misconceptions about sound. - Prepare pupils for linking particles and sound transmission.	Apply the particle model to explain how sound is transmitted through solids, liquids and gases. Evaluate why sound cannot travel through a vacuum.		
Hook / Intro (5 mins)	Introduce Key Idea “How can sound travel from a speaker to your ears when nothing visible moves between them?” Suggested Strategy Demonstrate: - Tuning fork in air. - Ruler vibrating on the edge of a desk. - Speaker producing sound. Ask: - What do all these examples have in common? - What is actually moving? - How does the sound reach your ears? Pedagogical Rationale Helps pupils identify vibrations as the source of sound and prepares them for wave transmission.			
Direct Teaching: Cell Structure (10	Content: Producing Sound Introduce:			

– 15 mins)

Sound is produced by vibrations.

Examples:

- Vocal cords vibrating.
- Speaker cones vibrating.
- Musical instruments vibrating.

How Sound Travels

Introduce:

Sound travels as a **longitudinal wave**.

Sound moves through a:

Medium

Examples:

- Air
- Water
- Solids

Particle Model Explanation

When an object vibrates:

1. Nearby particles vibrate.
2. Vibrations are passed between particles.
3. Energy moves through the medium.
4. Sound reaches the ear.

Compression and Rarefaction

Introduce:

Compression

- Particles close together.

Rarefaction

- Particles spread apart.

These travel through the medium as the sound wave moves.

Speed of Sound

Recall:

Speed of sound in air ≈ 340 m/s

Explain:

Sound travels faster in:

- Solids

	- Liquids than in gases because particles are closer together. Sound and Vacuum Introduce: Vacuum - Contains no particles. Key Idea: Sound cannot travel through a vacuum because there are no particles to pass on vibrations. Teacher Modelling (EEF 3) Use a slinky demonstration to model: - Compression - Rarefaction - Longitudinal wave motion Model explanation: “The particles themselves do not travel from one end of the slinky to the other. They transfer energy by passing on vibrations.” Check for Understanding (Hinge Point) - How is sound produced? - What is a medium? - What are compressions? - Why does sound travel through solids? - Why can sound not travel through a vacuum? Mini whiteboards / cold calling			
Guided Practice (10 mins)	Task Type Supported explanation and modelling. Pupils - Label a longitudinal wave. - Identify compressions and rarefactions. - Explain sound transmission using a particle diagram. Teacher Role - Model first examples. - Reinforce language.			

	Correct misconceptions immediately.			
Main Task (20 mins)	Core Task Pupils: - Explain how sound is produced. - Describe how sound travels through different media. - Explain observations involving sound transmission. - Use particle diagrams to support explanations. Suggested Activities - Longitudinal wave labelling. - Sound transmission scenarios. - Particle model explanation task. - Structured GCSE-style application questions. Teacher Flexibility Teachers select format based on class need: - Slinky demonstration worksheet. - Diagram annotation. - Card sort activity. - Written explanation task. Success Criteria - Describe how sound is produced. - Explain how sound is transmitted. - Identify compressions and rarefactions. - Explain why sound requires a medium. - Use scientific vocabulary accurately. Adaptation Prompts If pupils struggle - Use particle diagrams. - Provide sentence starters. - Label wave diagrams. If secure - Compare sound transmission in different materials. - Apply knowledge to unfamiliar contexts. - Explain speed differences using the particle model.			
Support / Diamond (challenge)	Support - Longitudinal wave diagram. - Vocabulary mat.			

	- Particle model scaffold. Example sentence starters: “Sound is produced when _____.” “Sound travels because _____.” “A vacuum cannot transmit sound because _____.” Diamond (Challenge) - Explain why sound travels faster through solids than gases. - Analyse sound transmission in unfamiliar materials. - Evaluate the importance of the particle model when explaining sound.			
Common misconceptions	- Sound can travel through a vacuum. - Sound waves are transverse. - Particles travel from the source to the listener. - Sound is created by air rather than vibrations. - Louder sounds travel faster.			
Assessment (5 mins)	Formative and Summary Quick Check Options - Define a medium. - Explain how sound is produced. - Explain why sound cannot travel through a vacuum. - Label compressions and rarefactions. Diagnostic Focus Can pupils: - Explain sound production? - Explain transmission using particles? - Distinguish sound from light? - Use scientific vocabulary accurately?			
Exit ticket (5 mins)	Purpose Inform planning for 8C.03 Loudness and Amplitude Example Questions - What produces sound? - What is a medium? - Why can sound not travel through space?			

	Teacher uses responses to identify misconceptions before introducing amplitude and loudness.			
Adaptive teaching	• Retrieval links waves to particle theory. • Hinge questions identify misconceptions early. • Slinky and particle models reduce cognitive load. • Vocabulary is explicitly taught and revisited. • Challenge extends application of the particle model. • Exit ticket informs progression to amplitude.			
British Values	Individual Liberty - Students independently apply scientific knowledge to explain how sound is transmitted. Mutual Respect - Students recognise the importance of hearing and communication in everyday interactions.			
Teacher Notes for MTP adaptations				

8C.03 Loudness and Amplitude		HPA CHALLENGE	Skills	EEF Recommendations
Learning Objectives	- Describe the relationship between amplitude and loudness - Explain how reflection and absorption affect sound - Interpret wave diagrams and oscilloscope traces to determine amplitude	Analyse how amplitude affects the energy transferred by a sound wave. Apply knowledge of reflection and absorption to explain sound behaviour in unfamiliar situations.	Working Scientifically WS 1.1 (Development of Scientific Thinking) Understand how wave properties affect observable phenomena. WS 3.5 (Interpret Data) Interpret wave diagrams and oscilloscope traces. WS 3.6 (Explain using Evidence) Explain observations involving sound reflection and absorption. WS 4.1 (Scientific Vocabulary) Use terms such as amplitude, loudness, reflection, absorption and echo accurately. Maths Skills 1c (Comparisons) Compare amplitudes and loudness. 2c (Patterns and Relationships) Identify links between wave properties and observations. 4a (Interpretation) Interpret oscilloscope traces and wave diagrams.	EEF 4 (Memory): Retrieve prior learning about sound waves and longitudinal wave structure. EEF 3 (Modelling): Model how amplitude is represented in wave diagrams and oscilloscope traces. EEF 6 (Language): Explicit teaching of wave vocabulary and scientific terminology. EEF 7 (Feedback): Feedback used to improve interpretation of diagrams and explanations.
Do Now (5 mins)	Purpose Retrieve prior learning about sound production and transmission. Suggested Structure (teacher adapts) - What type of wave is a sound wave? - What produces sound? - Why can sound not travel through a vacuum? Diamond (Challenge) - Why can some sounds be heard from a much greater distance than others? Teacher Uses Responses To - Assess understanding of sound transmission. - Identify misconceptions about sound waves. - Prepare pupils for wave property analysis.	Evaluate how materials can be used to control sound in different environments.		
Hook / Intro (5 mins)	Introduce Key Idea “Why does a whisper sound different from a shout if both are sound waves?” Suggested Strategy Play or demonstrate: - A quiet sound - A loud sound Ask: - What is different about these sounds? - Is the sound travelling faster? - Is the wave changing in some way? Pedagogical Rationale Focuses attention on the properties of waves rather than the source of sound.			
Direct Teaching:	Content: Amplitude			

Cell Structure (10 – 15 mins)	Introduce: Amplitude - The maximum displacement of a wave from its resting position. Show wave diagrams. Explain: - Large amplitude → loud sound. - Small amplitude → quiet sound. Key Idea Loudness depends on amplitude. Amplitude is linked to the amount of energy transferred by the wave. Wave Diagram Large Amplitude  Small Amplitude  Oscilloscope Traces Introduce: Oscilloscope - A device that displays wave patterns on a screen. Explain: - Larger trace height = larger amplitude. - Smaller trace height = smaller amplitude. Reflection of Sound Introduce: Reflection - Sound waves bounce off surfaces.			
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Example:

- Echoes

Conditions:

- Hard surfaces reflect sound well.

Absorption of Sound

Introduce:

Absorption

- Materials take in sound energy.

Examples:

- Curtains
- Carpets
- Acoustic foam

Key Idea

Reflection increases echoes.

Absorption reduces echoes.

Teacher Modelling (EEF 3)

Model comparison:

Property	Observation
Large Amplitude	Loud sound
Small Amplitude	Quiet sound
Reflection	Echo produced
Absorption	Echo reduced

Model interpretation of oscilloscope traces.

Check for Understanding (Hinge Point)

- What is amplitude?
- What happens when amplitude increases?
- What is an echo?
- Why do carpets reduce echoes?
- How can amplitude be identified on an oscilloscope trace?

Mini whiteboards / cold calling

Guided Practice
(10 mins)

Task Type

Supported interpretation and explanation.

	Pupils • Compare wave amplitudes. • Interpret oscilloscope traces. • Identify examples of reflection and absorption. Teacher Role • Model first examples. • Reinforce terminology. • Correct misconceptions immediately.			
Main Task (20 mins)	Core Task Pupils: • Describe the relationship between amplitude and loudness. • Interpret wave diagrams and oscilloscope traces. • Explain reflection and absorption using scientific vocabulary. • Apply understanding to real-world situations. Suggested Activities • Oscilloscope interpretation task. • Wave diagram analysis. • Concert hall acoustics scenario. • Soundproofing case study. Teacher Flexibility Teachers select format based on class need: • Diagram annotation. • Data interpretation. • Card sorting activity. • Structured written explanation. Success Criteria • Define amplitude correctly. • Explain the relationship between amplitude and loudness. • Interpret oscilloscope traces. • Explain reflection and absorption. • Use scientific vocabulary accurately. Adaptation Prompts If pupils struggle • Use labelled wave diagrams. • Highlight amplitude on traces.			

	• Provide sentence starters. If secure • Analyse unfamiliar wave patterns. • Explain real-life acoustic examples. • Evaluate methods of reducing sound reflection. •			
Support / Diamond (challenge)	Support • Wave diagrams. • Oscilloscope examples. • Vocabulary mat. Example sentence starters: “A larger amplitude means _____.” “An echo occurs because _____.” “Sound is absorbed when _____.” Diamond (Challenge) • Explain why concert halls use sound-absorbing materials. • Analyse how amplitude affects energy transfer. • Evaluate whether reflection or absorption is more important in different environments.			
Common misconceptions	• Amplitude and frequency are the same thing. • Loud sounds travel faster than quiet sounds. • Echoes are caused by sound being absorbed. • Oscilloscopes measure volume directly. • Soft materials reflect sound better than hard surfaces.			
Assessment (5 mins)	Formative and Summary Quick Check Options • Define amplitude. • Explain the relationship between amplitude and loudness. • Identify reflection and absorption examples. • Interpret an oscilloscope trace. Diagnostic Focus Can pupils: • Explain amplitude accurately? • Link amplitude to loudness?			

	- Describe reflection and absorption? - Interpret wave diagrams correctly?			
Exit ticket (5 mins)	Purpose Inform planning for 8C.04 Frequency and Pitch Example Questions - What is amplitude? - How does amplitude affect loudness? - Why do echoes occur? Teacher uses responses to identify misconceptions before introducing frequency and pitch.			
Adaptive teaching	- Retrieval strengthens understanding of sound waves. - Hinge questions identify misconceptions about wave properties. - Diagrams and oscilloscope traces reduce cognitive load. - Vocabulary is explicitly taught and revisited. - Challenge develops application and evaluation. - Exit ticket informs progression to frequency and pitch.			
British Values	Individual Liberty - Students independently interpret wave patterns and apply scientific explanations to real-world situations. Democracy - Students discuss and justify explanations for sound behaviour using scientific evidence.			
Teacher Notes for MTP adaptations				

8C.04 Frequency and Pitch		HPA CHALLENGE	Skills	EEF Recommendations
Learning Objectives	Describe the relationship between frequency and pitch	Analyse how frequency affects the pitch of a sound wave.	Working Scientifically WS 1.1 (Development of Scientific Thinking)	EEF 4 (Memory): Retrieve prior learning about sound waves and amplitude.

	- Interpret wave diagrams to determine frequency - Calculate frequency using the equation frequency = $1 \div \text{time period}$	Apply the frequency equation to unfamiliar wave scenarios.	Understand how wave properties influence observable phenomena. WS 3.5 (Interpret Data) Interpret wave diagrams and oscilloscopes. WS 3.6 (Explain using Evidence) Explain the relationship between frequency and pitch. WS 4.1 (Scientific Vocabulary) Use terms such as frequency, pitch, hertz, wavelength and time period accurately.	EEF 3 (Modelling): Model frequency calculations step-by-step using worked examples.
Do Now (5 mins)	Purpose Retrieve prior learning about sound waves, amplitude and loudness. Suggested Structure (teacher adapts) - What is amplitude? - How does amplitude affect loudness? - What is an oscilloscope used for? Diamond (Challenge) - Why do some sounds appear “high” while others sound “low”? Teacher Uses Responses To - Assess understanding of previous wave properties. - Identify misconceptions about pitch and loudness. - Prepare pupils for frequency as a measurable wave property.	Evaluate how wave diagrams and calculations can be used to compare different sounds.	WS 4.1 (Scientific Vocabulary) Use terms such as frequency, pitch, hertz, wavelength and time period accurately. Maths Skills 1c (Comparisons) Compare frequencies and pitches. 2c (Patterns and Relationships) Identify relationships between frequency and pitch. 3c (Formulae) Use and rearrange simple equations. 4a (Interpretation) Interpret wave diagrams and numerical data.	EEF 6 (Language): Explicit teaching of frequency and pitch vocabulary. EEF 7 (Feedback): Feedback used to improve mathematical accuracy and scientific explanations.
Hook / Intro (5 mins)	Introduce Key Idea “Why does a whistle sound different from a drum?” Suggested Strategy Play two contrasting sounds: - High-pitched whistle - Low-pitched drum Ask: - Which sound is higher? - Which sound is lower? - What might be different about the waves producing these sounds? Pedagogical Rationale Encourages pupils to distinguish pitch from loudness before introducing frequency.			
Direct Teaching: Cell Structure (10 – 15 mins)	Content: Frequency Introduce:			

Frequency

- The number of waves passing a point each second.

Unit: Hertz (Hz)

Explain:

- 1 Hz = 1 wave per second
- 10 Hz = 10 waves per second

Content: Pitch

Introduce:

Pitch

- How high or low a sound appears.

Key Relationship

- High frequency = high pitch
- Low frequency = low pitch

Wave Diagrams

Show examples:

- Low Frequency
- High Frequency

Explain:

Higher frequency means more waves pass a point each second.

Content: Time Period

Introduce:

Time Period

- The time taken for one complete wave.

Unit:

- Seconds (s)

Frequency Equation

Introduce:

Frequency = $1 \div \text{Time Period}$

Worked Example 1

Time Period = 0.5 s

Frequency = $1 \div 0.5$

Frequency = 2 Hz

Worked Example 2

	Time Period = 0.25 s Frequency = $1 \div 0.25$ Frequency = 4 Hz Key Idea As time period becomes smaller: Frequency becomes larger. Teacher Modelling (EEF 3) Model: 1. Counting waves from a diagram. 2. Identifying frequency. 3. Using the calculation formula. 4. Linking calculations to pitch. Model explanation: “The second wave has a higher frequency because more waves pass a point each second, therefore the sound has a higher pitch.” Check for Understanding (Hinge Point) • What is frequency? • What is pitch? • Which wave has the highest frequency? • What unit is used for frequency? • Calculate the frequency if the time period is 2 seconds. Mini whiteboards / cold calling			
Guided Practice (10 mins)	Task Type Supported calculation and interpretation. Pupils • Compare wave diagrams. • Identify high and low frequency waves. • Complete scaffolded frequency calculations. • Link frequency values to pitch. Teacher Role • Model the first calculation. • Reinforce units. • Correct misconceptions immediately.			

Main Task (20 mins)	Core Task Pupils: - Describe the relationship between frequency and pitch. - Interpret wave diagrams. - Calculate frequency using the formula. - Explain sound differences using scientific vocabulary. Suggested Activities - Frequency calculation worksheet. - Wave comparison task. - Oscilloscope interpretation. - GCSE-style application questions. Teacher Flexibility Teachers select format based on class need: - Structured calculations. - Card sort activity. - Diagram interpretation. - Extended explanation questions. Success Criteria - Define frequency and pitch. - Explain the relationship between them. - Calculate frequency correctly. - Use units appropriately. - Interpret wave diagrams accurately. Adaptation Prompts If pupils struggle - Provide formula triangles. - Use worked examples. - Highlight frequency and wavelength visually. If secure - Interpret unfamiliar graphs. - Compare frequency and amplitude simultaneously. - Explain observations using calculations.			
Support / Diamond (challenge)	Support - Frequency equation sheet. - Worked examples. - Vocabulary mat. Example sentence starters:			

	“A higher frequency means _____.” “Pitch increases because _____.” “Frequency is measured in _____.” Diamond (Challenge) • Explain why frequency affects pitch but not loudness. • Analyse complex wave diagrams. • Apply calculations to unfamiliar scenarios.			
Common misconceptions	• Frequency and amplitude are the same thing. • Loud sounds always have a higher frequency. • Frequency is measured in seconds. • High frequency means high amplitude. • Larger waves always have a higher pitch.			
Assessment (5 mins)	Formative and Summary Quick Check Options • Define frequency. • Define pitch. • Calculate a frequency. • Identify the higher frequency wave. Diagnostic Focus Can pupils: • Explain the relationship between frequency and pitch? • Calculate frequency correctly? • Use Hz correctly? • Interpret wave diagrams accurately?			
Exit ticket (5 mins)	Purpose Inform planning for 8C.05 Light Example Questions • What is frequency? • What is the unit of frequency? • How does increasing frequency affect pitch? Teacher uses responses to identify misconceptions before moving on to light waves.			
Adaptive	• Retrieval strengthens understanding of			

teaching	• amplitude and wave properties. • Hinge questions identify misconceptions about frequency and pitch. • Worked examples reduce cognitive load during calculations. • Vocabulary is explicitly taught and revisited. • Challenge develops mathematical and conceptual understanding. • Exit ticket informs progression to light waves.			
British Values	Individual Liberty - Students independently apply mathematical and scientific knowledge to explain pitch and frequency.			
	Democracy - Students compare and justify interpretations of wave data and calculations using evidence.			
Teacher Notes for MTP adaptations				

8C.05 Light		HPA CHALLENGE	Skills	EEF Recommendations
Leaning Objectives	- Describe what happens when light travels between different media - Recall the speed of light - Compare the properties of sound and light waves	Analyse the similarities and differences between sound and light waves. Apply knowledge of wave behaviour to explain why light can travel through space but sound cannot. Evaluate how scientific models help explain the behaviour of light.	Working Scientifically WS 1.1 (Development of Scientific Thinking) Use evidence to compare different types of waves. WS 1.2 (Models) Use ray diagrams and wave models to explain the behaviour of light. WS 3.6 (Explain using Evidence) Explain observations involving light using scientific knowledge. WS 4.1 (Scientific Vocabulary) Use terms such as light ray, medium, transmission and speed of light accurately. Maths Skills 1c (Comparisons) Compare properties of light and sound. 2c (Patterns and Relationships) Identify relationships between wave type and behaviour.	EEF 4 (Memory): Retrieve prior learning about sound waves and wave models. EEF 3 (Modelling): Model the behaviour of light using ray diagrams and demonstrations. EEF 6 (Language): Explicit teaching of wave and light vocabulary. EEF 7 (Feedback): Feedback used to improve scientific comparisons and explanations.
Do Now (5 mins)	Purpose Retrieve prior learning about wave behaviour, sound waves and the movement of energy. Suggested Structure (teacher adapts) - What type of wave is sound? - What is a medium? - Why can sound not travel through a vacuum? Diamond (Challenge) - How does sunlight reach Earth if space is mostly a vacuum? Teacher Uses Responses To - Assess understanding of sound transmission. - Identify misconceptions about light and sound. - Prepare pupils to compare different types of waves.			
Hook / Intro (5 mins)	Introduce Key Idea “How can we see stars millions of kilometres away?” Suggested Strategy Display images of: - The Sun - The Moon - Distant stars Ask: - How does light from these objects reach our eyes? - Why can light travel through space but sound cannot? - Are sound and light the same type of wave? Pedagogical Rationale Creates curiosity and provides a real-world context for comparing light and sound.			

	Direct Teaching: Cell Structure (10 – 15 mins) Content: Light Waves Introduce: Light • A type of transverse wave. • Transfers energy. • Travels in straight lines. Speed of Light Recall: Speed of light $\approx 300,000,000$ m/s (3×10^8 m/s) Explain: • Light travels much faster than sound. • This is why lightning is seen before thunder is heard. Light and Media Introduce: Medium • A substance through which a wave can travel. Explain: Light can travel through: • Air • Water • Glass • Vacuum Key Idea Unlike sound waves, light does not require a medium. This is why sunlight can travel through space. Comparing Sound and Light Waves <table><tr><th>Property</th><th>Sound</th><th>Light</th></tr><tr><td>Wave Type</td><td>Longitudinal</td><td>Transverse</td></tr><tr><td>Requires Medium?</td><td>Yes</td><td>No</td></tr><tr><td>Travels Through Vacuum?</td><td>No</td><td>Yes</td></tr><tr><td>Speed in Air</td><td>~340 m/s</td><td>~300,000,000 m/s</td></tr></table> Teacher Modelling (EEF 3)	Property	Sound	Light	Wave Type	Longitudinal	Transverse	Requires Medium?	Yes	No	Travels Through Vacuum?	No	Yes	Speed in Air	~340 m/s	~300,000,000 m/s			
Property	Sound	Light																	
Wave Type	Longitudinal	Transverse																	
Requires Medium?	Yes	No																	
Travels Through Vacuum?	No	Yes																	
Speed in Air	~340 m/s	~300,000,000 m/s																	

	Model comparison using a Venn diagram. Example explanation: “Both sound and light transfer energy, but sound requires particles while light can travel through a vacuum.” Model a simple light ray travelling through different media. Check for Understanding (Hinge Point) • What type of wave is light? • Can light travel through a vacuum? • What is the speed of light? • How is light different from sound? Mini whiteboards / cold calling			
Guided Practice (10 mins)	Task Type Supported comparison and explanation. Pupils • Compare sound and light in a table. • Identify similarities and differences. • Interpret simple ray diagrams. Teacher Role • Model first examples. • Reinforce correct vocabulary. • Correct misconceptions immediately.			
Main Task (20 mins)	Core Task Pupils: • Compare sound and light waves. • Explain how light travels through different media. • Recall and apply the speed of light. • Use evidence to explain why light can travel through space. Suggested Activities • Sound vs light comparison table. • Venn diagram activity. • Light-ray interpretation task. • Structured explanation questions. Teacher Flexibility Teachers select format based on class need: • Comparison table.			

	• Card sort activity. • Diagram annotation. • Extended explanation task. Success Criteria • Identify light as a transverse wave. • Recall the speed of light. • Compare light and sound accurately. • Explain why light can travel through a vacuum. • Use scientific vocabulary accurately. Adaptation Prompts If pupils struggle • Provide completed comparison examples. • Use visual diagrams. • Provide sentence stems. If secure • Apply understanding to astronomy examples. • Analyse unfamiliar wave scenarios. • Explain why scientific models are useful. •			
Support / Diamond (challenge)	Support • Sound vs light comparison grid. • Vocabulary mat. • Annotated ray diagrams. Example sentence starters: “Light differs from sound because _____.” “Light can travel in a vacuum because _____.” Diamond (Challenge) • Explain why communication with spacecraft would be impossible using sound waves. • Analyse situations involving both sound and light. • Evaluate why light is considered an electromagnetic wave while sound is a mechanical wave.			
Common misconceptions	• Light requires air to travel. • Sound and light are the same type of wave. • Light travels infinitely fast.			

	• Light and sound travel at the same speed. • Light waves are longitudinal.			
Assessment (5 mins)	Formative and Summary Quick Check Options • State the speed of light. • Explain why sound cannot travel through space. • Compare sound and light waves. • Identify the type of wave that light is. Diagnostic Focus Can pupils: • Compare light and sound correctly? • Explain transmission through different media? • Recall the speed of light? • Use scientific vocabulary accurately?			
Exit ticket (5 mins)	Purpose Inform planning for 8C.06 Reflection Example Questions • What type of wave is light? • Why can light travel through a vacuum? • Give one difference between sound and light. Teacher uses responses to identify misconceptions before introducing reflection.			
Adaptive teaching	• Retrieval strengthens understanding of wave models. • Hinge questions identify misconceptions about light. • Comparisons reduce cognitive load. • Vocabulary is explicitly taught and revisited. • Challenge develops deeper conceptual understanding. • Exit ticket informs progression to reflection.			
British Values	Tolerance - Students recognise that scientific models are continually refined as evidence improves. Individual Liberty - Students independently compare light and sound using scientific evidence.			

Teacher Notes for MTP adaptations

8C.06 Reflection		HPA CHALLENGE	Skills	EEF Recommendations
Learning Objectives	- Describe how light is reflected from a mirror - Explain how images are formed in a plane mirror - Construct ray diagrams to model reflection and image formation	Analyse how ray diagrams can be used to explain image formation. Apply the law of reflection to unfamiliar situations. Evaluate the strengths and limitations of ray diagrams as scientific models of light behaviour.	Working Scientifically WS 1.1 (Development of Scientific Thinking) Understand how scientific models explain observations. WS 1.2 (Models) Use ray diagrams as models of light behaviour. WS 3.6 (Explain using Evidence) Explain image formation using scientific reasoning. WS 4.1 (Scientific Vocabulary) Use terms such as reflection, incident ray, reflected ray, plane mirror and image accurately. Maths Skills 1c (Comparisons) Compare incident and reflected rays. 2c (Patterns and Relationships) Identify relationships between incoming and reflected light.	EEF 4 (Memory): Retrieve prior learning about light waves and light rays. EEF 3 (Modelling): Model ray diagrams step-by-step using worked examples. EEF 6 (Language): Explicit teaching of reflection vocabulary. EEF 7 (Feedback): Feedback used to improve ray-diagram construction and scientific explanations.
Do Now (5 mins)	Purpose Retrieve prior learning about light and wave behaviour. Suggested Structure (teacher adapts) - What type of wave is light? - Can light travel through a vacuum? - What is the speed of light? Diamond (Challenge) - Why can you see your reflection in a mirror but not in a wall? Teacher Uses Responses To - Assess understanding of light. - Identify misconceptions about reflection. - Prepare pupils for image formation.			
Hook / Intro (5 mins)	Introduce Key Idea “How does a mirror create an image that appears to be behind the glass?” Suggested Strategy Use a plane mirror. Ask pupils: - Where does the image appear? - Is the image actually inside the mirror? - How does light travel from the object to your eye? Pedagogical Rationale Creates curiosity about image formation and the behaviour of reflected light.			
Direct Teaching: Cell Structure (10 – 15 mins)	Content: Reflection Introduce: Reflection The bouncing of light from a surface.			

Key Terms**Incident Ray**

- The ray of light travelling towards a surface.

Reflected Ray

- The ray of light travelling away from the surface.

Normal Line

- An imaginary line drawn at 90° to the surface.

Law of Reflection

State:

The angle of incidence equals the angle of reflection.

Explain:

- Measured from the normal.
- Applies to all reflected light rays.

Plane Mirrors

Introduce:

Plane Mirror

- A flat reflective surface.

Images formed in a plane mirror are:

- Upright.
- Same size as the object.
- Virtual images.
- Laterally inverted.

Virtual Image

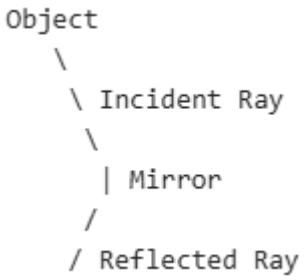
Introduce:

Virtual Image

- An image that appears to be behind the mirror.
- Light does not actually pass through the image position.

Teacher Modelling (EEF 3)

Model a ray diagram:

	Object  Then model image formation: • Draw two reflected rays. • Extend rays behind the mirror. • Show where they appear to meet. • Label the virtual image. Key Idea The brain assumes light travels in straight lines. This causes the image to appear behind the mirror. Check for Understanding (Hinge Point) • What is reflection? • What is an incident ray? • What is a reflected ray? • What is a virtual image? • What does the law of reflection state? Mini whiteboards / cold calling			
Guided Practice (10 mins)	Task Type Supported ray-diagram construction. Pupils • Label incident and reflected rays. • Identify the normal line. • Measure angles of incidence and reflection. • Complete partially drawn ray diagrams. Teacher Role • Model first examples. • Reinforce correct use of rulers. • Check angle measurements.			
Main Task (20 mins)	Core Task Pupils:			

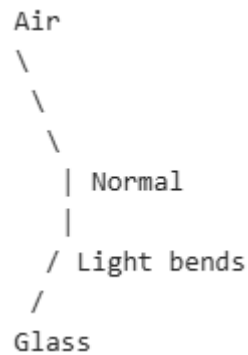
	- Describe reflection from a plane mirror. - Explain image formation. - Construct ray diagrams. - Apply the law of reflection to different situations. Suggested Activities - Mirror practical investigation. - Ray-diagram construction. - Reflection angle calculations. - GCSE-style application questions. Teacher Flexibility Teachers select format based on class need: - Plane mirror practical. - Diagram completion. - Card sort activity. - Written explanation task. Success Criteria - Define reflection accurately. - Identify incident and reflected rays. - State the law of reflection. - Construct labelled ray diagrams. - Explain how virtual images are formed. Adaptation Prompts If pupils struggle - Provide partially completed diagrams. - Use colour-coded rays. - Provide labelled examples. If secure - Complete independent ray diagrams. - Apply reflection to unfamiliar situations. - Explain limitations of simple ray models.			
Support / Diamond (challenge)	Support - Reflection vocabulary mat. - Ray-diagram guide. - Worked example sheets. Example sentence starters: “The incident ray is _____.” “The reflected ray is _____.”			

	“The image appears behind the mirror because _____.” Diamond (Challenge) - Explain why virtual images cannot be projected onto a screen. - Analyse reflection in multiple-mirror systems. - Evaluate how useful ray diagrams are for modelling light behaviour.			
Common misconceptions	- Light stops when it reaches a mirror. - Images form on the surface of the mirror. - Incident and reflected rays travel in the same direction. - Reflection changes the speed of light. - Virtual images are physically present behind the mirror.			
Assessment (5 mins)	Formative and Summary Quick Check Options - Define reflection. - State the law of reflection. - Label a ray diagram. - Explain what a virtual image is. Diagnostic Focus Can pupils: - Explain reflection accurately? - Use ray diagrams correctly? - Identify virtual images? - Apply the law of reflection?			
Exit ticket (5 mins)	Purpose Inform planning for 8C.07 Refraction Example Questions - What is reflection? - What does the law of reflection state? - What is a virtual image? Teacher uses responses to identify misconceptions before introducing refraction.			
Adaptive teaching	- Retrieval strengthens understanding of light waves. - Hinge questions identify misconceptions about			

	image formation. • Ray-diagram modelling reduces cognitive load. • Vocabulary is explicitly taught and revisited. • Challenge develops analytical and evaluative thinking. • Exit ticket informs progression to refraction.			
British Values	Individual Liberty - Students independently apply ray models to explain how mirrors form images. Democracy -Students discuss and justify explanations for reflection using scientific evidence.			
Teacher Notes for MTP adaptations				

8C.07 Refraction		HPA CHALLENGE	Skills	EEF Recommendations
Learning Objectives	- Describe what happens when light enters a different medium - Explain how light passes through transparent materials and lenses using ray diagrams - Construct ray diagrams showing refraction	Analyse how changes in speed cause light to refract when moving between media.	Working Scientifically WS 1.1 (Development of Scientific Thinking) Understand how scientific models explain the behaviour of light. WS 1.2 (Models) Use ray diagrams to represent the movement of light through different media. WS 3.6 (Explain using Evidence) Explain observations involving refraction using scientific knowledge. WS 4.1 (Scientific Vocabulary) Use terms such as refraction, lens, ray diagram, converging lens and diverging lens accurately. Maths Skills 1c (Comparisons) Compare the paths of light in different media. 2c (Patterns and Relationships) Identify relationships between changes in speed and changes in direction.	EEF 4 (Memory): Retrieve prior learning about light rays and reflection. EEF 3 (Modelling): Model refraction using ray diagrams and practical demonstrations. EEF 6 (Language): Explicit teaching of specialist optics vocabulary. EEF 7 (Feedback): Feedback used to improve ray-diagram construction and scientific explanations.
Do Now (5 mins)	Purpose Retrieve prior learning about light and reflection. Suggested Structure (teacher adapts) - What type of wave is light? - What is reflection? - What does the law of reflection state? Diamond (Challenge) - Why does a straw appear bent when placed in a glass of water? Teacher Uses Responses To - Assess understanding of reflection. - Identify misconceptions about light behaviour. - Prepare pupils for refraction.	Apply ray diagrams to explain how lenses alter the path of light. Evaluate the usefulness of ray diagrams as models for explaining refraction.		
Hook / Intro (5 mins)	Introduce Key Idea "Why do objects sometimes appear bent when viewed through water or glass?" Suggested Strategy Demonstrate: - A pencil or straw placed in water. - A coin appearing to move when water is added to a container. Ask: - Has the object actually changed shape? - Why does it look different? - What is happening to the light? Pedagogical Rationale Provides a visible and engaging example of refraction before introducing the scientific explanation.			
Direct Teaching: Cell Structure (10	Content: Refraction Introduce:			

– 15 mins)	Refraction - The change in direction of light when it travels from one medium to another. Examples of media: - Air - Water - Glass Why Refraction Happens Explain: - Light travels at different speeds in different media. - When light changes speed, it changes direction. - This causes refraction. Key Idea Light bends because its speed changes. Refraction Rules Air → Glass - Light slows down. - Light bends towards the normal. Glass → Air - Light speeds up. - Light bends away from the normal. Lenses Introduce: Converging Lens - Thicker in the middle. - Brings light rays together. Diverging Lens - Thinner in the middle. - Spreads light rays apart. Teacher Modelling (EEF 3) Model ray diagrams step-by-step. Air to Glass			
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Converging Lens

Show parallel rays entering and meeting at a focal point.

Diverging Lens

Show parallel rays spreading apart after passing through the lens.

Check for Understanding (Hinge Point)

- What is refraction?
- Why does light refract?
- What happens when light enters glass from air?
- What type of lens brings light rays together?
- What type of lens spreads light rays apart?

Mini whiteboards / cold calling

Guided Practice
(10 mins)

Task Type

Supported ray-diagram interpretation.

Pupils

- Label refracted rays.
- Identify changes in direction.
- Compare converging and diverging lenses.
- Complete partially drawn ray diagrams.

Teacher Role

- Model first examples.
- Reinforce scientific vocabulary.
- Check use of rulers and straight lines.

Main Task (20 mins)

Core Task

Pupils:

- Describe refraction.
- Explain why light changes direction.

	- Construct ray diagrams showing refraction. - Explain how lenses affect light rays. Suggested Activities - Refraction ray-diagram construction. - Lens comparison table. - Interpretation of refraction examples. - GCSE-style application questions. Teacher Flexibility Teachers select format based on class need: - Practical refraction investigation. - Diagram annotation. - Structured worksheet. - Extended written explanation. Success Criteria - Define refraction accurately. - Explain why refraction occurs. - Construct accurate ray diagrams. - Describe the action of converging and diverging lenses. - Use scientific vocabulary correctly. Adaptation Prompts If pupils struggle - Provide partially completed ray diagrams. - Use colour-coded rays. - Provide labelled lens diagrams. If secure - Explain apparent depth examples. - Apply ray diagrams to unfamiliar situations. - Analyse lens applications in technology.			
Support / Diamond (challenge)	Support - Refraction vocabulary mat. - Ray-diagram templates. - Lens information sheet. Example sentence starters: “Refraction occurs because _____.” “Light bends towards the normal because _____.”			

	“A converging lens causes light rays to _____.” Diamond (Challenge) - Explain why a swimming pool appears shallower than it really is. - Compare refraction through different materials. - Evaluate the usefulness of ray diagrams when explaining refraction.			
Common misconceptions	- Refraction and reflection are the same process. - Light always bends towards the normal. - Lenses create light. - Refraction happens because light “wants” to change direction. - Light changes direction without changing speed.			
Assessment (5 mins)	Formative and Summary Quick Check Options - Define refraction. - Explain why light bends. - Identify the type of lens shown. - Complete a simple ray diagram. Diagnostic Focus Can pupils: - Explain why refraction occurs? - Construct ray diagrams accurately? - Distinguish between reflection and refraction? - Use scientific vocabulary correctly?			
Exit ticket (5 mins)	Purpose Inform planning for 8C.08 The Eye and Vision Example Questions - What is refraction? - Why does light change direction when entering glass? - What type of lens brings light rays together? Teacher uses responses to identify misconceptions before studying vision and corrective lenses.			
Adaptive teaching	- Retrieval links reflection to refraction. - Hinge questions identify misconceptions about light behaviour. - Practical demonstrations support conceptual			

	understanding. • Vocabulary is explicitly taught and revisited. • Challenge develops application and evaluation skills. • Exit ticket informs progression to the eye and vision.			
British Values	Individual Liberty - Students independently apply scientific models to explain how light behaves in different media. Democracy - Students compare and justify interpretations of ray diagrams using scientific evidence.			
Teacher Notes for MTP adaptations				

8C.08 the Eye and Vision		HPA CHALLENGE	Skills	EEF Recommendations
Learning Objectives	- Identify the main structures of the eye - Explain how light is focused onto the retina using ray diagrams - Describe how lenses can be used to correct vision defects	Analyse how the structures of the eye work together to produce clear vision. Apply knowledge of lenses and refraction to explain vision defects.	Working Scientifically WS 1.1 (Development of Scientific Thinking) Understand how biological structures and physical processes work together. WS 1.2 (Models) Use ray diagrams as models to explain vision. WS 3.6 (Explain using Evidence) Explain how the eye focuses light. WS 4.1 (Scientific Vocabulary) Use terms such as retina, pupil, iris, cornea, optic nerve and lens accurately. Maths Skills 1c (Comparisons) Compare short-sightedness and long-sightedness. 2c (Patterns and Relationships) Identify relationships between lens shape and image formation.	EEF 4 (Memory): Retrieve prior learning about refraction and lenses. EEF 3 (Modelling): Model how ray diagrams explain vision and vision correction. EEF 6 (Language): Explicit teaching of eye and vision vocabulary. EEF 7 (Feedback): Feedback used to improve explanations and ray-diagram interpretation.
Do Now (5 mins)	Purpose Retrieve prior learning about refraction and lenses. Suggested Structure (teacher adapts) - What is refraction? - What does a converging lens do? - What does a diverging lens do? Diamond (Challenge) - Why does the eye contain a lens? Teacher Uses Responses To - Assess understanding of lens behaviour. - Identify misconceptions about refraction. - Prepare pupils for vision and image formation.	Evaluate the effectiveness of different corrective lenses in improving vision.		
Hook / Intro (5 mins)	Introduce Key Idea “Your eyes continually perform optical calculations without you even noticing.” Suggested Strategy Display: - A camera - A human eye Ask: - What do these objects have in common? - How do they produce images? - What happens if they cannot focus properly? Pedagogical Rationale Links vision to familiar technology and highlights the eye as an optical system.			
Direct Teaching: Cell Structure (10 – 15 mins)	Content: The Structure of the Eye Introduce key structures: Cornea			

- Transparent outer layer.
- Refracts incoming light.

Iris

- Controls the size of the pupil.

Pupil

- Opening that allows light to enter the eye.

Lens

- Refracts light to focus images.

Retina

- Light-sensitive layer where images are formed.

Optic Nerve

- Carries electrical signals from the eye to the brain.

Key Idea

For clear vision, light must be focused onto the retina.

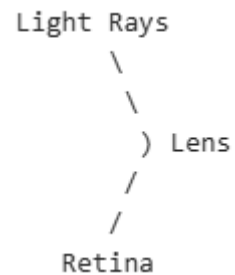
How the Eye Forms an Image

Explain:

1. Light enters through the cornea and pupil.
2. The lens refracts the light.
3. Light is focused onto the retina.
4. The optic nerve transmits signals to the brain.

Teacher Modelling (EEF 3)

Model a ray diagram:



Model explanation:

“The lens refracts incoming light so that the rays converge on the retina, forming a clear image.”

	Vision Defects Short-Sightedness (Myopia) Problems: • Distant objects appear blurred. • Image forms in front of the retina. Correction: • Diverging lens. Long-Sightedness (Hyperopia) Problems: • Near objects appear blurred. • Image forms behind the retina. Correction: • Converging lens. Key Idea Corrective lenses change the path of light before it enters the eye. Check for Understanding (Hinge Point) • What does the retina do? • What is the role of the optic nerve? • What causes short-sightedness? • Which lens corrects long-sightedness? • Why must light be focused on the retina? Mini whiteboards / cold calling			
Guided Practice (10 mins)	Task Type Supported labelling and explanation. Pupils • Label diagrams of the eye. • Match structures to functions. • Interpret simple ray diagrams. Teacher Role • Model first examples. • Reinforce anatomical vocabulary. • Correct misconceptions immediately.			
Main Task (20 mins)	Core Task Pupils: • Identify structures of the eye. • Explain how light is focused onto the retina.			

	- Describe vision defects. - Explain how lenses correct defects. Suggested Activities - Eye structure labelling. - Ray-diagram interpretation. - Vision defect comparison table. - GCSE-style application questions. Teacher Flexibility Teachers select format based on class need: - Diagram annotation. - Card sort activity. - Structured worksheet. - Extended explanation task. Success Criteria - Identify the main structures of the eye. - Explain how images are formed. - Describe short- and long-sightedness. - Explain how corrective lenses work. - Use scientific vocabulary accurately. Adaptation Prompts If pupils struggle - Provide labelled diagrams. - Use colour-coded ray diagrams. - Provide sentence starters. If secure - Explain why images become blurred. - Compare vision defects in detail. - Apply understanding to unfamiliar ray diagrams.			
Support / Diamond (challenge)	Support - Eye structure diagram. - Ray-diagram templates. - Vocabulary mat. Example sentence starters: “The function of the retina is _____.” “Short-sightedness occurs when _____.” “A converging lens helps by _____.”			

	Diamond (Challenge) - Analyse how the eye adapts to different viewing distances. - Explain why different lenses are needed for different vision defects. - Evaluate the strengths and limitations of corrective lenses.			
Common misconceptions	- The iris is the coloured image you see. - The retina sends signals directly to the brain. - The lens creates light. - All sight problems are corrected using the same lens. - The eye produces images rather than detecting light.			
Assessment (5 mins)	Formative and Summary Quick Check Options - Identify an eye structure. - State the function of the retina. - Explain one vision defect. - Identify the correct corrective lens. Diagnostic Focus Can pupils: - Identify eye structures? - Explain image formation? - Describe vision defects? - Use scientific vocabulary accurately?			
Exit ticket (5 mins)	Purpose Inform planning for 8C.09 The Electromagnetic Spectrum Example Questions - What is the function of the retina? - Which lens corrects short-sightedness? - Why must light be focused on the retina? Teacher uses responses to identify misconceptions before introducing electromagnetic waves.			
Adaptive teaching	- Purpose - Inform planning for 8C.09 The Electromagnetic Spectrum - Example Questions			

	• What is the function of the retina? • Which lens corrects short-sightedness? • Why must light be focused on the retina? • Teacher uses responses to identify misconceptions before introducing electromagnetic waves.			
British Values	Rule of Law - Students understand the importance of following professional medical advice regarding eyesight and corrective lenses. Individual Liberty - Students apply scientific knowledge to make informed decisions about eye health and vision correction.			
Teacher Notes for MTP adaptations				

8C.09 The Electromagnetic Spectrum		HPA CHALLENGE	Skills	EEF Recommendations
Learning Objectives	- Describe the regions of the electromagnetic spectrum - Explain how different types of electromagnetic radiation affect living cells - Analyse the relationship between frequency and the potential damage caused by electromagnetic radiation	Analyse how the structures of the eye work together to produce clear vision. Apply knowledge of lenses and refraction to explain vision defects. Evaluate the effectiveness of different corrective lenses in improving vision.	Working Scientifically WS 1.1 (Development of Scientific Thinking) Understand how scientific models explain wave behaviour across the electromagnetic spectrum. WS 3.5 (Interpret Data) Interpret information about frequency, uses and hazards of electromagnetic waves. WS 3.6 (Explain using Evidence) Explain the effects of electromagnetic radiation on living cells. WS 3.7 (Evaluation) Evaluate risks and benefits of different regions of the spectrum. WS 4.1 (Scientific Vocabulary) Use terms such as electromagnetic spectrum, infrared, ultraviolet, X-rays and gamma rays accurately. Maths Skills 1c (Comparisons) Compare frequencies across the spectrum. 2c (Patterns and Relationships) Identify patterns between frequency and energy. 4a (Interpretation) Interpret diagrams and data relating to electromagnetic waves.	EEF 4 (Memory): Retrieve prior learning about waves, frequency and light. EEF 3 (Modelling): Model the electromagnetic spectrum and compare regions using frequency and uses. EEF 6 (Language): Explicit teaching of specialist wave vocabulary. EEF 7 (Feedback): Feedback used to improve explanations of radiation effects and comparisons between wave types.
Do Now (5 mins)	Purpose Retrieve prior learning about waves, frequency and light. Suggested Structure (teacher adapts) - What type of wave is light? - What is frequency? - How does increasing frequency affect pitch in sound waves? Diamond (Challenge) - Are all light waves exactly the same? Teacher Uses Responses To - Assess understanding of wave properties. - Identify misconceptions about light. - Prepare pupils for the electromagnetic spectrum.			
Hook / Intro (5 mins)	Introduce Key Idea "The visible light you can see is only a tiny part of a much larger family of waves." Suggested Strategy Display images showing: - Radio mast - Microwave oven - TV remote control - Sunlight - X-ray image - Cancer radiotherapy equipment Ask: - What do these technologies have in common? - Are they all types of light? - Why might some forms be more dangerous than others?			

	Pedagogical Rationale Provides real-world relevance and introduces the idea that electromagnetic waves have a wide range of uses.			
Direct Teaching: Cell Structure (10 – 15 mins)	Content: Electromagnetic Spectrum Introduce: Electromagnetic Spectrum • A family of waves that transfer energy. • All electromagnetic waves are transverse waves. • All travel at the speed of light in a vacuum. Order of the Electromagnetic Spectrum From lowest frequency to highest frequency: • Radio waves • Microwaves • Infrared • Visible light • Ultraviolet • X-rays • Gamma rays Key Idea As frequency increases: • Energy increases. • Potential biological damage increases. Uses of Electromagnetic Waves Radio Waves • Communication • Radio and television broadcasting Microwaves • Cooking • Mobile phone communication • Satellite communication Infrared • Thermal imaging • Remote controls Visible Light • Vision • Photography Ultraviolet • Security marking • Sterilisation X-rays			

	• Medical imaging • Airport security Gamma Rays • Sterilisation • Cancer treatment Effects on Living Cells Lower Frequency Waves (Radio, Microwaves, Infrared) • Generally less damaging. • Mainly cause heating effects. Higher Frequency Waves (Ultraviolet, X-rays, Gamma Rays) • Can damage cells and DNA. • Increase the risk of mutations. • May increase the risk of cancer. Teacher Modelling (EEF 3) Model spectrum diagram: Low Frequency Radio → Microwave → Infrared → Visible Light → UV → X-rays → Gamma High Frequency Model explanation: “Gamma rays have the highest frequency and therefore the most energy. This means they can cause the most damage to living cells.” Check for Understanding (Hinge Point) • What is the electromagnetic spectrum? • Which waves have the highest frequency? • Which waves are used in communication? • Which waves can damage DNA? • What happens to energy as frequency increases? Mini whiteboards / cold calling			
Guided Practice (10 mins)	Task Type Supported classification and comparison. Pupils • Sequence the electromagnetic spectrum.			

	• Match wave types to uses. • Classify waves according to risk level. Teacher Role • Model first examples. • Reinforce frequency patterns. • Correct misconceptions immediately.			
Main Task (20 mins)	Core Task Pupils: • Describe the electromagnetic spectrum. • Compare different regions of the spectrum. • Explain how electromagnetic waves affect living cells. • Analyse the relationship between frequency and potential damage. Suggested Activities • Spectrum ordering activity. • Uses and risks comparison table. • Case-study analysis. • GCSE-style application questions. Teacher Flexibility Teachers select format based on class need: • Card sort activity. • Comparison table. • Information carousel. • Extended written explanation. Success Criteria • Describe the electromagnetic spectrum. • Identify the correct order of waves. • Explain how frequency changes across the spectrum. • Explain why some waves are more dangerous than others. • Use scientific vocabulary accurately. Adaptation Prompts If pupils struggle • Provide a labelled spectrum diagram. • Use retrieval and matching activities. • Highlight the frequency trend visually. If secure			

	• Compare multiple wave types. • Explain medical applications in detail. • Evaluate risks and benefits of different waves.			
Support / Diamond (challenge)	Support • Electromagnetic spectrum diagram. • Vocabulary mat. • Uses-and-risks comparison table. Example sentence starters: “The frequency of _____ is higher than _____.” “This wave is used for _____.” “This type of radiation may damage cells because _____.” Diamond (Challenge) • Analyse why certain waves are chosen for medical applications. • Compare the risks and benefits of X-rays and gamma rays. • Evaluate whether the benefits of high-frequency radiation outweigh the risks.			
Common misconceptions	• Visible light is the only type of light. • All electromagnetic waves are equally dangerous. • Frequency and speed are the same thing. • Microwaves are always harmful. • Gamma rays and X-rays have the same effects as radio waves.			
Assessment (5 mins)	Formative and Summary Quick Check Options • Sequence the electromagnetic spectrum. • Identify a use of a wave type. • Explain how frequency changes across the spectrum. • State which waves are most likely to damage cells. Diagnostic Focus Can pupils: • Describe the electromagnetic spectrum?			

	• Link frequency and energy? • Explain effects on living cells? • Apply knowledge to real-world examples?			
Exit ticket (5 mins)	Purpose Review and consolidate the entire 8C Waves topic. Example Questions • Which electromagnetic wave has the highest frequency? • Why are gamma rays potentially harmful? • Give one use of infrared radiation. Teacher uses responses to identify areas for future retrieval and revision.			
Adaptive teaching	• Retrieval links wave properties across the topic. • Hinge questions identify misconceptions about frequency and radiation. • Visual models support understanding of an abstract spectrum. • Vocabulary is explicitly taught and revisited. • Challenge develops application and evaluation skills. • Exit ticket supports future retrieval practice.			
British Values	Tolerance - Students recognise that scientific developments involving electromagnetic radiation have both benefits and risks for society. Individual Liberty - Students evaluate evidence about the effects of radiation and make informed judgements about its use.			
Teacher Notes for MTP adaptations				