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Future: At GCSE the topics of light and sound will come into a unit about waves. Wave behaviour is common in both natural and man-made systems. Waves carry energy from one place to another and can also carry information.

In KS2 you learnt that recognise that they need light in order to see things and that dark is the absence of light and shadows are formed when the light from a light source is blocked by an opaque object and how sounds are made, associating some of them with something vibrating and recognise that vibrations from sounds travel through a medium to the ear.

Why?
Light and sound travel by waves and modern technologies such as imaging and communication systems show how we can make the most of electromagnetic waves.

Careers:
electrician
sound engineer
optician
ophthalmologist
audiologist

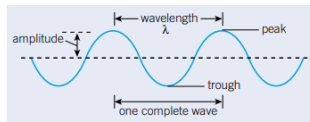
Light and Sound

1	I can state that sound is a longitudinal wave, with reference to the direction of vibrations and energy
2	I can recognise and label a diagram of a longitudinal wave, including compressions and rarefactions
3	I can describe the reflection of a sound wave as an echo and describe some applications of echoes, including sonar, ultrasound and echolocation
4	I can state that light waves are transverse with reference to the direction of vibrations and energy.
5	I can draw a ray diagram of reflection, showing that the angle of incidence is always equal to the angle of reflection
6	I can explain how we see different colours, with reference to reflection of light from objects compared to emission of RGB.

Amplitude	The maximum amount of vibration, as measured from the middle position of the wave. Usually measured in metres.
Frequency	The number of waves produced in one second, in hertz.
Longitudinal wave	Where the direction of vibration is the same as that of the wave.
Medium	The material that affects light or sound (or other waves) by slowing it
Oscillate	Move to and fro about a certain position along a line.
Reflection	The change in direction of light or sound when it hits a boundary and bounces back.
Refraction	Change in direction of light going from one material to another.
Spectrum	A band of light produced when light is spread to by a prism.
Transverse wave	A wave in which the direction of vibration is perpendicular to that of the wave.

Properties of waves

A wave is an **oscillation** or **vibration** that transfers energy. Matter is not transferred. Waves can be longitudinal or transverse.



Amplitude – distance from the middle to the top or bottom of the wave

Wavelength – distance between a point on the wave to the same point on the next wave

Trough – bottom of the wave **Peak** – top of the wave

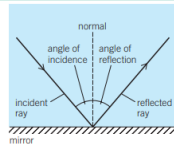
Frequency – how many waves go past a particular point in a second, measured in **hertz** (Hz) or kHz

Reflection and refraction of light

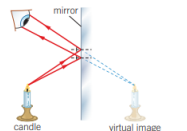
The **law of reflection** states that:

The **angle of incidence** is equal to the **angle of reflection**.

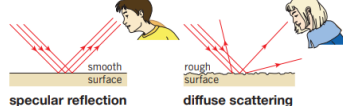
The **normal** is an imaginary line at 90° to the mirror.



Images in mirrors are **virtual** – they look like they are behind the mirror.



Whether or not you can see a clear reflected image depends on how smooth the surface is:

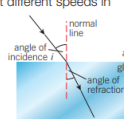


Refraction is when light changes direction when it travels from one **medium** (material, such as air or water) to another.

Refraction happens because light travels at different speeds in different materials.

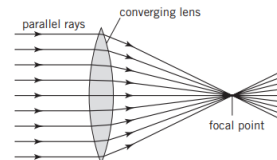
Rays of light will be refracted:

- towards the normal if they slow down, such as going from air to glass
- away from the normal if they speed up, such as going from water to air.



Lenses use refraction to spread out or **focus** light.

Convex (or **converging**) lenses (like the ones in your eyes) are shaped to focus the light to a point – called the **focal point**.

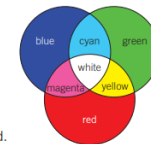


Colours of light

A **prism** refracts different colours of light by different amounts. This disperses light into a continuous **spectrum** of colours.

The **primary colours** of light are **red, green, and blue**.

Secondary colours are produced when any two primary colours are mixed.



Filters subtract colours from white light, so that only one colour of light is transmitted.

Objects appear to be different colours because they reflect some colours of light and absorb others.

Black objects absorb all colours and white objects reflect all colours.

How does light travel?

Luminous objects are sources of light, e.g., the Sun.

Non-luminous objects do not produce their own light, e.g., the Moon.

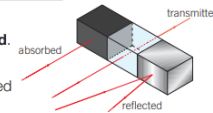
When light hits an object it can be **absorbed, reflected, or transmitted**.

If an object is:

transparent – most light is transmitted

translucent – light is scattered

opaque – no light is transmitted so a shadow is produced.

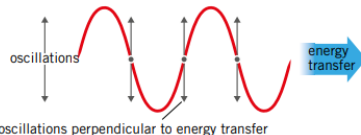


Light can travel through gases, some solids and liquids, and completely empty space (a vacuum).

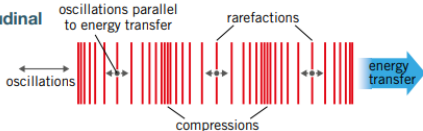
The speed of light in a **vacuum** is about 300 000 km/s.

Transverse and longitudinal waves

Transverse waves



Longitudinal waves



Measuring sound

a loud and high-pitched

b loud and low-pitched

c quiet and high-pitched (higher pitch than a)

Oscilloscopes are instruments that give a visual representation of a sound wave. The taller the waves, the more energy that is in the wave and higher the volume. The more waves there are in the screen, the higher the frequency and the pitch is higher.

Humans can hear frequencies 20 Hz to 20 kHz. Above this is ultrasound. Below this is **infrasound**.

Sound volume is measured in **decibels** (dB). The decibel scale is not linear – a 10dB increase is 10 times the volume.

Complete some of the tasks below to reach a total of _____ points over this unit of work – Highlight the box once completed.

Topic	1 Point	2 Points	4 Points	6 Points	10 Points
Reflection and Refraction 	Write a tweet that defines what refraction is. (140 characters).	Draw a diagram that shows how light refracts through a piece of Perspex. Make sure that you label the angles correctly.	Design a lab leaflet, explaining the difference between refraction and reflection.	Design a blank light maze using the reflection of light. Challenge a classmate to complete the maze.	Research how the effects of reflection and refraction are used in machinery. Create a list of appliances and technology and write a short essay on how the properties of light allow them to work.
How we see colours 	State the part of your eye that sends the signals of what we see to your brain.	Create a mnemonic to help you remember the spectrum of light.	Draw a diagram showing how light travels into our eyes. Draw the path the light takes and label the parts of the eye.	Write two exam questions based on how we see colour. Include a question about rods and cones and the structure of the eye.	Write a letter to a scientific journal explaining why it is strange that we see the colour magenta.
EM Spectrum. 	Which part of the EM spectrum do we see (Extension – Which range of wavelengths does this include).	Describe what UV light is in one paragraph.	Create a diagram showing the main parts of the EM spectrum and include approximate wavelengths.	Research some technological uses for different parts of the EM spectrum. Create a list of technologies that use the EM spectrum and the wavelengths that they use.	We know that some animals can see into the infra-red and ultra violet wavelengths of the EM spectrum. Write a short story about what you think life would be like if humans could also do this.
Wave Properties 	Name one property of a transverse wave.	Draw a table for longitudinal and transverse waves and write down the properties of each.	Create a poem to help you remember the different properties for the different waves.	Complete a fact sheet about wave properties – you can only use 3 diagrams and 25 keywords!	Research and produce a poster about how X-Rays – What type of wave do they use? How do they work?

