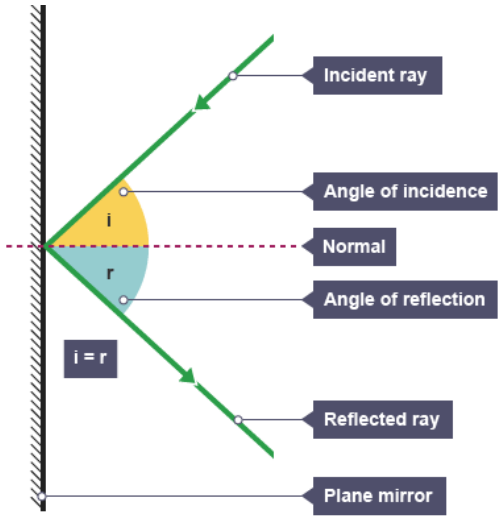
SCIENCE

Year 8: Waves

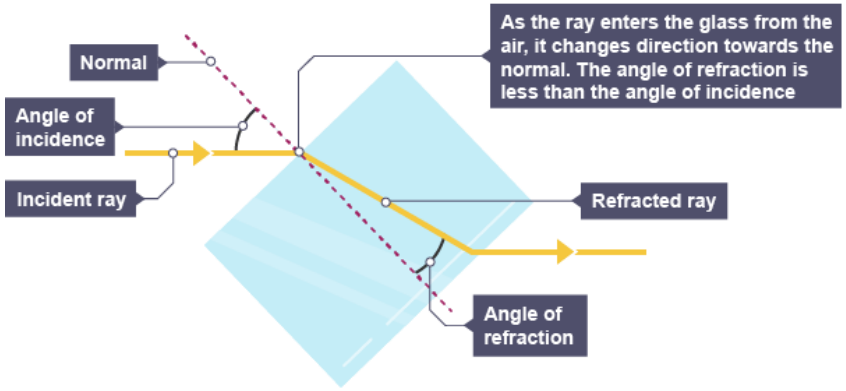
1) What is reflection?

- When light reaches a surface, it can bounce off it. This is **reflection**.
- The law of reflection states that the angle of incidence, i, equals the angle of reflection, r (i = r).
- If light meets a rough surface, each ray obeys the law of reflection but the light is not all reflected in one direction. Instead, the light is reflected in all directions. This is called **diffuse scattering**. It explains why you can see a clear image of yourself in a shiny flat mirror, but not in a dull rough wall.



1) What is refraction?

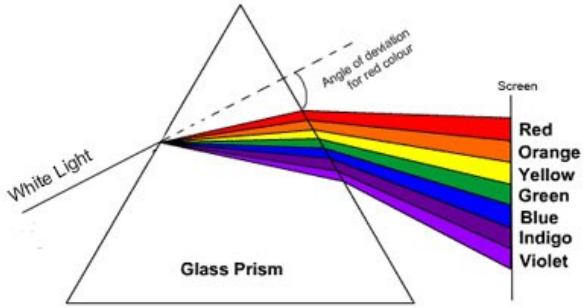
- Light waves change speed when they pass across the boundary between two substances with a different density, such as air and glass. This causes them to change direction, an effect called **refraction**.
- The diagram shows how this works for light passing into, and then out of, a glass block.

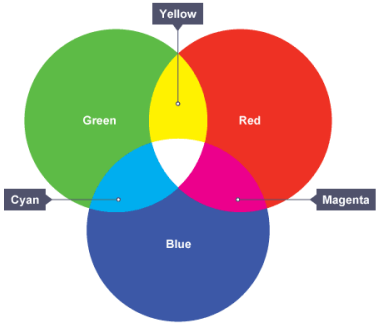


Keyword	Meaning	Keyword	Meaning
Absorb	When a substance 'takes in' the energy of a wave, reducing its intensity.	**Refraction**	When a wave changes speed as it crosses a boundary between two substances with different densities, causing it to change direction.
Amplitude	The maximum height of a wave from its resting position - the greater the amplitude of a sound, the louder it is.	**Transmit**	When a substance allows a wave to travel through it.
Crest	The highest point of a wave.	**Transverse**	A type of wave where the vibrations causing it are at right-angles to the direction of travel, eg. light waves.
Frequency	The number of waves per second - the higher the frequency of a sound, the higher its pitch.	**Trough**	The lowest point of a wave.
Longitudinal	A type of wave where the vibrations causing it are in the same direction as the direction of travel, eg. sound.	**Wave**	Something that transfers energy from one place to another with no net transfer of matter.
Reflection	When a wave changes direction by bouncing off a surface.	**Wavelength**	The distance between the crests of two waves next to each other.

3) What is white light made of?

- White light is a mixture of different colours, each with a different **frequency**. White light can be split up into a **spectrum** of these colours using a **prism**, as ach colour is refracted by a different amount. This is a process called **dispersion**.
- There are three primary colours in light: red, green and blue. These colours can be added together to make the secondary colours. All three primary colours add together make white light.





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5) How do we see colour?

- When light hits a surface, it is **absorbed** or **reflected**.

- The light that is **reflected** is the colour of the object in that light. For example, a blue object **absorbs** all the colours of the **spectrum** except blue: it reflects blue light.
- The table gives some more examples, displaying the colour of light shining on an object, the colour(s) **absorbed** by an object, the colour **reflected** by an object in this light and the colour of an object seen in this light.

	White paper	Red apple	Green apple
Colours(s) that the object can reflect	All	Red only	Green only
Appearance of object in white light	White (no colours absorbed)	Red (all colours absorbed except red)	Green (all colours absorbed except green)
Appearance of object in red light	Red (only red light to reflect)	Red	Black (no green light to reflect)
Appearance of object in green light	Green (only green light to reflect)	Black (no red light to reflect)	Green
Appearance of object in blue light	Blue (only blue light to reflect)	Black (no red light to reflect)	Black (no green light to reflect)

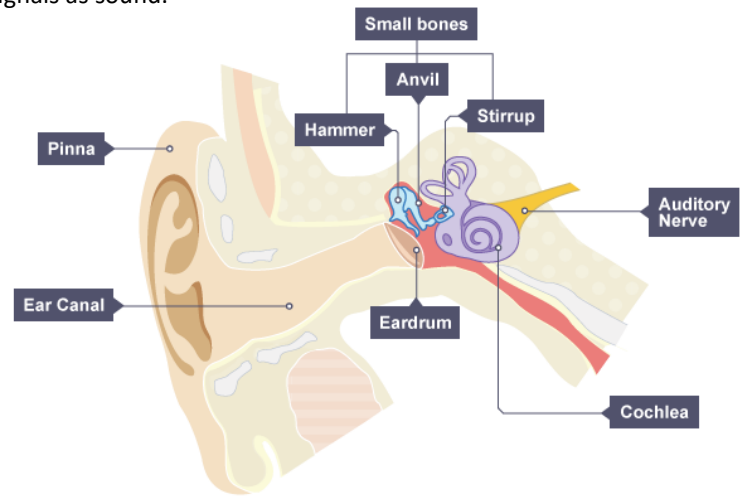
5) How do waves travel?

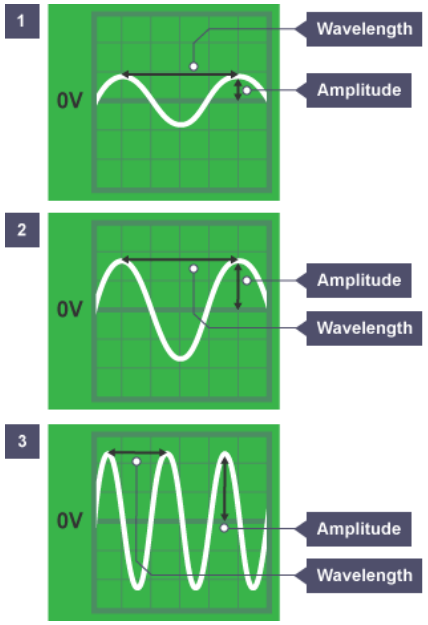
- Light travels as **transverse** waves, with the vibrations at 90° to the direction of travel.
- Sound waves are **longitudinal** - the vibrations are in the same direction as travel.
- Light travels in straight lines and can travel through a vacuum (empty space). Sound needs a substance (solid/ liquid/ gas) to travel through.
- There is a large difference between the speed of light in air (almost 300,000,000 m/s) and the speed of sound in air (343 m/s).

	Light waves	Sound waves
Type of wave	Transverse	Longitudinal
Can they travel through matter (solids, liquids and gases)?	Yes (if transparent or translucent)	Yes
Can they travel through a vacuum?	Yes	No
How are they detected?	Eyes, cameras	Ears, microphones
Can they be reflected?	Yes	Yes
Can they be refracted?	Yes	Yes

6) How do we hear sound?

- We can detect sound using our ears. An ear has an eardrum inside, connected to three small bones (called ossicles).
- The vibrations in the air make the eardrum vibrate, and these vibrations are passed through the three small bones to a spiral structure called the cochlea.
- Signals are passed from the cochlea to the brain through the auditory nerve, and our brain interprets these signals as sound.



7) How can we visualise sound?

- Both our ears and microphones contain a diaphragm. The vibrations in air make the diaphragm vibrate, and these vibrations are changed to electrical impulses.
- In the lab, these impulses can be sent to an **oscilloscope**, which represents them as a graph on a screen.
- Diagrams 1 and 2 show two sounds with the same **wavelength** and **frequency**, so they will have the same pitch. The sound in diagram 2 has a greater **amplitude** than the one in diagram 1, so it will be louder.
- Diagrams 2 and 3 show two sounds with a different **wavelength** and **frequency**. The sound in diagram 3 has a higher **frequency** than the one in diagram 2, so its pitch will be higher.