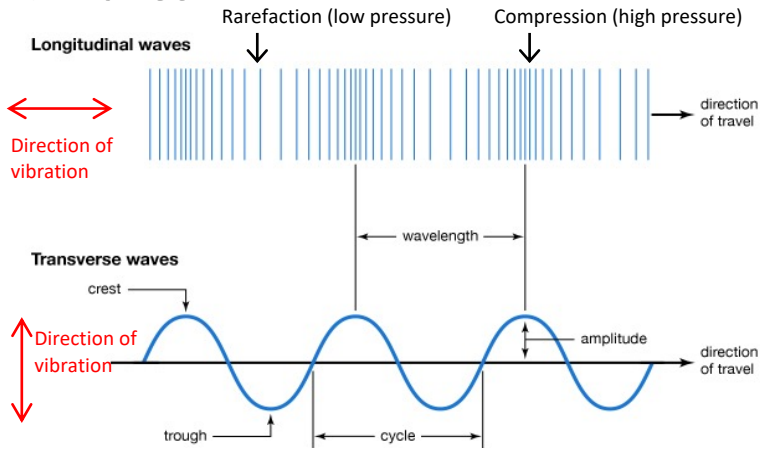
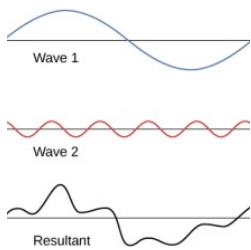


# Waves

## 1. Waves



There are two types of wave, **transverse and longitudinal**. Water and light waves are transverse, sound waves are longitudinal.



**Superposition** – waves can combine to create a new wave.

**Mechanical** waves need particles, e.g. sound.

**Electromagnetic** waves travel through a vacuum (no particles), e.g. light.

State of matter	Relative speed of sound
Solid	Very fast
Liquid	Medium
Gas	Slow
Vacuum	Stopped

The **density** of a material affects the speed sound passes through it. In a solid the particles are close-packed so vibrations travel fastest.

The speed of sound in a vacuum is 0m/s.

## 2. Properties of light

The speed of light is 300 000 000m/s.

**Transparent** materials transmit light through them.

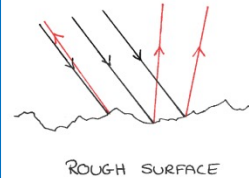
**Opaque** materials absorb light.

**Translucent** materials transmit light through, but scatter it on the way, so only a hazy image is seen.

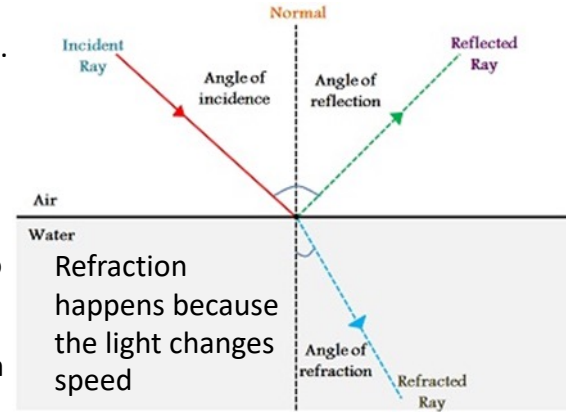
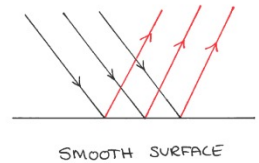
When light reaches a boundary it can be **absorbed, reflected or refracted**.

The Law of Reflection states that the angle of incidence is equal to the angle of reflection.

**Specular reflection** occurs at smooth surfaces. If parallel rays hit the surface they are all reflected in the same direction. An image is produced.



**Diffuse reflection** occurs at rough surfaces. If parallel rays hit the surface they are scattered in different directions. The Law of Reflection still applies, but the surface is at a different angle each time. No image is produced.



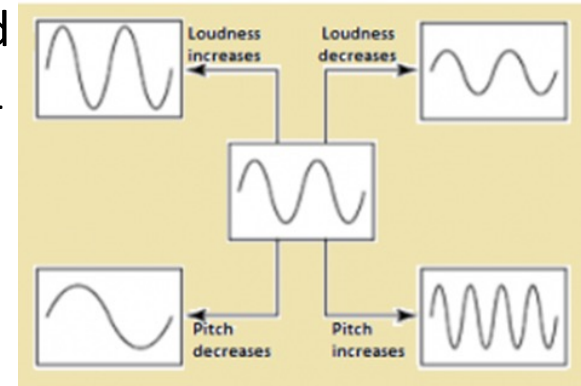
Refraction happens because the light changes speed

## 3. Properties of sound

The speed of sound in air is 340m/s.

The louder the sound, the bigger the amplitude of the wave.

The higher the pitch the higher the frequency (and so the shorter the wavelength) of the wave.



Frequency is measured in Hertz (Hz).

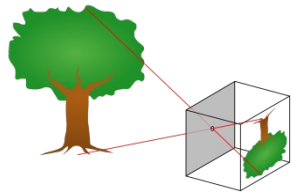
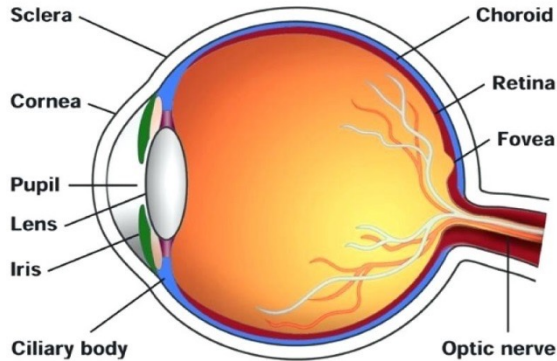
# Waves

## 6. Vision

Light rays enter the eye through the **cornea** and then the pupil. The **iris** controls the size of the pupil (and the amount of light).

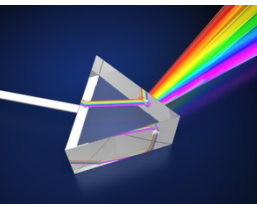
The cornea and the **lens** refract the light to focus it on the **retina** at the back of the eye.

The retina is a layer of light sensitive cells that convert the rays into electrical signals to travel along the optic nerve to the brain.



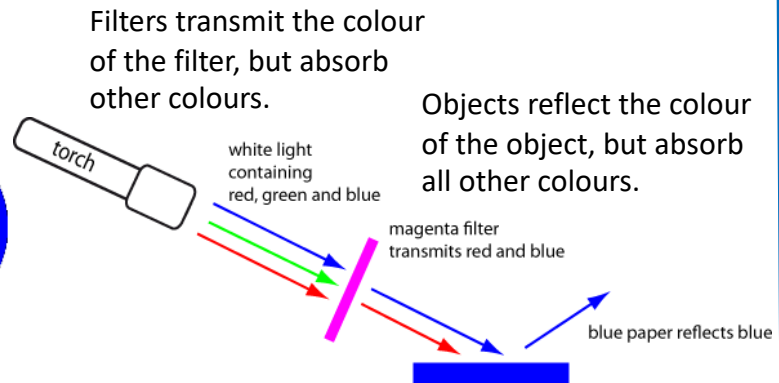
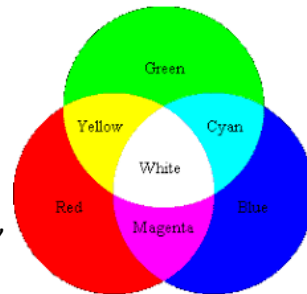
A pinhole camera works in a similar way, with rays entering through the pin hole and projecting onto the screen.

## 7. Colour



White light is made up of the 7 colours of the spectrum – red, orange, yellow, green, blue, indigo and violet.

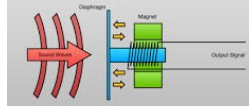
There are 3 primary colours of light – red, blue and green.



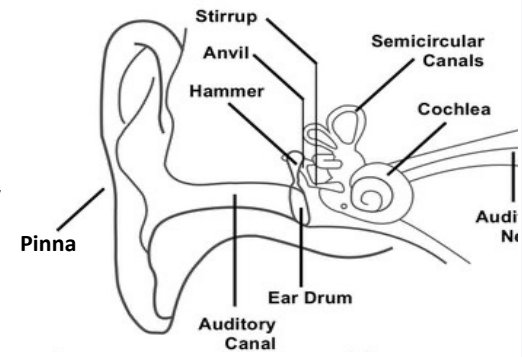
## 4. Hearing

The **pinna** funnels sound waves down the ear canal to the **ear drum**.

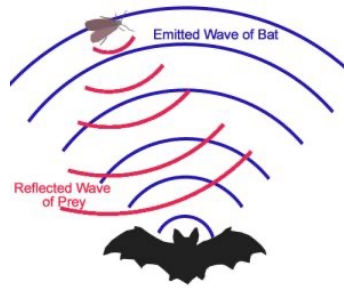
The changes in pressure cause the ear drum to vibrate. The vibrations are transmitted by the 3 small bones to the **cochlea**. This converts the sound to electrical signals to travel to the brain along the auditory nerve.



A microphone works in a similar way, with sound (pressure) waves causing the diaphragm to vibrate.



## 5. Ultrasound



Ultrasound is sound waves of a **very** high frequency, above 20 000Hz.

Ultrasound and echolocation use the same principle. Sound waves are reflected when the sound reaches a boundary or object. The distance the sound travels can be calculated.

Ultrasound can be used in medical imaging (e.g. pre-natal scans of a foetus), in physiotherapy to treat injuries and in cleaning sensitive objects (e.g. the inside of watches).