Edward Peake Church of England Middle School		
Topic: Waves. Sound and light	**Year: 8**	**Strand: Physics**

What should I already know?

Different types of sound

- Sounds are only possible when a vibration occurs. Banging on a drum or plucking a guitar produces vibrations that cause a sound to be made.
- We can change the vibrations of a sound by giving them more energy. The stronger the vibrations, the louder the sound.
- Some sounds we hear have a high pitch, like a whistle or a siren. Some have a low pitch, like the rumble of thunder. When we change the pitch, we change how rapidly an object vibrates

.How sounds behave.

- We hear sounds because the vibrations travel through a material, like air, to the ear.
- Sounds may be reflected by hard materials and absorbed by soft materials.
- Sounds get fainter as they travel further from the source.

How light behaves.

- Light appears to travel in straight lines.
- Shadows have the same shape as the objects that made them because of light travelling in straight lines

.How we see things.

- We see objects because they emit or reflect light into our eyes.
- We can see objects that don't emit their own light because they reflect light from other sources into our eyes.
- We can explain this using the idea that light travels in straight lines.

What will I know by the end of the unit?

What sound is

- Energy is transferred by sound in the form of waves.
- Sound travels as longitudinal waves (vibrations) passed on by particles of a material.
- Sounds can be represented by waveforms, showing wavelength, frequency and amplitude.
- The greater the amplitude of the waveform, the louder the sound.
- The greater the frequency (and the shorter the wavelength), the higher the pitch.
- The ear is a detector of sound waves of a certain frequency range.

How sound behaves.

- The denser the medium, the faster sound travels.
- Sound is transmitted, reflected or absorbed by different types of surfaces.
- Echoes occur when sound waves are reflected by hard materials.

What light is.

- Light travels as transverse waves that carry energy.
- White light can be split into a spectrum of colours.
- Coloured light causes an object to appear a different colour.

How light behaves.

- Light waves can travel through a vacuum.
- Light can be reflected, absorbed and refracted.
- When it is reflected, the angle of incidence equals the angle of reflection. Light can form an image in a mirror.
- Light can be refracted through lenses and prisms.
- Wave properties can be described using a ray diagram as a model.

Vocabulary

Absorption	Taking in, for example, energy transferred by sound
Amplitude	Distance from the middle to the top or bottom of a wave.(Volume of a sound)

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Angle of incidence	Angle between the normal line and incident ray.
Angle of reflection	Angle between the normal line and the reflected ray.
Auditory nerve	Electrical signal travels along the auditory nerve to the brain
Auditory range	Iis the range of sound frequencies from the lowest to the highest that an animal or human can hear
Compression	The part of a longitudinal wave where the air particles are close together.
Concave lens	A lens which is thinner in the middle which spreads out light rays.
Convex lens	A lens which is thicker in the middle which beds light rays towards each other.
Crest	Top of a wave
Decibel (dB)	The unit used to measure the loudness of sound. (abbreviated: dB
Echo	This Is the repeating of a sound caused by the bouncing of sound waves from a surface. for example, I heard the echo of my footsteps in the empty hallway.
Frequency	The number of waves produced in one second; unit Hertz (Hz). Or this can be explained as the number of waves that go past a point per second.
Hertz (Hz)	The unit of frequency equal to one cycle per second. (abbr.: Hz)
Hypothesis.	A prediction or educated guess that can be tested and can be used to guide further study.
Image	picture of an object that we see in a mirror or through a lens or system of lenses
Incident ray	Incoming ray of light. Or it can be explained as the wave coming from a source
Lens	A specially shaped piece of transparent material that refracts light passing through it to form an image.
longitudinal	A wave where the vibrations are in the same direction as the direction of travel.
Normal line	A dotted line which is at right angles to the surface, from which angles are measured.
Opaque	Material that allows no light to be transmitted through it.eg wood
Oscillation	Moving backwards and forwards
Oscilloscope	Equipment that allows sound waves, which have been turned into electrical signals, to be viewed as waveforms
Ossicles	One of the 3 small bones in the tympanic cavity of the ear essential for enabling us to hear.
Particle	A very small part of a material, such as an atom or a molecule
Peak	Top of a wave
Pitch	Is the term used to explain how high or low the frequency of a sound is
Rarefaction	Part of a longitudinal wave where the air particles are spread out. (Do not get muddled with reflection on refraction)
Ray model	Is a simple diagrammatic model used to show how light behaves as it reflects off a mirror or passes through transparent materials
reflection	Change in direction of a ray or wave after it hits a surface and bounces off.
Reflected ray	Is an outgoing ray after reflection from a surface.
Refraction	Is a change in direction of a wave, such as light, caused when it enters a material of a different density.
Retina	Is the back layer of the eye, with light-detecting cels where an image is formed.
Scattering	Is when light bounces off an object in all directions.

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Soundproofing	Using materials that absorb sound. Good materials are not able to be penetrated by most ordinary audible sounds.
Spectrum	A wide range of values, for example, of frequencies or wavelengths in the visible spectrum of light.
Superpose	When waves join together so that they add up or cancel out
Translucent	A material that lets some but not all light to be transmitted through.
Transparent	A material which allows all light to be transmitted through. eg glass.
Transverse	Vibrations are at right angles to the direction of travel.
Trough	Bottom of a wave
Undulation	The action of moving smoothly up and down
Vacuum	A space where there are no particles of matter
vibration	Repeated movement backwards and forwards.
Volume	The measurement of the amount of space a material takes up, unit cm^3 or m^3; also a measurement of how loud a sound is, unit decibel (dB)
Waveform	A graph of the displacement of a wave motion at different distances along the wave (or at different times) in other words a mathematical representation of the form of a wave. plotted as a graph.
Wavelength	Distance from one point on a wave to the same point on the next wave. In other words, the distance from a corresponding point on a wave to another. eg crest to crest.

Key information Light and Sound	Key information Light

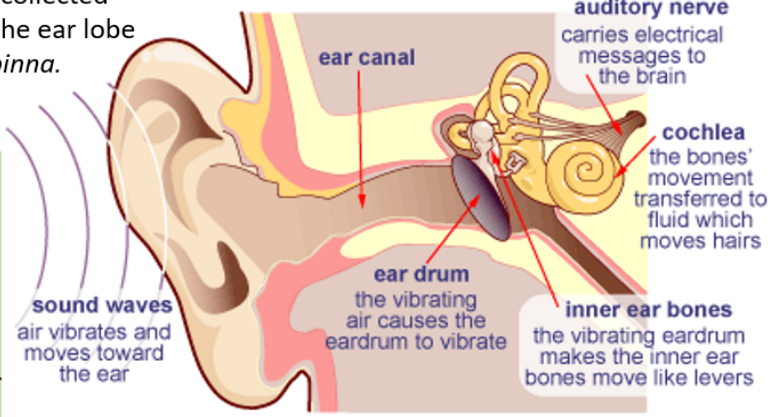
The ear

Too much wax in your ear canal (or compacted wax from using cotton buds), can press on your ear drum and reduce the vibrations felt.

Sound waves are collected by the ear lobe or *pinna*.

The waves travel along the ear canal.

The auditory nerve takes the signals to the brain.



The cochlea turns the vibrations into electrical signals.

The small bones [ossicles] amplify the vibrations.

The waves make the ear drum vibrate.

Constant loud noises can be extremely damaging to your hearing.

Persistent levels above 90dB can result in hearing damage.

Levels can be measured in decibels – more than 130dB will causes pain.

Above 140dB even short exposure car results in hearing loss.

Tinnitus - noises 'in the ears' and/or 'in the head' with no external source

Loud bangs / accidents / infections can damage the ear drum (although it may repair itself)
Middle ear can get infected (antibiotics may help)
As people age the tiny bones in the inner ear can fuse together, preventing amplification of the vibrations so hearing worsens
Nerve cells in the cochlea sometimes fail, so the messages are not sent to the brain
Cochlea can be affected by loud noise (constant loud noises can causes hearing loss, and there is no treatment for this)

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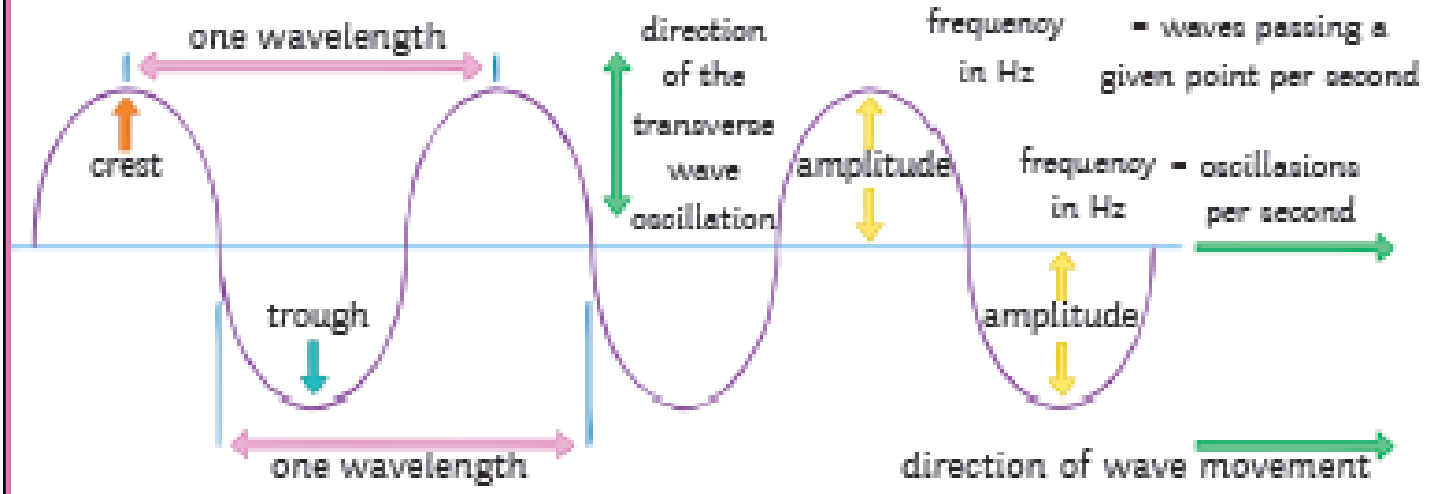

The frequency of a wave is the number of waves which pass a given point every second.

Key information light	**Key information sound**

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Medium:

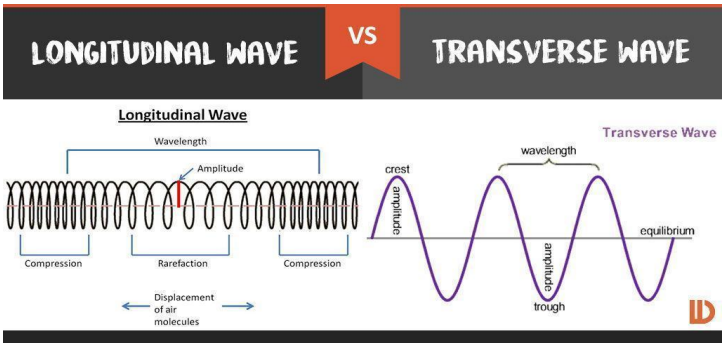
1. A medium is defined as the substance that transfers the energy, or light from one substance to another substance or from one place to another, or from one surface to another.
2. The medium acts as a carrier here.
3. The medium can transfer any form of energy, sound wave, light, and heat.

Light waves travel in straight lines.
Light travels extremely fast, faster than sound.
Shadows form because light cannot bend round corners.
Shadows form where the light cannot get to.

Luminous objects give out their own light, e.g. stars (like our Sun), light bulbs, candles.
Non-luminous objects do not give out their own light, they absorb and reflect light from luminous objects

Opaque - materials which do not allow light to pass through them (e.g. a brick wall).
Transparent - materials which do allow light to pass through them (e.g. a glass window).
Translucent - materials which only allow part of the light to pass through them (e.g. paper).

Light waves travel from the object, through the pupil of your eye, through the lens and land on the back of your eye (the retina).
This image is upside down and the information is transmitted down the optic nerve to the brain.
The brain interprets the image and turns it the right way up.
Cameras work in a very similar way.



Sound

- Sounds are produced by vibrations.
- Sound travels as waves, which are vibrating particles.
- Sound waves are reflected by surfaces.
- Sound travels as a longitudinal wave.
- Where two waves meet, they affect each other. This is called **superposition.**

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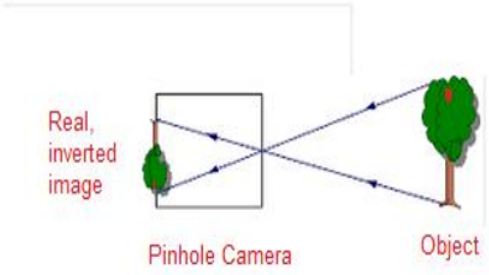
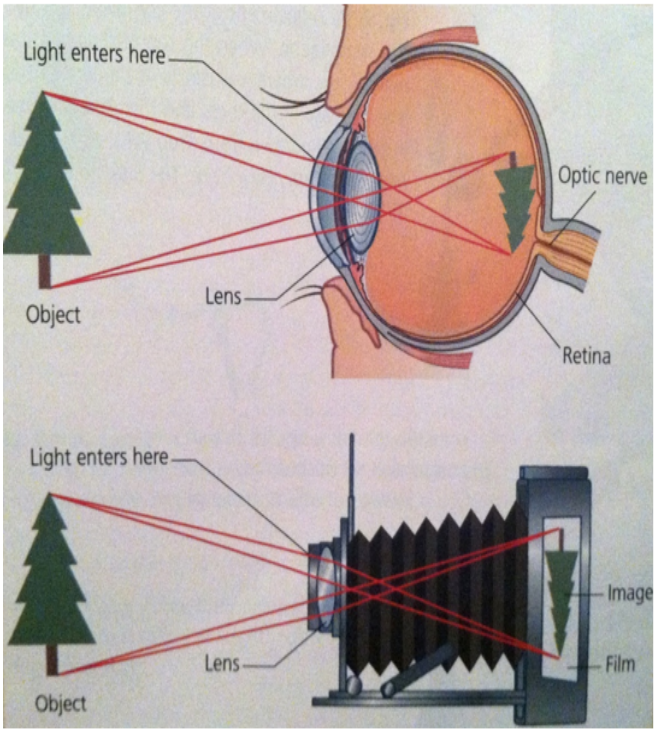
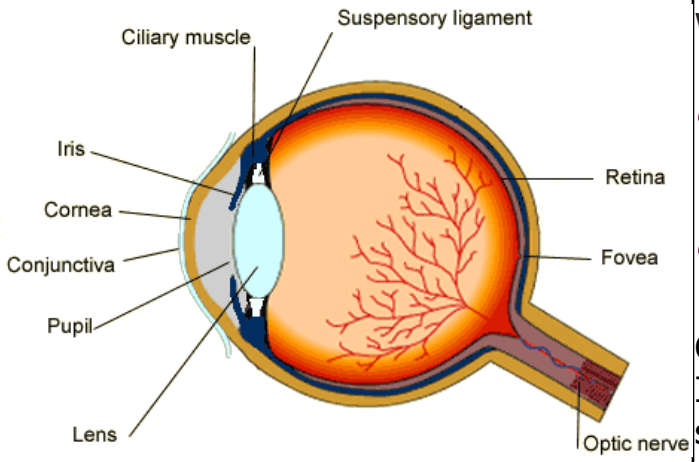


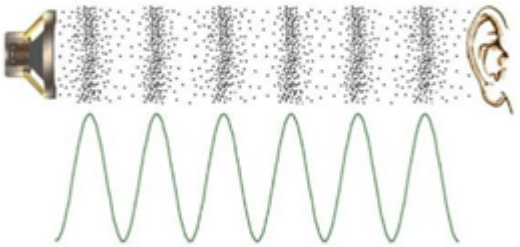




Transverse Waves eg Light waves

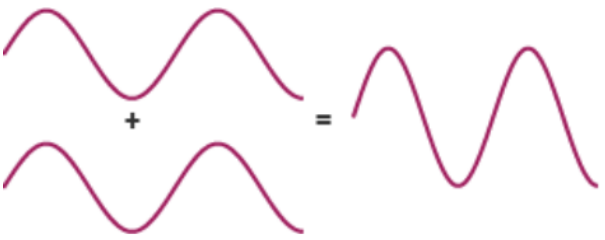
Sound is a wave that transfers energy from one place to another. A sound is caused by a source **vibrating**. The energy is transferred by the vibrations being passed on. The vibrations are detected by our ears and our brain processes this information as sound.

Sound can travel through any substance that is made up of matter. However, the **denser** the material, the faster the vibrations can be transferred. This means denser materials have a higher speed of sound. For example, sound travels about 10 times faster through gold than it does through air. Sound cannot travel through a **vacuum** because there are no particles to pass on the vibration.



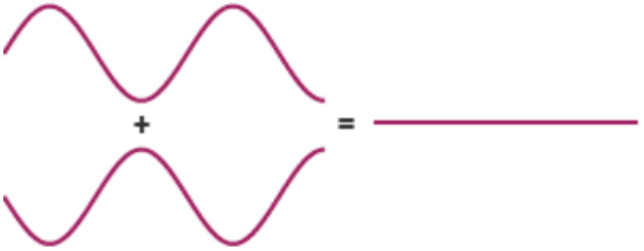
Adding waves

If two waves meet each other in step, they add together and reinforce each other. They produce a much higher wave, a wave with a greater amplitude.



Cancelling

If two waves meet each other out of step, they cancel out.



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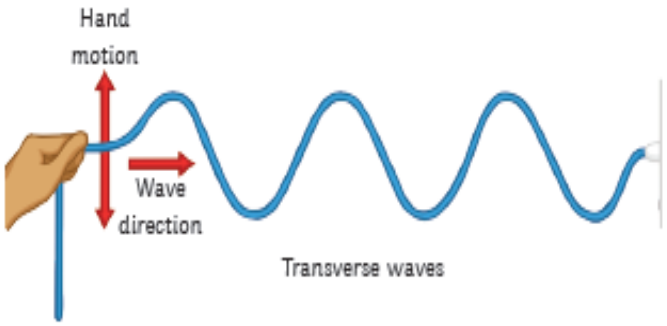
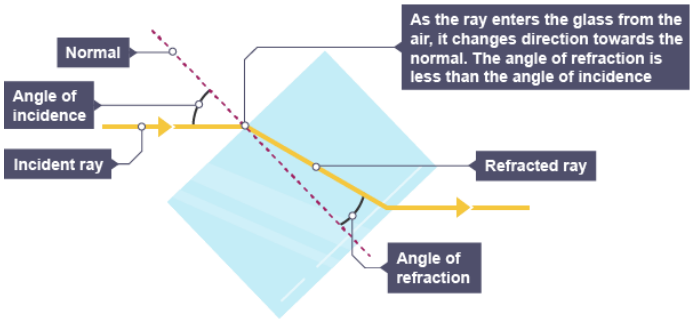
In a transverse wave, the vibrations are at a right angle (perpendicular) to the direction of the energy transfer. The wave has peaks (or crests) and troughs. Examples include water waves and light waves.

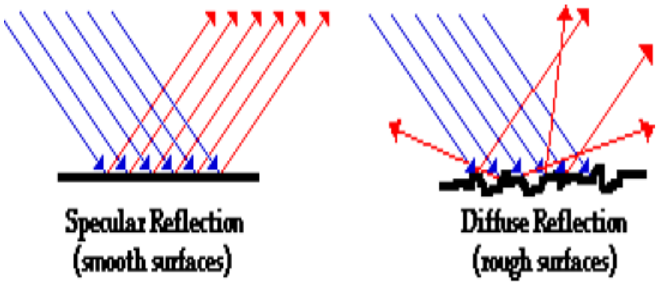


Refraction



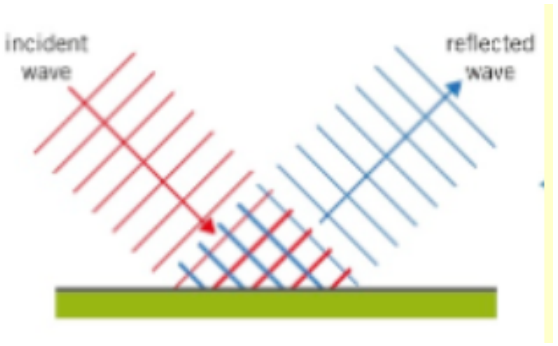
Diffuse Scattering & Specular Reflection

- Reflection from a smooth surface is called **specular reflection.** This happens because the light rays reflect at perfect angles.
- Reflection from a rough surface is called **diffuse scattering. This** happens because the light rays reflect at different angles.



Sound is created when something vibrates and sends waves of energy (vibration) into our ears. The vibrations travel through the air or another medium (solid, liquid or gas) to the ear. The stronger the vibrations, the louder the sound. Sounds are fainter the further you get from the sound source.

Reflected waves



An oscilloscope is a piece of equipment which can help us visualise sound waves. Sound waves cannot usually be seen when they are transferred through a material. However, using a microphone and an oscilloscope, we can transform the longitudinal sound wave into a transverse wave that can be seen on the oscilloscope screen.

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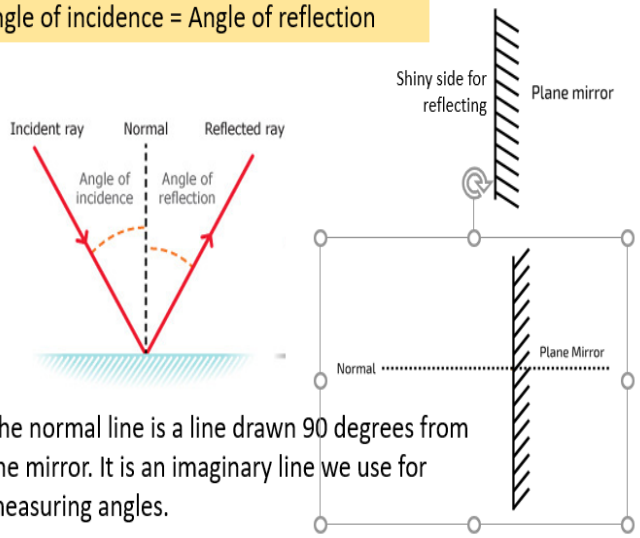
Reflection
A plane mirror reflects light and produces a clear image. This is the same size as the real object (and appears to be behind the mirror), the same distance away, and the right way up, but it is back to front (left is right etc.). This is called lateral inversion.

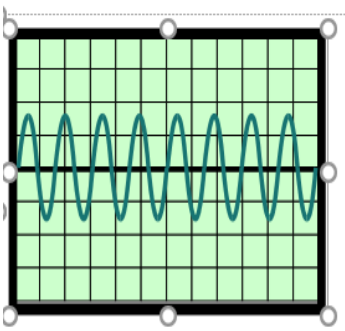
Law of Reflection:-
Angle of incidence = Angle of reflection



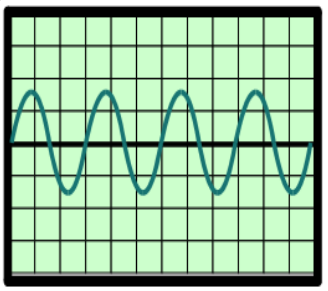
The normal line is a line drawn 90 degrees from the mirror. It is an imaginary line we use for measuring angles.

Lenses

convex lens	Lens	concave lens
⟷	Ray Diagram	>—<
	Illustration	
Causes parallel waves to converge at the principal focus.	Action	Causes parallel waves to diverge from the principal focus.
real or virtual	Type of Image	always virtual



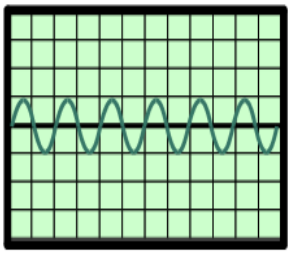
✓ A high pitch sound.



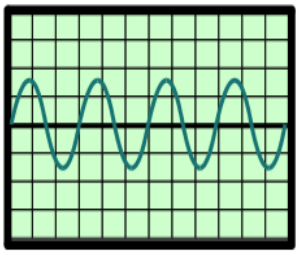
✓ A low pitch sound.

The longer the wavelength of the wave on the trace, the lower the frequency of the sound.

The more waves you can see, the higher the pitch/frequency.



✓ A quiet sound.



✓ A louder sound.

The larger the amplitude of the wave on the trace, louder the sound.

The bigger the waves you can see, the louder the sound.

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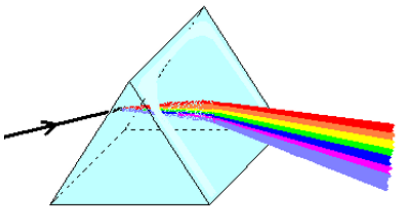
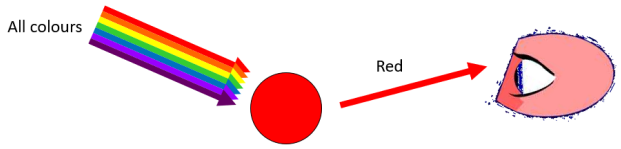
How we see colours



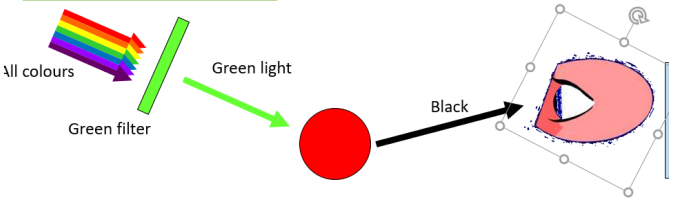
Dispersion of white light.

Red, orange, yellow, green, blue, indigo, violet.

Remember white light is made of a spectrum of colours.

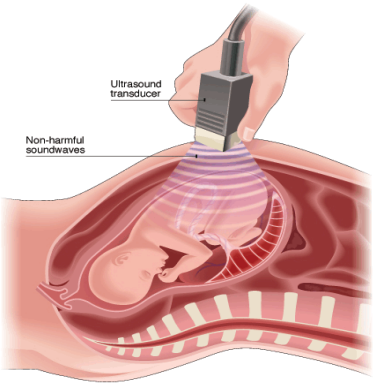


If only green light is shone ...



Ultrasound has two main advantages over X-ray imaging:

- It's able to produce images of soft tissue.
- It doesn't damage living cells.



Ultrasound can be used:

- to measure the speed of blood flow
- to detect gallstones and tumours
- for pre-natal scanning because there is less risk to mother or baby than using X-rays.

Useful Websites

Online dictionary
https://kids.wordsmyth.net/we/

Light

https://www.bbc.co.uk/bitesize/guides/zq7thyc/revision/1
https://www.youtube.com/watch?v=C9NlDtFNVc0

Oak academy complete unit. Online lessons. Light section only
https://continuityoak.org.uk/lessons
Go to year 8

Sound
What are sound waves? - BBC Bitesize
https://www.bbc.co.uk/bitesize/topics/zw982hv

Oak academy complete unit. Online lessons.
https://continuityoak.org.uk/lessons

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