Beckfoot

Subject: Science	Topic: Waves (6)	Year Group: 11

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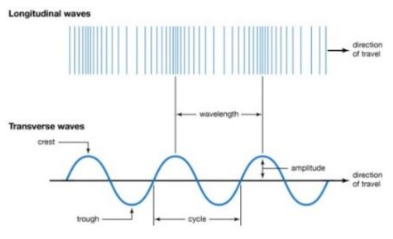
Properties of Waves

1	**Transverse waves** oscillate perpendicular (at right angles) to the direction of travel, e.g. ripples on water.		
2	**Longitudinal waves** oscillate parallel (in the same direction) to the direction of travel e.g. sound waves.		
3	Wavelength	The distance from one point on a wave to the equivalent point on the next wave.	
4	Frequency	The number of waves that pass a point in one second.	
5	Amplitude	The maximum displacement of a point on the wave from its undisturbed position.	

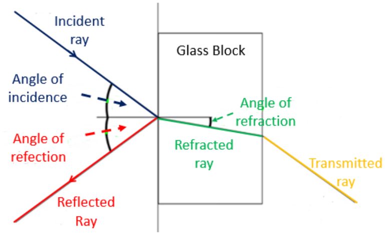
Properties of Waves Equations

1	Frequency	$T = 1 / f$ T = time period in seconds, s f = frequency in hertz, Hz
2	Wave speed, frequency and wavelength	$v = f \times \lambda$ v = wave speed in metres per second, m/s f = frequency in hertz, Hz λ = wavelength in metres, m

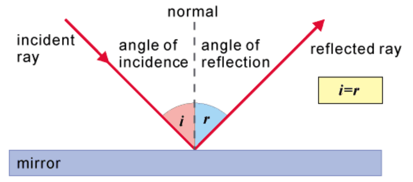
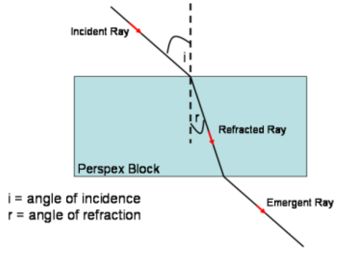
Measuring Wave Speed (RP)

1	**Investigating waves using a ripple tank.**	Oscillator creates waves in ripple tank. A light shines through meaning the waves can be seen on the screen below. If a strobe is set on the ripple tank at the same frequency as the waves, it appears as though they are standing still.
2	**Investigating waves using a string.**	An oscillator creates waves along the string, because the wave 'bounces back' when it reaches the end it can create a 'standing wave'.
3	Wavelength	Can be calculated by measuring the distance between waves – remember to take into account the effect of magnification on the screen. For a standing wave on a string, a measurement between two nodes is half a wavelength.
	Frequency	Frequency is shown on the oscillator or by calculating the number of waves passing a single point.
	Wave speed	Calculate using the equation $v = f \times \lambda$.

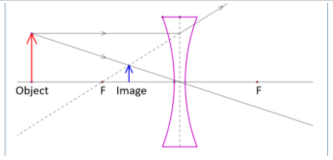
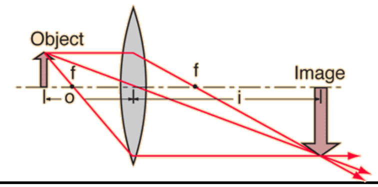
Reflection and Refraction (RP)

1	Use **a ray box** with a slit to create a beam of light. Place a **Perspex box** on a piece of white paper- draw an outline. **Shine the beam** towards the Perspex. Draw on the paper **where it enters and exits**. Some light will also reflect. Now find the angles with a protractor. Measure from the normal (a straight line 90˚ from the perspex).	 Angle of incidence = Angle of reflection. The angle of refraction tells you the refractive index (the difference in speed that light travels compared to air. Refractive index = sin (angle of incidence) / sin (angle of refraction).

Reflection and refraction

1	Waves can be **reflected** at a boundary between two different materials.	
2	Waves can be **refracted** when the density of the material it is travelling through changes, this makes the wave change speed and so the direction of travel.	

Lenses

1	**Concave** lenses make parallel waves spread out.	
2	**Convex** lenses make parallel waves converge (come together) to a focus.	
3	Focal length	Is the distance from the principal focus (where the rays are focused) to the lens.
4	Real image	Can be formed on a screen behind the lens.
5	Virtual image	Is formed where the rays appear to come from (e.g. a magnifying glass).

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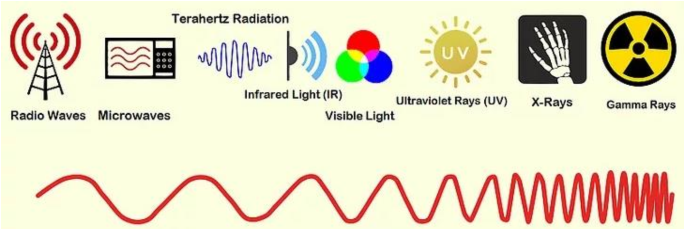
Electromagnetic Spectrum

1	Electromagnetic waves are electric and magnetic disturbances that can be used to transfer energy. This makes them useful for certain technologies.	
2		
3	Radio waves - longest wavelength	Used for communication
4	Microwaves	Used for communication. Used for heating up food.
5	Infrared (IR)	All objects emit infrared radiation – the hotter the object, the more infrared it emits. Different surfaces absorb and emit different levels of IR radiation. Infrared cameras can be used to detect heat, so can be used for night vision or for medical purposes.
6	Visible light	Light from the sun or from bulbs is white light, this means it contains all the colours of the spectrum.
7	Ultraviolet (UV)	Can be used to mark valuable objects, then visible under certain light. Can be harmful to eyes and skin
8	X-Rays	Can travel straight through objects, if the are not too dense. Used for medical purposes. Can cause ionising radiation.
9	Gamma rays – shortest wavelength	Can travel straight through objects, if the are not too dense. Used for killing harmful bacteria e.g. on food. Used for cancer treatments.

Visible Light

1	White light can be split into the colours of the rainbow using a prism.	Red, Orange, Yellow, Green, Blue, Indigo, Violet Red has the longest wavelength Violet has the shortest wavelength
2	Objects absorb and reflect different wavelengths depending on their colour.	E.g. A red top will reflect light of red's wavelength, but absorb all other wavelengths.
3	Colours can mix to form different shades. There are 3 primary colours and 3 secondary. The 3 primary colours form white light.	Primary – Red, green, blue. Secondary – Cyan (green + blue), magenta (red + blue), yellow (red + green). (These primary and secondary colours are different to the ones you learn in art, because light is different to colour pigments, like paint).
4	Opaque	Allows no light through
5	Translucent	Allows light to pass through but distorts the image.
6	Transparent	Allows light through and provides a clear image (includes coloured filters).

Key Vocabulary

1	Longitudinal Wave	Oscillate parallel (in the same direction) to the direction of travel e.g. sound waves.
2	Transverse Wave	Oscillate perpendicular (at right angles) to the direction of travel, e.g. ripples on water.
3	Wavelength	The distance from one point on a wave to the equivalent point on the next wave.
4	Frequency	The number of waves that pass a point in one second.

Key Vocabulary Continued…

5	Amplitude	The maximum displacement of a point on the wave from its undisturbed position.
6	Oscillator	Machine used to make waves at a specific frequency.
7	Ray diagram	A symbol drawing used to demonstrate how light rays move.
8	Normal	A straight line perpendicular (90˚) from the object light is travelling towards.
9	Angle of incidence	Angle between the incident ray and the normal
10	Angle of reflection	Angle between the reflected ray and the normal (equal to angle of incidence).
11	Angle of refraction	Angle between the refracted ray and the normal.
12	Convex	A lens that makes light rays parallel to the principle axis meet at a point.
13	Concave	A lens that makes parallel rays spread out.
14	Principle focus	The point where light rays parallel to the principle axis of a lens focus.
15	Real image	An image formed by a lens that can be projected onto a screen.
16	Virtual image	An image seen in a lens or mirror, from which light rays appear to come after being refracted by a lens or reflected by a mirror.
17	Electro-magnetic spectrum	The continuous spectrum of electromagnetic waves, which have various uses.

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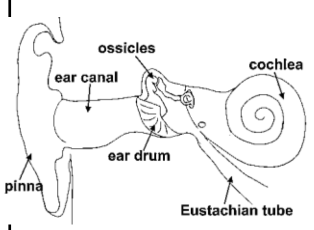
Sound Waves

1	Sound waves are longitudinal waves.	Particles vibrate in the same direction the wave travels.
2	Can pass travel through solids.	Create vibrations in the solid, transferring energy through the material.
3	Echo sounding, e.g. used in ships in deep water, and by bats and dolphins (echolocation).	High frequency sound waves can be used to detect objects, as the sounds waves are reflected from the object, then redetected, the time taken for the wave to return can be used to calculate the distance.

Hearing

1	Sound waves entering the ear cause the ear drum and other parts to vibrate.	
2	Humans can only hear a narrow range of frequencies. (20 Hz to 20,000 Hz (20 kHz)). Humans hear best at 3,000 Hz	This is because the conversion of soundwaves to vibrations of a solid (like those in the ear) only work at a limited frequency range.

Ultrasound

1	Ultrasound waves are…	Higher than the normal range of human hearing.
2	Can be partially reflected at the boundary between two different media.	This means a detector can be used to find how far away a boundary is, and so build an image. This is used in medicine (e.g. pregnancy scans) and industry.

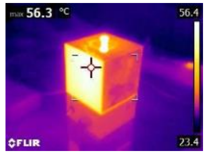
Seismic Waves

1	Seismic waves travel through the Earth and across its surface.	These can cause earthquakes and subsequently tsunamis. Earthquakes are generated in the Earth's crust, at continental fault lines.
2	Primary waves (P-Waves)	Are **longitudinal** waves that cause the initial tremor. The push or pull on material as they move through the Earth.
3	Secondary waves (S-Waves)	Are **transverse** waves that appear a few minutes after the initial tremor. They move more slowly than p-waves and shake the material they pass through
4	Studies of seismic waves have led to discoveries about the Earth's structure	Measurements of the changes in speed of seismic waves have allowed scientists to measure the boundary between the crust and mantle.

Infrared Radiation and Black Bodies

1	All objects emit and absorb infrared radiation.	The hotter an object, the more infrared radiation it absorbs.
2	A perfect black body is one that absorbs all of the radiation on it – it doesn't reflect any.	Because it is the best absorber it is also the best possible emitter.
3	A body at a constant temperature absorbs radiation at the same rate it emits it.	If a body is increasing in temperature it is absorbing faster than emitting. If it is decreasing in temperature it is emitting faster than absorbing.
4	Certain objects are designed to emit infrared radiation quickly.	E.g. halogen hobs heat up food faster than ordinary hobs, as they emit more infrared radiation.
4	The temperature of the earth depends on the rate of absorption and emission and reflection of infrared radiation.	Changes in the levels of greenhouse gases absorbing and reemitting greenhouse gases can change the temperature of the Earth.

Radiation RP

1	You can compare how much surfaces emit infrared radiation by seeing how quickly it cools down.	The quicker it emits IR radiation, the faster it will cool down. If you are measuring the temperature of the surface, the one which emits more IR radiation will have a higher temperature.
2	Matt, black surfaces emit more IR radiation,	Shiny, light coloured surfaces emit less IR radiation.
3	A Leslie cube (a cube with different surfaces on each side) can be used for this experiment. Hot water goes in the cube, then measure the temperature of each side.	 

Key Vocabulary

1	Ossicles	Small bones in the ear, vibrate when sound waves enter the ear.
2	Ear drum	Thin membrane which separates the outer and inner ear. Sound waves cause vibrations when they hit this.
3	Ultrasound	Sound waves with a higher frequency than human hearing.
4	Seismic waves	Waves which travel through the Earth's crust, usually caused by an earthquake.
7	Infrared radiation	Electromagnetic waves with wavelengths between visible light and microwaves.
8	Black body	An object that absorbs all radiation that hits it.
9	Leslie cube	A device used to measure the IR radiation emitted from different surfaces.