Physics Paper 2 Revision

Monday, 25 September 2023

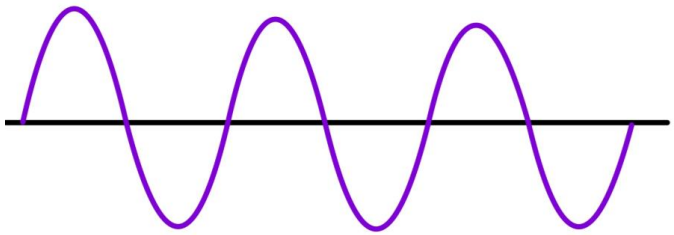
Waves

Revision Session

6.1.1 Transverse & Longitudinal

Think
Pair
Share

What are transverse and longitudinal waves?

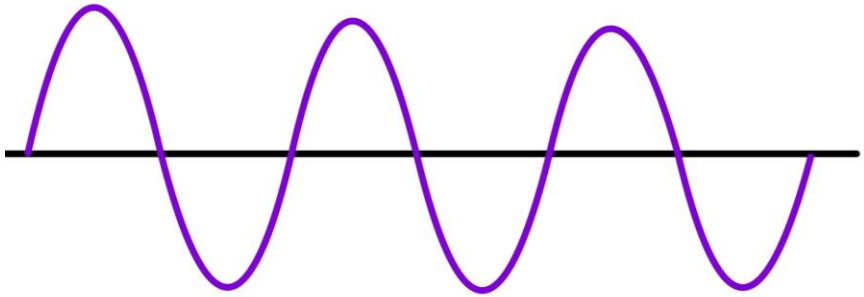
Type of Wave	Diagram	Example
Transverse		
Longitudinal		

6.1.1 Transverse & Longitudinal

Think
Pair
Share

What are the differences between these waves?

Transverse



Longitudinal

<u>Do not</u> have areas of compression and rarefaction.

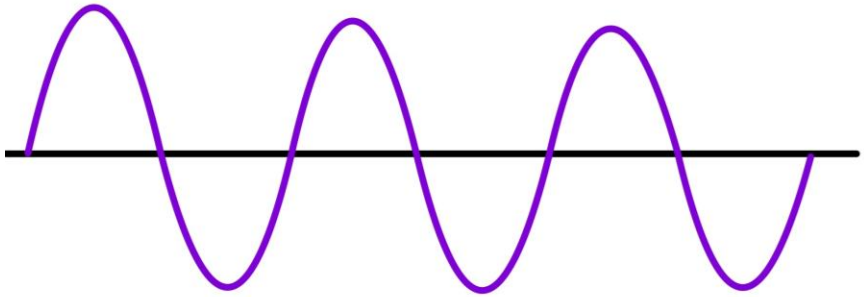
Have areas of compression and rarefaction.

6.1.1 Transverse & Longitudinal

Think
Pair
Share

What are the differences between these waves?

Transverse



Longitudinal

Can travel through a vacuum

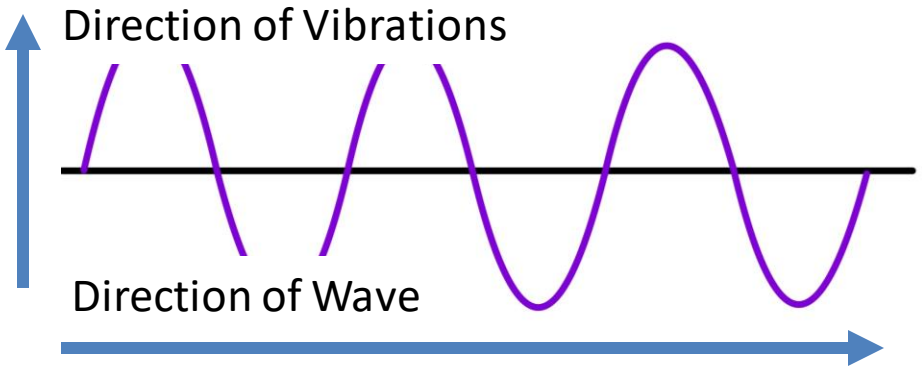
Unable to travel through a vacuum.

6.1.1 Transverse & Longitudinal

Think
Pair
Share

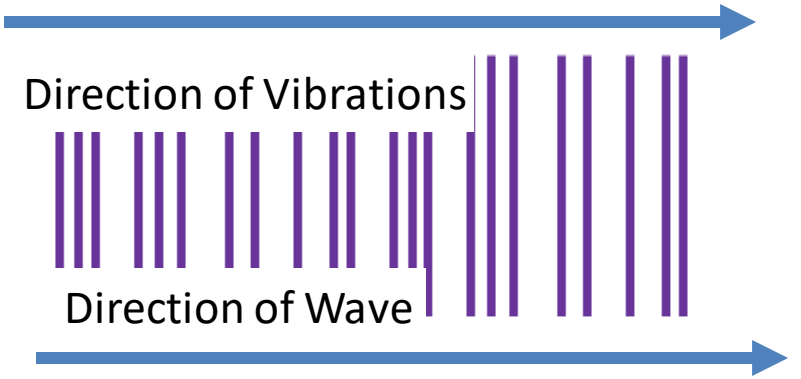
What are the differences between these waves?

Transverse



The vibrations are at right angles to the direction of wave travel

Longitudinal

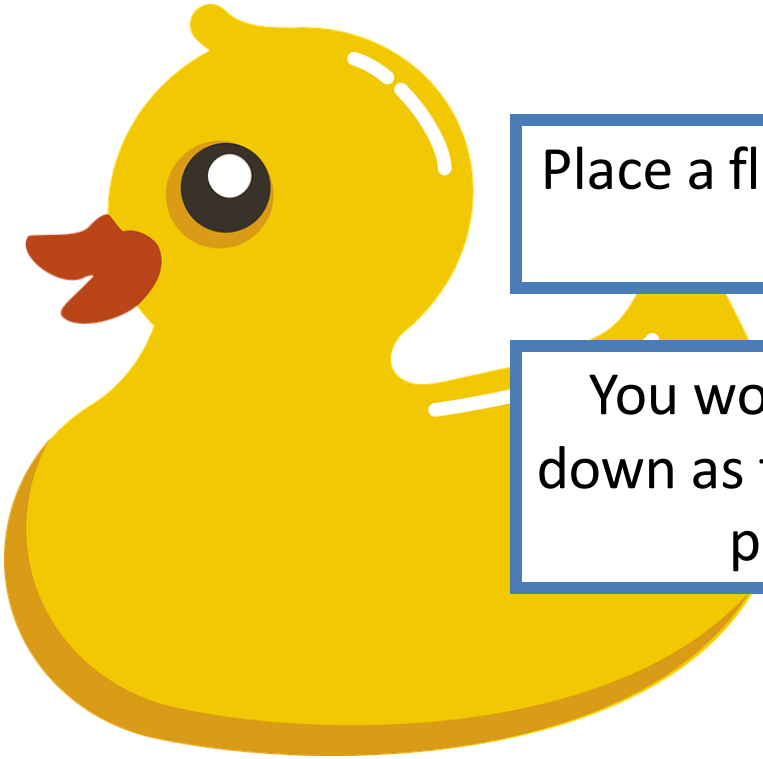


The vibrations are parallel to the direction of the waves travel

6.1.1 Transverse & Longitudinal

Think
Pair
Share

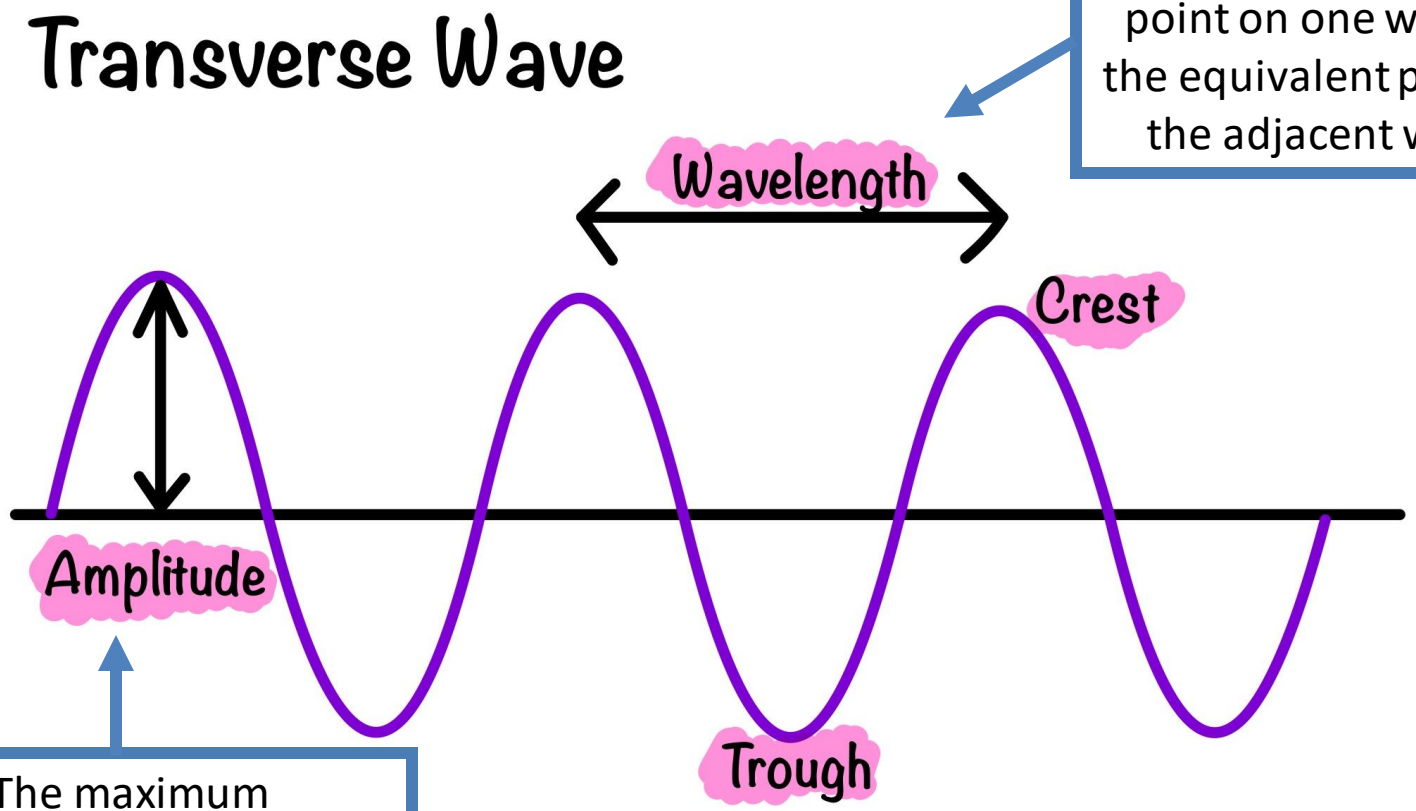
How can we prove that it is the wave travelling and not the air/water itself?



Place a floating object such as a rubber duck on the surface of the water.

You would observe the duck moving up and down as the waves pass but staying in the same place if the water doesn't move.

6.1.2 Properties of Waves



The distance from a point on one wave to the equivalent point on the adjacent wave.

The maximum displacement of a point on a wave away from its undisturbed position.

6.1.2 Properties of Waves

Think
Pair
Share

What is frequency?

Hertz
Hz

Period = 1 / Frequency
T = 1 / f

Seconds
s

Key Term	Definition
Frequency	

6.1.2 Properties of Waves

Think
Pair
Share

What is wave speed?

Hertz
Hz

Wave Speed = Frequency x Wavelength

$$v = f \times \lambda$$

Metres per second
m/s

Metres
m

Key Term	Definition
Wave Speed	

6.1.2 Properties of Waves

Think
Pair
Share

How can we measure the speed of sound waves in air?

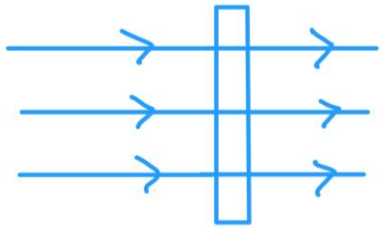
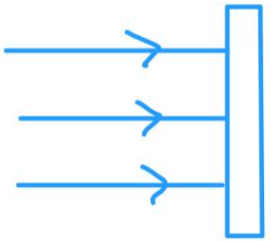
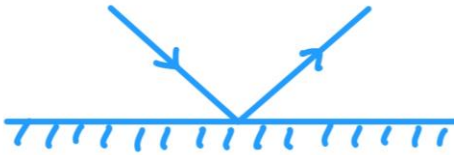
2 people stand 500m apart.

1 person fires a gun into the air and raises their other hand into the air at the same time.

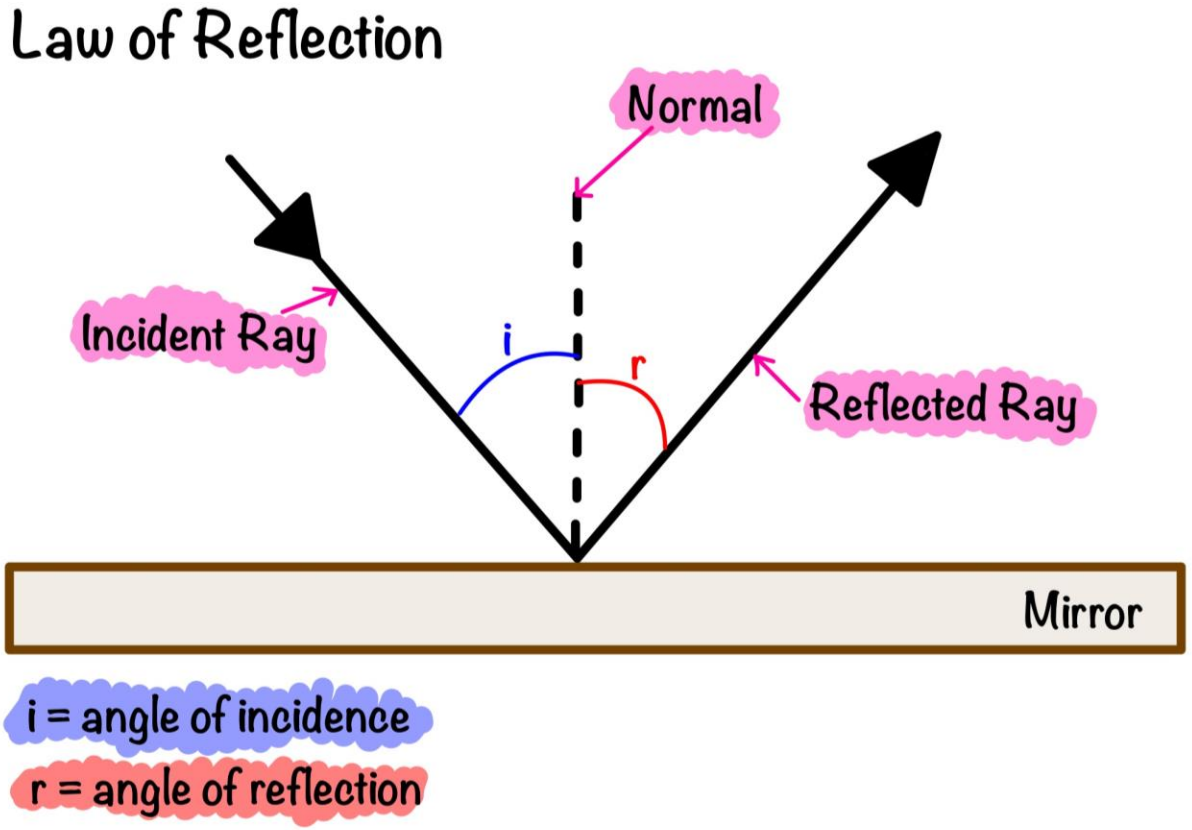
The second person records how long it takes for them to hear the bang.

Divide the distance by the time to determine the speed of sound.

6.1.3 Reflection of Waves

Key Term	Definition	Diagram
Transmit		
Absorb		
Reflect		

6.1.3 Reflection of Waves



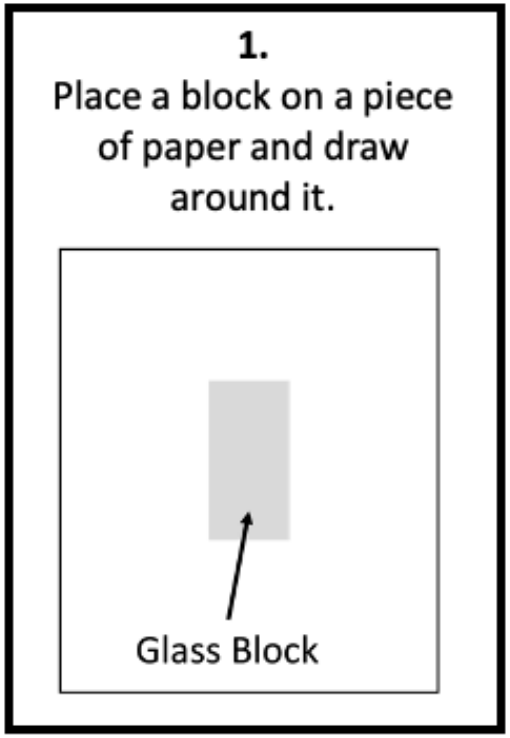
The angle of incidence = The angle of reflection

Triple only

6.1.3 Reflection of Waves

Think
Pair
Share

How can we investigate the **reflection** of light by different types of materials?



Triple only

6.1.3 Reflection of Waves

Think
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Share

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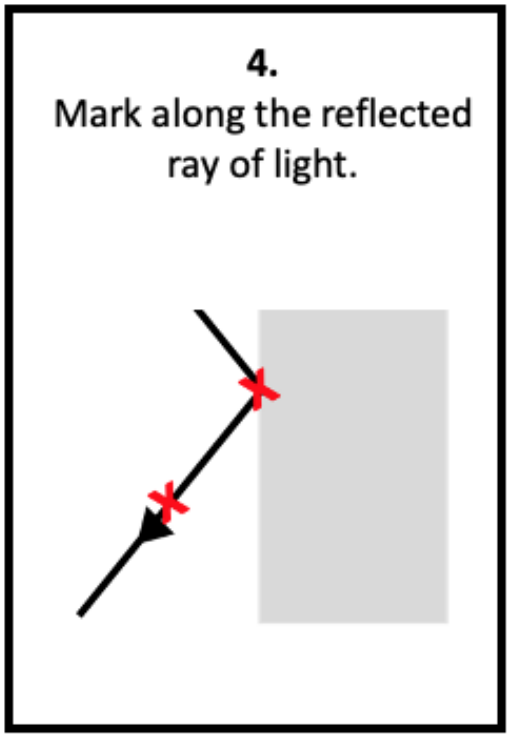


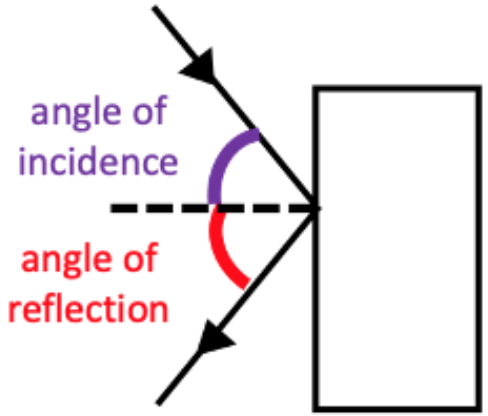
Triple only

6.1.3 Reflection of Waves

Think
Pair
Share

How can we investigate the **reflection** of light by different types of materials?

7
Use a protractor to measure the angle of incidence and angle of reflection.



Triple only

6.1.3 Reflection of Waves

Think
Pair
Share

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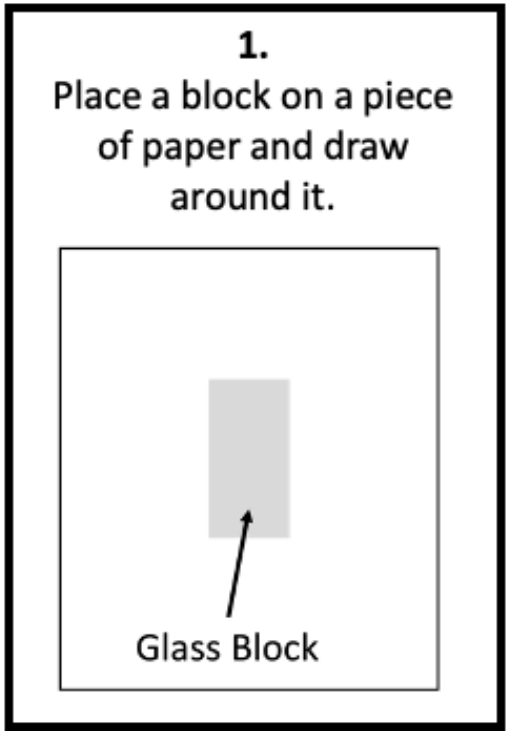

Triple only

6.1.3 Reflection of Waves

Think
Pair
Share

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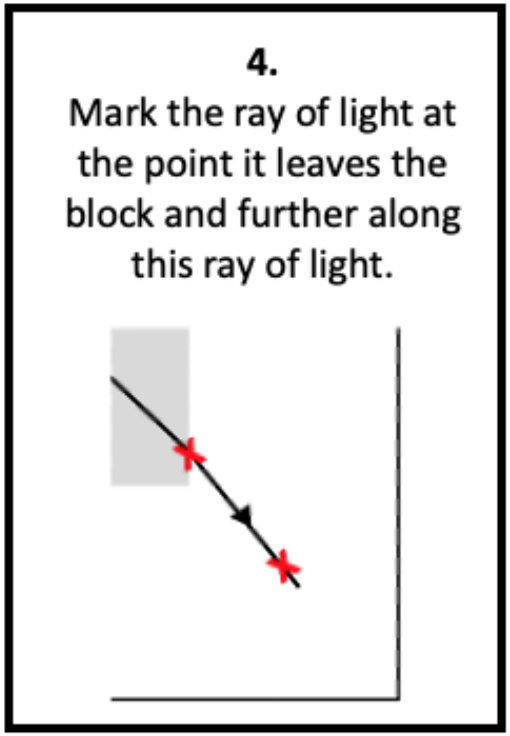


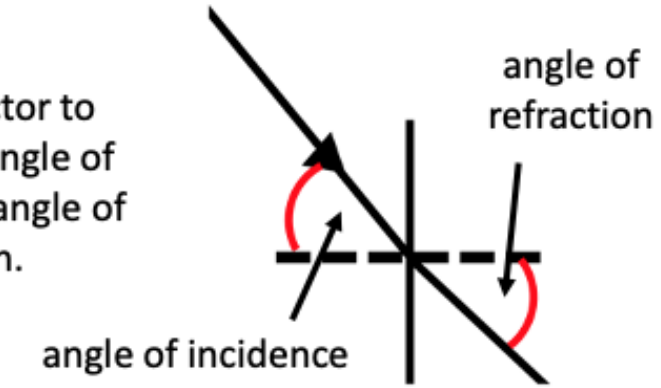
Triple only

6.1.3 Reflection of Waves

Think
Pair
Share

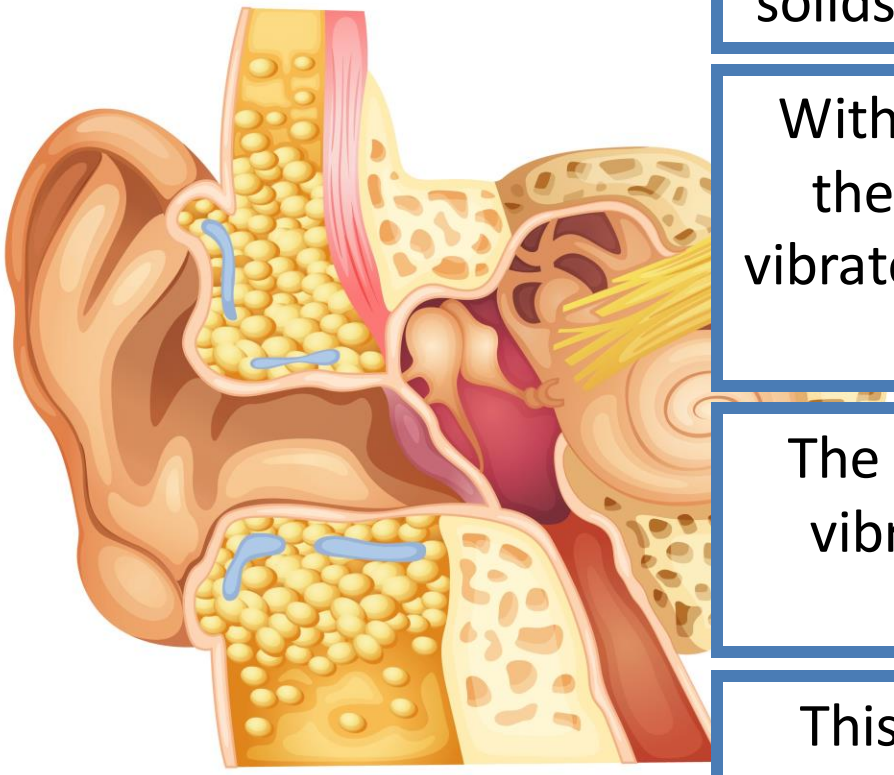
How can we investigate the **refraction** of light by different types of materials?

7
Use a protractor to measure the angle of incidence and angle of refraction.



Triple only

6.1.4 Sound Waves



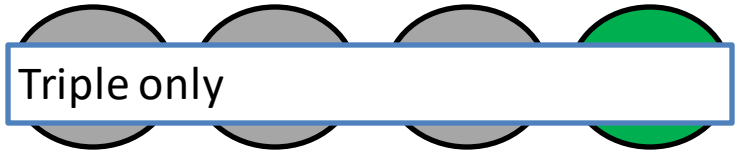
Sound waves can travel through solids causing vibrations in the solid.

Within the ear, sound waves cause the ear drum and other parts to vibrate which causes the sensation of sound.

The conversion of sound waves to vibrations of solids works over a limited frequency range.

This restricts the limits of human hearing.

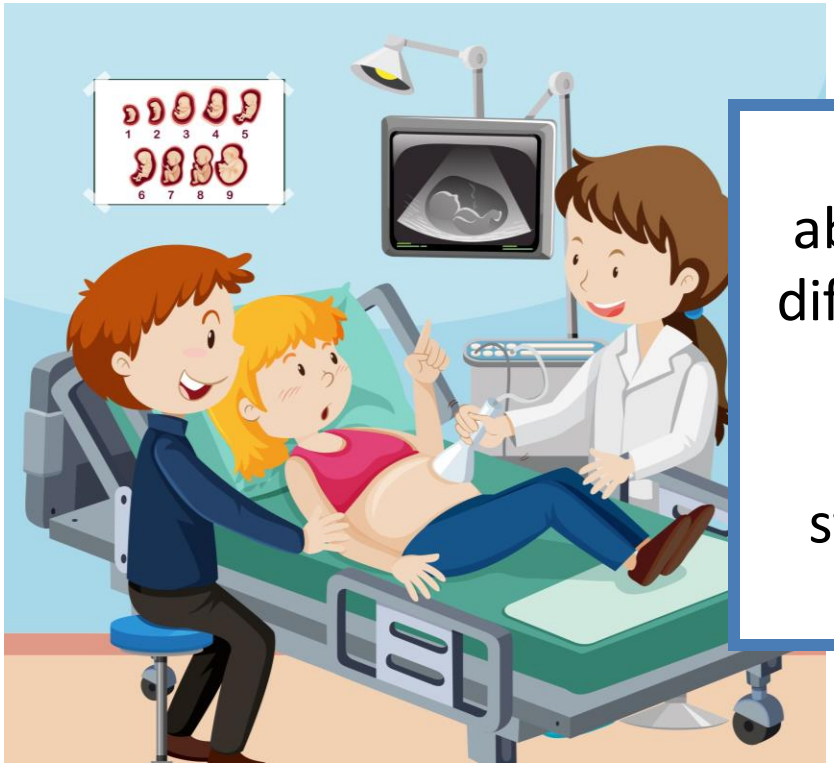
The range of normal human hearing is from 20 Hz to 20 kHz.



6.1.5 Detection & Exploration

Think
Pair
Share

How can waves be used for detection and exploration?



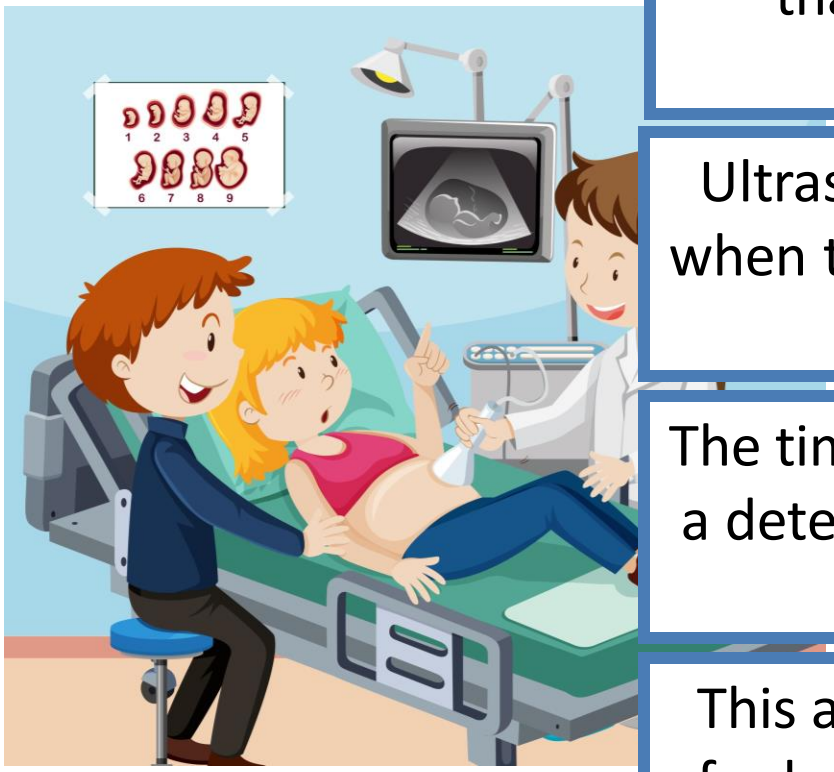
The differences in velocity, absorption and reflection between different types of wave in solids and liquids can be used both for detection and exploration of structures which are hidden from direct observation.

Triple only

6.1.5 Detection & Exploration

Think
Pair
Share

How can waves be used for detection and exploration?



Ultrasound waves have a frequency higher than the upper limit of hearing for humans.

Ultrasound waves are partially reflected when they meet a boundary between two different media.

The time taken for the reflections to reach a detector can be used to determine how far away such a boundary is.

This allows ultrasound waves to be used for both medical and industrial imaging.

Triple only

6.1.5 Detection & Exploration

Think
Pair
Share

How can waves be used for detection and exploration?

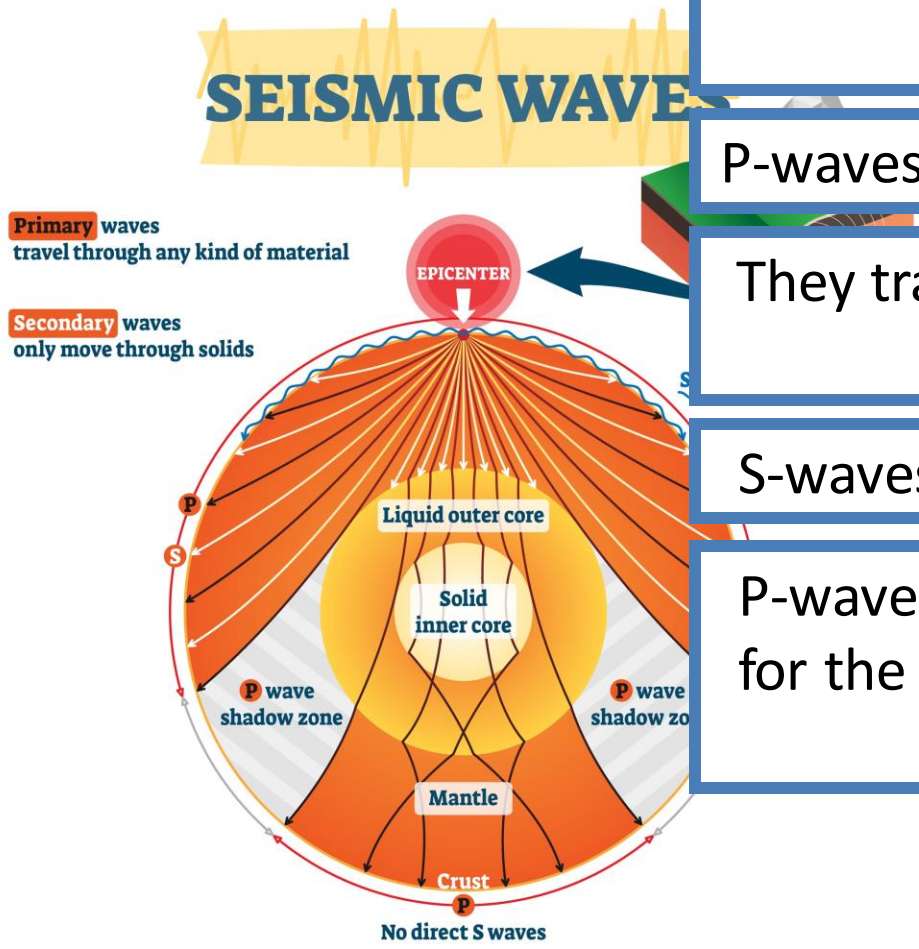
Seismic waves are produced by earthquakes.

P-waves are longitudinal, seismic waves.

They travel at different speeds through solids and liquids.

S-waves cannot travel through a liquid.

P-waves and S-waves provide evidence for the structure and size of the Earth's core.

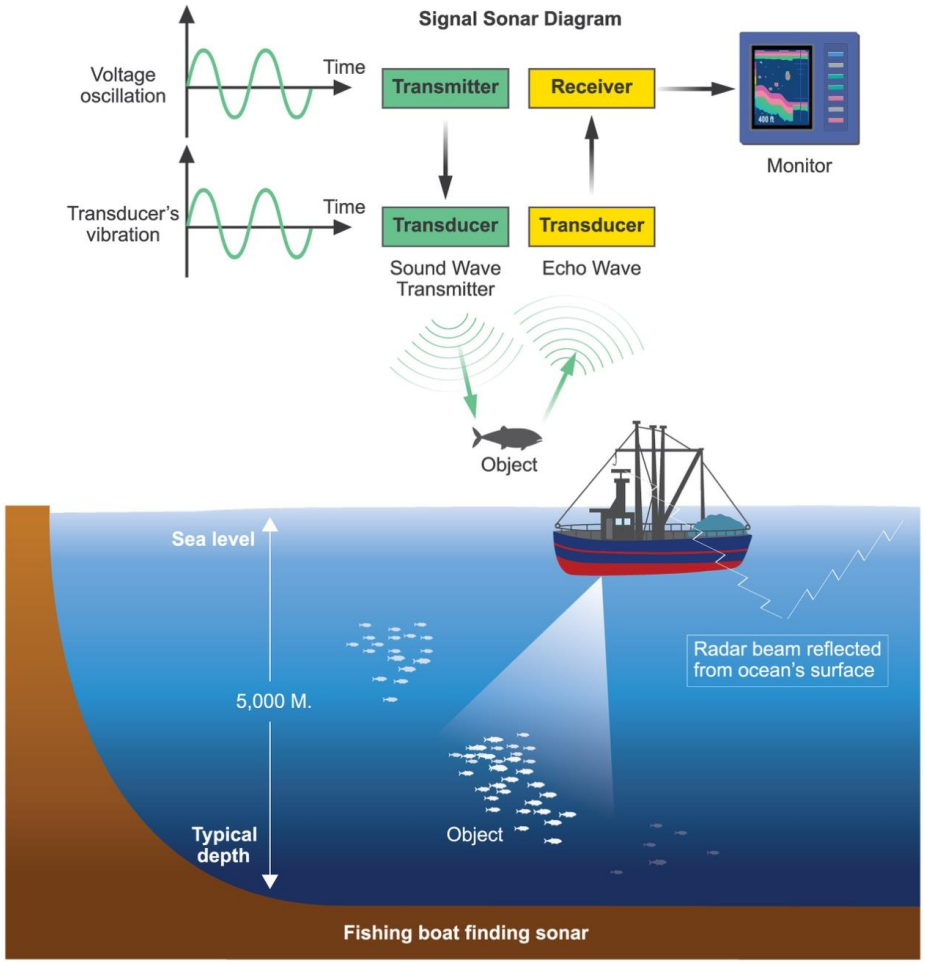


Triple only

6.1.5 Detection & Exploration

Think Pair Share

How can waves be used for detection and exploration?



Echo sounding, using high frequency sound waves is used to detect objects in deep water and measure water depth.

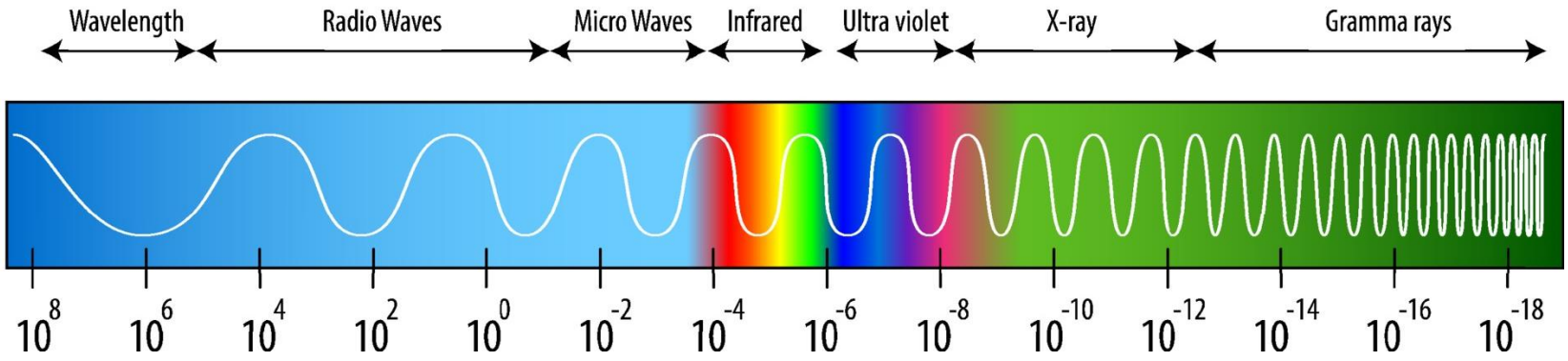
Triple only

6.2.1 Types of EM Waves

Think
Pair
Share

What are electromagnetic waves?

Key Term	Definition
Electromagnetic Waves	



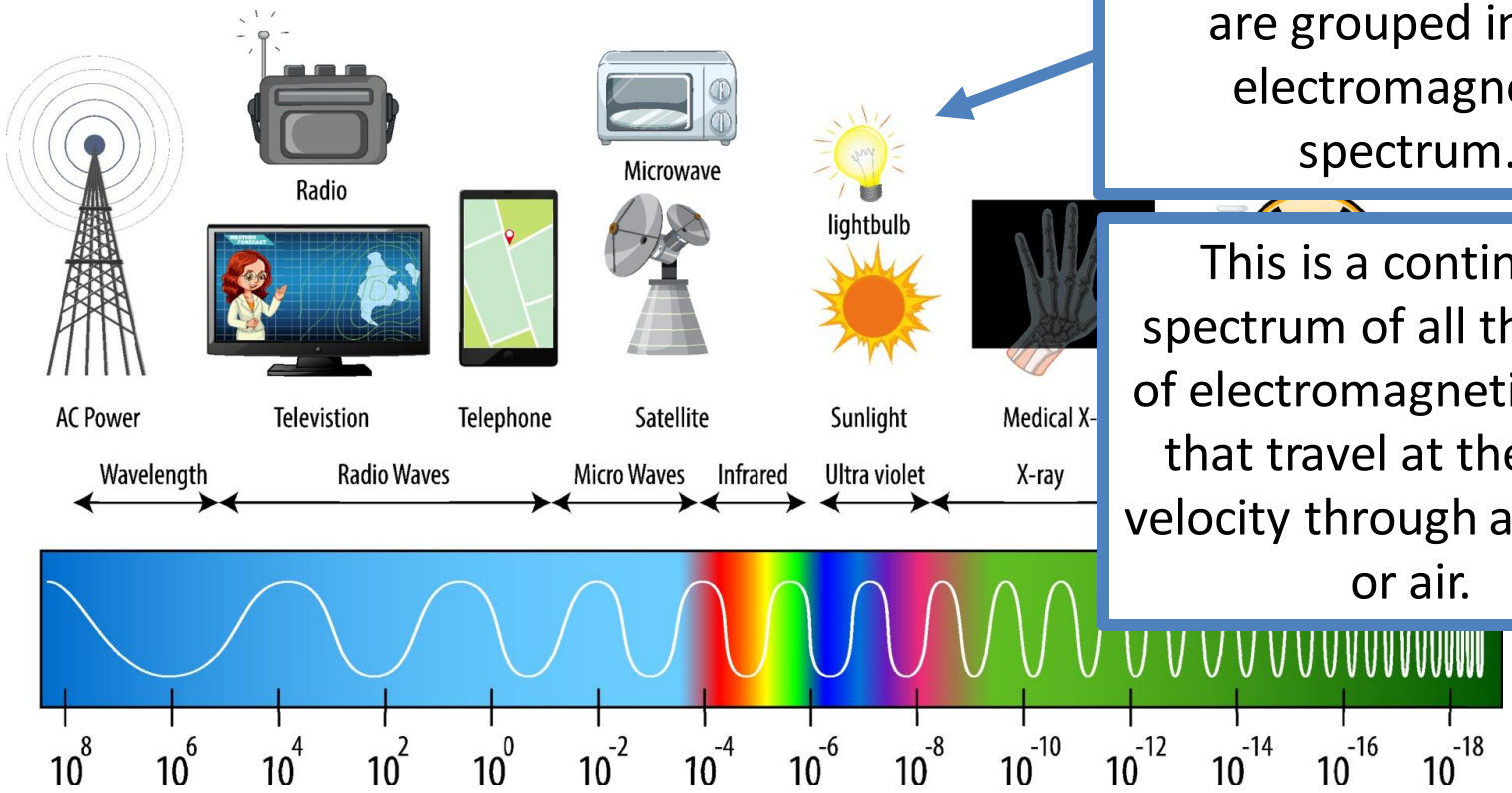
6.2.1 Types of EM Waves

Think
Pair
Share

What are electromagnetic waves?

Electromagnetic waves are grouped in the electromagnetic spectrum.

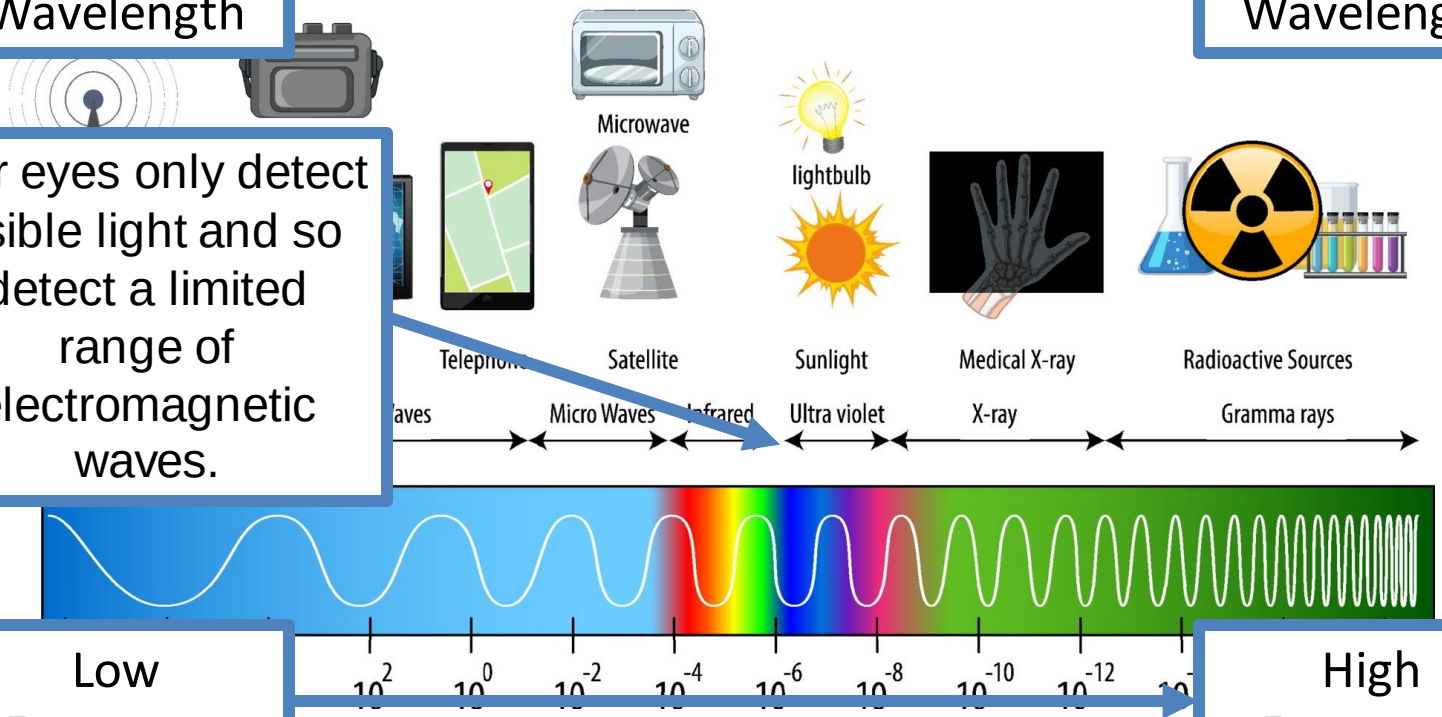
This is a continuous spectrum of all the types of electromagnetic waves that travel at the same velocity through a vacuum or air.



6.2.1 Types of EM Waves

Long Wavelength → Short Wavelength

Our eyes only detect visible light and so detect a limited range of electromagnetic waves.



Low Frequency → High Frequency

The waves that form the electromagnetic spectrum are grouped in terms of their wavelength and their frequency.

Exam Practice

The diagram shows the position of 3 types of wave in the electromagnetic spectrum. Which position shows where visible light is in the spectrum? (1) **C**

Radio waves	**A**	**B**	**C**	Ultraviolet	X-rays	**D**

Which electromagnetic wave has the highest frequency? (1) **Gamma Rays**

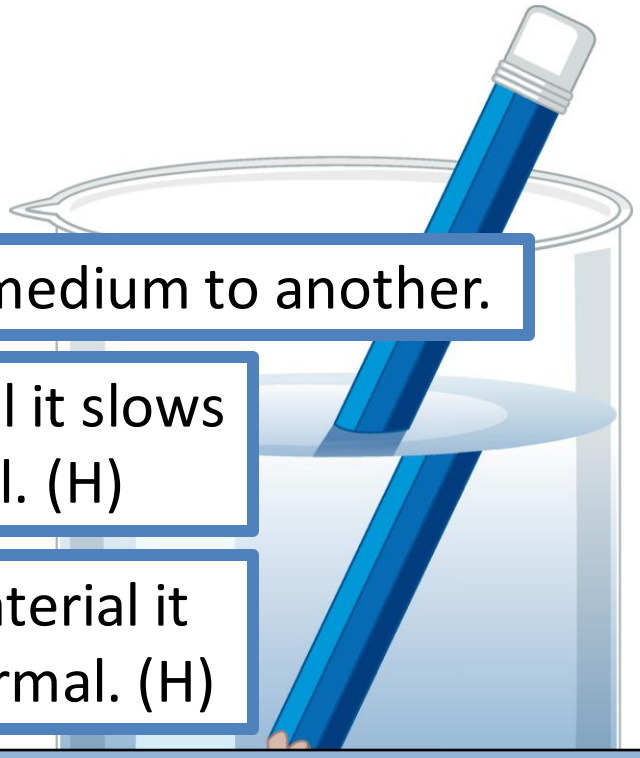
Visible light travels through air at 300 000 000 m/s. Why can we assume that radio waves travel through air at the same speed as light? (1)

All electromagnetic waves travel at the same speed through a vacuum

6.2.2 Properties of EM Waves

Think
Pair
Share

What is refraction?



Light refracts when it travels from one medium to another.

When light travels into a denser material it slows down and bends towards the normal. (H)

When light travels into a less dense material it speeds up and bends away from the normal. (H)

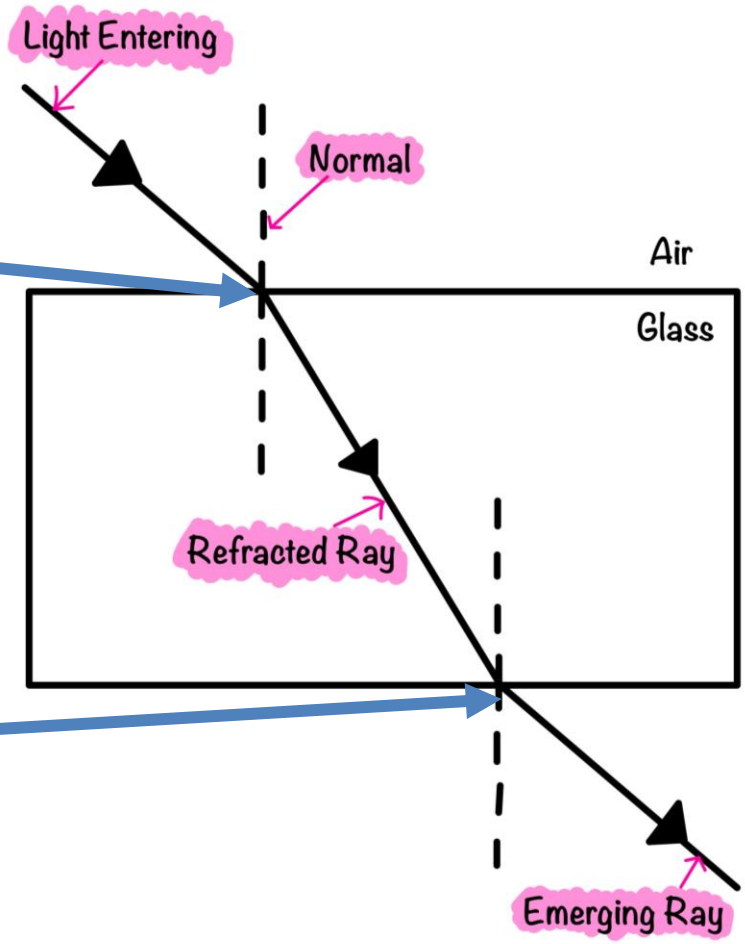
Key Term	Definition
Refraction	

6.2.2 Properties of EM Waves

Construct your own labelled ray diagrams to model refraction of light and explain why it occurs.

When light enters glass, it slows down and so changes direction. It bends towards the normal.

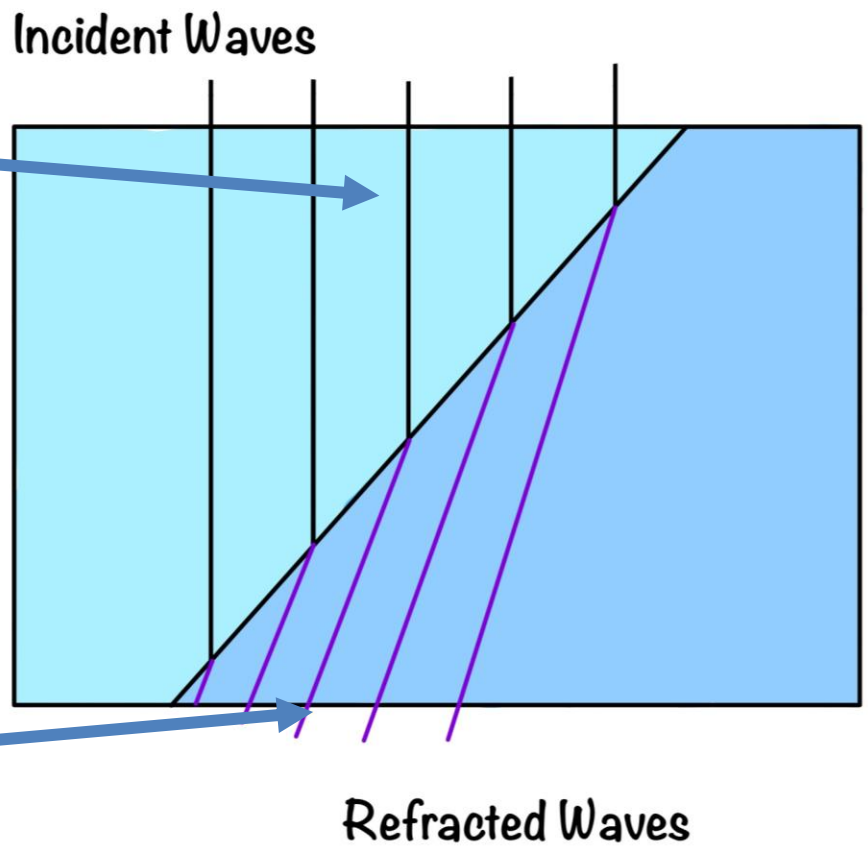
When light leaves the glass and enters air it speeds up and so bends away from the normal.



6.2.2 Properties of EM Waves

When a wave crosses a boundary at a non-zero angle to the boundary each wave front experiences a change in speed and direction.

In this diagram the wave has slowed down and so the refracted waves are closer together and at a smaller angle to the boundary than the incident wavefronts.



6.2.2 Properties of EM Waves

Key Term	Definition	Diagram
Transmit		
Absorb		
Reflect		

6.2.2 Properties of EM Waves

Think
Pair
Share

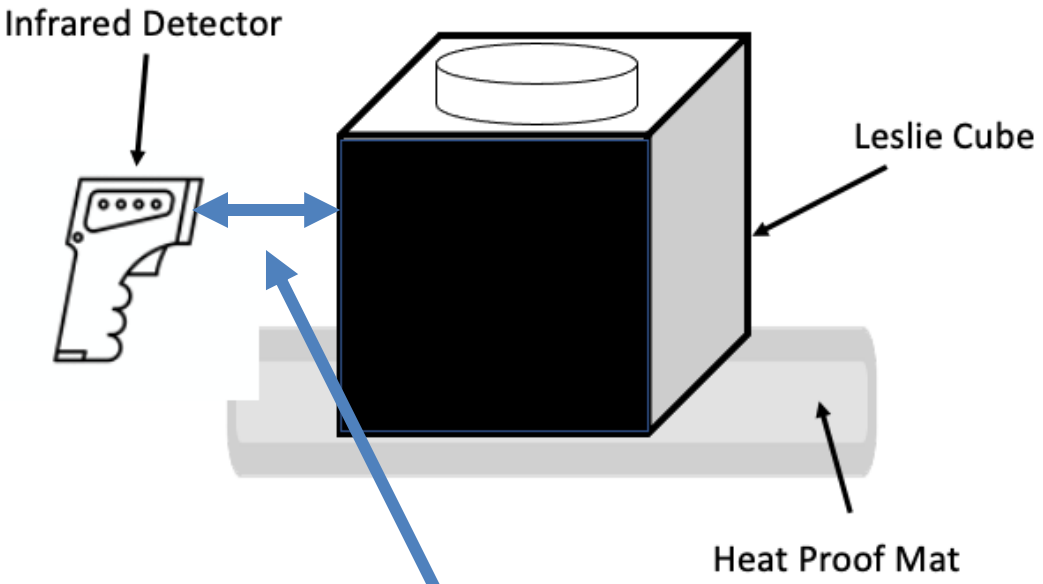
How can we investigate the the amount of infrared radiation radiated by different surfaces?

Place the Leslie cube on a heat proof mat.

Fill the cube with very hot water and replace the lid.

Use an infrared detector to record the amount of radiation from each surface.

Construct a bar chart to display the results.



Detector should be the same distance from the surface each time.

6.2.2 Properties of EM Waves

Think Pair Share

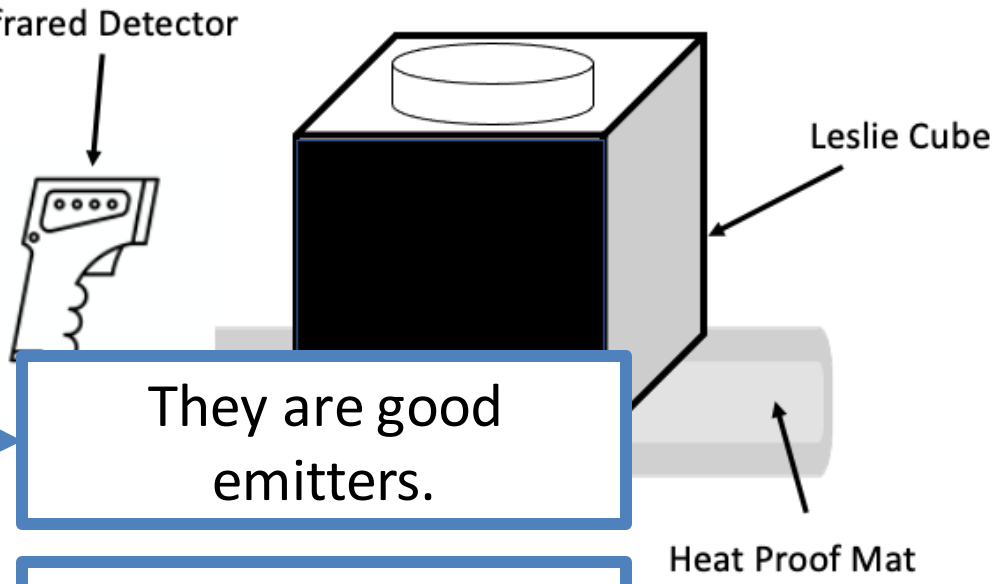
How can we investigate the the amount of infrared radiation radiated by different surfaces?

White surfaces will emit **less** infrared.

Black surfaces will emit **more** infrared.

Matt surfaces will emit **more** infrared.

Shiny surfaces will emit **less** infrared.



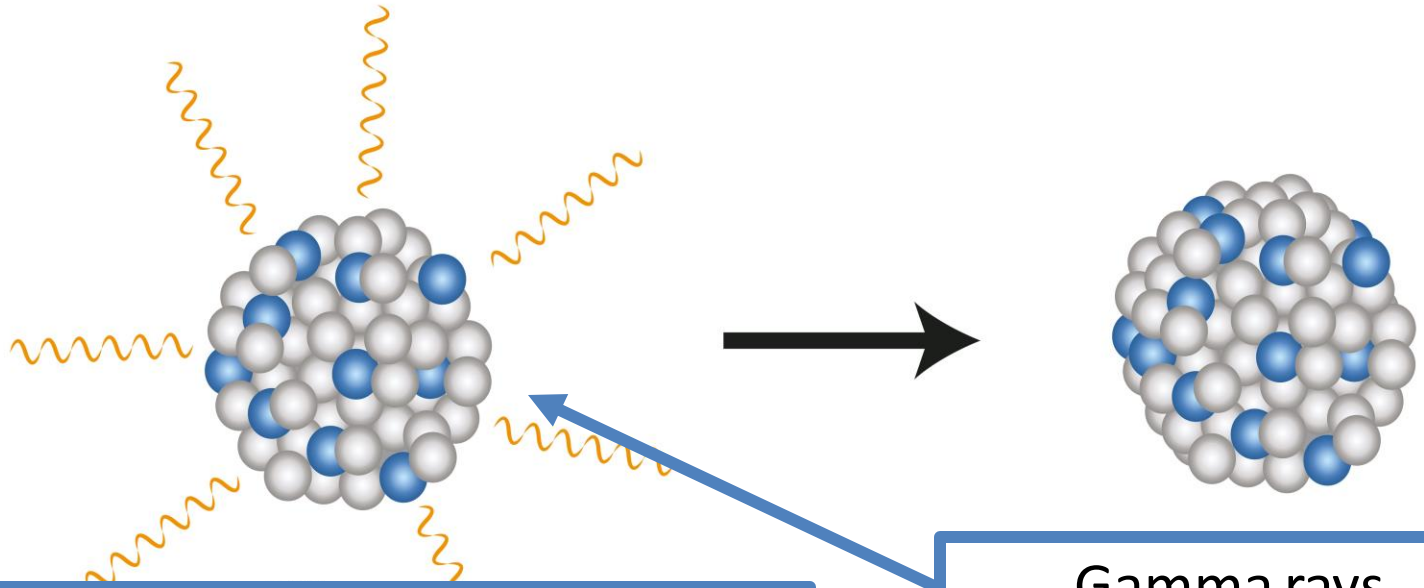
They are good emitters.

They are poor emitters.

6.2.3 Properties of EM Waves 2

Think
Pair
Share

How are electromagnetic waves generated?



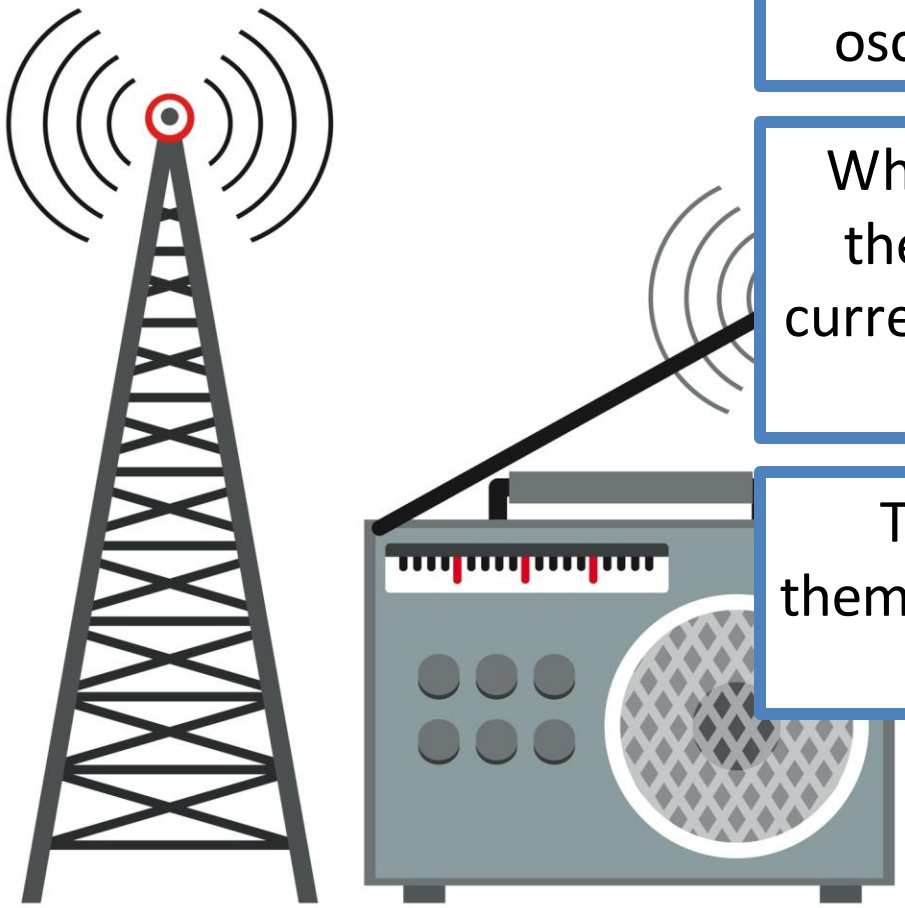
Changes in atoms and the nuclei of atoms can result in electromagnetic waves being generated or absorbed over a wide frequency range.

Gamma rays originate from changes in the nucleus of an atom.

6.2.3 Properties of EM Waves 2

Think
Pair
Share

How are radio waves generated?



Radio waves can be produced by oscillations in electrical circuits.

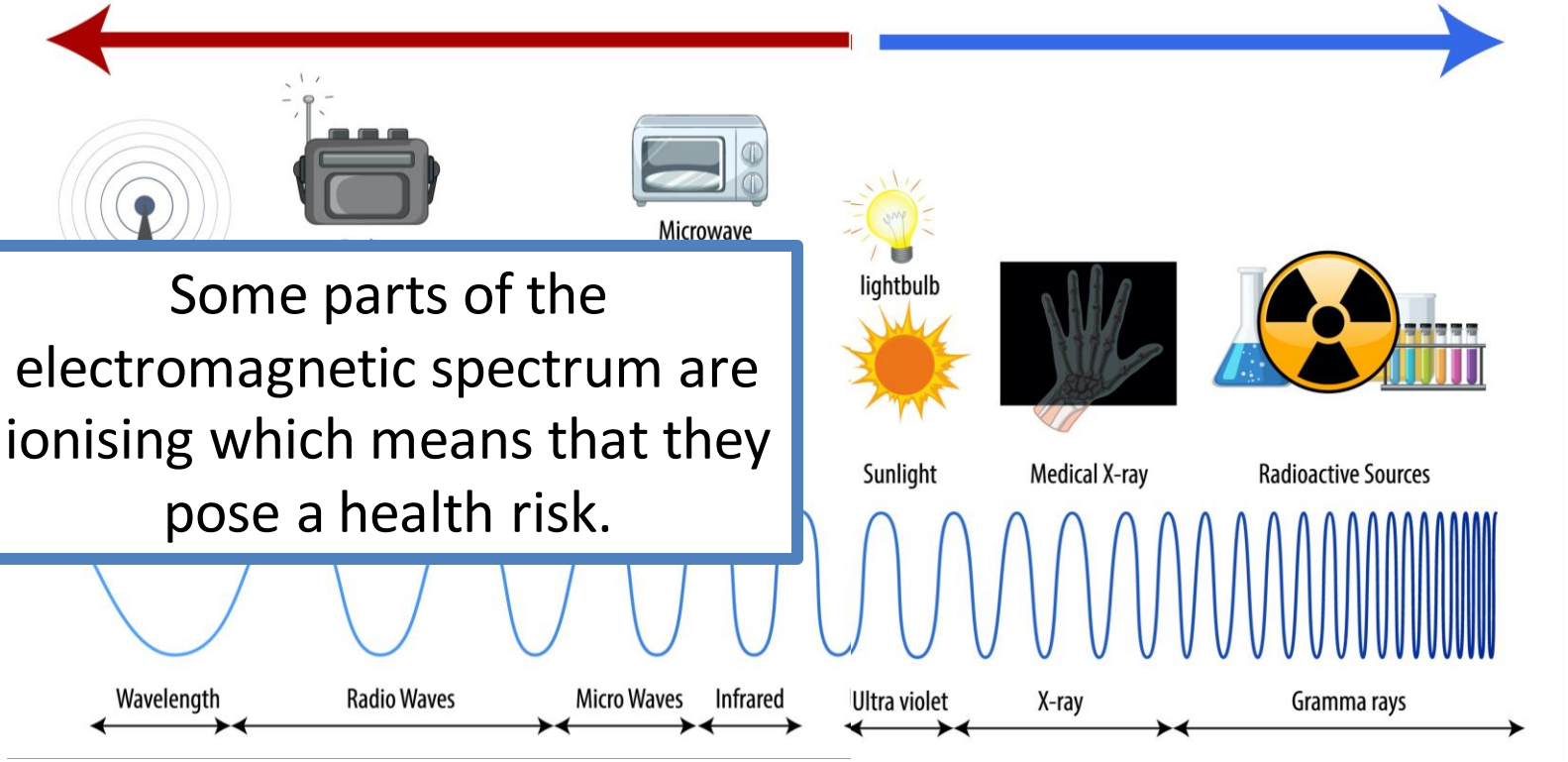
When radio waves are absorbed they may create an alternating current with the same frequency as the radio wave itself.

This means radio waves can themselves induce oscillations in an electrical circuit.

6.2.3 Properties of EM Waves 2

Think
Pair
Share

What are the risks of some of the parts of the electromagnetic spectrum?



Some parts of the electromagnetic spectrum are ionising which means that they pose a health risk.

6.2.3 Properties of EM Waves 2

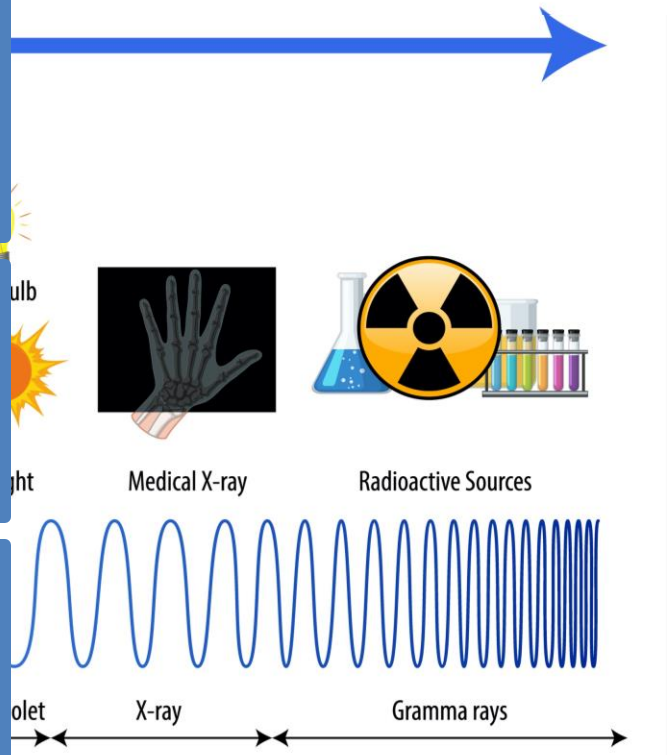
Think Pair Share

What are the risks of some of the parts of the electromagnetic spectrum?

Ultraviolet waves, X-rays and gamma rays can have hazardous effects on human body tissue.

Ultraviolet waves can cause skin to age prematurely and increase the risk of skin cancer.

X-rays and gamma rays are ionising radiation that can cause the mutation of genes and cancer.



6.2.3 Properties of EM Waves 2

Think Pair Share

What does the harm caused by ionising radiation depend on?

Key Term	Definition
Radiation Dose	

6.2.3 Properties of EM Waves 2

Think Pair Share

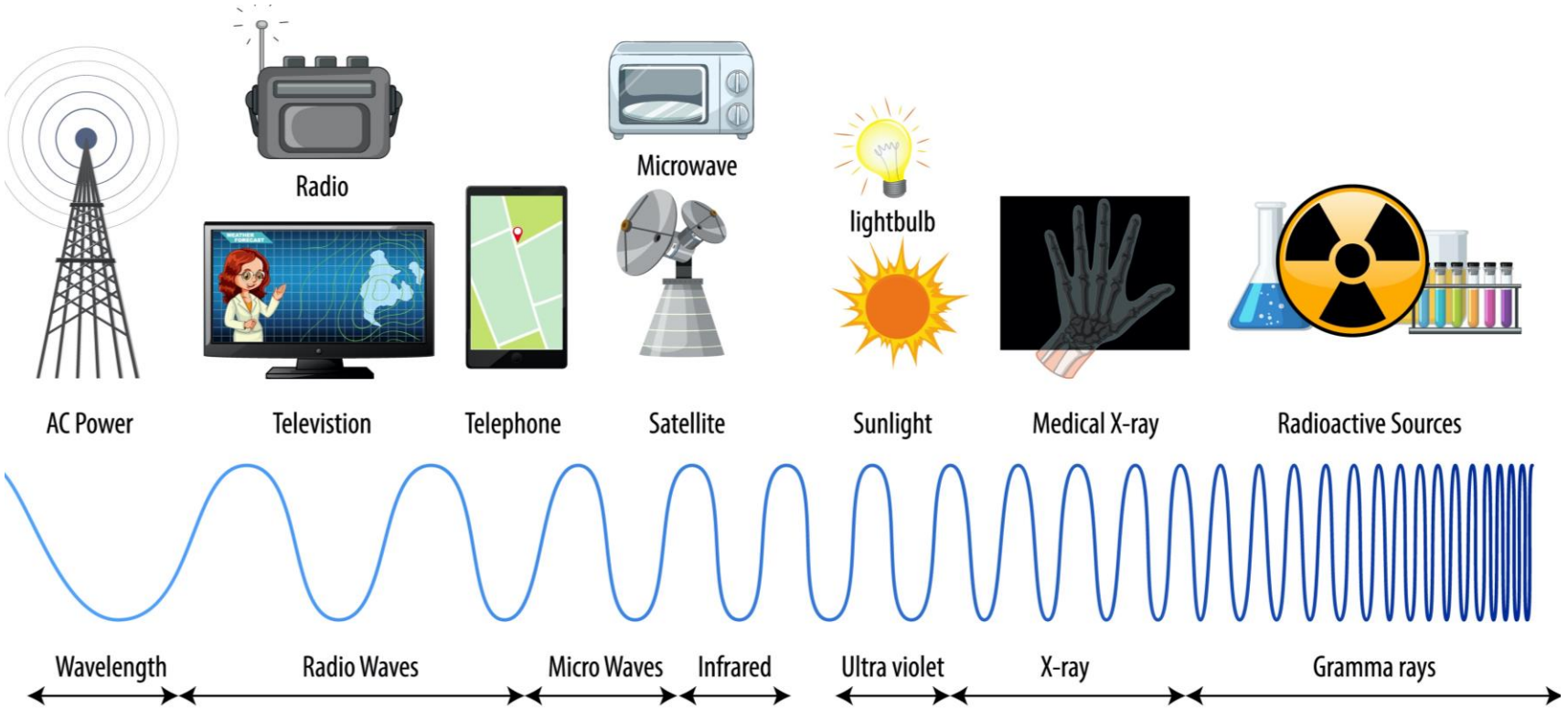
What does the harm caused by ionising radiation depend on?

Dose	The greater the dose the greater the risk of harm.
Type of Radiation	The shorter the wavelength of the radiation, the more ionising it is and the greater its risk.
	This means that gamma rays are more harmful that X-rays as it will cause more damage to tissue.

6.2.4 Uses of EM Waves

Think
Pair
Share

What uses do we have for different parts of the electromagnetic spectrum?



6.2.4 Uses of EM Waves

EM Wave	Use	Explanation (H)
Radiowaves		

6.2.4 Uses of EM Waves

EM Wave	Use	Explanation (H)
Microwaves		

6.2.4 Uses of EM Waves

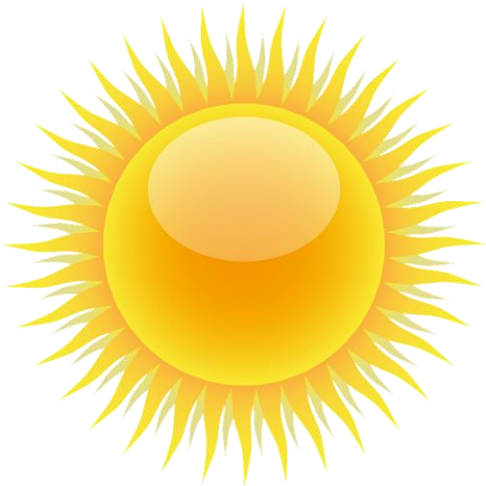
EM Wave	Use	Explanation (H)
Infrared		

6.2.4 Uses of EM Waves

EM Wave	Use	Explanation (H)
Visible Light		

6.2.4 Uses of EM Waves

EM Wave	Use	Explanation (H)
Ultraviolet		



6.2.4 Uses of EM Waves

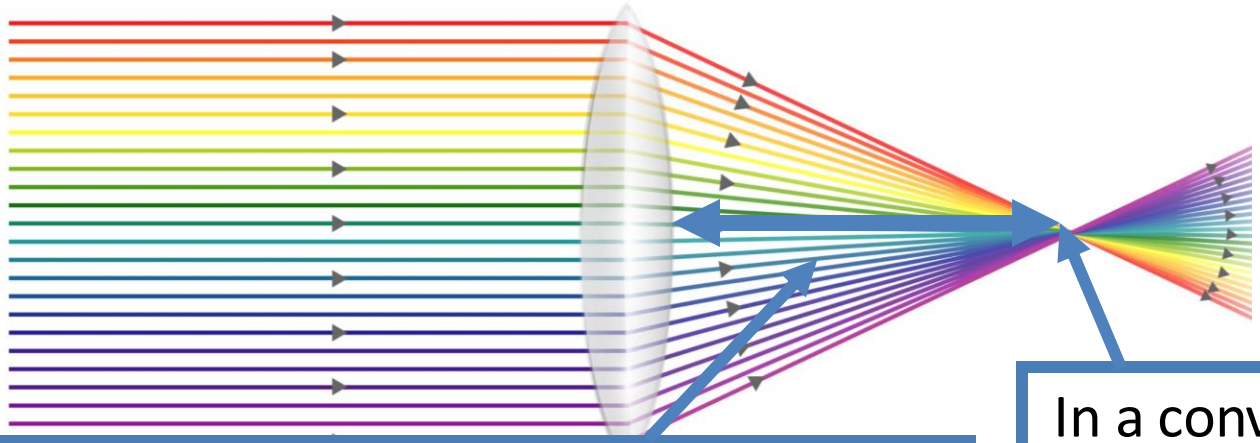
EM Wave	Use	Explanation (H)
X-Rays and Gamma Rays		

6.2.5 Lenses

Think
Pair
Share

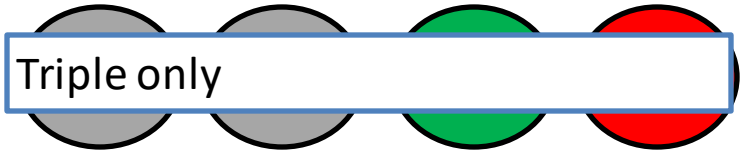
How do lenses work?

A lens forms an image by refracting light.



The distance from the lens to the principal focus is called the focal length.

In a convex lens, parallel rays of light are brought to a focus at the principal focus.



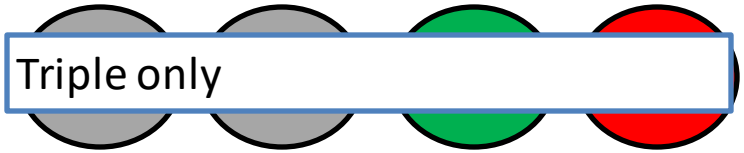
Triple only

6.2.5 Lenses

Think
Pair
Share

How do lenses work?

Lens	Diagram	Symbol	Type of Image Produced
Convex			
Concave			



6.2.5 Lenses

Think
Pair
Share

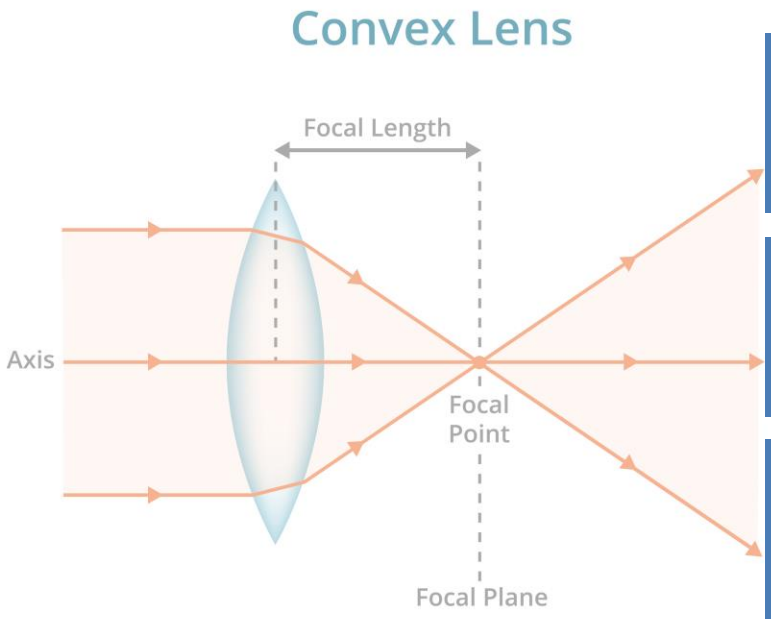
What are real and virtual images?

Key Term	Definition
Real Image	
Virtual Image	

6.2.5 Lenses

Think
Pair
Share

What are the differences between convex and concave lenses?



A convex lens is thicker in the middle than it is at the edges.

Parallel light rays that enter the lens converge.

They come together at a point called the principal focus.

6.2.5 Lenses

Think
Pair
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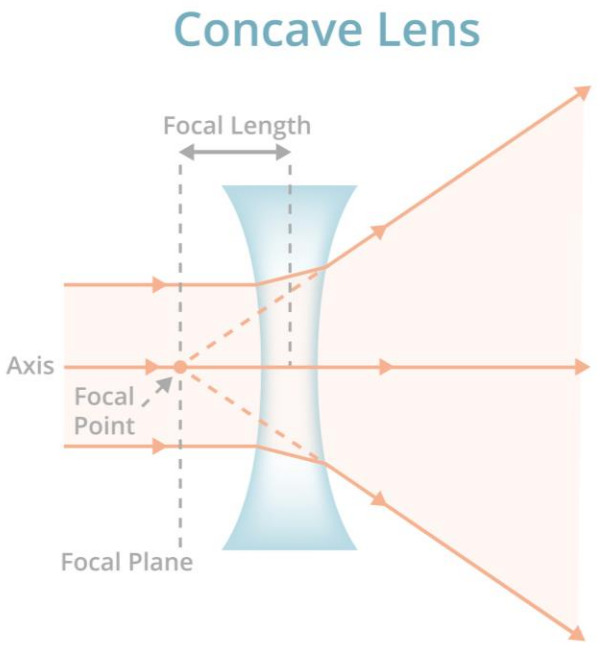
What are the differences between convex and concave lenses?

A concave lens is thinner in the middle than it is at the edges.

This causes parallel rays to diverge.

They separate but appear to come from a principle focus on the other side of the lens.



6.2.5 Lenses

Think
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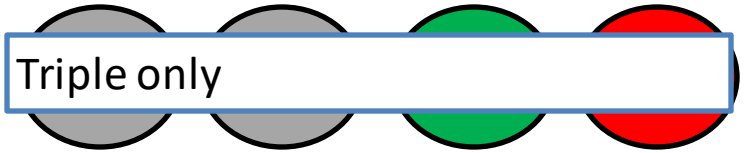
How do we calculate magnification?

Magnification = Image Height / Object Height

Magnification is a ratio and so has no units.

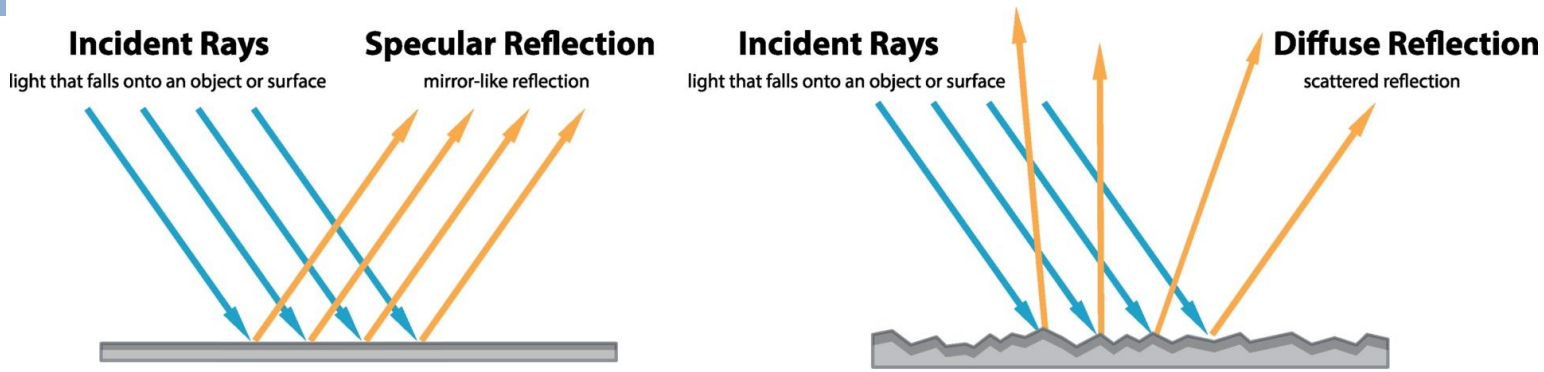
These can either be in mm or cm.



6.2.6 Visible Light

Think
Pair
Share

What are specular and diffuse speculation?



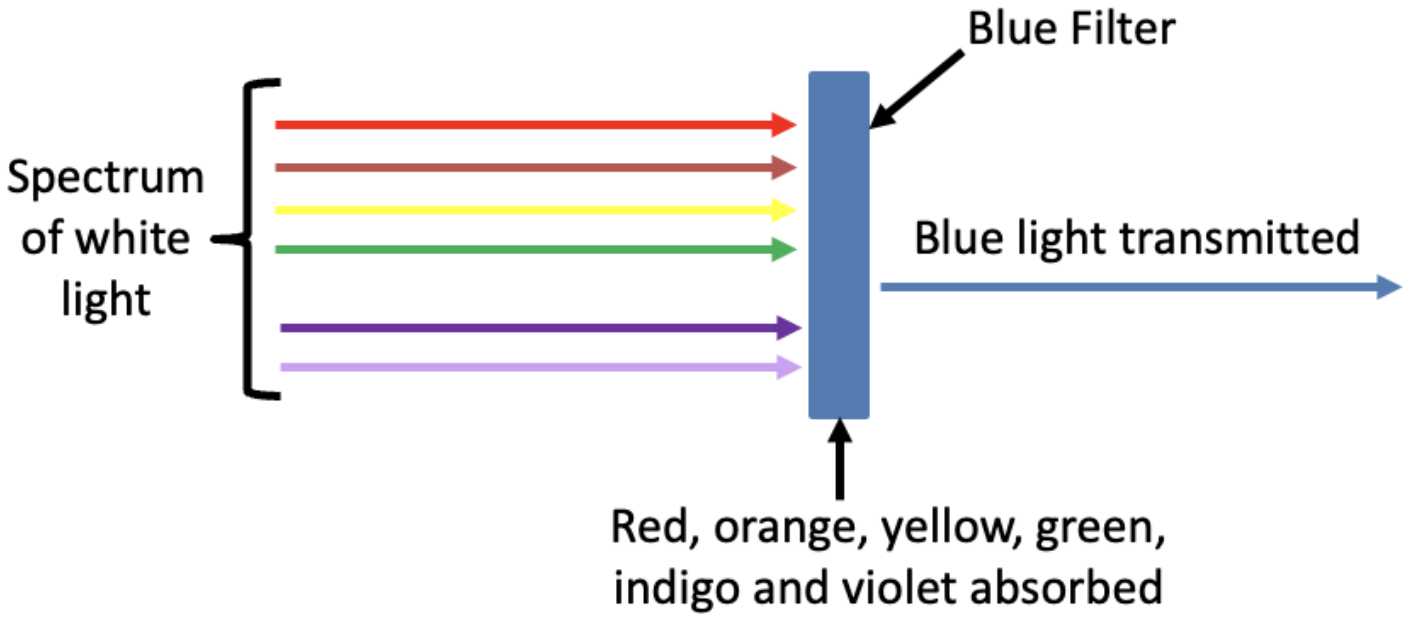
Key Term	Definition
Specular Reflection	
Diffuse Reflection	

Triple only

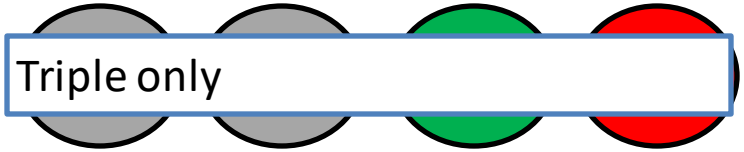
6.2.6 Visible Light

Think
Pair
Share

How do coloured filters work?



Colour filters work by absorbing certain wavelengths (and colour) and transmitting other wavelengths (and colour).



6.2.6 Visible Light

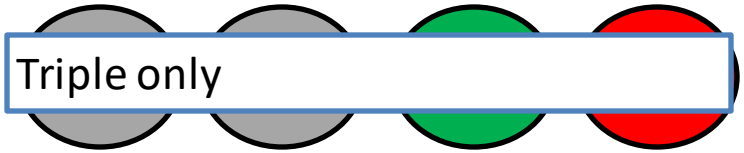
Think
Pair
Share

What determines the colour of an opaque object?

The colour of an opaque object is determined by which wavelengths of light are more strongly reflected.

For example, this t-shirt is strongly reflecting orange light.

Wavelengths that are not reflected are absorbed.



Triple only

6.2.6 Visible Light

Think
Pair
Share

What determines the colour of an opaque object?

If all wavelengths are reflected equally the object appears white.

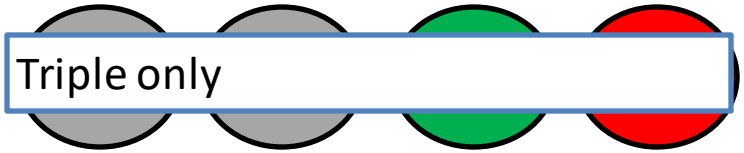
Triple only

6.2.6 Visible Light

Think
Pair
Share

What determines the colour of an opaque object?

If all wavelengths are absorbed the objects appears black.



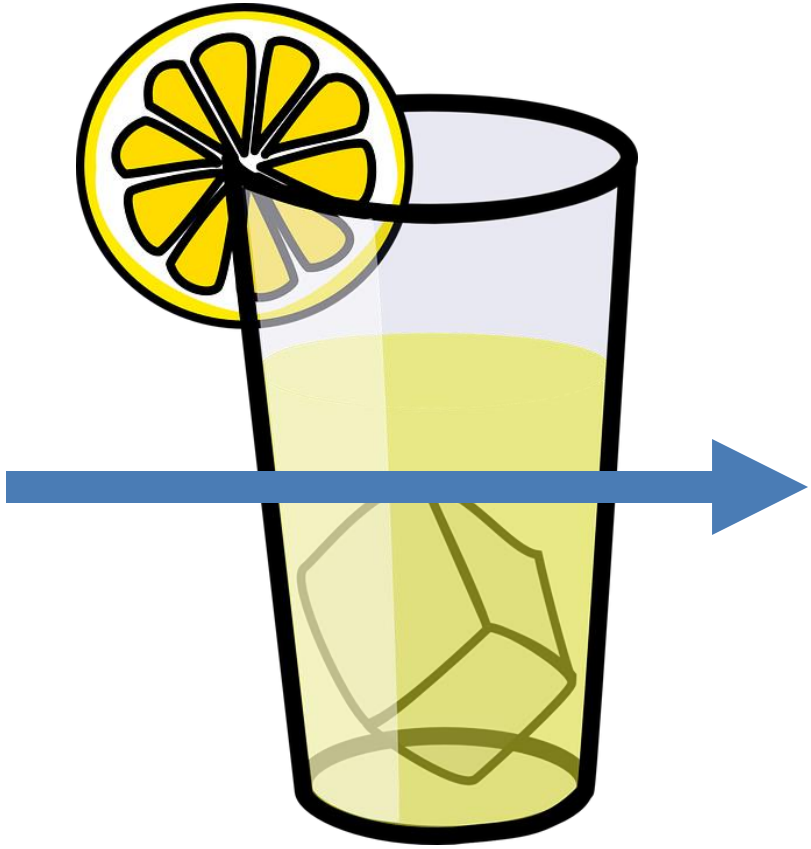
Triple only

6.2.6 Visible Light

Think
Pair
Share

What determines the colour of an opaque object?

Objects that transmit light are either transparent or translucent.



Triple only