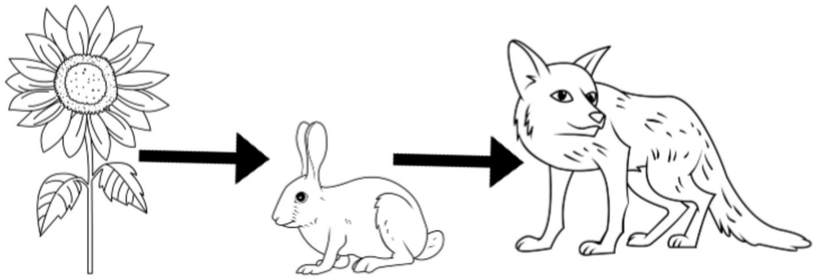
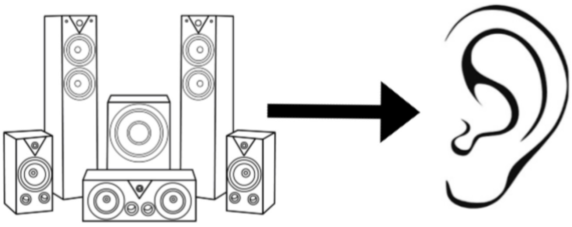
WAVES INTRODUCTION

Energy can either be transferred through ______________ or via a ____________. An example of energy being transferred through matter would be following a ___________ ___________. The energy from the _________ helps the plant make food via ________________.

The plant is then eaten by a ______________, so the energy is transferred to that animal. Then that herbivore is eaten by a ______________ and so the energy is transferred to that animal. And so on.

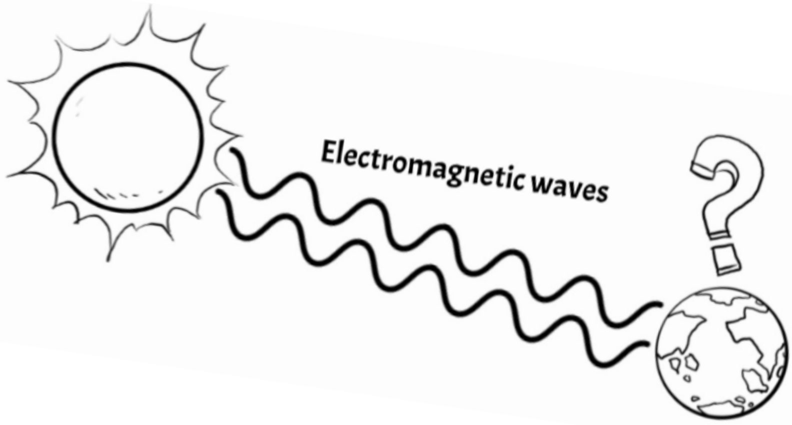




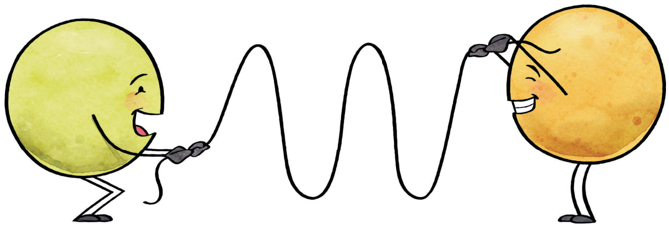
A wave is a disturbance that transfers energy ______________ transferring matter. An example of energy being transferred via a wave would be ____________ energy. When a speaker plays music the sound energy is passed to you but you don't feel 'wind' on your ears because no ____________ has moved.

There are two types of waves; ______________ waves and _______________ waves. ______________ waves require a medium to pass through. A ______________ is a physical substance such as air, water, soil, brick - any natural or man made physical substance. For example, sound waves need a medium to vibrate through such as air or water, but they cannot pass through a vacuum. A ______________ is a space in which there is no ______________ or very little matter that is very spaced apart like in outer space.

_________________ waves do not need a medium to pass through. For example, ___________ waves can travel through a vacuum. This is how the light from the _________ reaches the earth through space.



TYPES OF WAVES

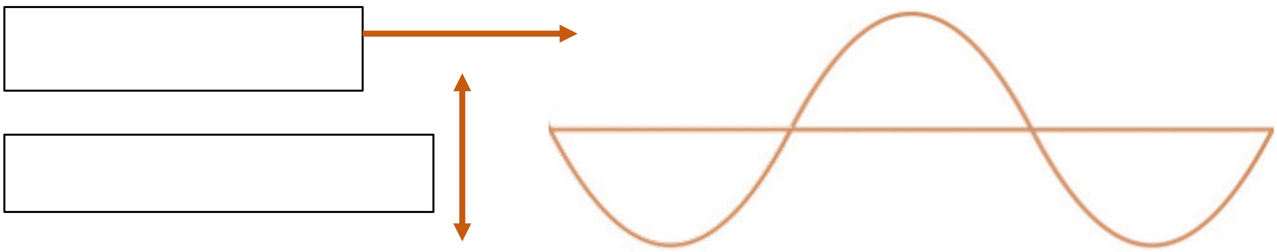


Mechanical and electromagnetic waves are characterized by the types of mediums they can travel through.

Another way to classify waves is by the _____________ of movement of the _____________ :

_____________ waves are waves in which the particles travel at _____________ _____________ to the direction or propagation of the wave.
_____________ waves (also called _____________ waves) are waves in which the particles travel in the _____________ or _____________ direction to the propagation of the wave.

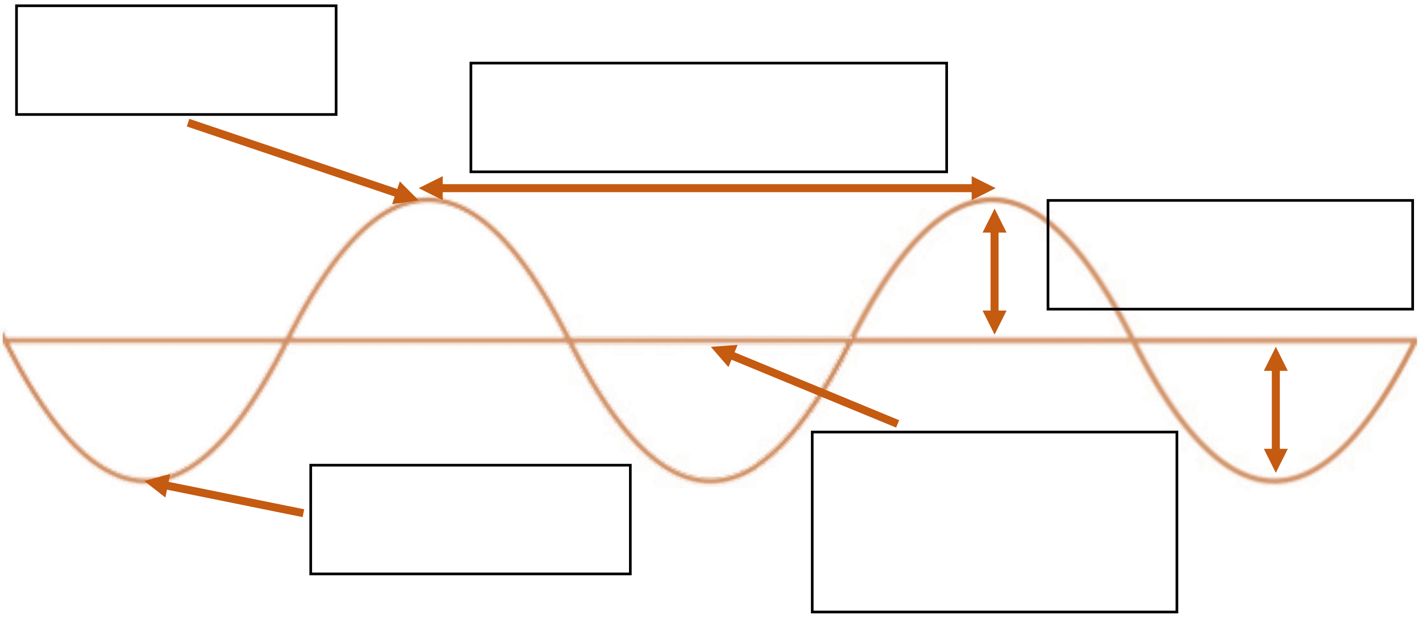
TRANSVERSE WAVES



Examples of transverse waves include waves at the beach, electromagnetic waves (including _____________), vibrations of a guitar string, and ripples in a pond. In all these examples, the particles move at _____________ angles to the direction of the wave.
Imagine sitting on a boat out in the ocean. The waves will come to shore, but your boat doesn't get carried to shore. Rather it just bobs up and down as the waves pass under it. This is important to remember because _____________ do not carry _____________, only energy.

TRANSVERSE WAVES

Labelling a transverse wave

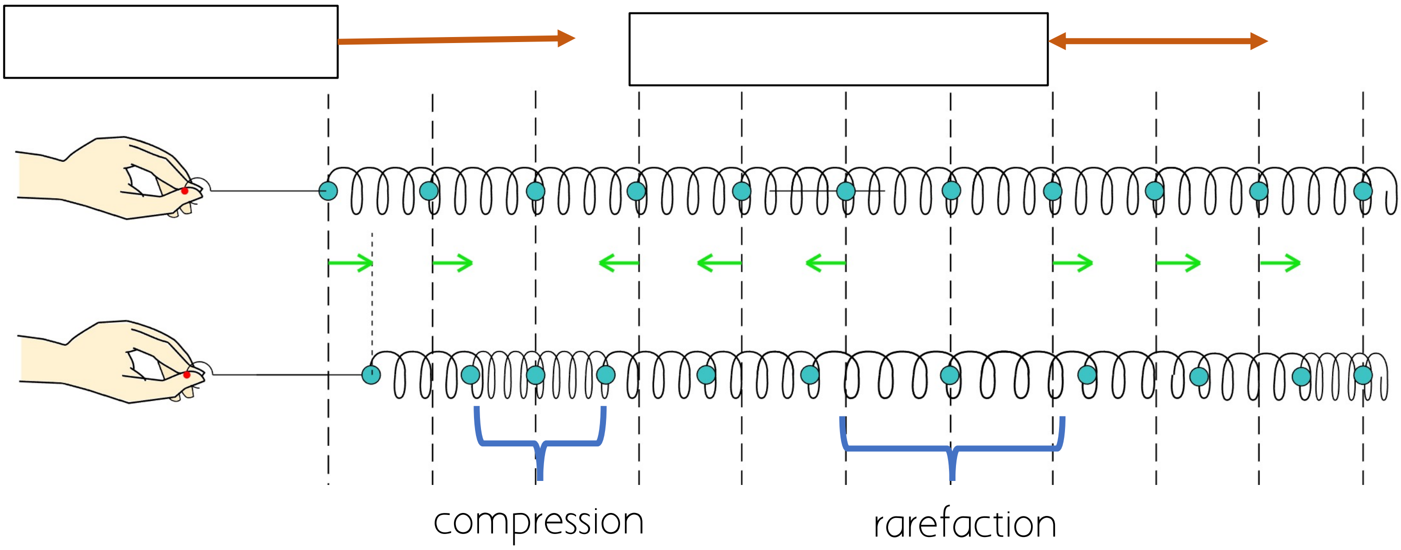


The distance between two consecutive ______________ of a wave is called the ______________ of the wave. The furthest point of a wave above the undisturbed position is called the peak or the ______________ of the wave. The furthest point of a wave below the undisturbed position is called the ______________ of the wave.

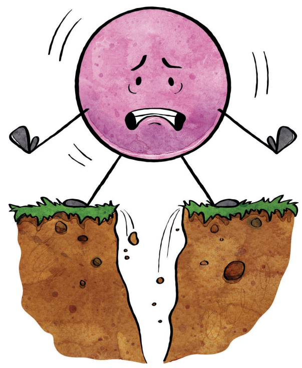
The height of a peak measured from the undisturbed position is called the ______________ of the wave. There are ______________ complete waves in the above diagram. The number of complete waves passing a point per second is called the ______________ of the wave and is measured in ______________

All waves carry ______________ from one place to another. The wavelength, frequency and amplitude of the wave affect the properties of the wave. For example, the wavelength and frequency of a light wave affect the light's ______________ while the amplitude of the light wave affects the brightness of the light.

LONGITUDINAL WAVES



Examples of longitudinal waves include sound waves, ultrasound waves, vibration of window panes during a thunder storm, and seismic P-waves from an Earthquake.

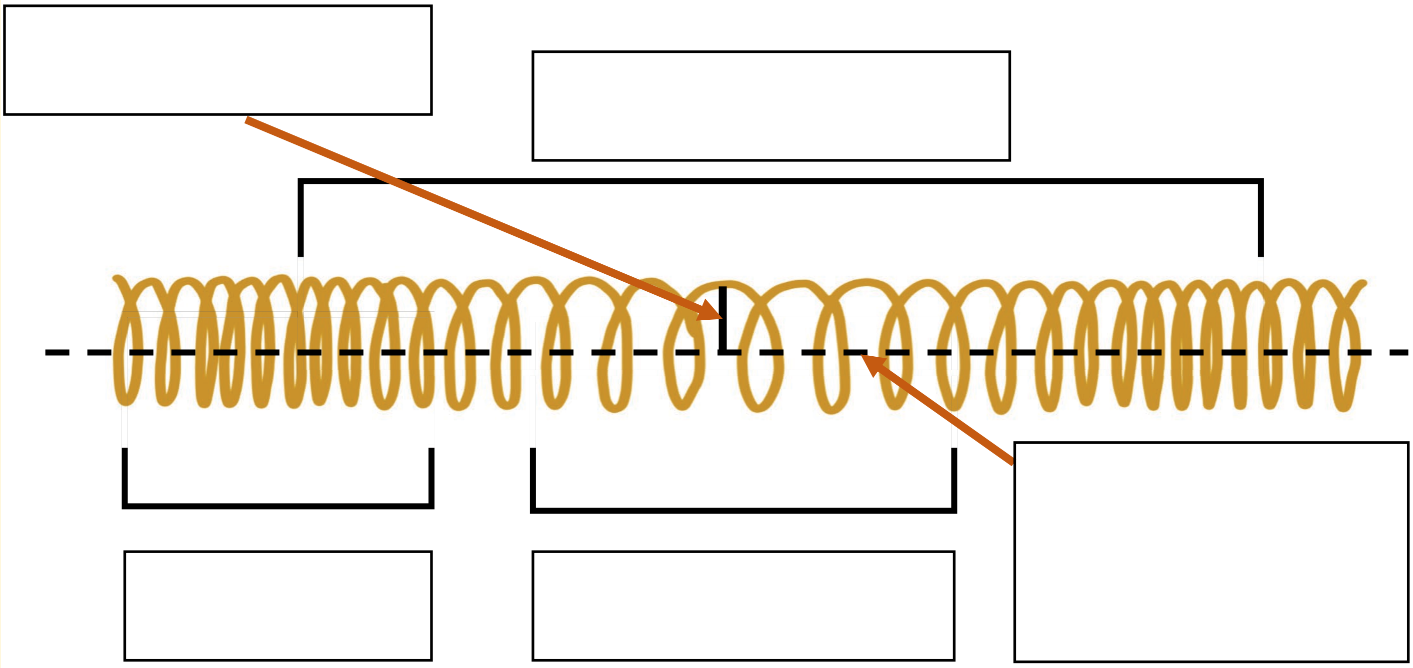


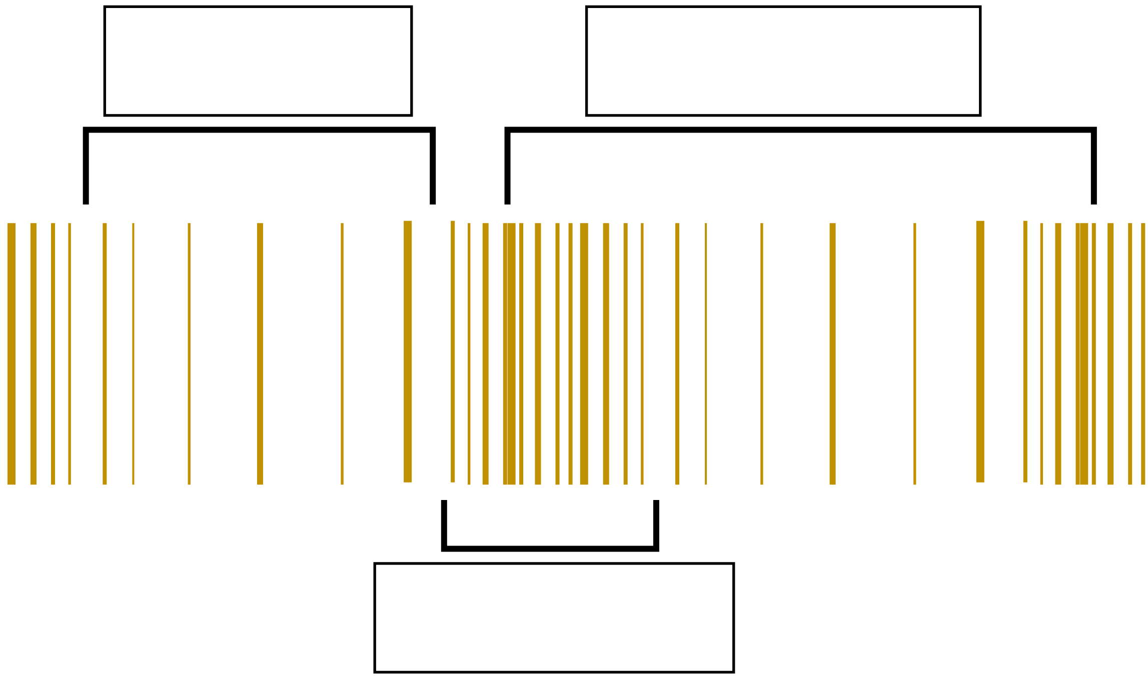
There are multiple ways that longitudinal waves are represented in diagrams. The above diagram is demonstrating sound waves using a slinky like you might do in the classroom. Longitudinal waves can also be represented using lines or dots (see examples on the next page.

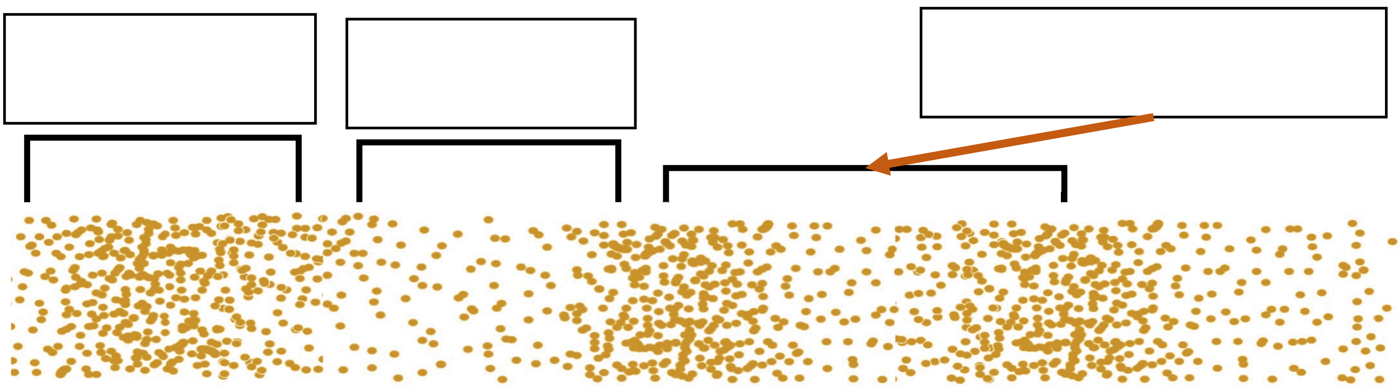
Like transverse waves, longitudinal waves also have wavelengths, frequency and amplitude. In addition to these, longitudinal waves have ______________ and ______________.

Compressions are areas where particles are ______________ together and therefore have a higher ______________. Rarefactions are areas of ______________ pressure due to the particles having more space between them. You can see these labelled on the diagram above.

LONGITUDINAL WAVES





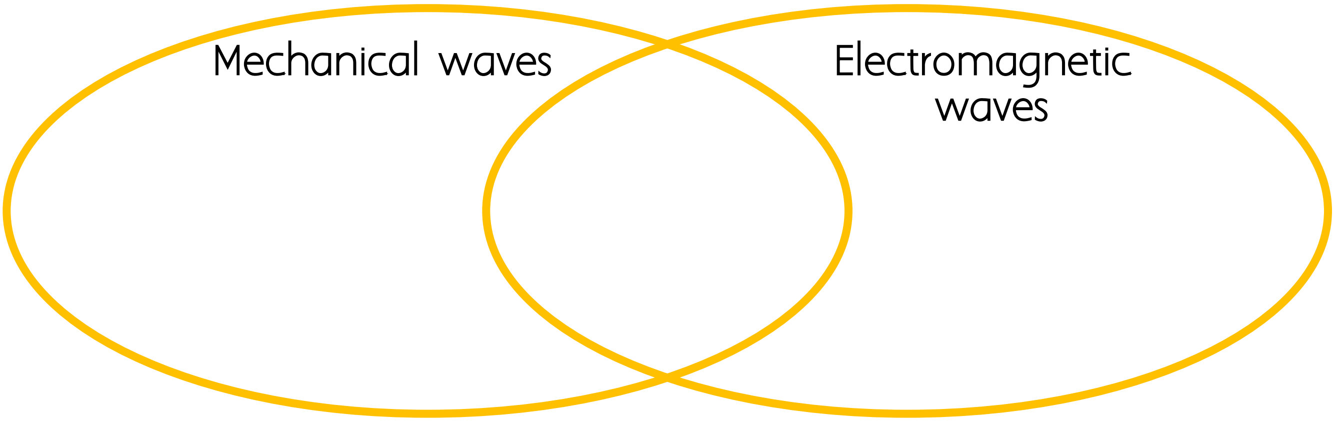


COMPARING WAVE TYPES

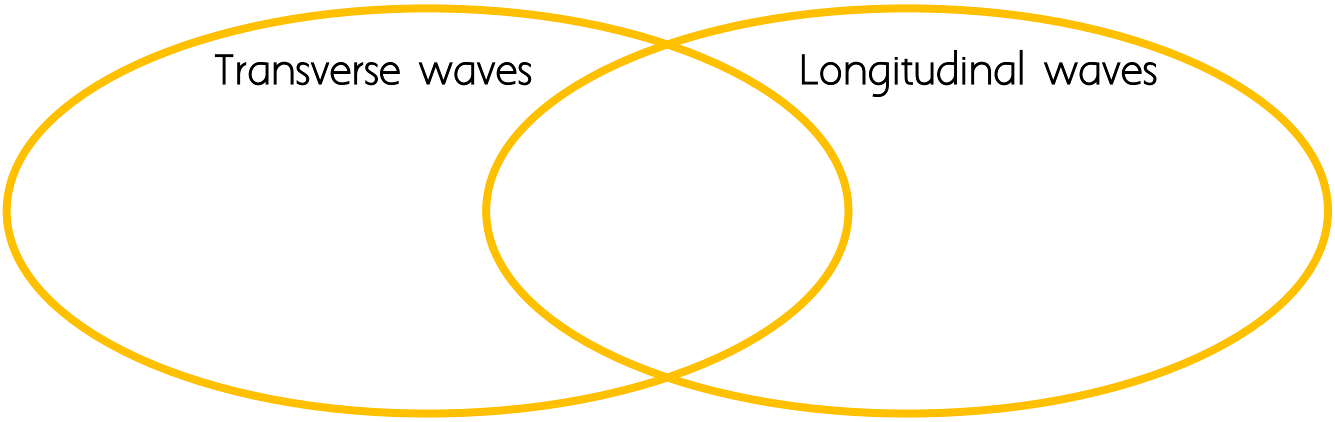
1. Complete the following Venn diagrams to compare the different wave types.
2. Use the following bank of compare & contrast vocabulary to write a summary conclusion for each diagram.

Compare & contrast vocabulary

- Similarly
- Just like
- As well as
- In the same way
- Alike
- Alternatively
- Whereas
- In contrast,
- Dissimilar
- However
- Unlike
- Although
- On the other hand



Summary:



Summary:

CALCULATING SPEED OF A WAVE

V stands for ____________ which is the speed of the wave in ___________________________

Frequency is the number of waves that pass through a point per ____________ and is measured in ____________

$$V = f\lambda$$

Lambda represents the ____________ of the wave in _____________

The above formula can be used to calculate the speed of a longitudinal or transverse wave.

1. Use the wave formula and the values in the following table to calculate the speed:

Question #	Frequency (Hz)	Wavelength (m)	Speed (m/s)
1	15	1	
2	2.5	3	
3	2.5	5.5	
4	12	2.2	
5	10.5	5	

CALCULATING SPEED OF A WAVE

Use the formula on the previous page to solve the following problems.

Option A (EASY): Use the wave formula to calculate the speed of the following waves:

1. A water wave has a frequency of 2 hertz and a wavelength of 5 meters.
2. A wave has a frequency of 10 hertz and a wavelength of 15 meters.
3. A wave has a frequency of 10 hertz and a wavelength of 2.5 meters.
4. A wave has a frequency of 50 Hz and a wavelength of 15m.
5. A wave has a frequency of 2.5Hz and a wavelength of 2.5m.

Option B (MEDIUM): Complete the following calculations:

1.A wave has a frequency of 10 hertz and a wavelength of 2.5 meters. Calculate its speed.

2.A wave has a frequency of 25 Hz and a wavelength of 10m. Calculate its speed.

3.A wave has a frequency of 2.5Hz and a wavelength of 5.5m. Calculate its speed.

4. What is the frequency of a sound wave that travels at 30m/sec and has a wavelength of 2 meters?

5.The speed of a wave is 20m/sec and has a frequency of 4 Hertz. What is its wavelength?

Option C (DIFFICULT): Complete the following calculations:

1. Calculate the frequency of a sound wave that travels at 30m/sec and has a wavelength of 2 meters.

2. The speed of a wave is 20m/sec and has a frequency of 5 Hertz. Calculate its wavelength.

3. What is the frequency of a wave that has a speed of 17m/s and a wavelength of 3.5cm?

4. The frequency of wave A is 250 hertz and the wavelength is 35 centimetres. The frequency of wave B is 280 hertz and the wavelength is 31 centimetres. Which is the faster wave?

CALCULATING SPEED OF A WAVE

Optional EXTENSION

A wave _______________ is the time taken for one complete wavelength to pass a given point. As the frequency of a wave increases, the time period of the wave decreases. The unit for time period is 'seconds'.

$$wave\ period = \frac{1}{Frequency} \quad OR \quad T = \frac{1}{f}$$

$$wave\ period = \frac{wavelength}{velocity} \quad OR \quad T = \frac{\lambda}{v}$$

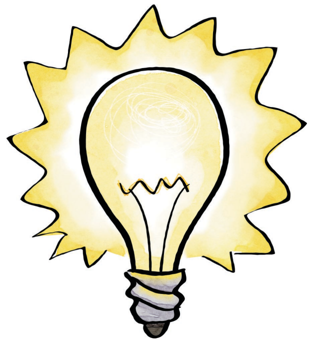
1. Calculate the period and frequency of a sound wave that travels at 33m/sec and has a wavelength of 2 meters.

2.A wave has a period of 2 seconds and a wavelength of 4 meters. Calculate its speed and frequency.

3. You are sitting on a boat watching water waves and see 10 wavelengths pass under you in a time of 50 seconds.
    1. What is the period of the water waves?
    2. What is the frequency of the water waves?
    3. If the wavelength is 3 meters, what is the wave speed?

4. Whales use sonar for echolocation. This means they send out sound waves to try and locate food sources. A whale is out in the ocean hunting krill via sonar. He emits a pulse at 22 KHz and 0.42 s later hears it echo bouncing back from a school of krill. If the whale's sound waves have a 2.0 cm wavelength, how far away is the krill?

LIGHT & WAVES

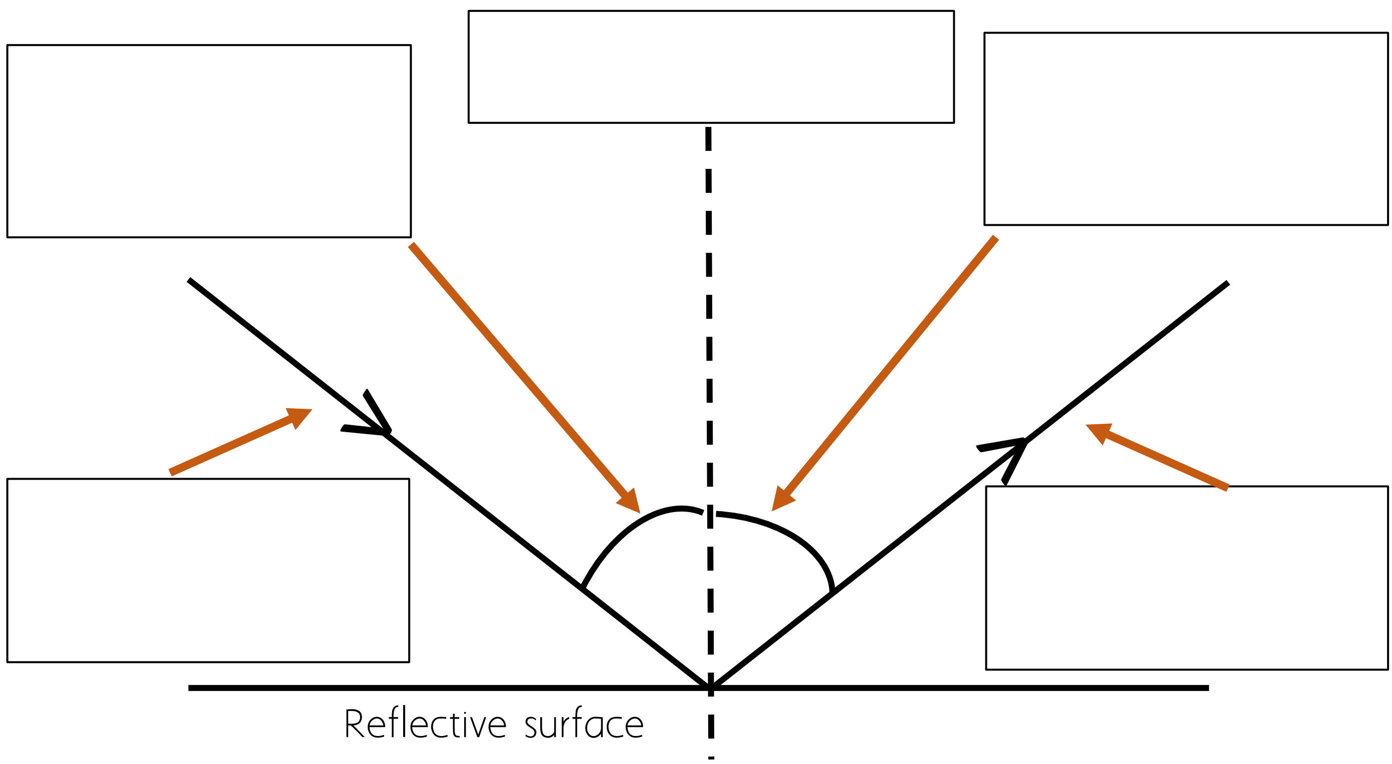


Light travels via ______________, electromagnetic waves. Light travels in ______________ lines. Shadows are produced when light cannot pass through ______________ objects. Light can pass through ______________ objects or substances.

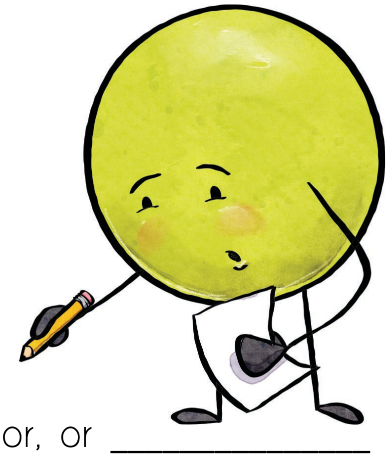
Light can also be reflected, refracted or ______________. Reflection of light refers to the ______________ back of light from a surface. Refraction of light refers to the ______________ of light. Absorption of light is when the energy of the wave is ______________ to the particles of the surface it hits.

REFLECTION

When light hits a particular surface, some or all the light can bounce off the surface. The beam of light coming into the surface is called the ______________ ray. The beam of light being reflected off the surface is called the ______________ ray. The normal is at _____ degrees to the reflective surface. The angle the incident ray makes with the normal is called the angle of ______________. The angle the reflected ray makes with the normal is called the angle of ______________.

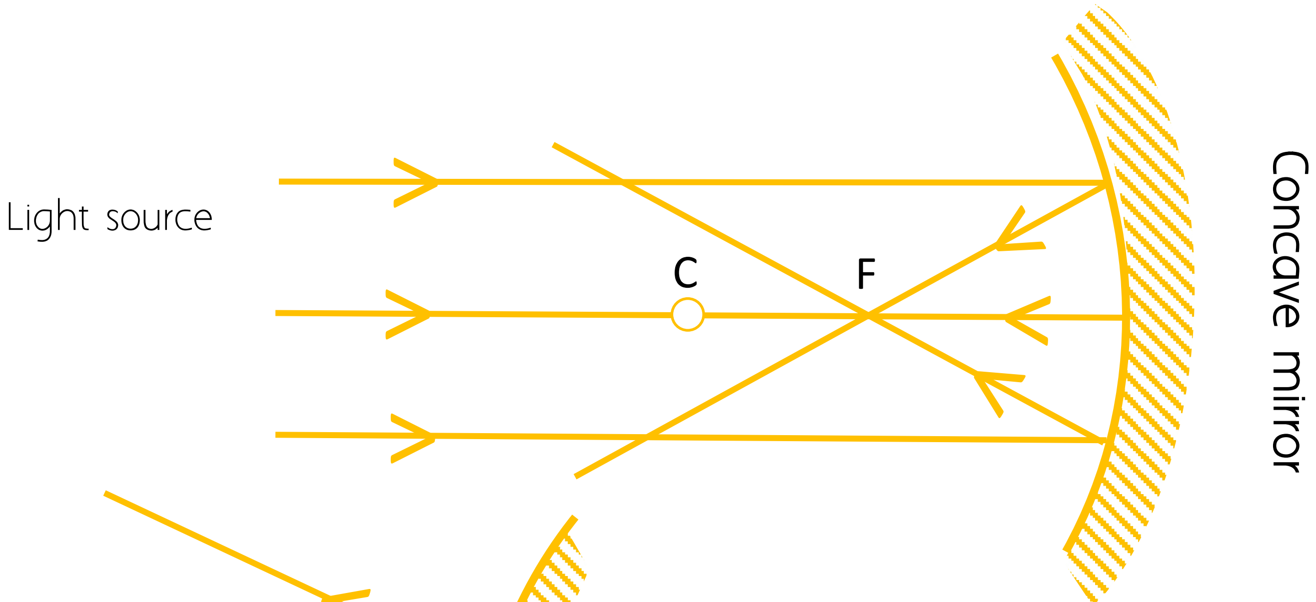


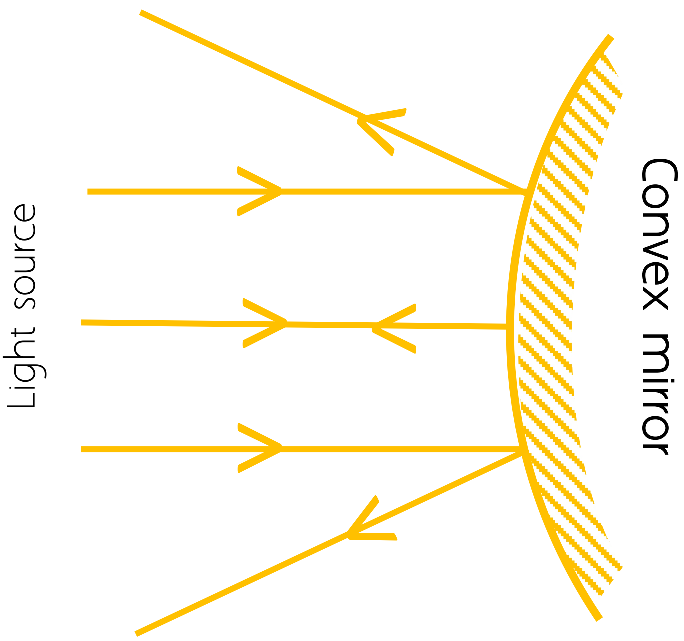
REFLECTION & CURVED MIRRORS



Light can be reflected off ____________ mirrors as well as straight mirrors.

When light is reflected off the inside of a spherical mirror, or ____________ mirror, then the light ____________ to a single point. This point is called the focal point or ____________. The focal ____________ is the distance from the mirror to the focal point. Spherical concave mirrors also have a '__________________________' which is a point that is ____________ from every part of the mirror's surface. This would be the ____________ if the mirror was a complete circle. Everyday examples of concave mirrors include inside car headlights, torches, dental mirrors and shaving mirrors.

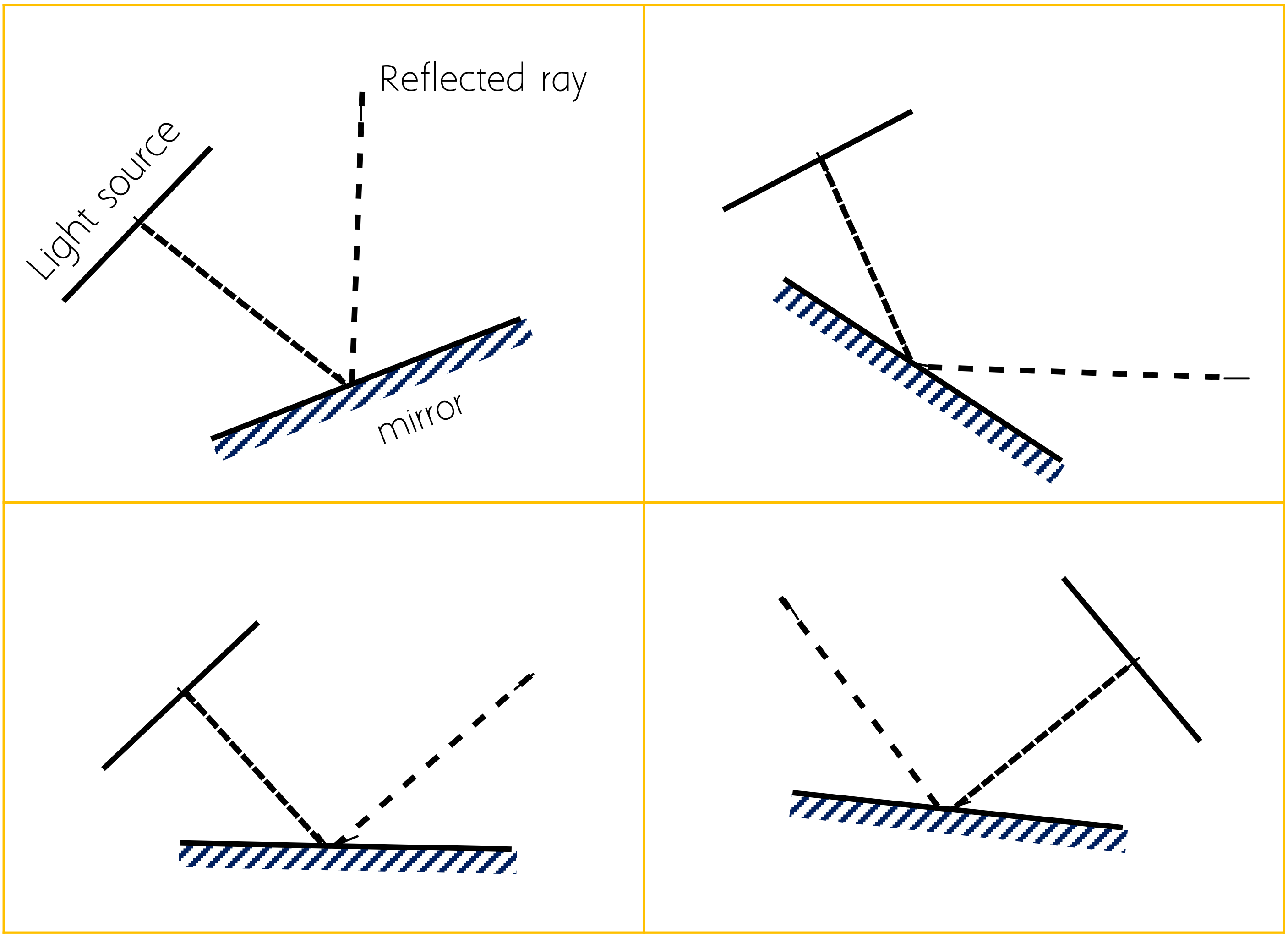




When light is reflected off the outside of a spherical mirror, or ____________ mirror, the light ____________ and spreads out. Everyday examples of convex mirrors include the side mirrors of a car and hallway/corner mirrors like those in supermarkets.

REFLECTION

Part 1: Complete the following reflection diagrams by drawing in the incident ray and reflected ray. Also label the light source, reflected ray and the mirror. Add arrows to the light rays to show the direction of light travel from the source.



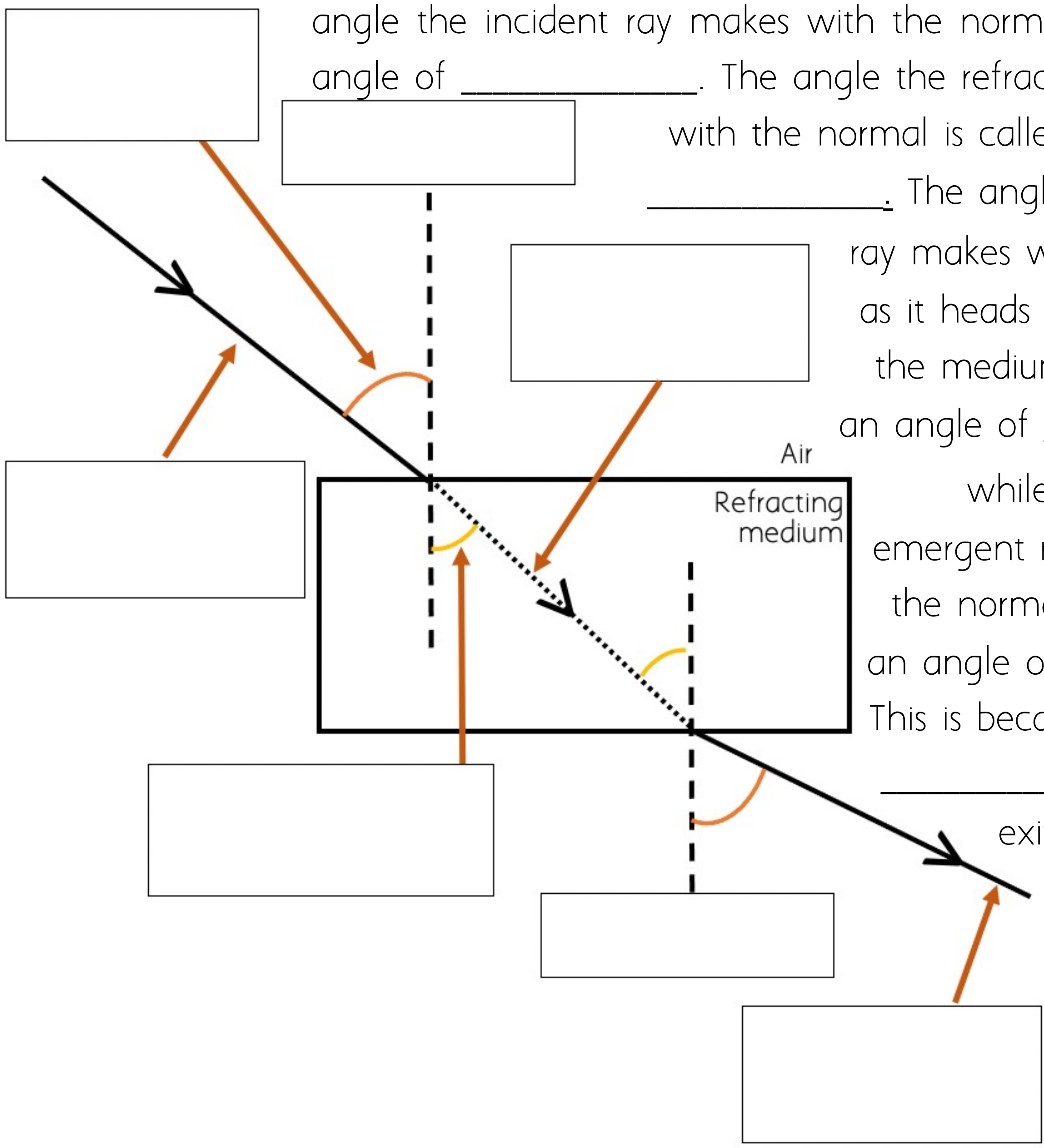
Part 2: Use a protractor to measure and draw in a normal. Then calculate the angle of incidence and angle of reflection for each diagram.

Diagram	Angle of incidence	Angle of reflection
1		
2		
3		
4		

REFRACTION

When light hits a surface that is _______________, which means it allows for light to pass through it, the _______________ at which the light travels changes. For example, light can travel faster through air than it can travel through glass. This causes the light to _______________ which is what we call refraction. The amount of bending that occurs depends on the _______________ _______________ of the medium. The refractive index is a measure of how much light will bend when passing from one medium to another.

The beam of light coming towards the medium is called the ______________ ray. The beam of light being bent as it travels through the medium is called the _______________ ray. The beam of light that exits the medium is called the _______________ ray. The normal is at ____ degrees to the medium. The angle the incident ray makes with the normal is called the angle of _______________. The angle the refracted ray makes with the normal is called the angle of _______________. The angle the refracted ray makes with the normal as it heads towards exiting the medium is also called an angle of _______________, while the angle the emergent ray makes with the normal is also called an angle of _____________. This is because the light is ______________ again as it exits the medium.

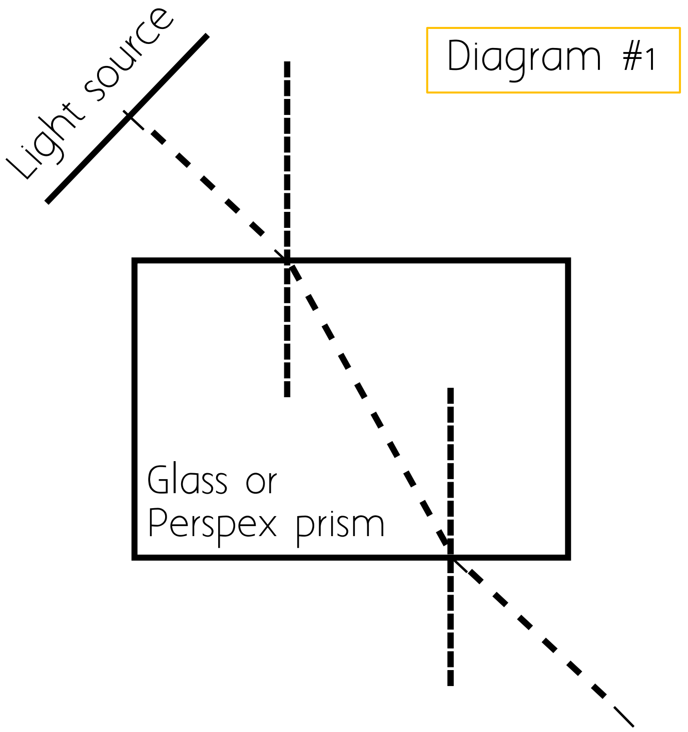


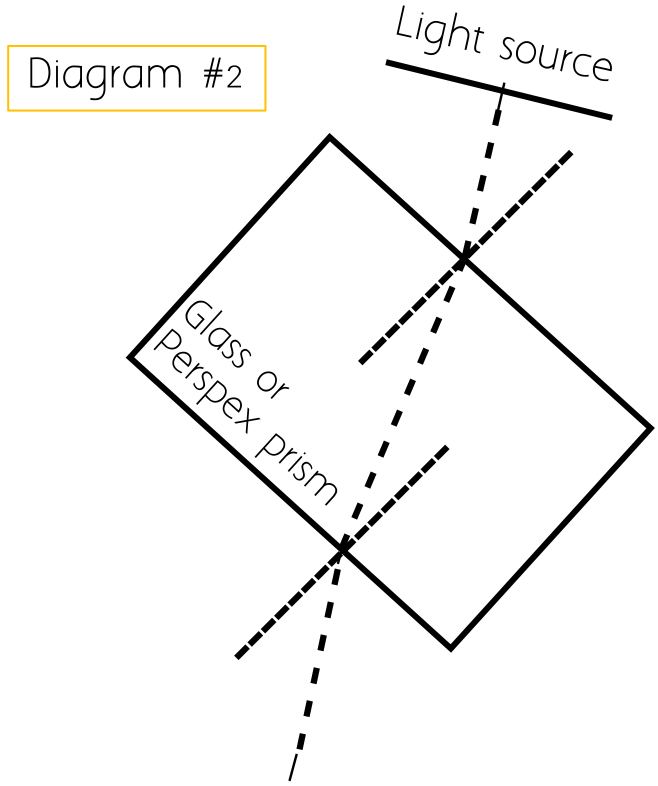
REFRACTION

Part 1: Complete the following refraction diagrams by drawing in the incident ray, refracted ray and emergent ray. Add arrows to the light rays to show the direction of light travel from the source.

Part 2: Draw in a normal for the incident rays and the emergent rays and mark the angles of incidence and refraction. Label the first angle of incidence as i_1 and the second angle of incidence as i_2 . Label the first angle of refraction as r_1 and the second as r_2.

Part 3: Use a protractor to measure each angle and record in the table below.





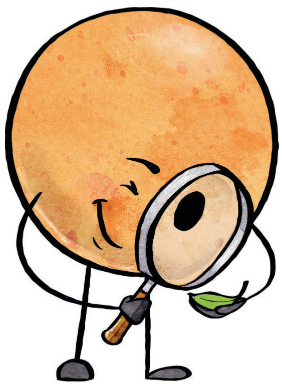
Ray Diagrams	Air to medium		Medium to air	
	i_1	r_1	i_2	r_2
Diagram # 1				
Diagram # 2				

Part 4: Write a conclusion for the relationship between these angles.

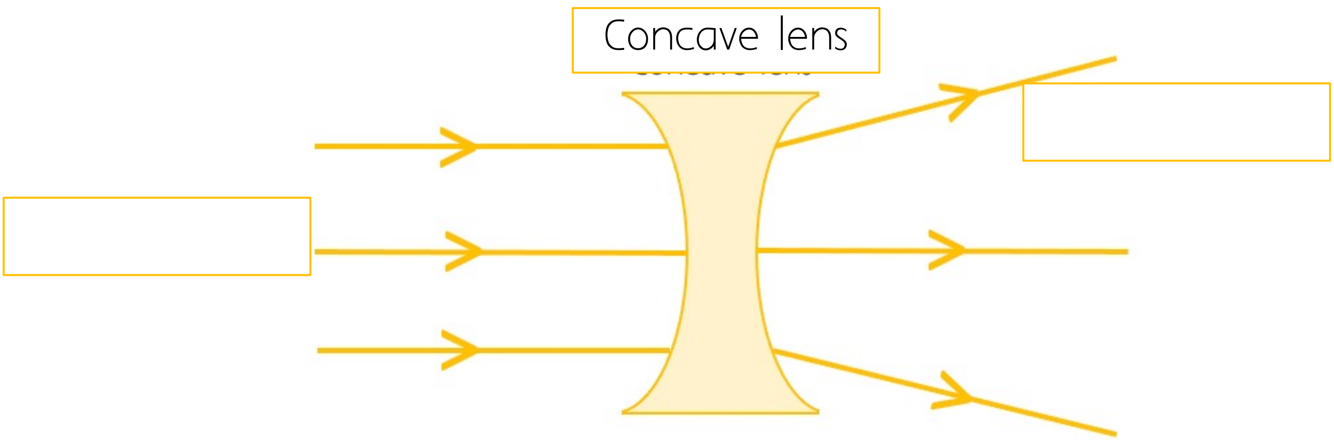
REFRACTION AND LENSES

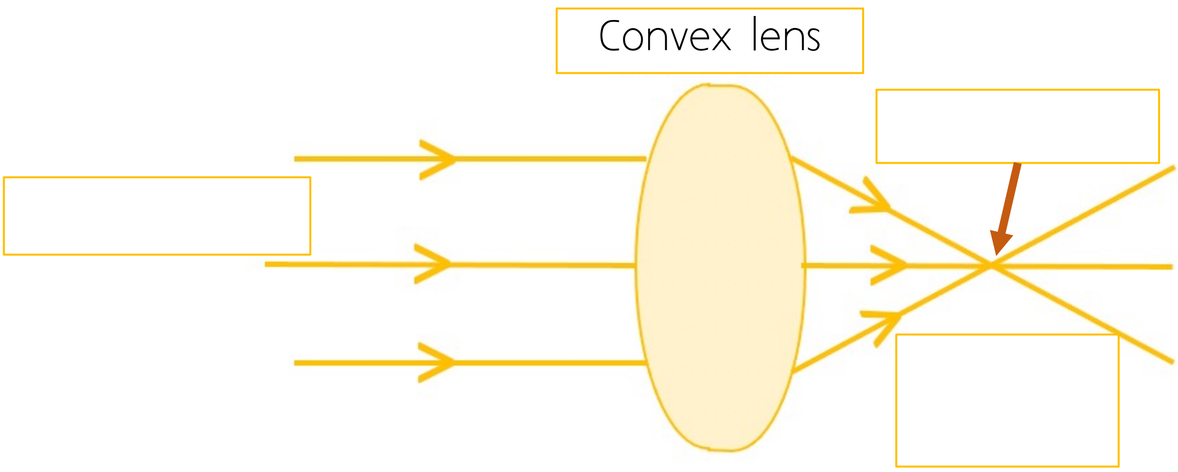
Light can be refracted through lenses of various materials too.

A concave lens is one that curves ______________ and so is ______________ in the middle than the ends. These lenses are also called ______________ lenses as they refract light ______________ from each other. Rays that pass through a concave lens bend the most towards the ends while the middle rays remain straight. Everyday examples of concave lenses include flashlights, binoculars and telescopes.



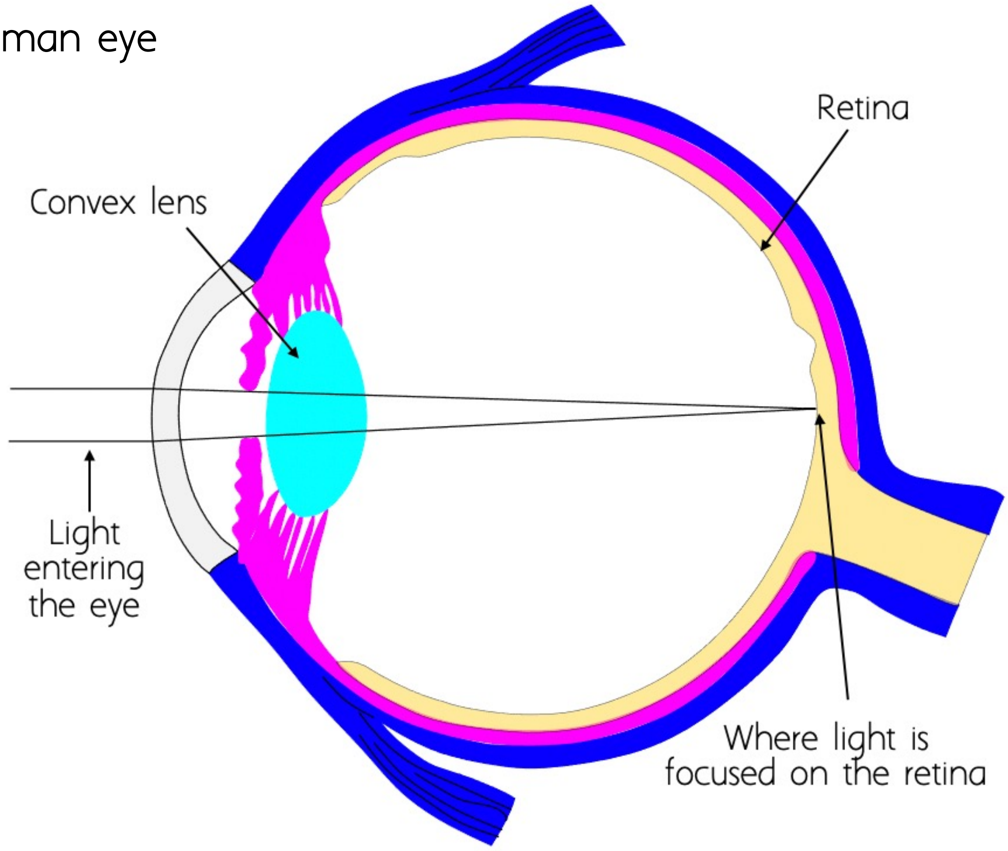
A convex lens is one that curves ______________ and so is ______________ in the middle than the ends. These lenses are also called ______________ lenses as they refract light ______________ each other and into a ______________ point. Everyday examples of convex lenses include the lens on the front of the human eye, magnifying glasses, cameras, and microscopes.





REFRACTION AND LENSES

The human eye



The convex lens on the front of the eye focuses light on the ____________ to create a clear image.

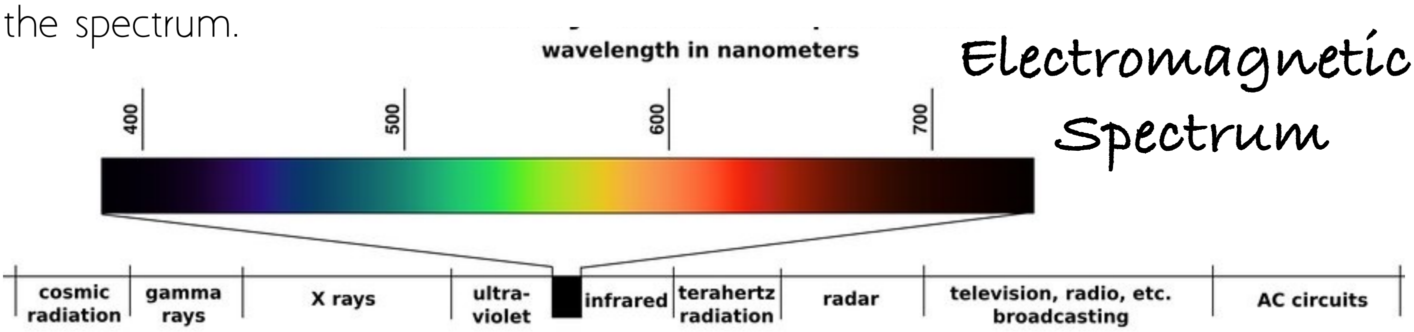
Glasses are another great example of the use of lenses.

Convex lenses in glasses are used to correct ____________. Farsightedness is when the distance between the lens and the retina of the eye is too ____________, so the focal point lies behind the retina.

____________ lenses in glasses are used to correct nearsightedness. Nearsightedness is when the distance between the lens and the retina of the eye is too ____________, so the light's focal point lies ____________ the retina.

LIGHT & COLOUR

The electromagnetic spectrum is the range of electromagnetic radiation wavelengths. Electromagnetic waves are organised on the spectrum according to their ______________. The different frequencies of the waves allow them to be used for different purposes in everyday lives. Electromagnetic radiation travels in ______________. Visible light and what we know as colour is part of the spectrum.



Visible light is made up of all the ______________. Each colour has its own unique ______________. If a surface absorbs all the wavelengths in visible light, then we see the surface as being ______________. If a surface absorbs all the wavelengths of visible light except the red wavelength, then the red wavelength can be ______________ into your eye. This means we see that surface as the colour red.

If a surface doesn't absorb any wavelengths of visible light, and rather reflects all the wavelengths, then we see that surface as ______________.

If we see the colour black, it means **all** the wavelengths of visible light are absorbed and **none** are reflected.

If we see the green, it means **all** the wavelengths of visible light are absorbed except green which is reflected.

If we see the colour white, it means **all** the wavelengths of visible light are reflected and **none** are absorbed.