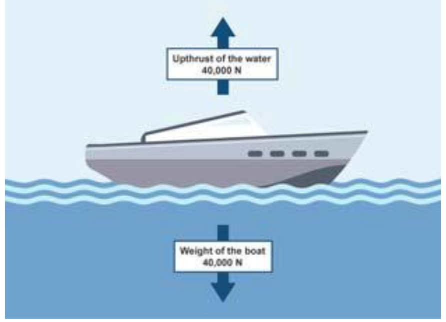
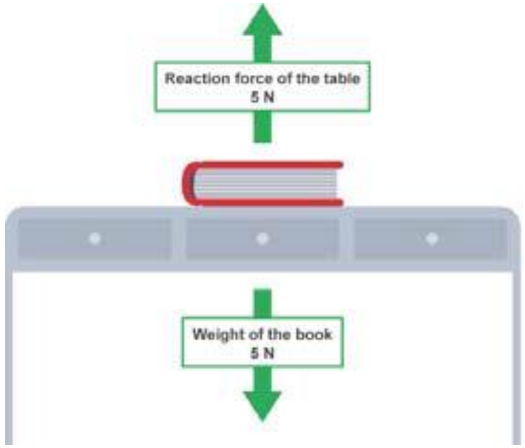
Force Diagrams

To show the forces acting on a body we use a free body force diagram. **A free body force diagram** shows all of the forces that are acting on the body. It has arrows that show the direction the force acts, the larger the arrow, the larger the force. A free body fore diagram should always have labelled arrows.

A boat floating



A book on a desk



Types of force

In the table below different forces are summarised:

Name of Force	What causes it?	Example
Friction	When two objects rub together	Car tyres moving on a road.
Air resistance	When an object rubs against air particles	A sky diver falling through the air
Reaction	A force that acts in the opposite direction	A book on a desk, the force acting up is a reaction force
Weight	The force an object exerts on the ground due to gravity	You will exert a force on the ground, that is your weight
Thrust	The force that drives on objects with an engine	Thrust moves a plane forwards

A force can be a **push or a pull,** for example when you open a door you can either push it or pull it. You can not see forces, you can only see what they do. When a force is applied to an object it can lead to a change in the objects

- **Speed**
- **Direction of movement**
- **Shape (think about a rubber band)**

Forces can also be divided into 2 types, contact forces and non contact forces.

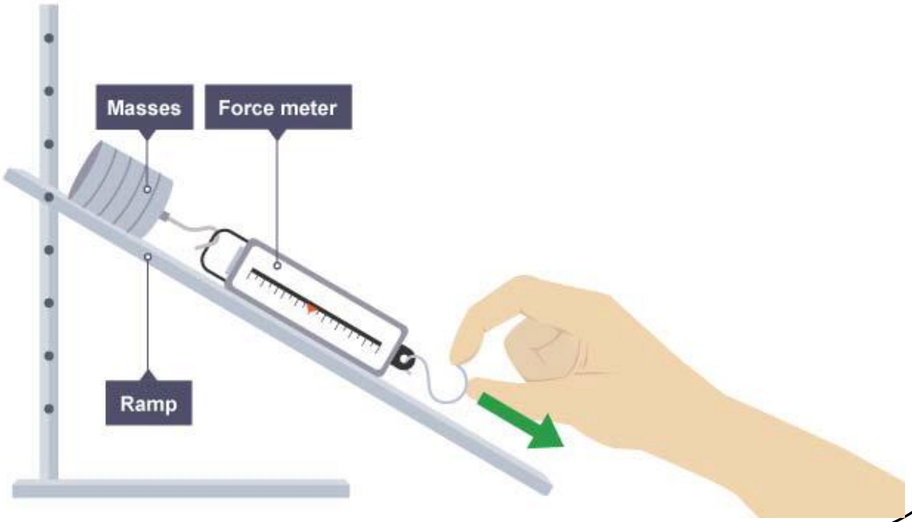
1. Contact forces for example friction, are caused when two objects are in contact.
2. Other forces for example gravity, are non contact forces. The two objects do not need to be in contact for the force to occur.

Measuring the size of forces

To measure the size of frictional forces on different surfaces you can drag
some masses along the different surfaces and record how much force is
required.

For this experiment :

• Independent variable: Surface
• Dependent variable: Force
• Control variable: Mass



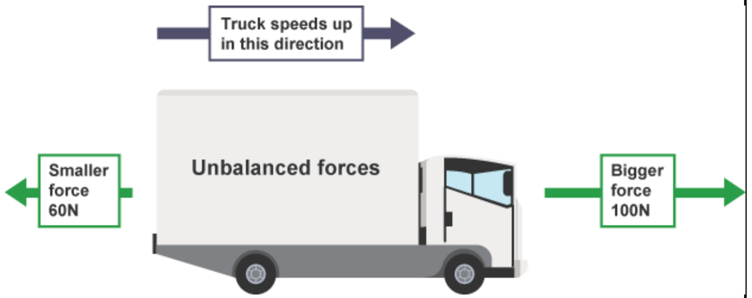
Unbalanced Forces

If the forces are unbalanced on an object there are two things that could happen:

1. If the object is stationary then it will move in the direction of the resultant force
2. If the object is moving, then the object will speed up or slow down in the direction of the resultant force.

For example, what is the resultant force on the lorry below?

100N-60N= 40N (to the right)



Remember the resultant force does not tell you what direction the lorry is moving in.

• If the resultant force is in the same direction as the movement of the lorry then the lorry will speed up
• If it is in the opposite direction the lorry will slow down

The larger the resultant force the larger the change in movement.

Balanced Forces

When we talk about the total force acting on object we call this the **resultant force.** When the forces acting in opposite directions are the same size we say the forces are **balanced**. This means one of two things:

1. The object is stationary (not moving)
2. The object is moving at a constant speed

This is known as Newton's first law.

For example, the resultant force acting on this object is 5N-5N=0N

Using Maths Skills in SCIENCE

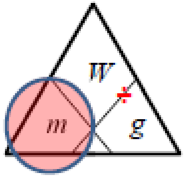
Setting out equations

e.g. A car travels 1,000m in a time of 40 seconds. What is the cars average speed?

Average speed= Distance ÷ Time
= 1,000 ÷ 40
<u>= 25m/s</u>

e.g. A crate has a weight of 500N. On Earth the gravitational field strength is 10N/kg. What is the mass of the crate?

Weight = Mass × Gravitational field strength



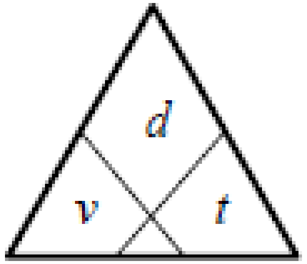
We need to find the mass so we cover up the mass term in the triangle and it tells us to find mass we do:

Mass = Weight ÷ Gravitational field strength
= 500 ÷ 10
<u>= 50kg</u>

Average Speed

Average speed (m/s) = Distance (m) ÷ Time (s)

$$v = \frac{d}{t}$$



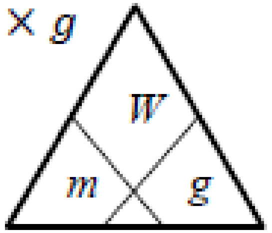
Average speed can also be measured in other units like km/h, mph or cm/s

You need to be careful which units you are using.

Weight

Weight (N) = Mass (kg) × Gravitational field strength (N/kg)

$$W = m \times g$$



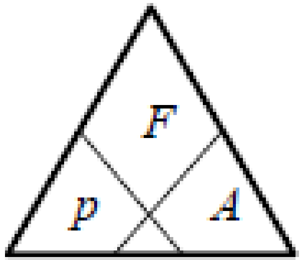
Weight is a measure of the size of the gravitational pull acting on an object.

This pull depends upon the size and mass of an object.

Pressure

Pressure (N/m²) = Force (N) ÷ Area (m²)

$$p = \frac{F}{A}$$



Pressure is caused by an object pushing on another.

The bigger the force applied by the object and the smaller the area over which the force is applied the larger the pressure

Distance-time graphs

A distance-time graph shows how far an object has moved from its starting point over time.

Distance travelled is always plotted on the y-axis (vertical)

Time taken is always plotted on the x-axis (horizontal)

You can find the speed of an object from a distance-time graph by finding the gradient of the graph. This is the ‘steepness’ of the line.

Gradient = Change in y-axis ÷ Change in x-axis

Using the graph opposite we can find the speed of the object represented by the green line between 6 and 10 seconds by:

Gradient = Change in y-axis ÷ Change in x-axis
= (7-6) ÷ (10-6)
= 1 ÷ 4
<u>= 0.25m/s</u>

We can also find the average speed of the green object by drawing a line from the start of its motion to the end of its motion. This is shown opposite by the **blue line** and how to find the average speed is shown below.

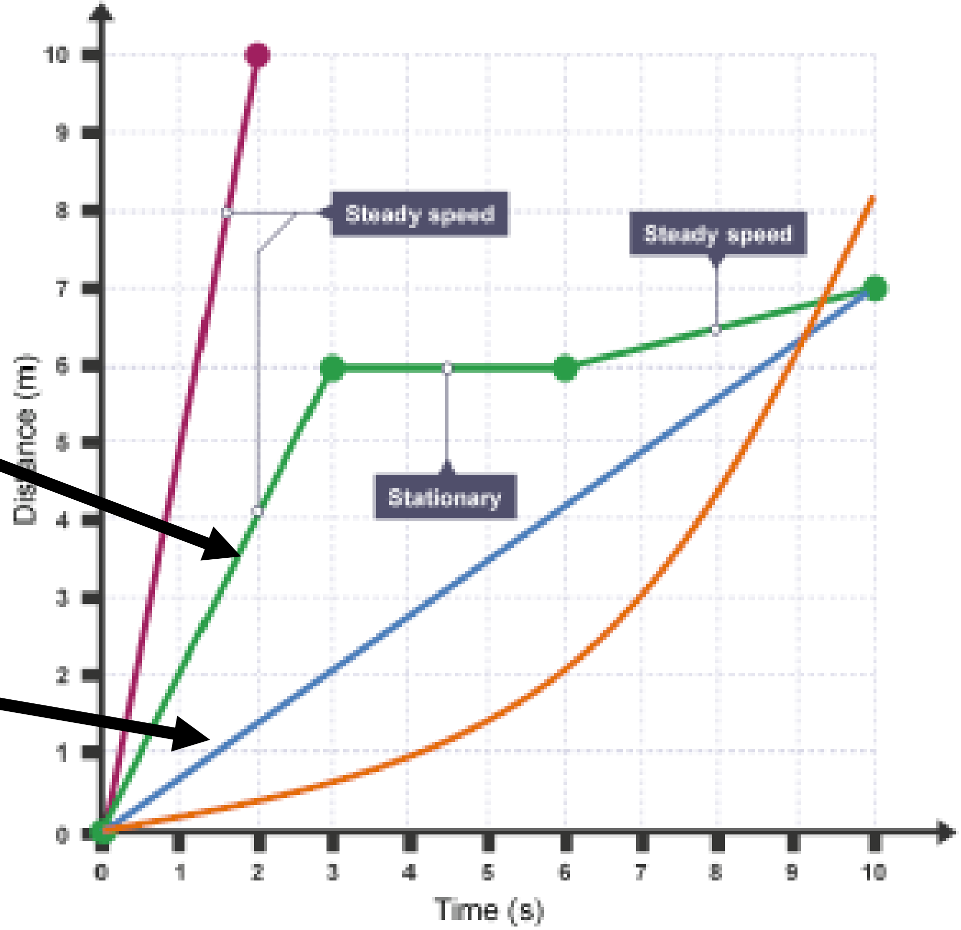
Gradient = Change in y-axis ÷ Change in x-axis
= (7-0) ÷ (10-0)
= 7 ÷ 10
<u>= 0.7m/s</u>

Interpreting Distance-time graphs

• A straight diagonal line of a distance-time graph shows that the object is travelling at a steady/constant speed.

• A straight horizontal line on a distance-time graph shows that the object is not moving (stationary)

• If a curved line were to appear on a distance-time graph (orange line) this shows the object is accelerating.



A force can be a _________ or a _________.
Forces are measured in _______________ using a _____________________________.

Explain the term 'interaction pairs' using two examples:

____

____

1. ________________________________
2. ________________________________

Make a list of:

a) Contact forces:

____

____

b) Non-contact forces:

____

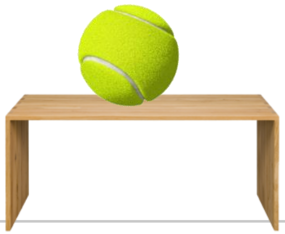
____

1: Forces
TASK 1

Draw force diagrams to show **ALL** the forces acting on:

a) Falling tennis ball:

b) Tennis ball sitting on a table:



Sketch a force diagram showing an object for which the forces are balanced (equilibrium):

Explain the term 'resultant forces'. Use a diagram to help with your explanation:

Sketch force diagrams showing the forces acting on an accelerating car and a decelerating:

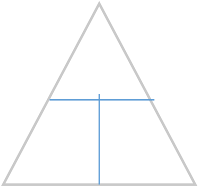
The equation used to calculate speed is:

Units:

Speed-

Distance-

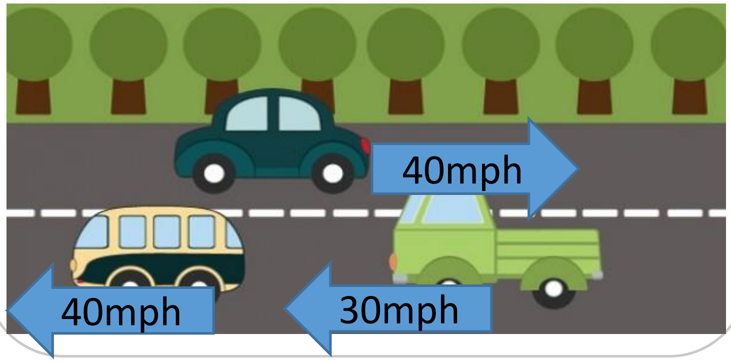
Time-

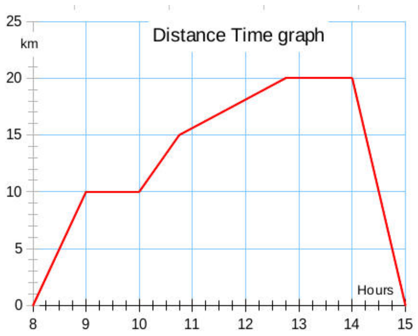


Two students are running. Runner A runs 100 metres in 12.5 seconds, runner B runs 150 metres in 18.9 seconds. Who is faster? Show your working and units.

Key words and definitions:

Describe the relative speeds of the vehicles below:





1: Forces TASK 2

Describe the journey made in the distance-time graph above:

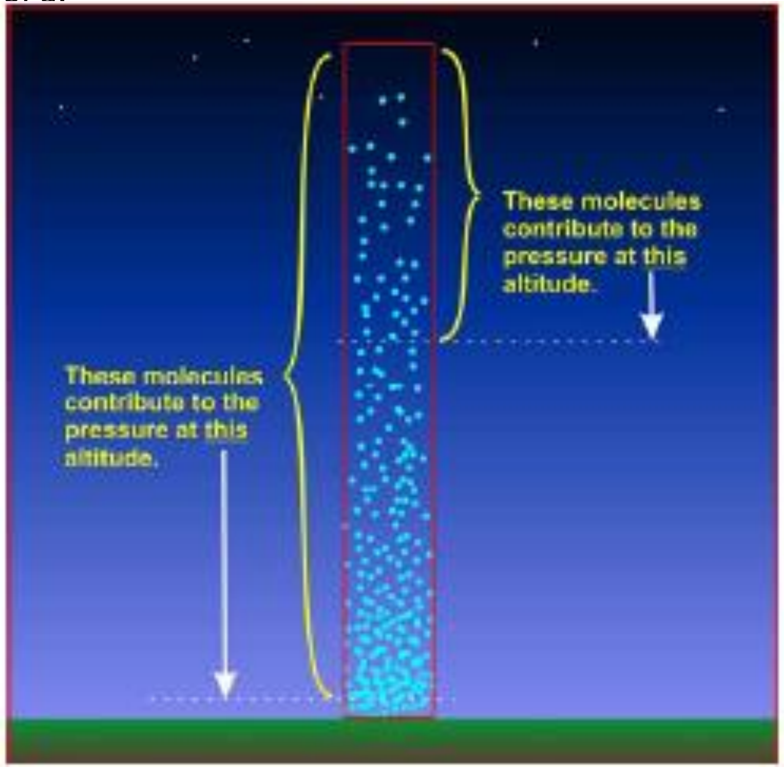
Calculate the average speed of the journey:

Chapter 1.3 and 1.4 Knowledge Organiser - FORCES

Science Department

Atmospheric pressure

The mass of the air above us is being attracted to the Earth by the force
of gravity. The weight of this air causes atmospheric pressure. The higher up in the atmosphere that you are the less molecules there are above you so the lower the atmospheric pressure. At the surface of the Earth we say that the pressure is equal to 1 atmosphere (atm) of pressure. This is equivalent to about 100,000Pa.

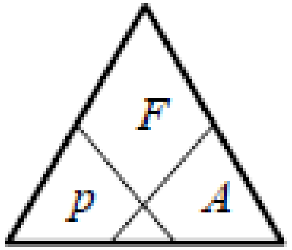


Using Maths Skills in Science

Pressure

Pressure (N/m^2) = Force (N) ÷ Area (m^2)

$$p = \frac{F}{A}$$



Pressure is caused by an object pushing on another.

The bigger the force applied by the object and the smaller the area over which the force is applied the larger the pressure

Pressure in liquids

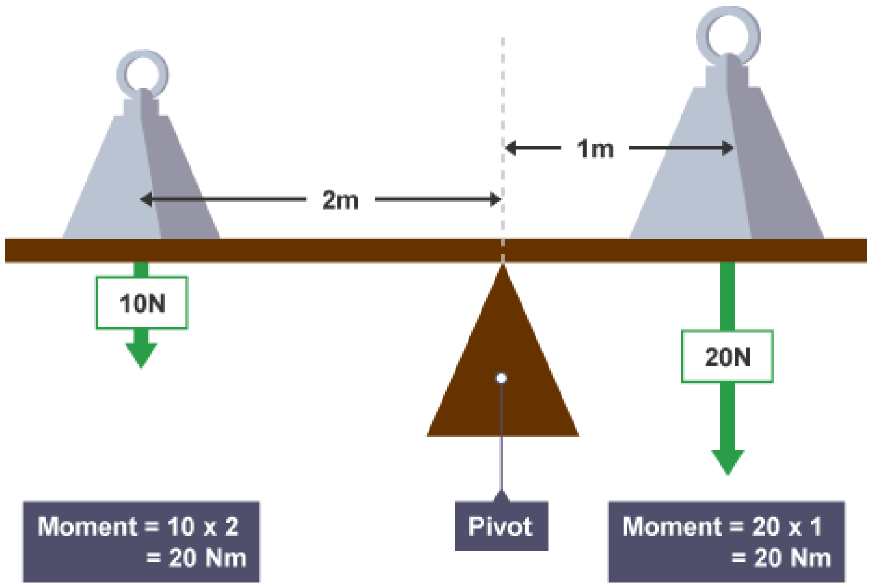
Like air pressure the pressure in a liquid depends upon the amount of liquid above the object. The more liquid above the object the greater the pressure that is exerted. This can be demonstrated by looking at water flowing out of bucket.

The lower down the bucket the hole is the greater force is being applied to the liquid coming out of the bucket. This causes the water jet to squirt further from the bucket.

Pressure is liquids acts on all sides of an object immersed (completely surrounded by) in a liquid. The deeper the object is in the liquid the more pressure that it will experience. If the object is less dense than the liquid it is suspended in the object will rise in the liquid and float.

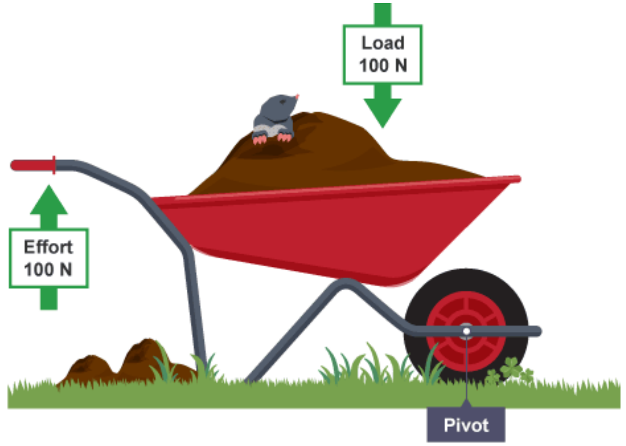
Moments
A moment is the turning effect of a force. In order for a force to provide a
turning effect there must be a pivot. For example in a see-saw.
You calculate the moment of a force using the equation:

moment = force × distance



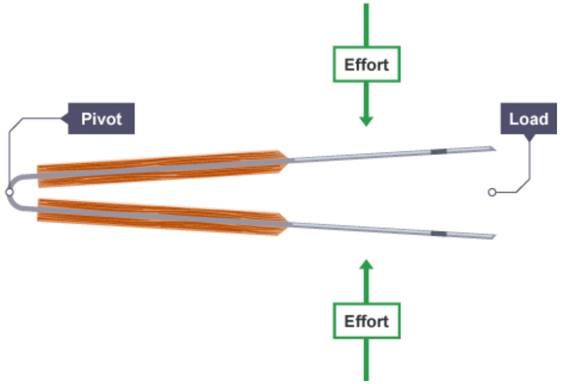
The unit of a moment is Newton metres (Nm).
In the situation above the moment is equal on both sides of the pivot so the
object will be in balance. If the moments on either side of a pivot are not equal
then the object will turn in the direction of the greater moment

Uses of moment in simple machines
By adjusting the distances from a pivot and adjusting the sizes of the forces acting
the idea of moments can be used to great effect. Look at the examples below for some uses of moments.



Wheelbarrows
By placing the load in a wheelbarrow nearer the pivot (the wheel) the force needed
to lift the wheelbarrow is must less because the handle is further away from the pivot.

Forceps
Forceps use the opposite effect than the wheelbarrow. By providing the force (effort) closer to the pivot the force at the end of the forceps will be smaller. This means you can pick up things more carefully.



Friction:
What causes friction?

____

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Explain how you could reduce friction.

____

____

_________________ resistance and _______ resistance are examples of **drag forces**

Describe the factors that affect the size of the frictional force…

____

____

Explain the forces acting on an object when it is squashed. Sketch a force diagram to help with your explanation.

1: Forces
TASK 1

Sketch a force diagram showing the forces acting on a dolphin as it swims through the water.

- Explain Hooke's Law
- Sketch a graph showing an extension that obeys Hooke's Law

Explain what is meant by centre of gravity. Sketch force diagrams to help with your explanation.

The equation used to calculate a moment is:

The units are:
Force-
Distance-
Moment-

1: Forces
TASK 2

State the **Law of Moments:**

KEY WORDS AND DEFINITIONS:

1: Forces
TASK 3

Define and explain the term 'Fluid pressure.
Sketch a diagram to help you explain

____

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The equation to calculate fluid pressure is:

Write down a 'worked example' to show you how to use the fluid pressure equation:

Why are gases compressible but liquids are not?

State two ways you can increase gas pressure:

1. .

2. .

Sketch and label a diagram to explain 'atmospheric pressure'

How do the brakes of a car use liquid pressure?

Write down two factors that affect the upthrust on a floating object:

1.

2.

State what happens to liquid pressure as you go deeper in a lake:

____

____

Ext: try to explain this:

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____

____

Key words and definitions:

Explain the term ‘stress’

____

____

____

____

1: Forces TASK 4

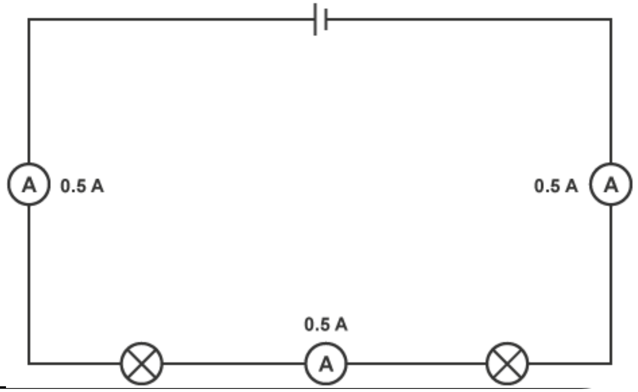
The equation used to calculate stress:

Write down a ‘worked example’ to show you how to use the stress equation:

Some particles carry an electric charge. In electric wires these particles are electrons. We get an electric current when these charged particles move from place to place.
An electric current is a flow of charge, and in a wire this will be a flow of electrons.

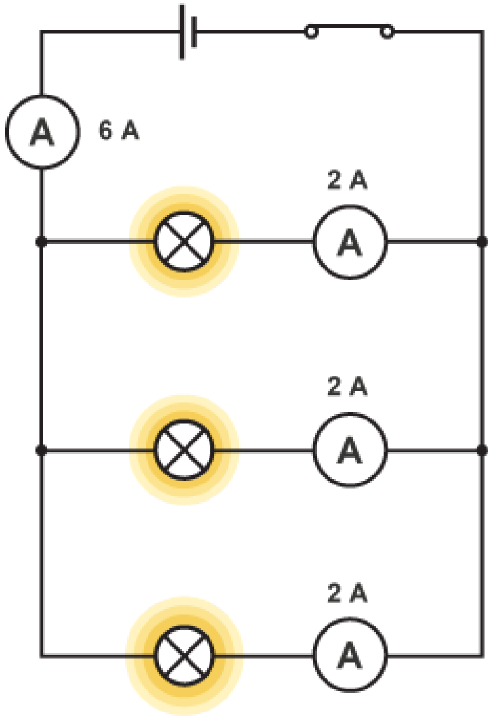
Current is a measure of how much electric charge flows through a circuit. The more charge that flows, the bigger the current.
Current is measured in amperes (amps). The symbol for ampere is A.

Current in series circuits
The current is the same everywhere in a series circuit. It does not matter where you put the ammeter, it will give you the same reading.



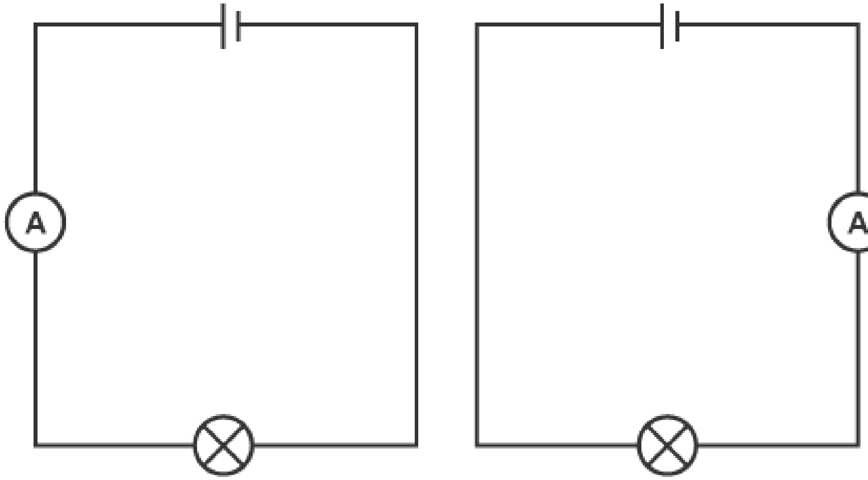
Current in series circuits continued…
The current in a series circuit depends upon the number of cells. If you make the cells face in the same direction, th**e more cells you add, the greater the current**.
If you put more lamps into a series circuit, the lamps will be dimmer than before because less current will flow through them.
You might think that the current gets less as it flows through one component after another, but it is not like this - the current isn't used up!

Current in Parallel Circuits
Current in parallel circuits
Current is shared!
When two components are connected in parallel, the current is shared between the components. The current is shared when it reaches the branches, then adds again where the branches meet.



Measuring current

A device called an ammeter is used to measure current. To
measure the current flowing through a component in a circuit,
you must connect the ammeter in series with it – look at the
diagram to see what is meant by this.



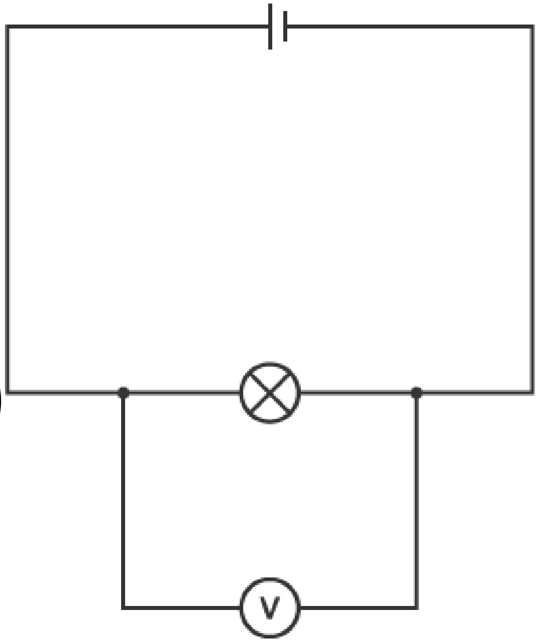
Measuring Potential Difference

Potential difference is a measure of the difference in energy between two parts of a circuit. The bigger the difference in energy, the bigger the potential difference.

Potential difference is measured in volts. The symbol for volts is V. Some people use the term voltage instead of potential difference but this is less accurate.

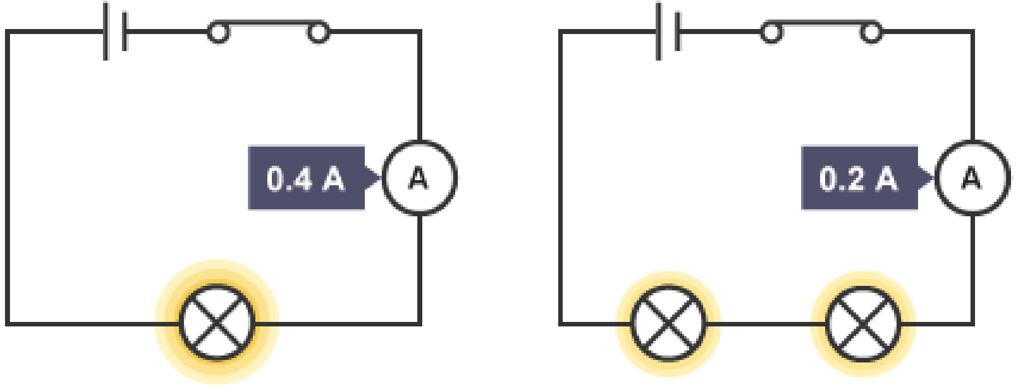
Potential difference is measured using a device called a voltmeter. Unlike an ammeter, you must connect the voltmeter in parallel to measure the potential difference across a component in a circuit.

Can you see the difference in how the AMMETER and VOLTMETER are positioned?

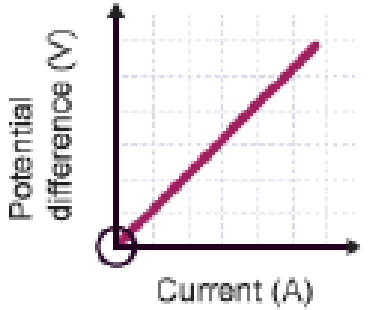


Resistance

The wires and the other components in a circuit reduces the flow of charge through them. This is called resistance.
The unit of resistance is the ohm, and it has the symbol Ω (an uppercase Greek letter omega).
The resistance increases when you add more components in series. For example, the resistance of two lamps is greater than the resistance of one lamp, so less current will flow through them. Can you see how this affects the lamps?



Resistance represents the ratio of potential difference to current. Therefore, if you plot a graph of current against potential difference for a wire, you get a straight line.



Conductors and insulators of electricity

Different materials have different resistances:

- an electrical conductor has a low resistance
- an electrical insulator has a high resistance

You can easily find out which materials are conductors and which are insulators using a simple circuit. You set up a series circuit with a cell, lamp and wires. Leave a gap in the circuit between two of the wires. Then connect the two wires using pieces of each material and see if the lamp lights up:

- it will light up if the material is a conductor
- it will not light up if the material is an insulator

The table lists some examples of conductors and insulators:

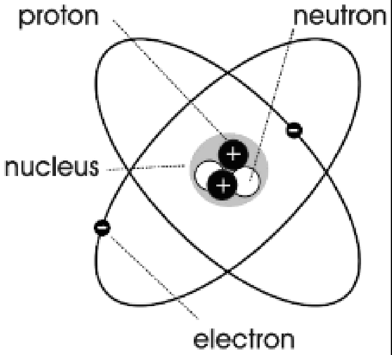
Conductors	Insulators
Metal elements	Most non-metal elements, e.g. sulfur, oxygen
Graphite (a form of carbon, a non-metal element)	Diamond (a form of carbon, a non-metal element)
Mixtures of metals, e.g. brass, solder	Plastic
Salt solution	Wood
Liquid calcium chloride	Rock

Calculating resistance

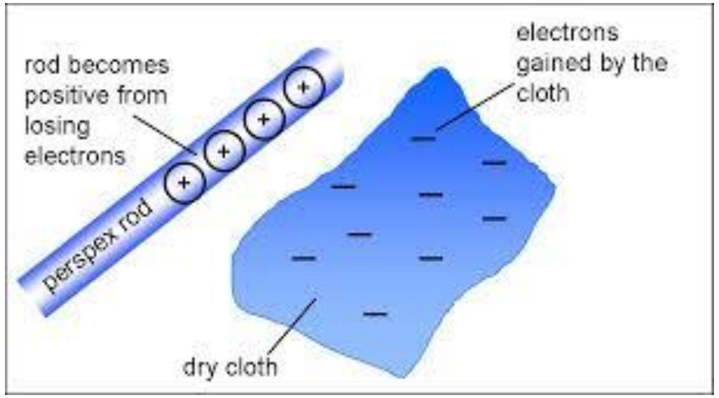
To find the resistance of a component, you need to measure:
the potential difference across it
the current flowing through it
The resistance is the ratio of potential difference to current. We use this equation to calculate resistance:
resistance = potential difference ÷ current
E.g. 3A flows through a 240 V lamp. What is the resistance of the lamp? resistance = 240 ÷ 3 = 80 Ω

All substances are made of atoms. These are often called particles. An atom is electrically neutral - has no overall electrical charge. However, each atom contains even smaller particles called electrons. (remember, these are negatively charged).

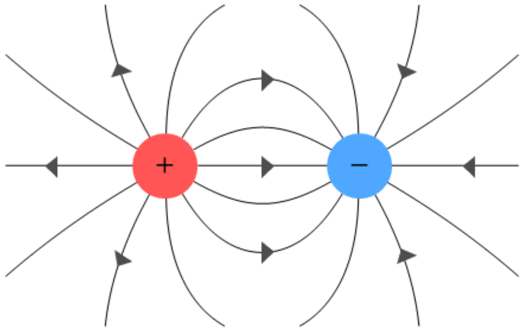
- If an atom gains an electron, it becomes negatively charged.
- If an atom loses an electron, it becomes positively charged.



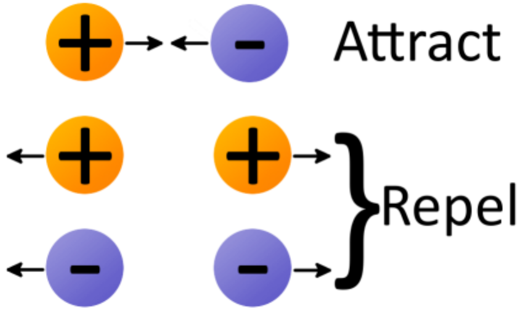
Electrons can move from one substance to another when objects are rubbed together. You may have done this with a party balloon: if you rub a balloon on your sweater, you can get the balloon to stick to the wall or to your hair. This is because of static electricity.



A charged object creates an electric field. You cannot see an electric field, but it surrounds the charged object. If another charged object is moved into the electric field, a force acts on it. The force is a non-contact force because the charged objects do not have to touch for the force to be exerted.



Two charged objects will:
- repel each other if they have like charges (they are both positive or both negative)
- attract each other if they have opposite charges (one is positive and the other is negative)



Charged objects will also attract small, uncharged objects. This is why a charged plastic comb or ruler, or a party balloon, can pick up small pieces of paper.
The only way to tell if an object is charged is to see if it repels another charged object.

Some particles carry electrical ___________. In electric wires these particles are ____________. An electrical current is a __________ ___ _____________.

Explain the term Current and what it is measured in.

____

____

____

Make a list of:

a) Contact forces:

____

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b) Non-contact forces:

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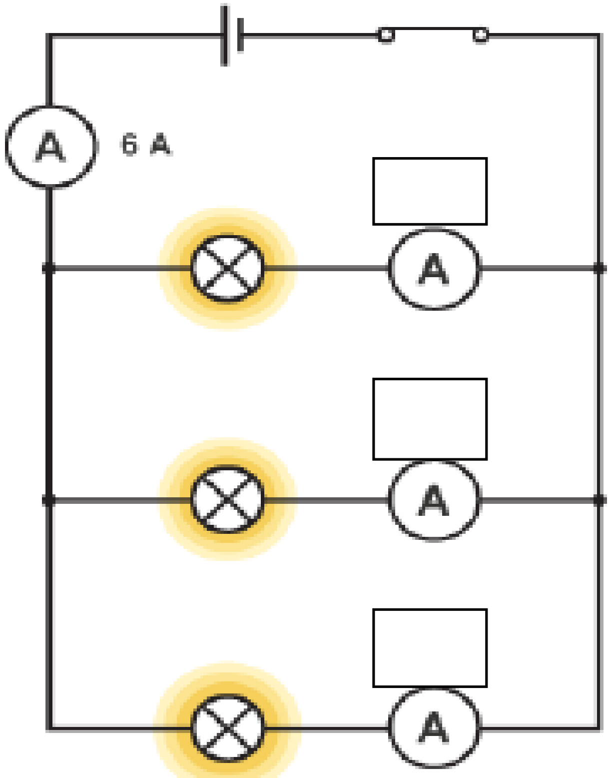
Current in a PARALLEL circuit

Add values into the boxes showing that current is SHARED in a parallel circuit



2:Electromagnets TASK 1

Describe the relationship between the number of cells in a circuit and size of current.

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Current in a SERIES circuit

Draw a SERIES circuit showing that current is the SAME everywhere.

Current is measured using an

____

Potential Difference is measured using a

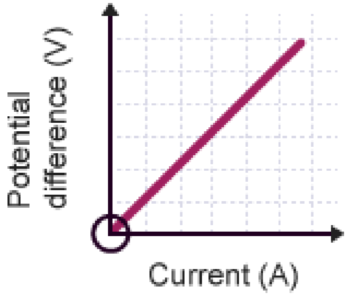
____

Units:
Current:
Potential Difference:
Resistance:

Potential difference is a measure of the ___________________ in _________________ between two parts of a ________________. The bigger the difference in energy, the bigger the ____________________ ______________________.

Measuring Potential Difference

Draw a circuit with a voltmeter showing how potential difference is measured.



2:Electromagnets TASK 2

Describe the relationship between resistance and the number of components in a circuit:

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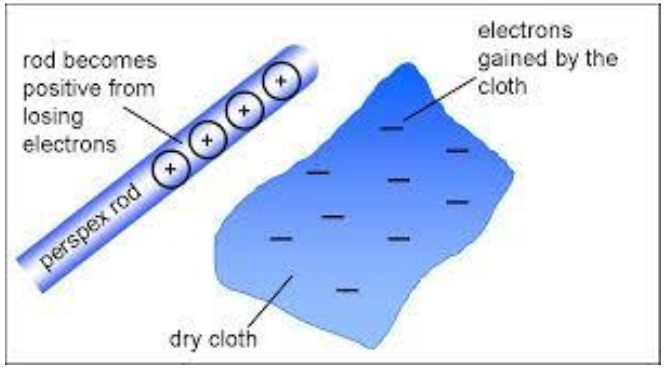
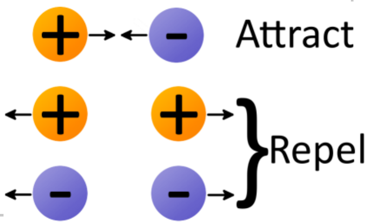
Charging up – Static Electricity Experiments



Electrons are _____________________ charged particles.
Electrons can __________ from one substance to another when objects are ___________ together.

Two charged objects will:

- ________________ each other if they have like charges (they are both positive or both negative)
- ______________________ each other if they have opposite



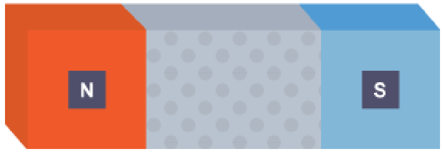
Chapter 2.3 and 2.4 Knowledge Organiser - ELECROMAGNETS

Science Department

Most materials are not magnetic, but some are. A magnetic material can be magnetised or will be attracted to a magnet. These metals are magnetic:

- iron
- cobalt
- nickel
- Steel is mostly iron, so steel is magnetic too.

A bar magnet is a permanent magnet. This means that its magnetism is there all the time and cannot be turned on or off. A bar magnet has two magnetic poles:

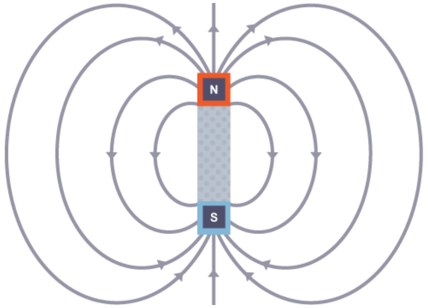


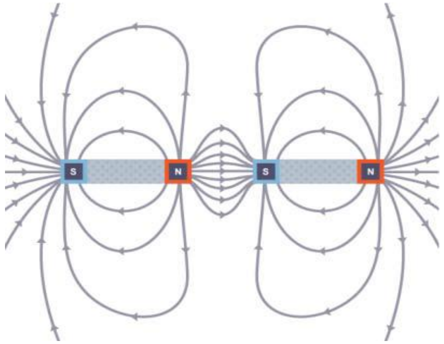
- north pole (or north-seeking pole)
- south pole (or south-seeking pole)

A north pole will attract a south pole on a magnet. But two like poles will
repel.

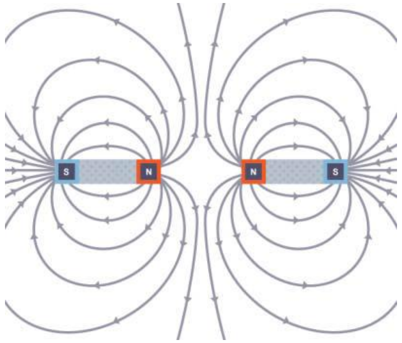
A magnet creates a magnetic field around it. You cannot see a magnetic field, but you can observe its effects. A force is exerted on a magnetic material brought into a magnetic field. The force is a non-contact force because the magnet and the material do not have to touch each other.
You will have used iron filings to create an image like this in your lesson. The filings show the shape of the field lines.

You may have also used plotting compasses to determine the *direction* of the field lines. A completed diagram would look like this. (make sure you can reproduce it accurately)
The magnetic field is strongest at the poles, where the field lines are most concentrated.



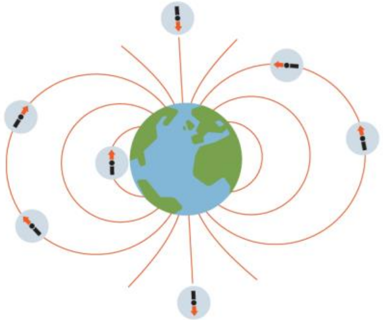


These images show two magnetic fields interacting. Can you tell which magnets are attracting and which are repelling?



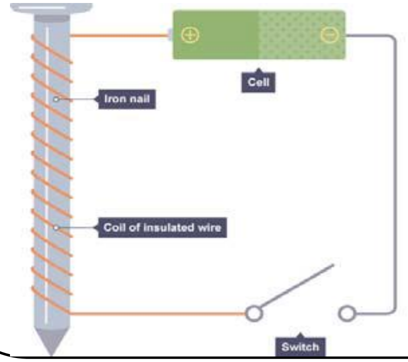
Due to the Earth's structure it acts like a giant magnet.
Can you see how the image looks similar to a bar magnet?

This allows us to use a compass to navigate as the magnetic needle will always point towards the North pole.



Electromagnets

When an electric current flows in a wire, it creates a magnetic field around the wire. This effect can be used to make an electromagnet. A simple electromagnet comprises a length of wire turned into a coil and connected to a battery or power supply.

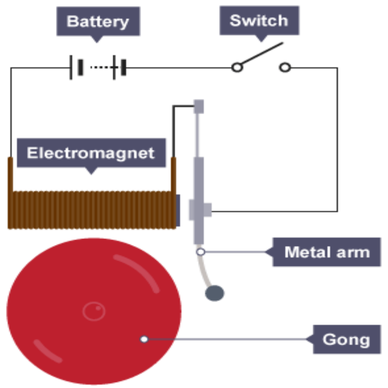


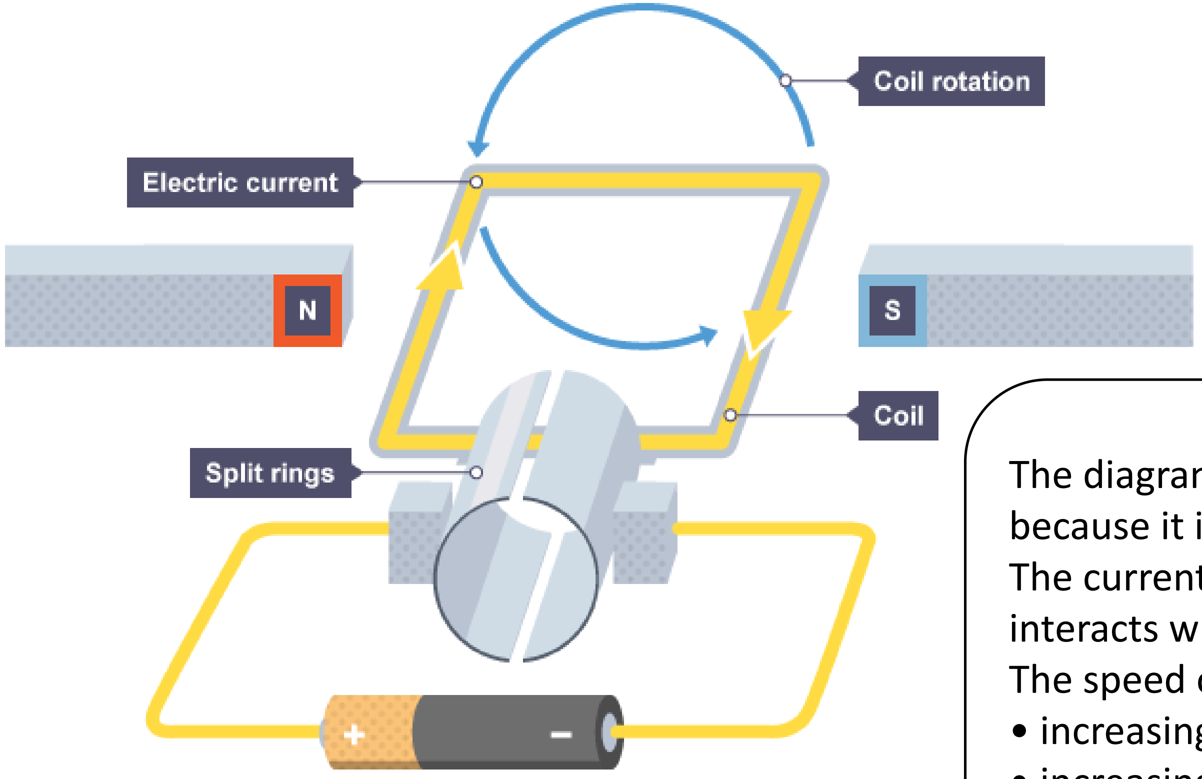
You can make an electromagnet stronger by doing these things:

- wrapping the coil around a piece of iron (such as an iron nail)
- adding more turns to the coil
- increasing the current flowing through the coil

There is a limit to how much current can be passed safely through the wire because the resistance of the wire causes heating.

Electromagnets are particularly useful because the magnetism can be turned on and off and the strength can be varied.





DC motors

Electric motors use the forces produced by magnetic fields to produce a turning motion. If you put a length of wire in a magnetic field and pass a DC current through it (such as from a battery), the wire will move. This is called the motor effect.

The split rings make electrical contact with the coil and reverse the current every half turn. When an electric current flows through the coil, a force is exerted on the coil, causing it to spin.

The diagram shows: the coil of wire has an electrical current running through it because it is connected to the cell. This generates a magnetic field around the wire. The current is turned on and off at the correct time so the magnetic field of the wire interacts with that of the two magnets. This makes the coil rotate.

The speed of the motor can be increased by:

- increasing the strength of the magnetic field
- increasing the current flowing through the coil

Complete the sentences:

- North-seeking poles _________ north-seeking poles
- South-seeking poles _________ south-seeking poles
- North-seeking poles _________ south-seeking poles

The only magnetic materials are:

1. .
2. .
3. .

Describe three similarities and three difference between permanent magnets and electromagnets:

____

____

____

____

____

____

____

____

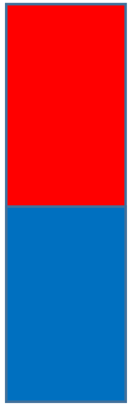
____

____

State two ways you can detect a magnetic field, then sketch a magnetic field around the magnet below (include arrows to show the direct of the field).

1.

2.



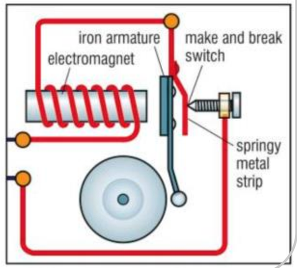
2: Electromagnets TASK 1

Sketch and label a diagram showing the magnetic field around a coil of wires carrying a current:

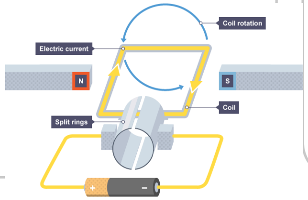
How is the Earth like a bar magnet?

2: Electromagnets TASK 2

Describe how an electric bell works using an electromagnet:



Describe how a motor works using an electromagnet:



How can you make an electromagnet stronger?

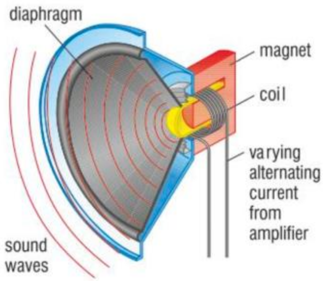
1.

2.

3.

4.

Describe how loud speakers work using an electromagnet:

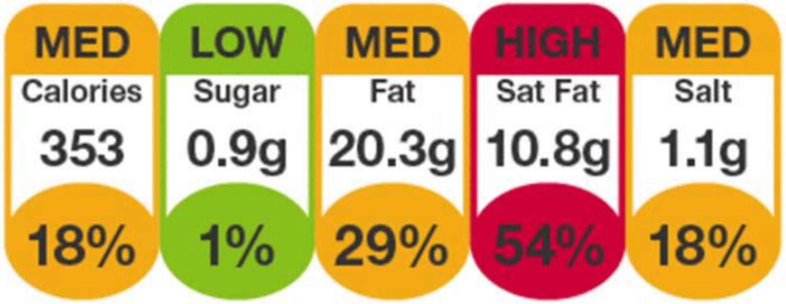


Key words and definitions:

Food labelling

Food labels give you information about which food groups and how much energy each food contains. They give guidance to tell you what percentage of nutrients each food contains.

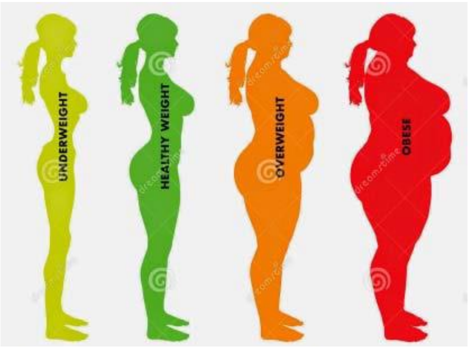
We measure the energy stored in food in calories.



Food labelling

Different people require different amounts of energy depending upon their energy needs. For example an accountant who sits at his desk all day may only require 2,500kcal of energy whereas a builder may require 4,500kcal.

Eating too much can cause obesity which can lead to heart disease and diabetes. Eating too little can lead to malnutrition and can be caused by diseases such as anorexia or bulimia.

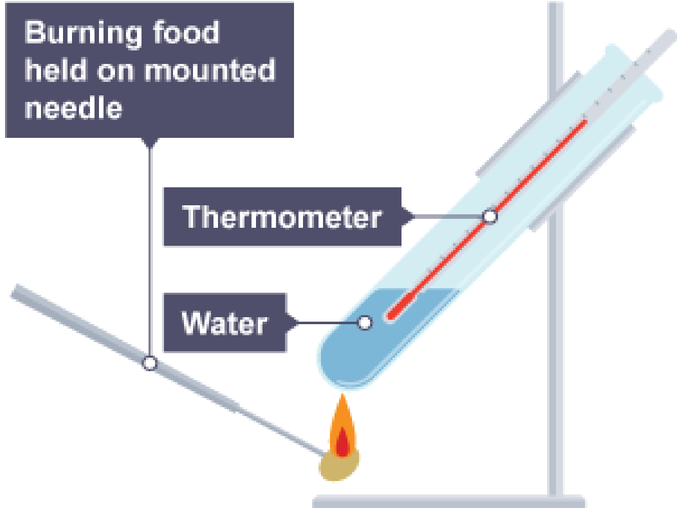


Energy in Food

The energy in food is often measured in kJ, the amount of energy you need depends on your lifestyle. If there is an imbalance you will put on or loose weight.

Measuring Energy in Food

The energy in different foods can be measured using a simple experiment. If the food is set on fire, it can be used to heat up water and by measuring the temperature change, you should be able to see Which foods cause the greatest rise in temperature and have given out the most energy.



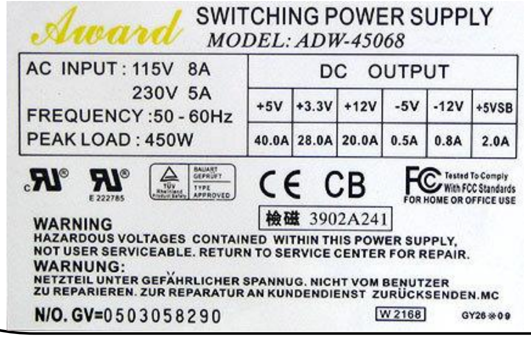
Electrical appliances use energy but we describe this energy use in a slightly different way.

• Power is the rate at which energy is used. The unit of power is the watt, which has the symbol W.

• 1 W is 1 J per second. So, for example, a 20 W electric lamp uses 20 J of electrical energy every second to stay alight.

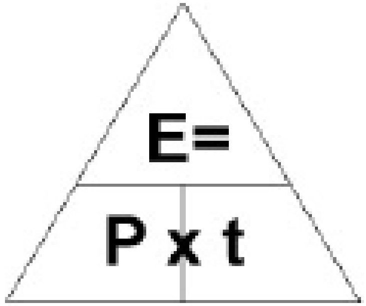
• Electrical appliances (TV sets, kettles and so on) have electrical rating plates on them. These show the power rating of the appliance in W.

See if you can find some more power ratings at home and explain what these mean.



Using Maths Skills in SCIENCE

To calculate power you divide the value of the energy transferred (in Joules) by the time taken for the transfer (in seconds).
You can also rearrange the equation using the triangle on the right.



Values for power and energy are useful to anyone wanting to use an electrical appliance. Therefore, we need to be able to compare these values.

Appliance	Power in W	Power in kW
Clock	10	0.01
Lamp	50	0.05
Drill	800	0.8
Iron	1250	1.25
Kettle	2400	2.4
Hot water heater	3000	3
Electric oven	12000	12

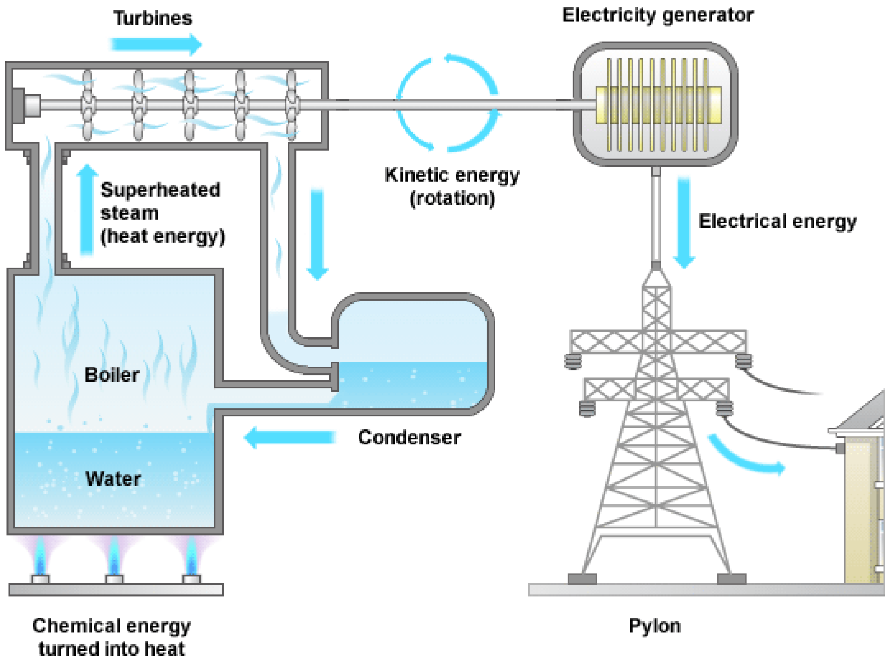
Sometimes, the values aren't all given in the same units. If you look at the table above, one column is given in kW, this means kilowatts (1kW = 1000W just like 1 kilometre is equal to 1000 metres). So if you want to change W to kW then divide the power value by 1000. If you want to change kW to W then multiply the value by 1000.

We get energy from many different types of energy resources, including fuels and stores of energy such as batteries or the wind. We can divide
energy resources into two categories:

• non-renewable energy resources cannot be replaced once they are all used up

• renewable energy resources can be replaced, and will not run out

Fossil fuels are non-renewable energy resources. Generally fossil fuels provide a high amount of energy but will soon run out and cause environmental problems including global warming due to CO2 emissions and acid rain sue to SO2 emissions from these power stations (shown below).



Renewable energy resource	☺	☹
Wind is used to turn a turbine	No fuel cost, no pollution these point are true for all renewable fuels!)	Noise pollution, unreliable
Water – either tides, waves or hydroelectric where water runs through a dam and turns a turbine	Reliable	Destruction of habitats, dams cause flooding of farmland
Geothermal – water is pumped down to hot rocks or steam naturally rises to turn a turbine	Hot water can be used directly for heating	Very rare for a country to have these hot rocks
Solar cells convert light energy directly into electricity (don't confuse with solar panels!!)	Useful in remote locations	Solar cells are expensive, inefficient and won't work when its's cloudy or at night!

Nuclear fuel (plutonium & uranium) is an alternative to traditional fossil fuels and emits no pollution, however there is radioactive waste to get rid of!

Stores of energy

Energy can be stored in different ways, including:
- kinetic energy
- internal energy
- elastic potential energy
- gravitational potential energy
- electrical energy
- magnetic energy

All objects have internal energy. This includes:
- energy caused by the movement of particles in the object,

sometimes called thermal energy
- energy due to the bonds between particles, sometimes called chemical energy

Do you think a hot or cold cup of tea would have more internal energy?

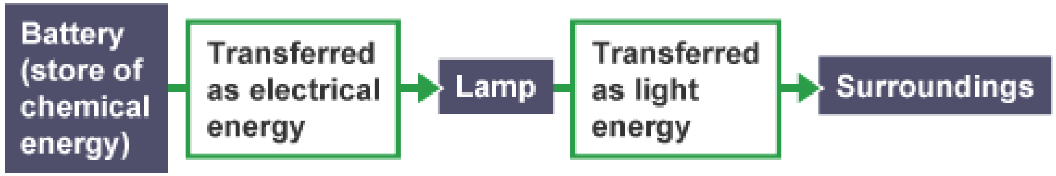
When an object is heated, its particles move more vigorously
and its internal energy increases. Unless the object changes
state (e.g melts or boils), its temperature will increase.

Energy can be transferred from one store to another in the following ways:

- by heating
- mechanically
- electrically
- by radiation

Some key examples:
1. If an object's motion changes = mechanical transfer
2. If an object is dropped = mechanical transfer
3. Completing an electrical circuit = electrical
4. Stretching a spring = mechanical
5. Metabolising food = heating (a weird one!)
6. Burning fuels = heating

You might need to be able to describe a transfer e.g. if an
object is dropped its gravitational potential energy is converted
into kinetic energy. Half way through the drop, half of the energy would have been transferred and so on.
Another example is shown below as a diagram– can you see
which of the 6 examples is shown?



Conservation of Energy

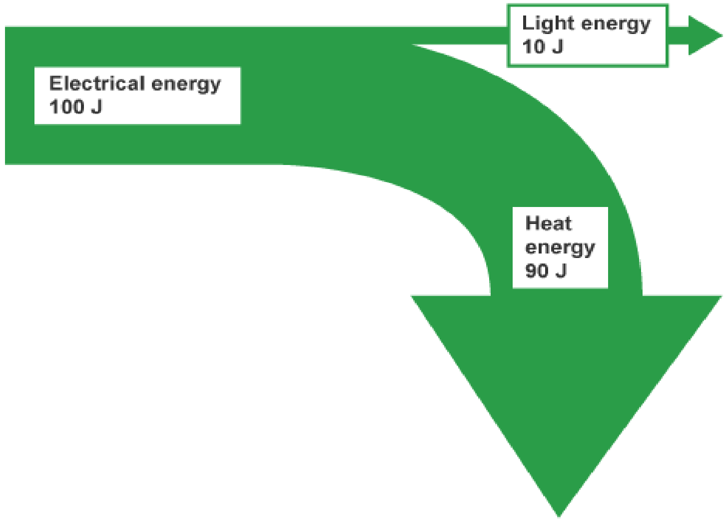
Energy can be stored or transferred, but **energy cannot be created or destroyed**. This means that the total energy of a system stays the same. When we use the word system we mean objects that might transfer energy e.g. a plug to a lamp to the surroundings.

The idea that the total energy has the same value before and after a change is called conservation of energy.

Sankey Diagrams

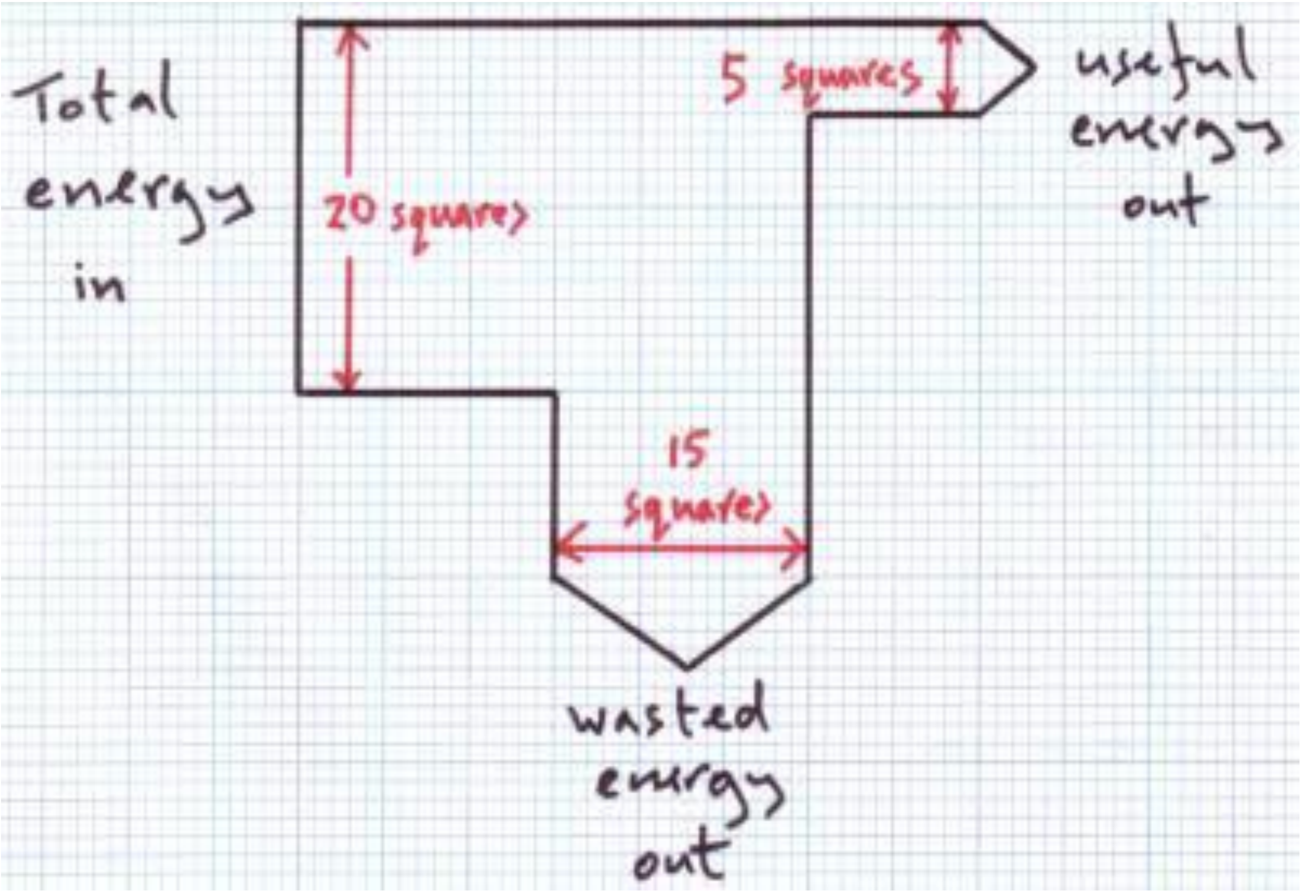
The key to understanding this idea is to be able to use Sankey diagrams. These diagrams (shown below and on the left) show how much energy is transferred into the system and where this energy goes.

The numbers on the arrows out of the system should add up to the value of the energy that went into the system. E.g. in the diagram below 10J + 90J adds up to the 100J that went into the system.



Drawing Sankey Diagrams

The diagram on the below shows an important point to remember. If you draw a Sankey diagram, the size of the arrow should represent the value of the energy. So in this diagram if 1 square represents 1 Joule of energy then there is a 5J useful energy transfer and the other 15J of energy are ‘wasted’.



3: Energy
TASK 1

Energy in Food
The energy in food is often measured in ________________ (units) ________,
the amount of energy you need depends on your ______________.

Power is the rate at which ____________ is used. The unit of power is the _______ (units) __________.
1 W is 1 J per second. So, for example, a 20 W electric lamp uses _____________of electrical energy every second to stay alight.

Make a list of:
a) **Non-renewable** Energy Resources:
____
____
b) **Renewable Energy** Resources:
____
____

	Advantages	**Disadvantages**
Wind		
Water		
Geo-thermal		
Solar		

Give some examples of appliances and their power ratings in W and kW.

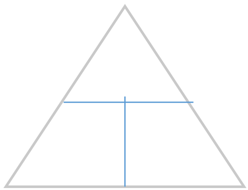
1.

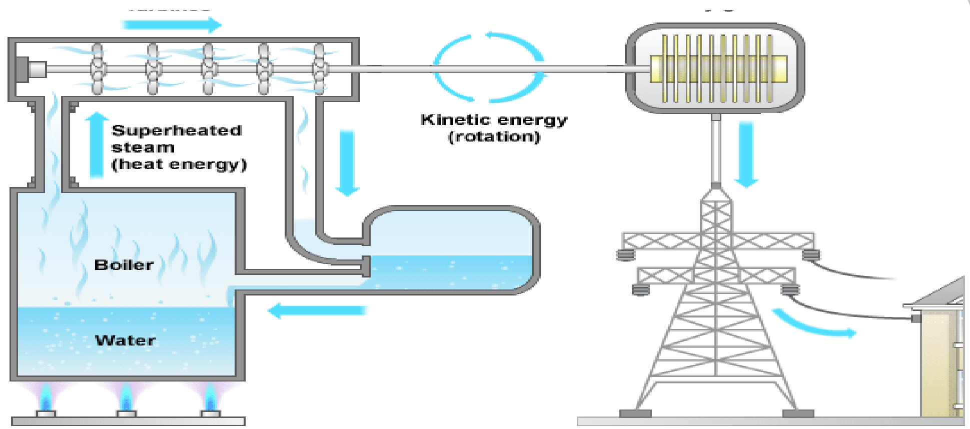
2.

3.

The equation used to calculate **ENERGY** is:

Units:
Energy -
Power-
Time-



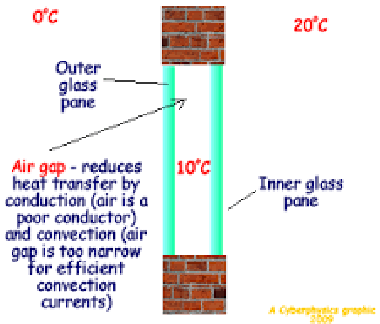


Energy STORES

List as many examples as you can below:

Law of the Conservation of Energy

Energy can be ___________ or ____________, but energy cannot be _____________or _________________. This means that the total energy of a _________________ stays the same.



3: Energy TASK 2

Define the term **Thermal Equilibrium:**

____

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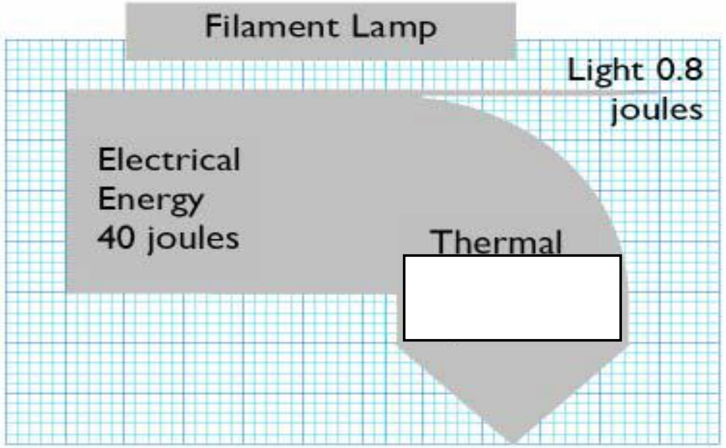
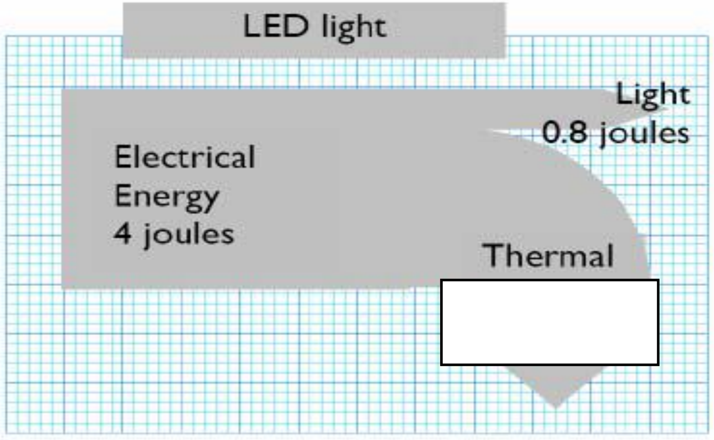
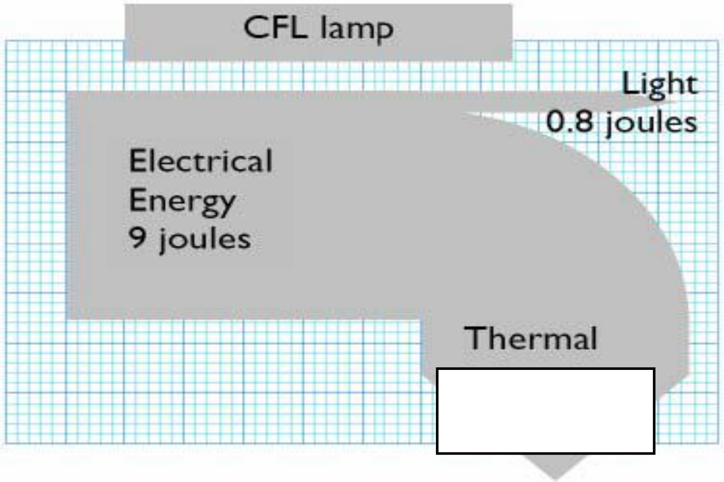
____

____

Sankey Diagrams:







Making life easier

A **simple machine** makes it easier to lift things, move things, or turn things. It reduces the force that you need to do a job, or increases the distance that something moves when you apply a force.

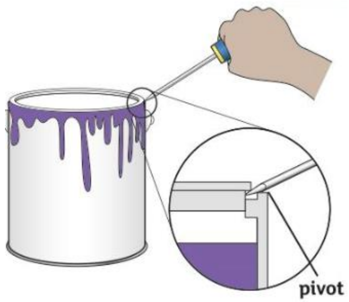
A wheel is a simple machine. There is less friction between a rolling wheel and a surface than between a sliding object and the same surface.

Levers

Most people use a **lever** to open a tin of paint. If you put a screwdriver between the lid and the rim of the tin, you can open the tin with a much smaller force.

The force applied to the lid by the lever (the **output force**) is bigger than the force that you apply with just your hand (the **input force**). A lever is a force multiplier.

Your hand moves down and the other end of the lever moves up. Your hand moves much further than the other end of the lever.



Using Maths skills in Science

Work Done = Force x Distance

work done = force × distance
= 2 N × 1 m
= 2 J

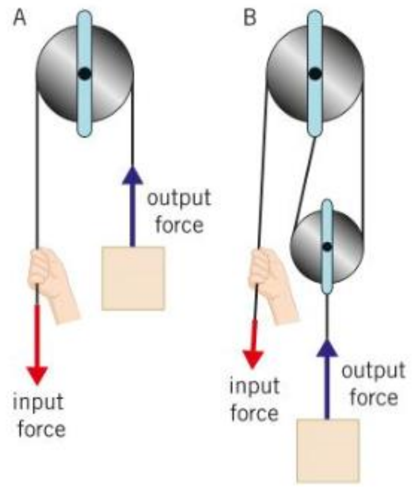
work done = force × distance
= 1 N × 0.2 m
= 0.2 J

Pulleys

You can use a pulley system to lift (or lower) heavy objects.

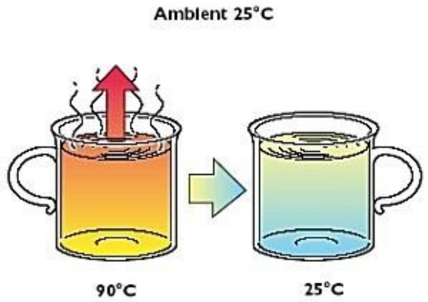
You can use a pulley to change the direction of the force. The pulley makes it easier to use your weight, but the input and output forces are the same.

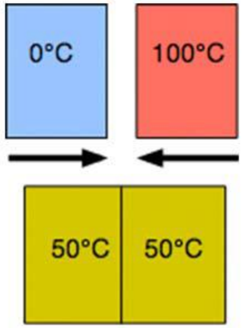
In image B on the right, the input force is smaller than the output force, but the distance that you need to move your hand is bigger than the distance moved by the weight.



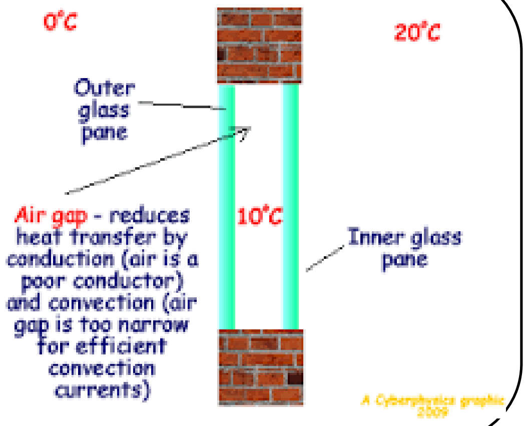
Heat Transfer

You need to know a little more about how heating transfers energy.
Some objects are hotter than others.
Energy is transferred from the hotter object to the cooler one.
This causes the difference in temperature between them to decrease.
So here, the hot tea loses some of its internal energy because the (ambient) temperature of the surroundings is lower. This continues until the temperatures are equal (i.e. until the tea reaches 25oC).
When the temperatures are equal we say that
a thermal equilibrium has been reached. Overall, no more energy transfer takes place.



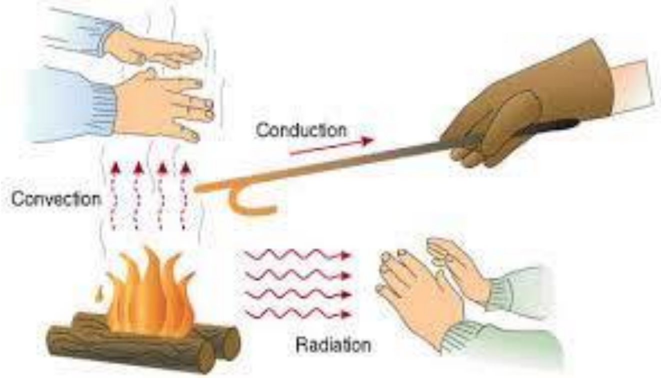


Insulation (if a material is a poor conductor we say it is an insulator) is used to reduce energy transfers by heating. You will have some insulation in your own home e.g. double glazed windows or cavity wall insulation. This acts to stop conduction and convection through the walls and roof of your house.

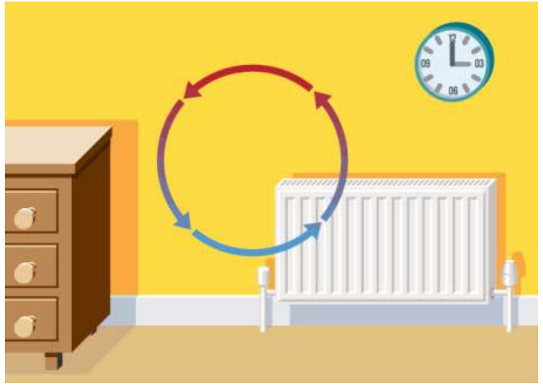


How is energy transferred by heating?

Energy is transferred either by contact (this method is called **conduction**) or without any contact (by **radiation or convection**).
When a substance is heated, its particles gain internal energy and move more vigorously. The particles bump into nearby particles and make them vibrate more. This passes internal energy through the substance by conduction, from the hot end to the cold end. (there are some great animations of this online!)
All objects transfer energy to their surroundings by infrared radiation.
The hotter an object is, the more infrared radiation it gives off.
No particles are involved in radiation.



The particles in liquids and gases can move from place to place. Convection happens when particles with a lot of thermal energy in a liquid or gas move, and take the place of particles with less thermal energy. Thermal energy is transferred from hot places to cold places by convection.



What is the equation for calculating work:

List the units:

- Work done-
- Force-
- Distance-

Fill in the formula triangle for Work done

Sketch a force diagram for lever action:

Give a definition for a simple machine.

Make a list of some simple machines and their uses:

3: Energy
TASK 1

List some examples of work done:

Sketch a force diagram for pulley action:

1. Calculate the work done if an object is moved with a force of 5N for 5m.

   ____
2. What is the work done on an object if a force of 3N moves the object 5m.

   ____
3. A force of 40N acts on an ice skater, she moves 10m. Calculate the work done.

   ____
4. Calculate the work done if an object is moved with a force of 3N for 2m.

   ____
5. What is the energy transferred if a force of 30N moves the object 8m.

   ____

1. Calculate the force acting on an object if the work done is 50J and the object moves 25m.

   ____
2. What is the force acting on an object if the energy transferred is 30J and the object moves 5m?

   ____
3. An object moves 5m, the work done is 65J, calculate the force acting on the object.

   ____
4. Calculate the distance an object has moved if the work done is 88J and the force is 11N.

   ____
5. What is the distance an object has moved if the energy transferred is 56J and the force is 7N?

   ____

3: Energy
TASK 2

Key words and definitions:

3: Energy TASK 3

Temperature is a measure of ___________________. You use a _____________________ to measure temperature. The unit of temperature are:

- .
- .
- .

The amount of energy needed to heat an objects depends on:

- ____________________________
- ____________________________
- ____________________________

List some materials that are good thermal conductors and their uses:

Add arrows to the following diagrams to show which direction the energy is transferred

List some materials that are good thermal insulators and their uses:

Sketch a diagram to explain how the particles transfer energy in solids:

Sketch a diagram to explain how the particles transfer energy in liquids and gases:

Explain why conduction cannot happen in gases:

____

____

____

3: Energy
TASK 4

Key words and definitions:

Explain how thermal energy is transferred from the Sun to the Earth

Describe which type of materials are best at emitting infrared radiation and why:

Describe which type of materials are best at absorbing infrared radiation and why:

Chapter 4.1 and 4.2 Knowledge Organiser - WAVES

Science Department

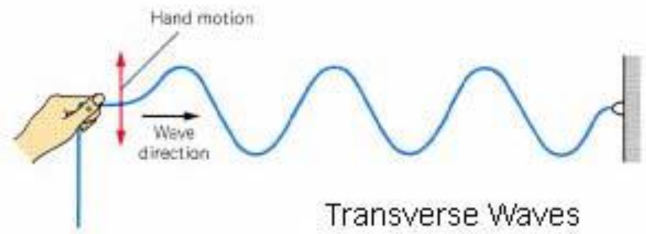
RAINFORD HIGH

Waves transfer energy from one place to another.
Waves are made by forcing something to vibrate or oscillate.
There are two types of waves; transverse and longitudinal.
Sound waves are longitudinal waves.
Light and waves on water are transverse waves. Sound travels faster through liquids and solids than it does through air and other gases.

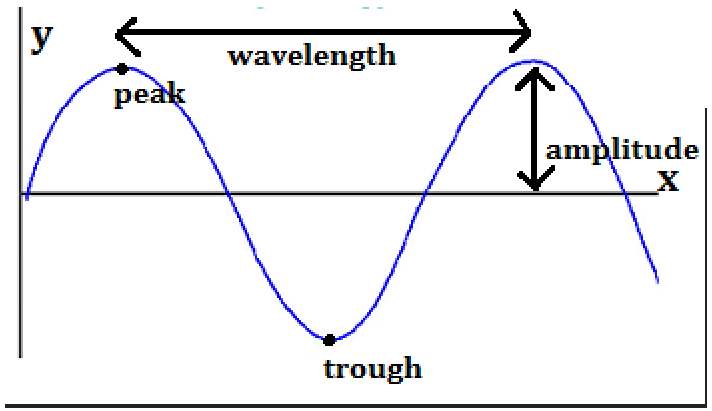
Substance	Speed of sound
Air	343 m/s
Water	1493 m/s
Steel	5130 m/s

Transverse Waves

If you throw a pebble into a pond, ripples spread out from where it went in. These ripples are waves travelling through the water. The waves move with a transverse motion. The undulations (up and down movement) are at 90° to the direction of travel.
For example, if you stand still in the sea, the water rises and falls as the waves move past you.
The diagram below shows a transverse wave.

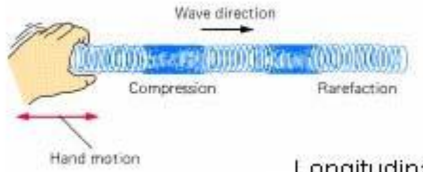


Transverse Waves



Longitudinal Waves

When an object or substance vibrates, it produces sound. These sound waves can only travel through a solid, liquid or gas. They cannot travel through empty space.
Sound waves are longitudinal waves - the vibrations are in the same direction as the direction of travel.
The diagram below shows this.



Longitudinal Waves

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

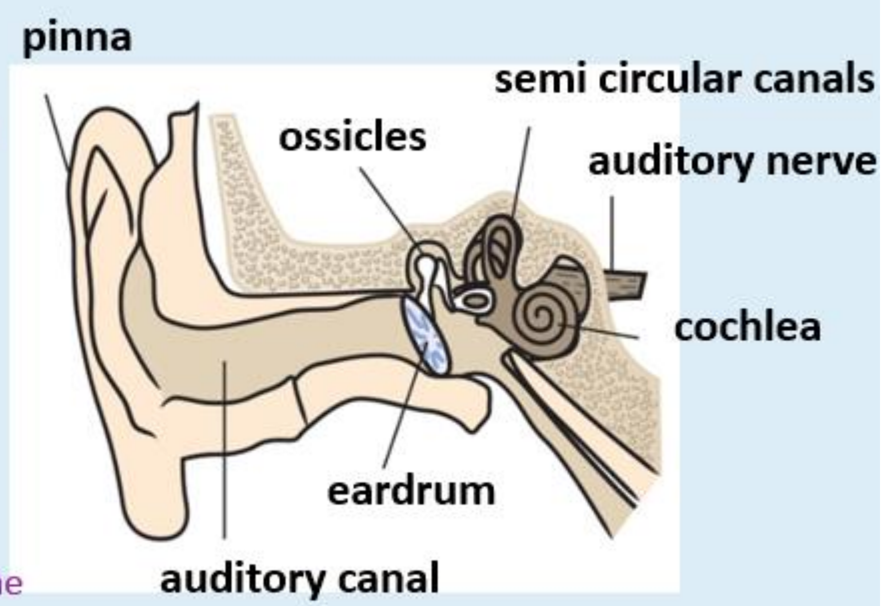
2. The waves travel along the auditory canal.

3. The waves make the ear drum vibrate.

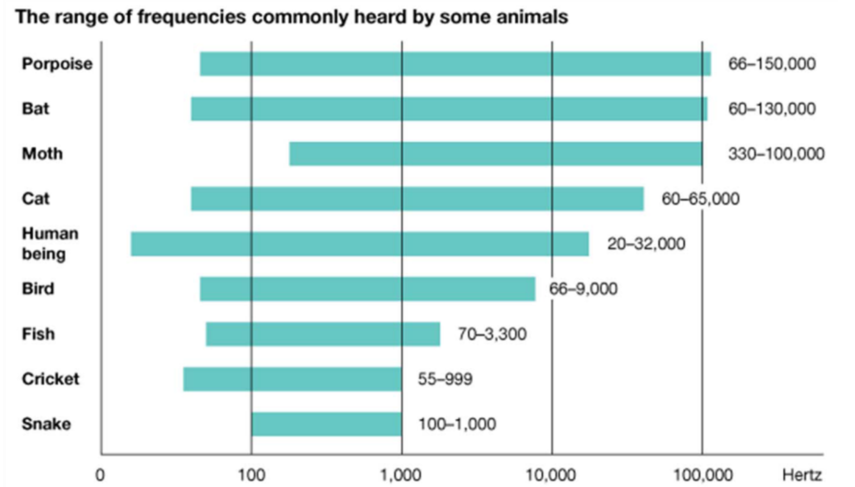
4. The small bones (ossicles) amplify the vibrations.

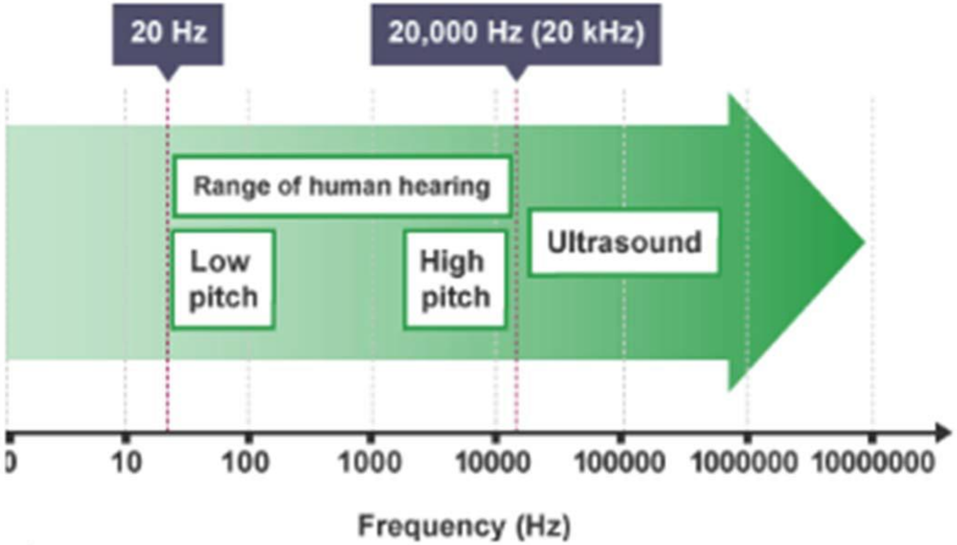
5. The cochlea turns these into electrical signals.

6. The auditory nerve takes the signals to the brain.



The frequency of sound waves is measured in hertz, which has the symbol Hz. The bigger the number, the greater the frequency and the higher the pitch of the sound. Human beings can generally hear sounds as low as 20 Hz and as high as 20,000 Hz (20 kHz).





Hearing Loss

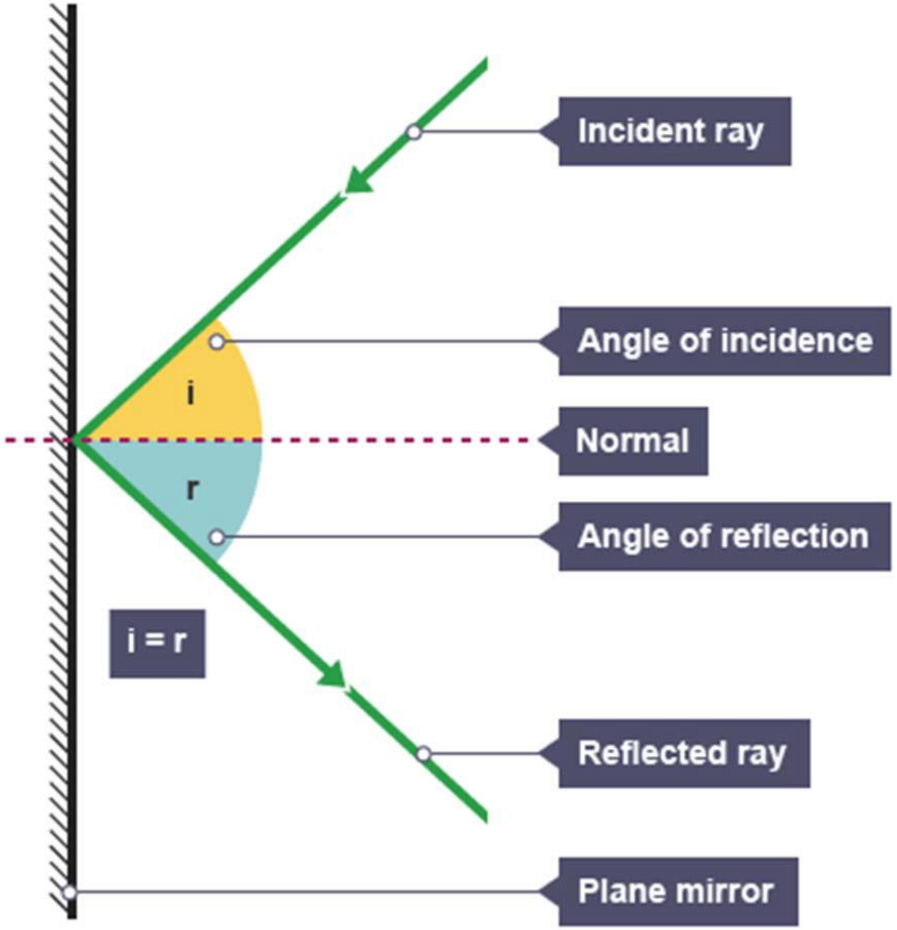
You measure sound intensity in decibels (dB). Loud noises and damage to the eardrum can cause hearing loss. Hearing loss can be prevented by:

- Wearing Ear defenders/ ear plugs
- Reducing the volume

Light - Reflection

The law of reflection states that for a plane (flat) mirror the angle of reflection will be the same as the angle of incidence. You need to make sure your diagrams show this.

- the **incident ray** is the light going towards the mirror
- the **reflected ray** is the light coming away from the mirror



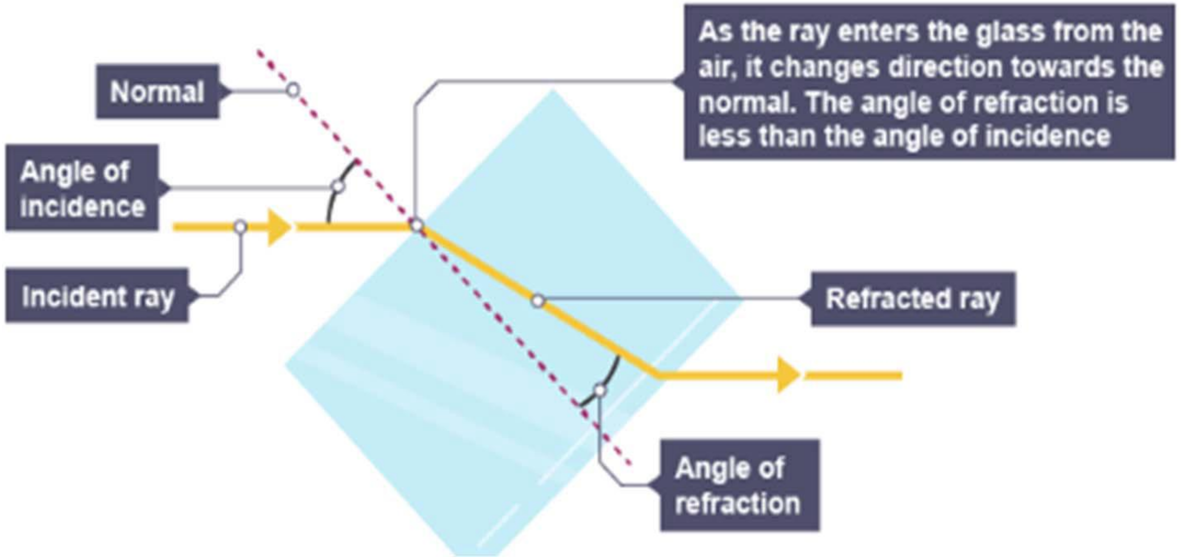
Refraction

Light waves change speed when they pass across the boundary between two substances with a different **density**, such as air and glass. This causes them to change direction, an effect called **refraction**.

At the boundary between two transparent substances:

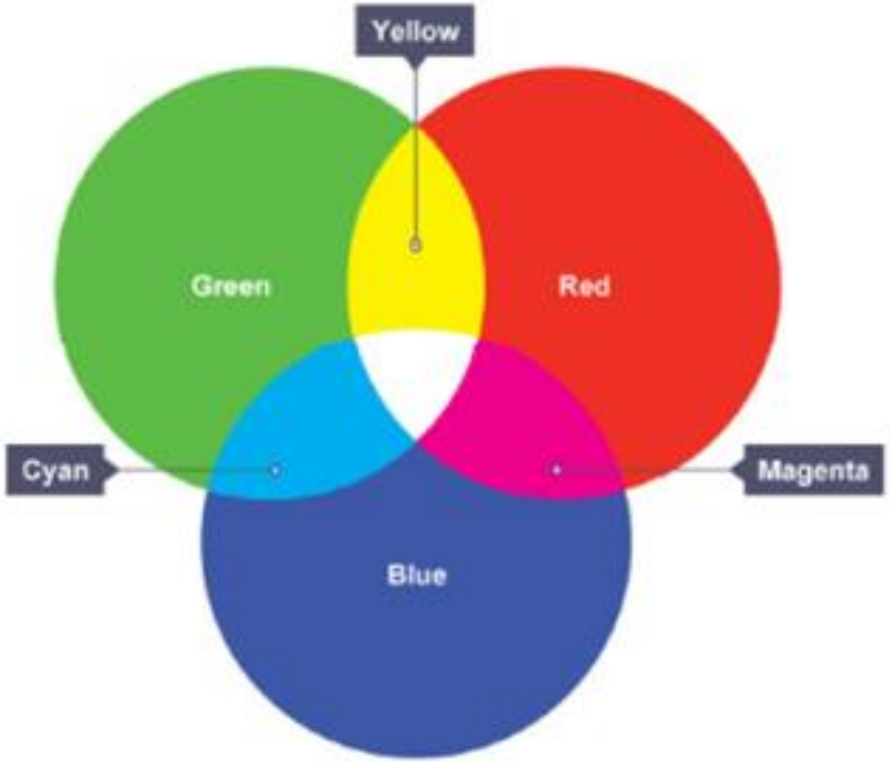
- the light slows down going into a denser substance, and the ray bends towards the normal
- the light speeds up going into a less dense substance, and the ray bends away from the normal

The diagram shows how this works for light passing into, and then out of, a glass block. The same would happen for a Perspex block:



Coloured light

There are three primary colours in light: red, green and blue. Light in these colours can be added together to make the secondary colours magenta, cyan and yellow. All three primary colours add together make white light.



Primary colours of light add together to make white light, or secondary colours

The way coloured light mixes is very different from the way that paint does.

	White paper	Red apple	Green apple
Colours(s) that the object can reflect	All	Red only	Green only
Appearance of object in white light	White (no colours absorbed)	Red (all colours absorbed except red)	Green (all colours absorbed except green)
Appearance of object in red light	Red (only red light to reflect)	Red	Black (no green light to reflect)
Appearance of object in green light	Green (only green light to reflect)	Black (no red light to reflect)	Green
Appearance of object in blue light	Blue (only blue light to reflect)	Black (no red light to reflect)	Black (no green light to reflect)

TIP

When drawing light ray diagrams make sure you always:

- Use a pencil and a ruler
- Draw the initial lines faintly so you can erase them
- Always add an arrow to show the direction of the light ray
- Real light rays are a solid line and virtual light rays are dashed lines

When light is incident upon a surface it might be reflected, absorbed, scattered, refracted or it may act as a filter and remove some colours of the light.

<u>Key Words</u>

Transparent – light can pass though
Opaque – light cannot pass through
Translucent – some light passes through

Detecting light

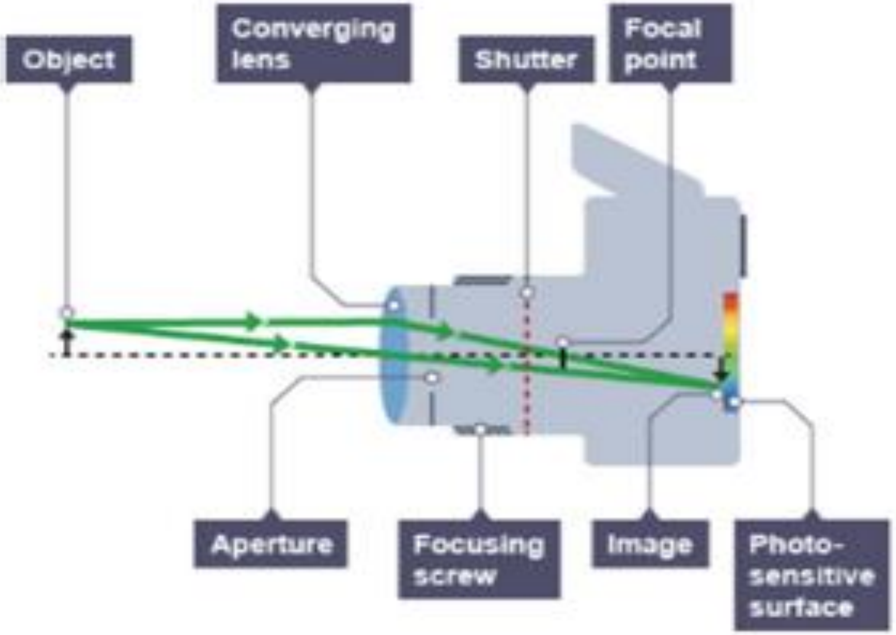
Cameras and our eyes detect light. In each case, they have:

- a material that is sensitive to light
- a change that happens when this material absorbs light

The camera

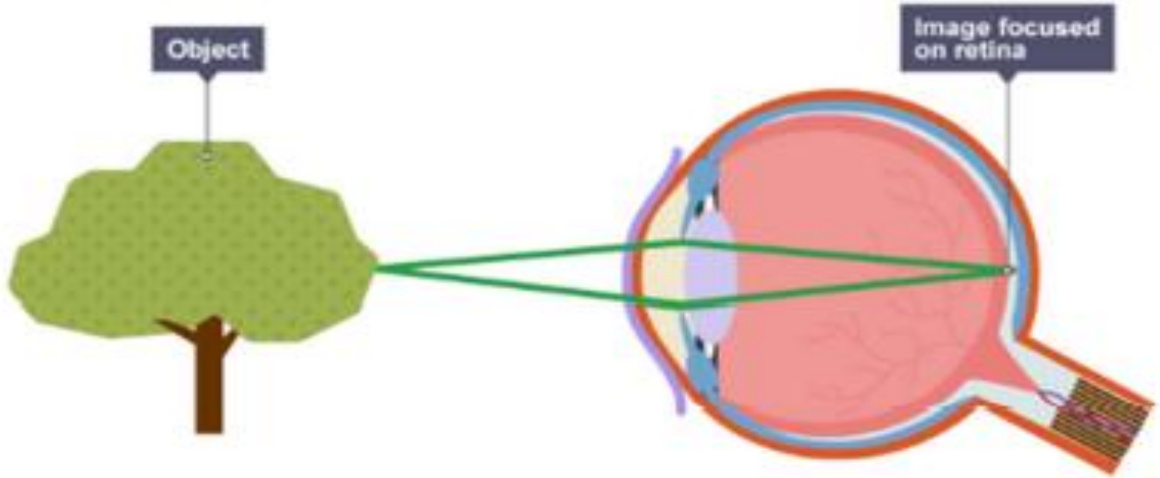
Cameras are devices that focus light from an object onto a photo-sensitive material using a lens. In an old-fashioned camera, the photo-sensitive material was camera film. When the film absorbed light, a chemical change produced an image in the film, called the 'negative'. This was used to produce a photograph on photo-sensitive paper.

In a modern camera or the camera in a mobile phone, the photo-sensitive material produces electrical impulses, which are used to produce an image file. This can be viewed on the screen, or its information sent to a printer.

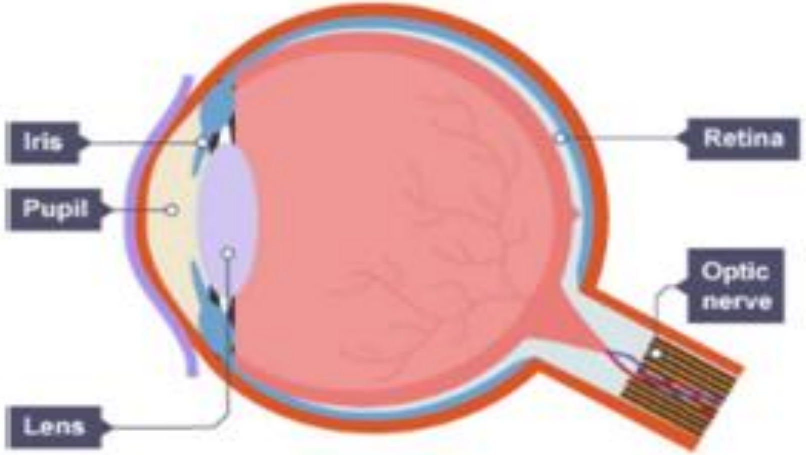


The eye

Like the camera, the eye focuses light from an object onto a photo-sensitive material. However, in the eye, this material is the retina. The retina contains cells that are sensitive to light. They produce electrical impulses when they absorb light. These impulses are passed along the optic nerve to the brain, which interprets them as vision.



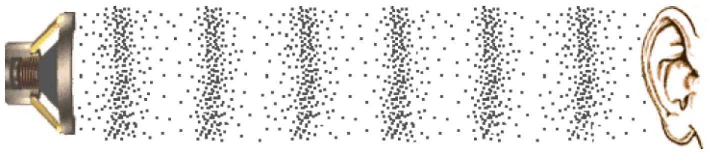
Light is focused onto the retina of the eye



Component parts of the eye

4: Waves
Sound
TASK 1

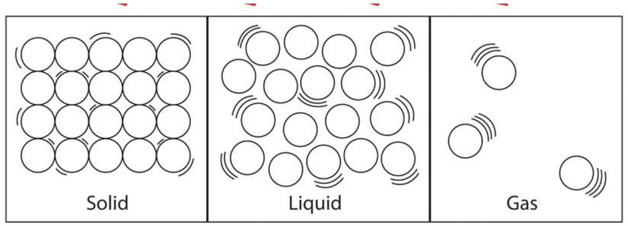
Label and annotate the diagram to explain what a sound wave is (you must include the word 'vibration'.



Sound is a type of __________________ wave.

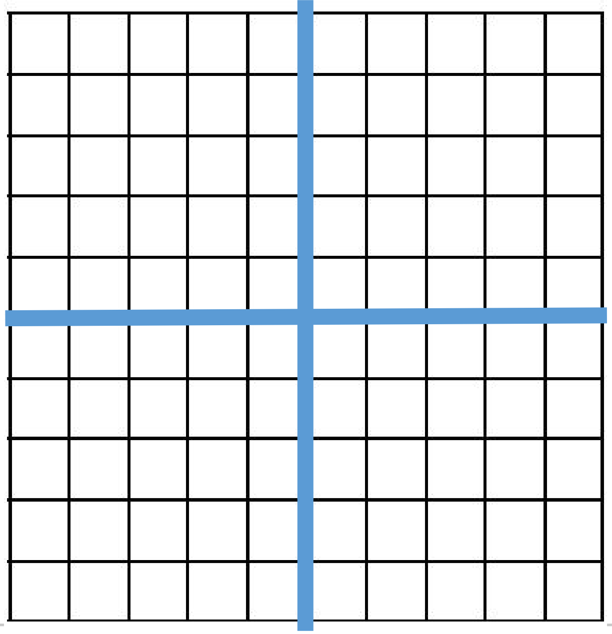
Explain why we can see the Sun, but can not hear it-

Label the diagrams with the average speed of sound for that medium, then explain the difference in terms of particle arrangement:



Sketch sound waves for the following sounds:

Quite high pitched; Loud high pitched; Quite low pitched; Loud low pitched

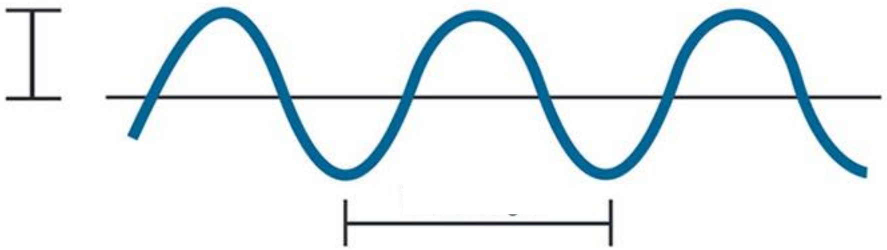


Explain the term 'frequency' and state its units:

What is the auditory range of humans?

What do we call frequencies above and below this range?

Add the following labels to the diagram of a wave: amplitude; wavelength; peak/crest; trough



Describe how hearing can be damaged:

____

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____

____

State one simple method of helping reduce hearing damage:

____

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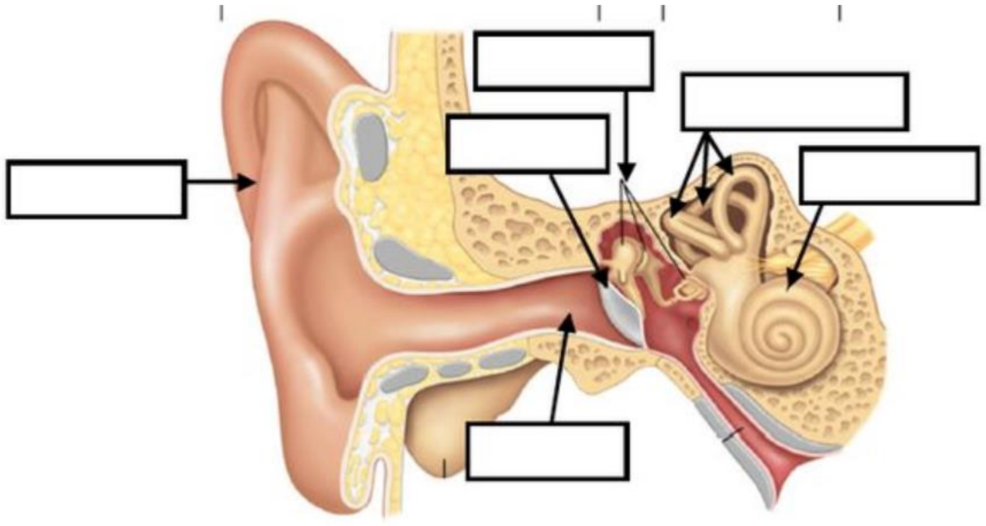
4: Waves
Sound
TASK 2

Key words and definitions:

Unit of sound intensity (volume)=

Label the parts of the ear and briefly describe its function.



Explain in detail how light allows us to see things.

Draw a light ray being reflected from a mirror. State the law of reflection.

What does a lens do?-

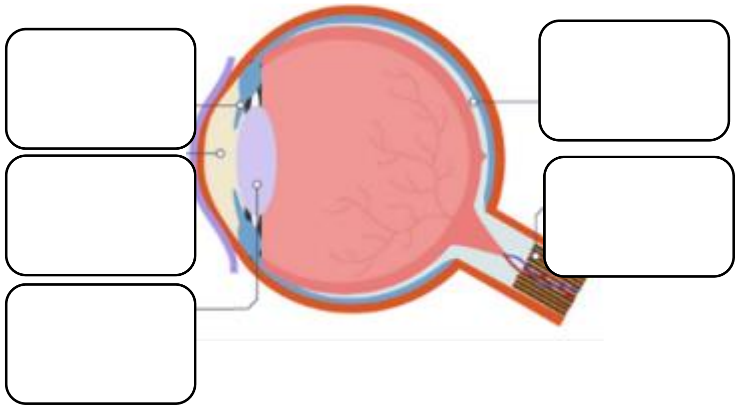
What are the primary colours of light?

What is white light?

Why are objects different colours?

Explain what a colour filter does to light.

Chapter 4: Waves
TASK 3



Explain in as much detail as possible how our eyes are like cameras.

Draw a diagram of light passing into and out of a glass block.
Explain why refraction happens.

Chapter 4.3 and 4.4 Knowledge Organiser - WAVES

Science Department

RAINFORD HIGH

Comparing Light and Sound waves

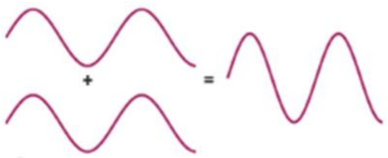
Similarities	Differences
• Both transfer energy • Both have a range of frequencies and wavelengths	• Travel as different type of wave • Sound waves need particles to carry energy but light waves do not • Different speeds – light travels up to a million times faster than sound

Superposition

Where two waves meet, they affect each other. This is called superposition.

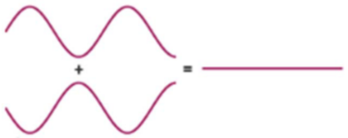
Adding

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.



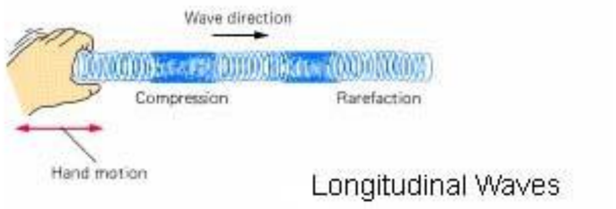
Cancelling

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



Sound Waves

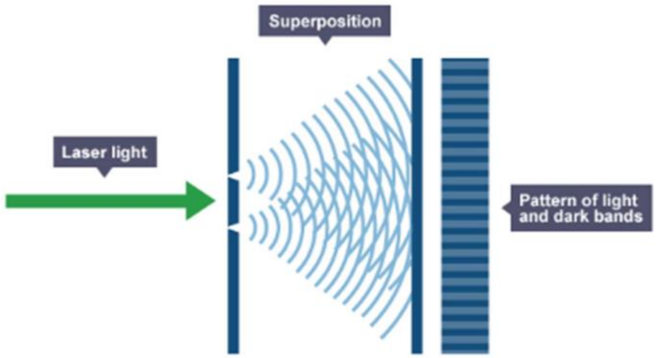
Sound waves can reflect off surfaces. We hear sound reflections as echoes. Hard, smooth surfaces are particularly good at reflecting sound. This is why empty rooms produce lots of echoes.
Soft, rough surfaces are good at absorbing sound. This is why rooms with carpets and curtains do not usually produce lots of echoes.



Demonstrating superposition

We can see superposition using two different pieces of scientific equipment. A ripple tank is a tank full of water in which a vibrating needle produces a stream of ripples. We can watch superposition and reflection in the water waves.

A laser can also show superposition of light waves if it is shone through two narrow slits that are close together. A pattern of bright and dark banks is seen on a screen on the other side of the slits. The waves add together in the bright bands and cancel out in the dark bands.



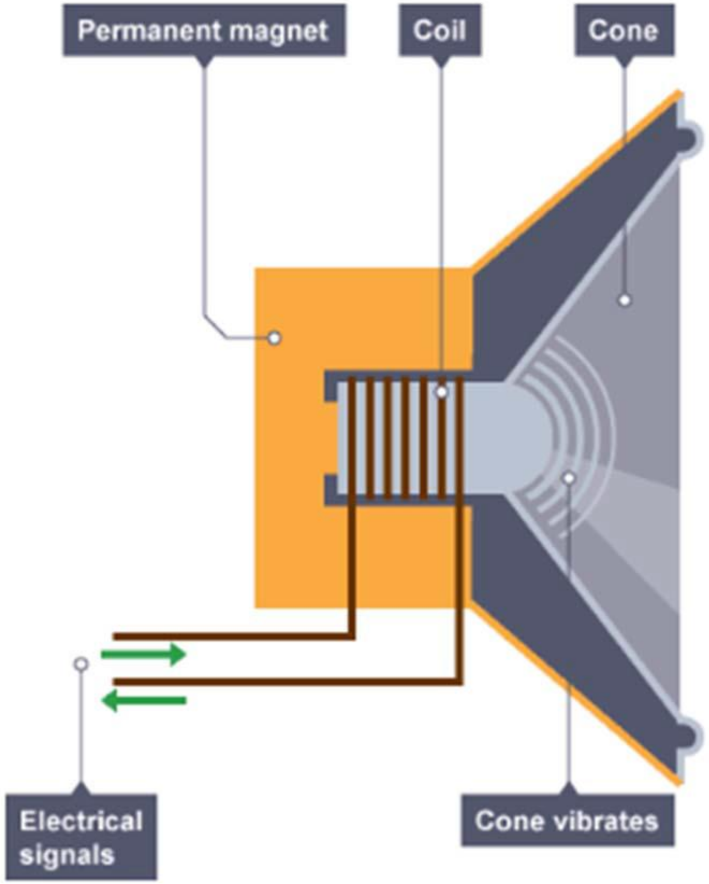
Medical uses of Ultrasound
Sound with a frequency of more than 20,000 Hz is called ultrasound. It is too high pitched for humans to hear, but other animals (such as dogs, cats and bats) can hear ultrasound. Ultrasound has many applications in medicine, including ultrasound scans to check on the health of unborn babies.


An ultrasound image of an unborn baby

Ultrasound waves can also be used to break down deposits of calcium in your kidneys or gall bladder (kidney or gall stones) so they can be passed out of your body safely without an operation. They are also used for physiotherapy.

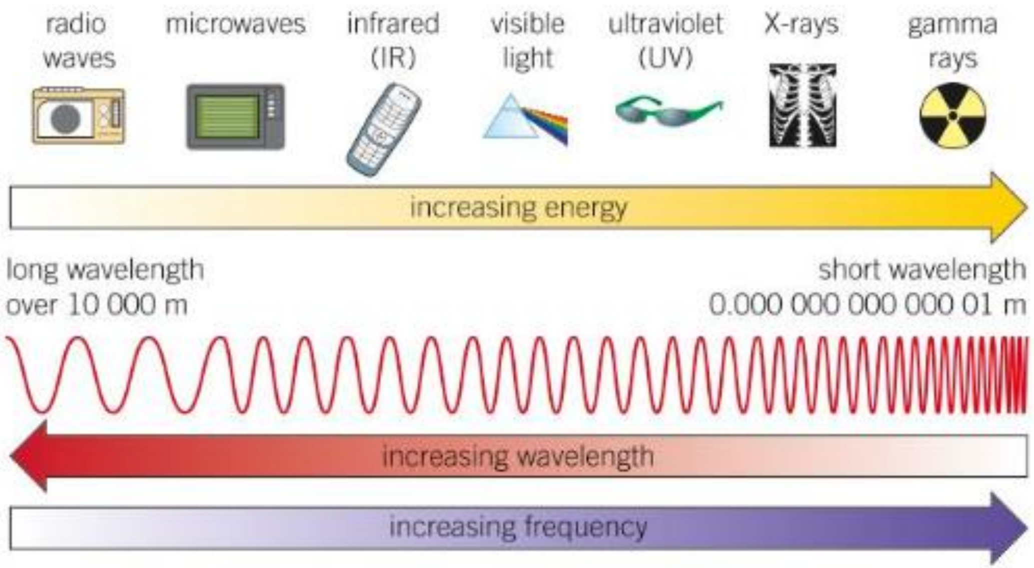
Industrial uses of Ultrasound
Ultrasound waves can be used in industry for:
- Detecting faults inside pieces of metal
- Cleaning jewellery
- Measure the purity of liquids
- Create a fine mist of water in a humidifier
- Ultrasonic welding for plastics

Loudspeakers
Sound waves are produced by all vibrating objects. Loudspeakers work by converting electrical energy into kinetic energy. This moves the cone which creates the sound waves.



The Electromagnetic Spectrum

The Sun emits a continuous spectrum of radiation. **Visible light** is just one part of this **electromagnetic spectrum**.



Uses of Electromagnetic spectrum waves

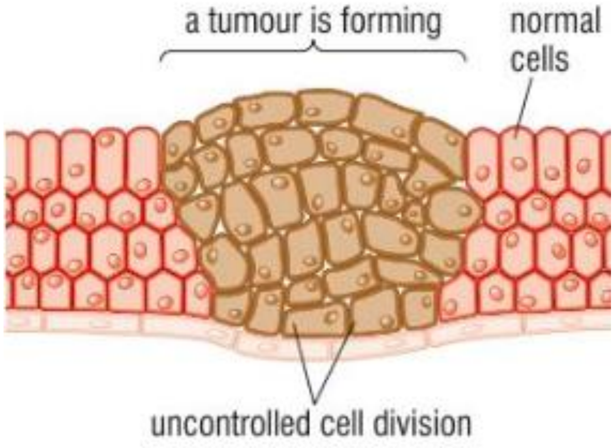
wave	radio waves	microwaves	infrared	visible light	ultraviolet	X-rays	gamma rays
use	TV signals	mobile phones	heating, cooking	photography	detecting forgeries	seeing broken bones	killing cancer cells

Radiation and the human body

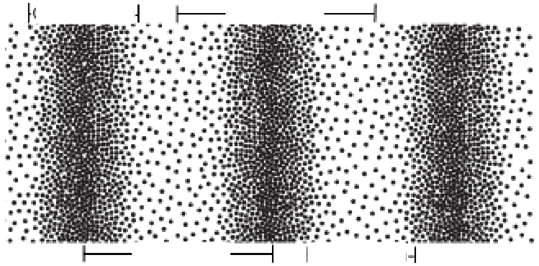
Wave	Does it get through the atmosphere?	Is it absorbed by the body?	Effect on the body
radio waves	most gets through	all goes through you	heating
microwaves	hardly any gets through	most goes through you	heating
infrared (IR)	some gets through	most absorbed by your skin	heating
visible light	all gets through	a little absorbed by your skin	heating
ultraviolet (UV)	some gets through	nearly all absorbed by your skin	ionising
X-rays	hardly any gets through	most goes through you	ionising
gamma	hardly any gets through	most goes through you	ionising

Ionisation

Waves with a low frequency and energy have a heating effect, but waves with a higher energy can knock electrons out of atoms in living cells. This is called **ionisation**. If the atoms are in your DNA then this can cause a mutation. The cell can replicate which can produce cancer.



Define the terms ‘compressions’ and ‘rarefaction’ and the label the pressure wave below:



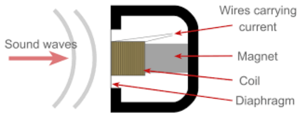
Sketch diagrams of these waves

Light is an example of a ________________ wave.

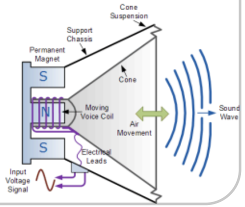
Sound is an example of a _______________ wave.

Explain how a microphone can be used to make sound and a loudspeaker can detect sound:

- Microphone



- Loudspeaker



Human audio range is between frequencies of _________________. Ultrasound is sound with a frequency above _______________.

A slinky can be used to model _____________ waves, ripples in water can be used to model ________________ waves.

4: Waves TASK 1

Describe two uses of ultrasound:

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Sketch and label diagrams to show how waves can be a) reflected, b) refracted and c) superposed

Compare and contrast the different types of wave:

4: Waves
TASK 2

Describe the effects of different waves on the body:

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Define the term ionisation:

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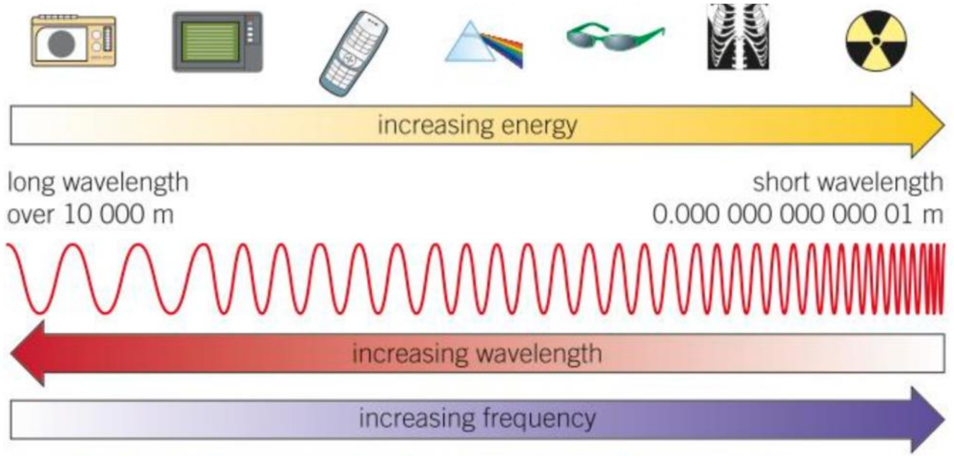
Label the diagram of the electromagnetic spectrum:



Key words and definitions:

Complete the table:

Wave	**Use**
Radio waves	
Microwaves	
Infrared	
Visible	
Ultra violet	
X-rays	
Gamma	

Complete the table:

Wave	**Does it get through the atmosphere?**	**Is it absorbed by the body?**	**Effect on body**
radio waves			
microwaves			
infrared (IR)			
Visible light			
ultraviolet (UV)			
X-rays			
Gamma			

Chapter 5.1 and 5.2 Knowledge Organiser - MATTER

Science Department

RAINFORD HIGH

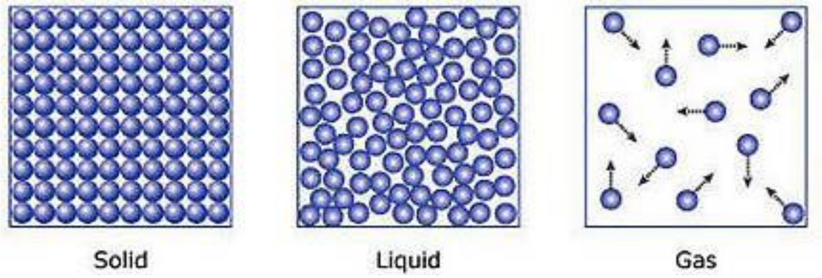
Particle Theory

All matter is made up of particles. Particles are found in all 3 states of matter. Particles in the 3 states behave differently.

In **solids**, particles are arranged in a **regular pattern** and they can only **vibrate** in a fixed position. Particles in solids are not free to move.

In **liquids**, particles can **slide pass** each other. They are **arranged randomly**.

In **gases**, particles carry a lot of energy and they **move in all directions** in a high speed. Particles are **far apart** and are **arranged randomly**.



Key Terms	Definitions
State of matter	Matter is divided into three states: solid, liquid, and gas.
Melting	Change of state from solid to liquid.
Freezing	Change of state from liquid to solid
Evaporation	Change of state from liquid to gas.
Condensation	Change of state from gas to liquid.
Diffusion	Particles spread from a region of higher concentration to a region of lower concentration.
Rate	How fast an event, e.g. diffusion, is happening.
Concentration	The number of particles in a known volume.
Particles	All matter is made up of tiny particles.
Pressure	Pressure is formed when particles collide with the walls of containers.

Diffusion and Factors Affecting Diffusion

Diffusion is the **movement of particles from a higher concentration to a lower concentration. Diffusion will stop when particles spread themselves evenly.** Diffusion occurs in liquids and gases but not in solids, because particles in a solid are not free to move.

There are **2 factors** affecting the rate of diffusion:

1. Temperature: When temperature increases, particles gain more energy. They can then move and spread out at a higher rate.

2. Concentration: When concentration increases, the rate of diffusion increases.

State	Properties
SOLID	Fixed shape, cannot flow, cannot be compressed (squashed) *Particles can vibrate in a fixed position but cannot more past each other. Particles are close together.*
LIQUID	Can flow, will take the shape of a container, cannot be compressed (squashed) *Particles are close together but are able to move past each other.*
GAS	Flow, completely fill any space that they occupy, can be compressed squashed. *Particles can move quickly in all directions, are far apart and have space to move into.*

Pure and Impure Substance

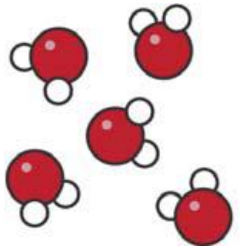
Pure Substances

If you could see the particles in pure water, you would only see water particles. There would be no other particles. Examples of pure substances include gold, oxygen and pure water.

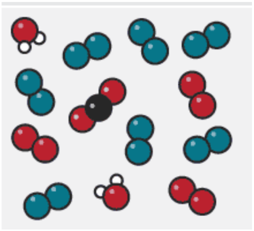
Impure Substances

Impure materials may be mixtures of elements, mixtures of compounds, or mixtures of elements and compounds. For example, even the most pure water will contain dissolved gases from the air. Impurities in a substance will affect its properties. For example, they may change its boiling point.

Pure Substances

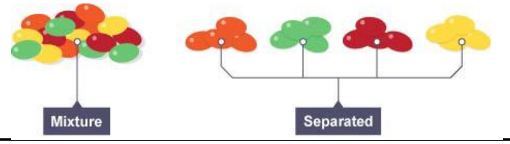


Impure Substances



Mixtures

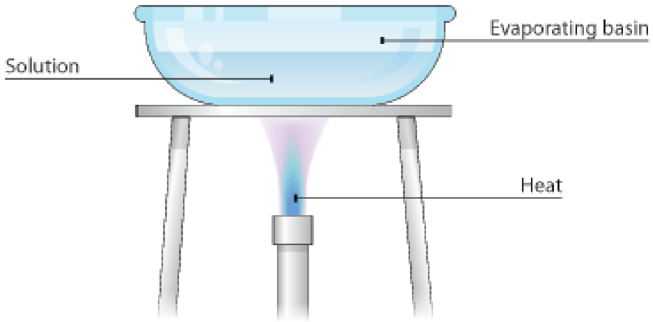
A mixture contains different substances that are not chemically joined to each other. For example, a packet of sweets may contain a mixture of different coloured sweets. The sweets are not joined to each other, so they can be picked out and put into separate piles.



Key Terms	Definitions
Pure	A material that is composed of only one type of particle.
Impure	A material that is composed of more than one type of particle.
Evaporation	A change of state involving a liquid changing to a gas
Distillation	A process for separating the parts of a liquid solution. The solvent is heated and the gas is collected and cooled.
Filtration	The act of pouring a mixture through a mesh, in attempts to separate the components of the mixture.
Mixture	A material made up of at least two different pure substances.
Chromatography	A technique used to separate mixtures of coloured compounds.

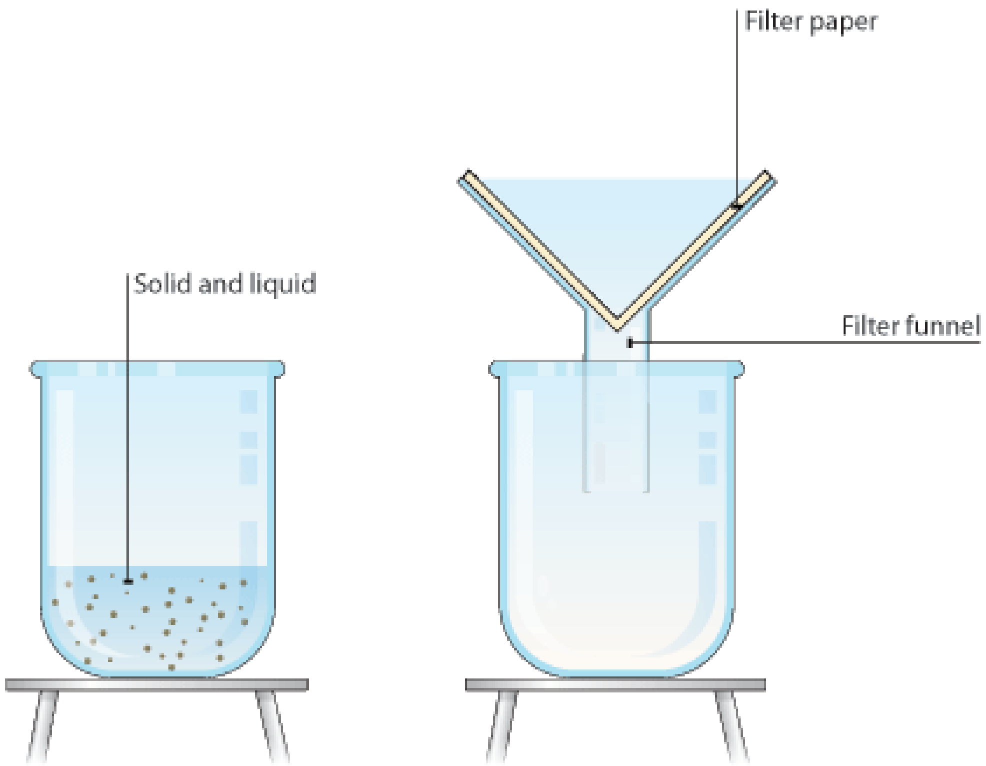
Evaporation

This is good for separating a soluble solid from a liquid (a soluble substance dissolves, to form a solution). For example copper sulphate crystals can be separated from copper sulphate solution using evaporation. Remember that it is the water that evaporates away, not the solution.



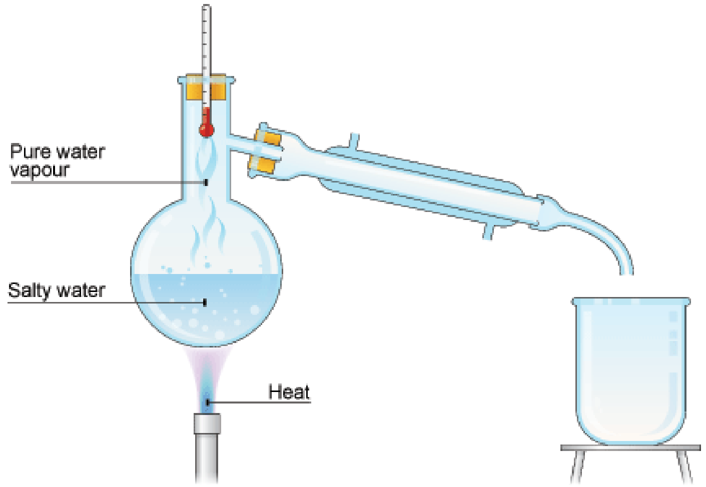
Filtration

This is good for separating an insoluble solid from a liquid. (An insoluble substance is one that does not dissolve). Sand, for example, can be separated from a mixture of sand and water using filtration. That's because sand does not dissolve in water.



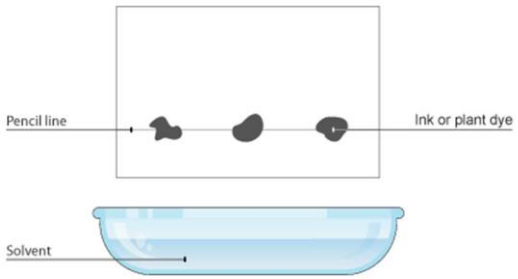
Distillation

This is good for separating a liquid from a solution. For example, water can be separated from salty water by simple distillation. This method works because the water evaporates from the solution, but is then cooled and condensed into a separate container. The salt does not evaporate and so it stays behind. Distillation can also be used to separate two liquids that have different boiling points.



Chromatography

Simple chromatography is carried out on paper. A spot of the mixture is placed near the bottom of a piece of chromatography paper and the paper is then placed upright in a suitable solvent, e.g. water. As the solvent soaks up the paper, it carries the mixtures with it. Different components of the mixture will move at different rates. This separates the mixture out.



Chapter 5: Matter Task 1

In the boxes below, draw and describe the properties of a solid, liquid and gas .

Solid

Liquid

Gas

Explain in as much detail as you can what freezing means .

Explain in as much detail as you can what boiling means .

What is diffusion?

Describe what condensation and evaporation mean.

What is gas pressure?

Draw in the balloons below particles showing low and high gas pressure:

Chapter 5: Matter TASK 2

Explain in detail the differences between mixtures and compounds. –

What is a saturated solution? –

Define these words:

Solvent:

Solute:

Dissolve:

Soluble:

Filtrate:

Residue:

With the aid of a diagram, show how a substance dissolves into a liquid

Using a diagram, show how filtration works.

What does solubility mean?

What things can affect solubility?

Explain the process and the result of a chromatography test on a felt tip pen.

Describe what distillation is and how it works.

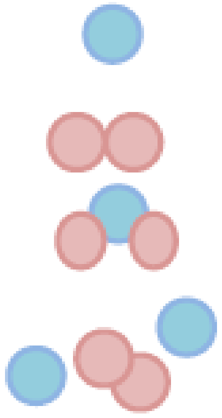
Explain how people get salt from salt water.

Chapter 5.3 and 5.4 Knowledge Organiser - MATTER

Science Department

RAINFORD HIGH

Atoms, elements and compounds



Atom	The building block of matter (the smallest thing everything is made of)
Element	A substance made of only one type of atom
Compound	A substance made of more than one type of atom which are chemical bonded
Mixture	A substance made of more than one elements or compounds that are <u>not</u> bonded together

All of the elements we know of are found on the periodic table.

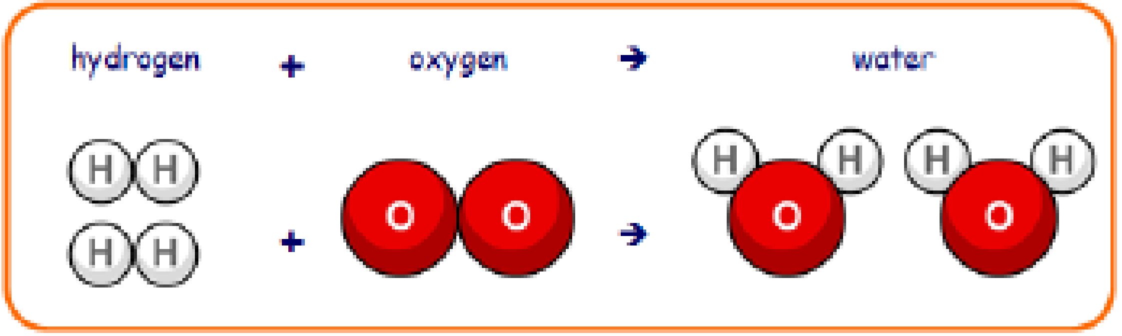
Each element is given its own chemical symbol, like **H** for hydrogen or **O** for oxygen. Chemical symbols are usually one or two letters long.
Every chemical symbol starts with a capital letter, with the second letter written in lower case.

Mg	mg	mG	MG
✓	✗	✗	✗

For example, **Mg** is the correct symbol for magnesium, but mg, mG and MG are wrong. **Take care to write chemical symbols correctly.**
The same chemical symbols are used all over the world, no matter which language is spoken, which makes them very useful

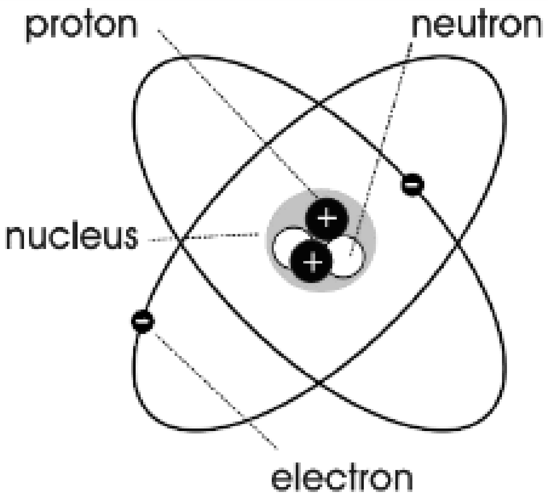
Chemical reaction

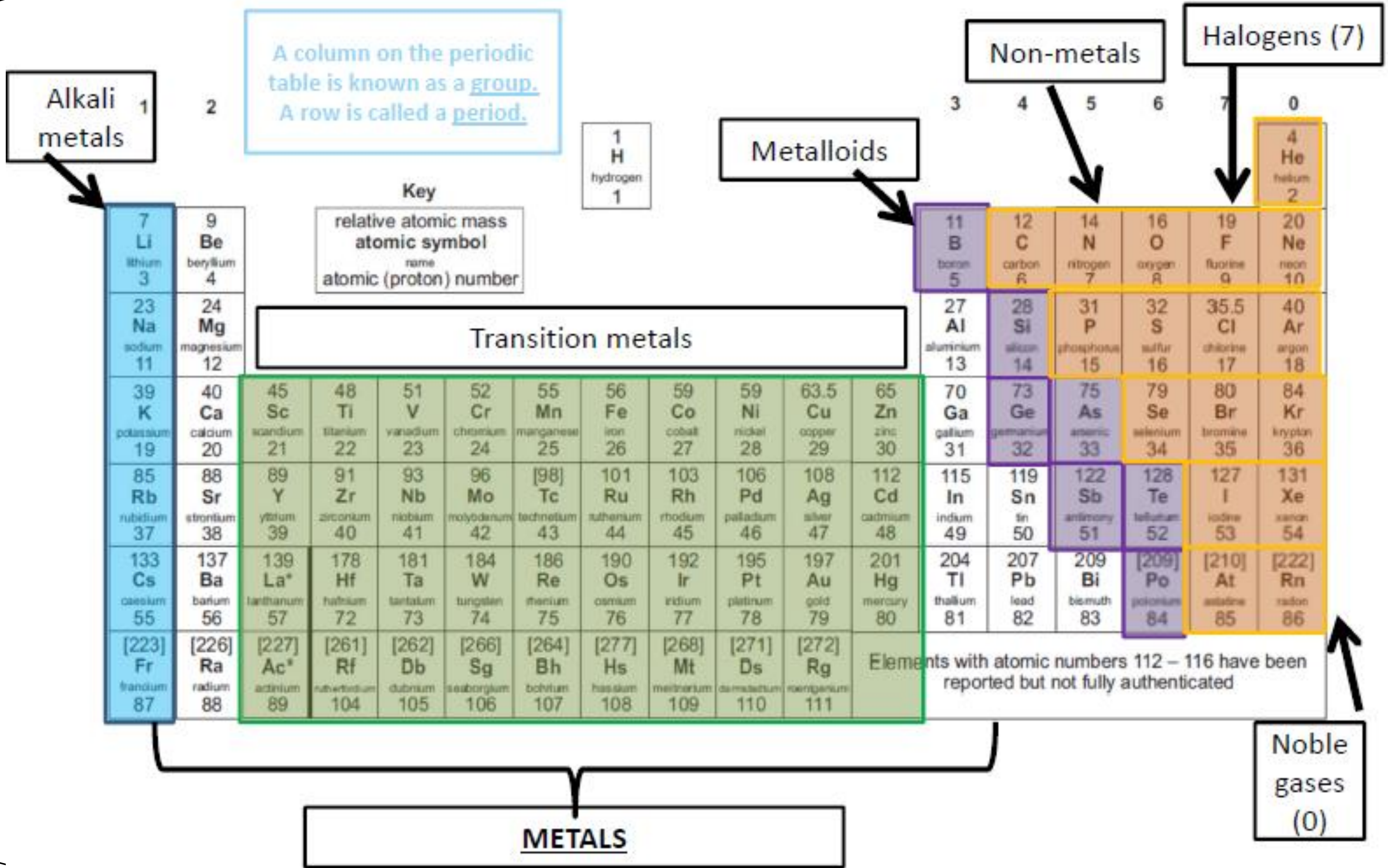
When two or more elements react in a chemical reaction a compound is formed.



The periodic table

The positioning of elements on the periodic table is not random, they elements are put in very specific positions and the locations of elements can tell us a lot about its properties (what the element is like).
In the 19th Century a scientist named Mendeleev grouped elements together that had similar properties, this idea was the foundation for the periodic table we use today.





A column on the periodic table is known as a group.
A row is called a period.
Alkali metals
Transition metals
Metalloids
Non-metals
Halogens (7)
Noble gases (0)
METALS
Key
relative atomic mass
atomic symbol
name
atomic (proton) number
1 2 3 4 5 6 7 0
Elements with atomic numbers 112 – 116 have been reported but not fully authenticated

Chemical reactions

In a chemical reaction, one or more new substances are always formed.
The starting substances used in a reaction are the **reactants.**
The new substances formed are the **products.**

reactants → products

Word equations

A word equation is a quick, shorthand way of writing a chemical reaction.
You must always include the reactants, the products and an arrow.

For example, magnesium and oxygen will react to form magnesium oxide.

The word equation for this would be:

Magnesium + Oxygen → Magnesium oxide

Where:
Reactants = magnesium and oxygen
Products = magnesium oxide
The arrow means 'change into'. In a chemical reaction, the reactants change into the products.

Conservation of mass and symbol equations

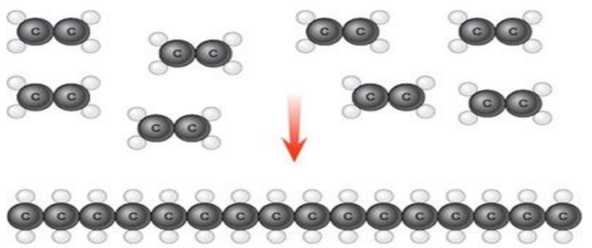
In a chemical reaction, atoms are never created or destroyed, they are simply rearranged. For example:
magnesium + copper oxide → magnesium oxide + copper

In this reaction, the bonds between the copper and oxygen break and the magnesium bonds with the oxygen. We have the same elements as we did at the start, but they are arranged differently.
This is known as the **conservation of mass.**
As every element has its own symbol on the periodic table, we can use this to create symbol equations. These are a good way of showing how mass is conserved in a chemical reaction.
The symbol equation for the above chemical reaction is:
Mg + CuO → MgO + Cu

Polymers

- Polymers are long chains of molecules and they can be cross-linked, joining several chains together.
- They are made from smaller molecules called **monomers (mono = one)**

Man-made (synthetic polymers) are made by joining lots of monomers together to make very long molecules (polymer).
This process is known as **polymerisation**.
Many polymers are made from chemicals that are obtained from crude oil.



Group 1: the alkali metals

The alkali metals are in group 1 of the periodic table.
They are very reactive with other substances, such as oxygen and water.

They are grouped together as they behave similarly when in contact with water and oxygen, but their reactivity increases as you go down the group.

These elements are called the 'alkali metals' because when the metal reacts with water, an alkaline solution is formed.

Group 0: the noble gases

The noble gases are the elements found on the far right of the periodic table (group 0).

They all have very low boiling points so are all gases at room temperature.

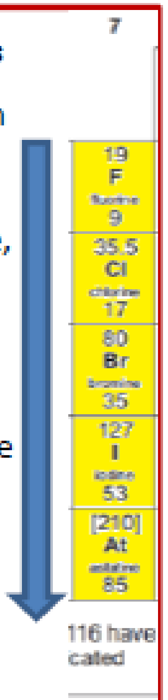
The noble gases are very unreactive (they will not react easily with other elements). which makes them very useful. For instance, neon is used to make brightly coloured signs.

Group 7: the halogens

The halogens are found in group 7 of the periodic table and contain elements such as fluorine, chlorine (used in swimming pools) and bromine.

The halogens tend to have low melting and boiling points, although these increase as you go down the group.

How do you think the boiling point of astatine will compare to fluorine?



Displacement

Unlike their melting and boiling points, the reactivity of the halogens *decreases* as you go down the group.
If a less reactive halogen came into contact with a compound of a less reactive halogen, then a **displacement** reaction happens.

For example:
Potassium + fluorine → potassium + chlorine
chloride fluoride

Fluorine is above chlorine in the periodic table so is more reactive. It will therefore bond with potassium, removing and replacing the less reactive chlorine.

Metals and non-metals

Metals are found on the left hand side and in the middle of the periodic table.
Some common properties of metals are:

- Lustrous (shiny)
- Malleable (can be hammered/pressed into shape without breaking)
- Good conductors of heat and electricity
- High melting and boiling points
- Hard
- Dense
- Ductile (can be drawn out into a thin wire without breaking).

5: Matter
TASK 1

What is the definition of an element?

____
____
____
____
____
____

List 7 examples of elements and their symbols -

Complete the following table:

Particle	Relative Charge	Relative Mass
Proton		
Neutron		
Electron		

What are the chemical formula for the following groups of compound:

- Hydroxides ___________
- Nitrates ____________
- Sulphates ____________
- Carbonates ____________

The chemical formula for common acids:

- Hydrochloric acid________
- Sulphuric acid_________
- Nitric acid _______

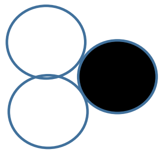
Draw an atom and label it using the keywords below:

Neutron, proton, electron, nucleus, electron shell

Draw a diagram showing the atomic structure of a solid element, a molecule with one element in it and a molecule with two elements in it (a compound)

Draw diagrams to represent the particles in the following: Oxygen 0_2; Argon, Ar; 2 nitrogen, N_2; Carbon dioxide CO_2; A mixture of all of them

Complete the drawing below, that turns a monomer into a polymer:



5: Matter

TASK 2

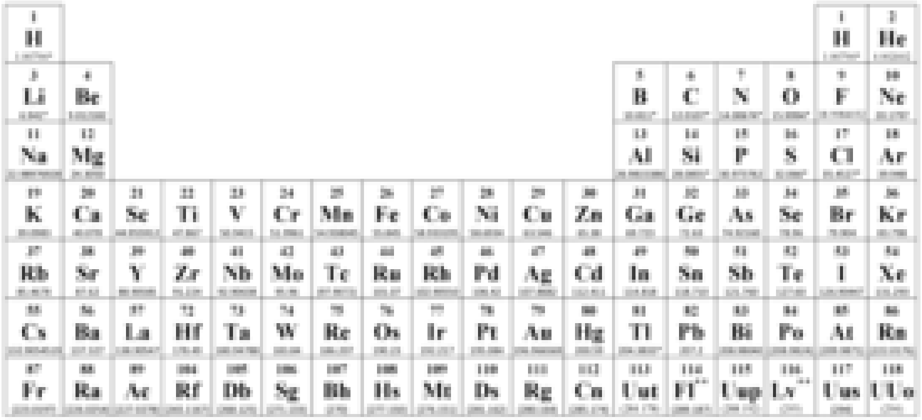
Name three examples of polymers and their uses:

1. ____________________________
2. ____________________________
3. ____________________________

Key words and definitions:

On the periodic table below, shade in the metals and non metals in different colours and label the groups and periods

Periodic Table of the Elements



H																H	He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	Ac	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Uut	Fl	Uup	Lv	Uus	Uuo

Explain the difference between groups and periods on the periodic table.

____

____

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What are the group 1 metals? What are their properties? –

____

____

____

____

____

What are the patterns in the properties of the group 1 metals? –

____

____

____

____

____

5: Matter
TASK 3

Complete the sentences below thinking about an elements position in the periodic table and its electron configuration:

Elements in the same group have the same

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

Elements in the same period have the same

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

What did Mendeleev do with the Periodic table?

……………………………………………………………………………

……………………………………………………………………………

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Write down the word equations for the reactions of Lithium, Sodium and Potassium with water. (Ext: chemical equations for the reactions)

- .
- .
- .
- .
- .
- .

Describe what chemical properties group 7 of the periodic table have and any patterns within them. –

____
____
____
____
____
____
____
____
____

Describe what chemical properties group 0 of the periodic table have and any patterns within them. –

____
____
____
____
____
____

Key words and definitions:

5: Matter
TASK 4

Describe what happens during a displacement reaction and list some word equations as examples

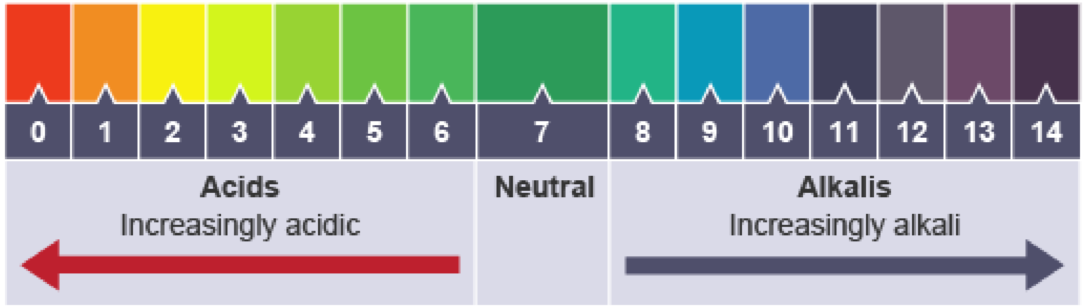
Describe some uses for the Group 7 and Group 0 elements.

____
____
____
____
____
____

Universal pH scale

Universal indicator is supplied as a solution or as universal indicator paper. It is a mixture of several different indicators. Unlike litmus, universal indicator can show us how strongly acidic or alkaline a solution is, not just that the solution is acidic or alkaline. This is measured using the pH scale, which runs from pH 0 to pH 14.

Universal indicator has many different colour changes, from red for strongly acidic solutions to dark purple for strongly alkaline solutions. In the middle, neutral pH 7 is indicated by green.



These are the important points about the pH scale:

- neutral solutions are pH 7 exactly
- acidic solutions have pH values less than 7
- alkaline solutions have pH values more than 7
- the closer to pH 0 you go, the more strongly acidic a solution is
- the closer to pH 14 you go, the more strongly alkaline a solution is

Indicators and the pH scale

Solutions can be acidic, alkaline or neutral: we get an acidic solution when an acid is dissolved in water we get an alkaline solution when an alkali is dissolved in water solutions that are neither acidic nor alkaline are neutral Pure water is neutral, and so is petrol. An indicator is a substance that changes colour when it is added to acidic or alkaline solutions. You can prepare homemade indicators from red cabbage or beetroot juice - these will help you see if a solution is acidic or alkaline. Litmus and universal indicator are two indicators that are commonly used in the laboratory.

Litmus indicator

Litmus indicator solution turns red in acidic solutions and blue in alkaline solutions. It turns purple in neutral solutions. Litmus paper is usually more reliable, and comes as red litmus paper and blue litmus paper. The table shows the colour changes it can make.

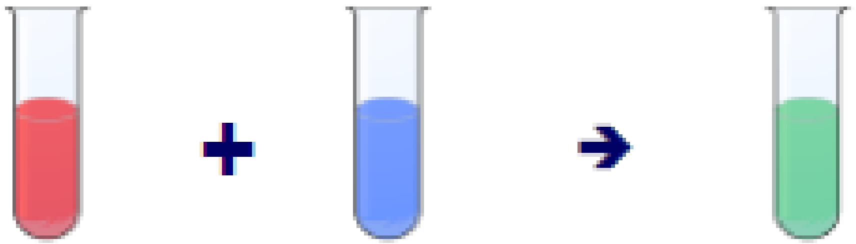
	Red litmus	Blue litmus
Acidic solution	Stays red	Turns red
Neutral solution	Stays red	Stays blue
Alkaline solution	Turns blue	Stays blue

Neutralisation

A chemical reaction happens if you mix together an acid and an alkali. The reaction is called neutralisation. A neutral solution is made if you add just the right amount of acid and base together. The products formed are salt and water.

acid + alkali $\longrightarrow$ salt + water

- When an alkali reacts with **hydrochloric acid**, the salt produced is a **chloride**.
- When an alkali reacts with **sulphuric acid**, the salt produced is a **sulphate**.
- When an alkali reacts with **nitric acid**, the salt produced is a **nitrate**.



acid + alkali → salt + water

E.g:

Hydrochloric acid + Sodium hydroxide → Sodium chloride + water

Other ways to neutralise

metal oxide + acid → salt + water

metal hydroxide + acid → salt + water

metal carbonate + acid → salt + water + carbon dioxide

Notice they all produce a salt and water...

Word and symbol equations

sodium hydroxide + hydrochloric acid → sodium chloride + water

$NaOH + HCl \rightarrow NaCl + H_2O$

copper oxide + sulphuric acid → copper sulphate + water

$CuO + H_2SO_4 \rightarrow CuSO_4 + H_2O$

sodium hydroxide + sulphuric acid → sodium sulphate + water

$2NaOH + H_2SO4 \rightarrow Na_2SO4 + 2H_2O$

copper carbonate + sulphuric acid → copper sulphate + water + carbon dioxide

$CuCO_3 + H_2SO_4 \rightarrow CuSO_4 + H_2O + CO_2$

Highlight all acids in red and all salts in green.

Reactions of metals with acid

The general equation for the reaction of a metal with acid is:

Metal + acid → salt + hydrogen

The test for hydrogen is sometimes called the squeaky pop test. Hydrogen makes a small 'pop' when it is placed near a lit wooden splint.

Reactions of metals with water

The general equation for the reaction of a metal with water is:

Metal + water → meal hydroxide + hydrogen

The test for hydrogen is sometimes called the squeaky pop test. Hydrogen makes a small 'pop' when it is placed near a lit wooden splint.

Reactions of metals with oxygen

The general equation for the reaction of a metal with oxygen is:

Metal + oxygen →metal oxide

This reaction only occurs on heating with oxygen. Reactions with oxygen where no heat is introduced do occur but at a much slower rate. For example the rusting of iron.

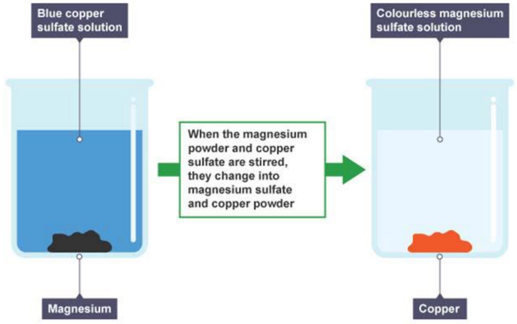
The reactivity series shows a list of metals in the order of how reactive they are. The metals towards the top of the list react readily with air and water and violently with acid.

The metals towards the bottom of the list do not even react with acid.
The order of the reactivity series can be remembered using a mnemonic.

"Pond slime can make a zoo interesting - the long crinkly sort goes purple."

Displacement reactions

Displacement reactions involve a reaction between a metal and a compound of a different metal.
A more reactive metal will displace a less reactive metal from its compounds.
For example the more reactive magnesium will displace the less reactive copper from the copper sulfate solution.



Magnesium + copper sulfate → magnesium sulfate + copper

Universal indicator has many different ________________ changes, from ___________ for strongly acidic solutions to dark ____________ for strongly alkaline solutions. In the middle, neutral pH 7 is indicated by ____________.

Describe what a Neutralisation Reaction is:

____

____

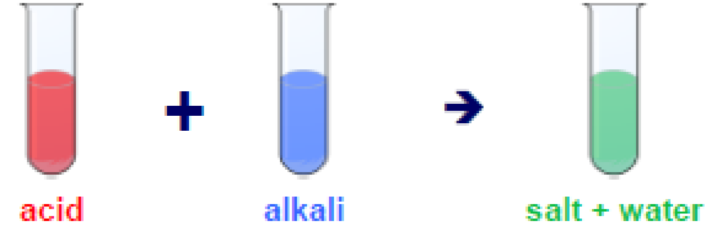
____

____

____

Making Salts

- Hydrochloric Acid makes ________________salts
- Nitric Acid makes __________________salts
- Sulphuric Acid makes __________________salts



E.g:

Hydrochloric acid + Sodium hydroxide → Sodium chloride + water

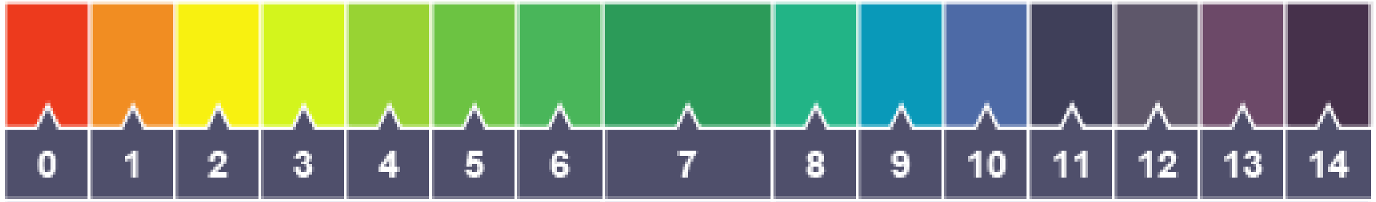
Litmus Indicator

	Red litmus	**Blue Litmus**
Acid		
Neutral		
Alkaline		

6: Reactions

Task 1

The pH Scale – add missing labels then research and find some examples of Acids, Neutral and Alkalis.



Acids –

Neutral –

Alkalis -

Reactions of metals with acid
The general equation for the reaction of a metal with acid is:

Reactions of metals with water
The general equation for the reaction of a metal with water is:

Reactions of metals with Oxygen
The general equation for the reaction of a metal with oxygen is:

6: Reactions Task 2

Element Symbols REVISION – write the first 20 symbols out from memory

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.
12.
13.
14.
15.
16.
17.
18.
19.
20.

Describe what a DISPLACEMENT Reaction is in your own words and give an example:
____
____
____
____
____
____
____
____

Key words and definitions:

Atom:____________________
____
____

Element:__________________
____
____

Compound:________________
____
____

Mixture:__________________
____
____

Chapter 6.3 and 6.4 Knowledge Organiser - REACTIONS

Science Department

RAINFORD HIGH

Combustion

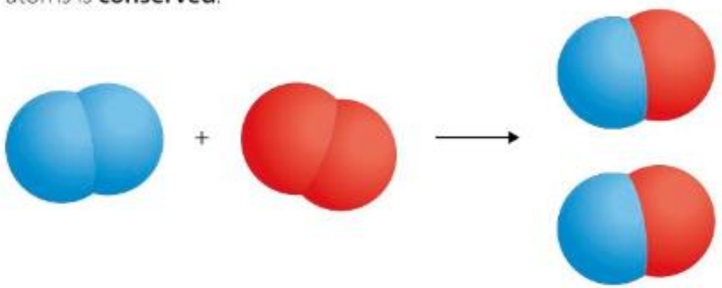
Fuels burn in chemical reactions. Burning is also called **combustion**. In a combustion reaction, a substance reacts with oxygen, and energy is transferred to the surroundings as heat and light.

The fuel methane is a compound of carbon and hydrogen. Its chemical formula is CH_4. When it burns, it reacts with oxygen from the air. The reaction makes two products, carbon dioxide and water:

methane + oxygen → carbon dioxide + water

The particle diagram below represents this reaction. It shows that one molecule of methane reacts with two molecules of oxygen to make one molecule of carbon dioxide and two molecules of water.

The diagram below summarises how the atoms are arranged in the reaction of nitrogen with oxygen. There are the same number of atoms of each element before and after the reaction. The number of atoms is **conserved**.

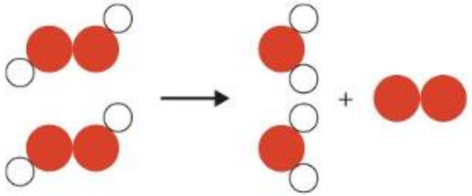


Thermal Decomposition

Copper carbonate is a green compound. It is made up of atoms of three elements – copper, carbon, and oxygen.

If you heat copper carbonate, it breaks down. The reaction makes copper oxide and carbon dioxide. Copper oxide is black. It remains in the test tube. Carbon dioxide forms as a gas.

copper carbonate → copper oxide + carbon dioxide



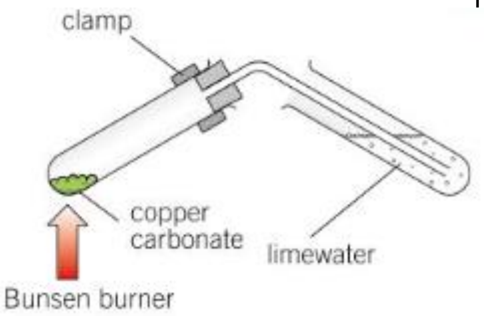
Testing for Carbon Dioxide

You can show that the gas is carbon dioxide by bubbling it through limewater in the apparatus shown. The limewater goes cloudy.

Other types of carbonate decompose on heating:

lead carbonate → lead oxide + carbon dioxide

zinc carbonate → zinc oxide + carbon dioxide



Balancing Equations

Word equations show reactants and products in reactions.
Balanced symbol equations also show:

- the formulae of reactants and products
- how the atoms are rearranged
- the relative amounts of reactants and products.

A balanced symbol equation is a bit like a particle diagram for a reaction. It shows the atoms in the reactants and products, and how they are rearranged.

Follow the steps shown in the examples below to write balanced symbol equations for chemical reactions.

Burning carbon

- First, write a word equation:

carbon + oxygen → carbon dioxide

- Write chemical symbols or formulae for each reactant and product. You cannot guess these.

$$C + O_2 \rightarrow CO_2$$

- Now balance the equation. There must be the same number of atoms of each element on each side of the equation. The equation shows one atom of carbon on each side of the arrow, and two atoms of oxygen. It is balanced.

Endothermic Reactions

The process in the cold pack is an **endothermic change**. In this type of change, energy is transferred *from* the surroundings *to* substances that are reacting, changing state, or dissolving. Endothermic changes include:

- some chemical reactions
- melting and boiling
- dissolving some substances in water.

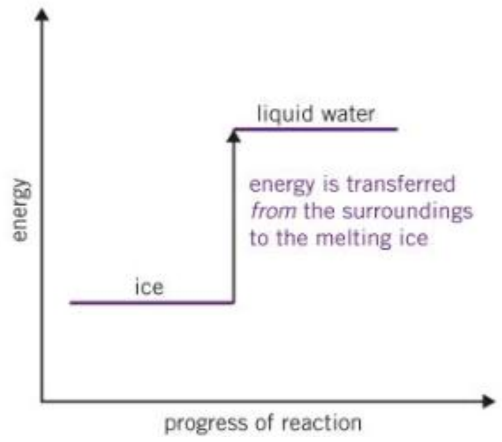
Exothermic Reactions

Some changes are exothermic. In this type of change, energy is transferred *to* the surroundings *from* substances that are reacting, changing state, or dissolving. **Exothermic changes** include:

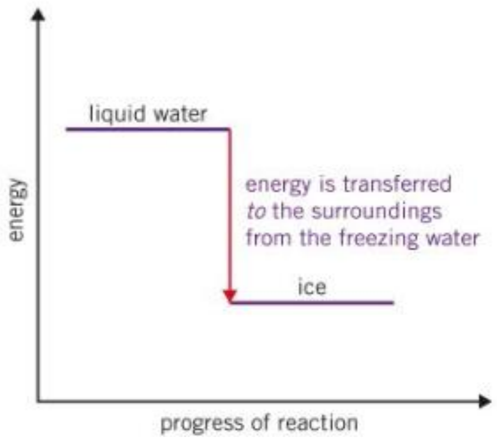
- chemical reactions, for example, combustion
- freezing and condensing
- dissolving some substances in water.

Changes of state – Energy Level Diagram

The **energy level diagrams** below represent changes of state. Both diagrams show that liquid water stores more energy than the same amount of ice. The first diagram shows that ice takes in energy from the surroundings as it melts. The second shows that water gives out energy to the surroundings as it freezes. Freezing is exothermic.



Endothermic

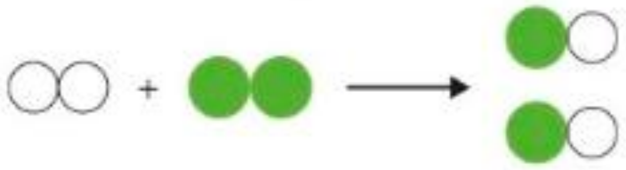


Exothermic

Bond Energies

You can use bond energy values to predict whether a chemical reaction will be exothermic or endothermic. Look at the equation for the reaction of hydrogen with chlorine.

$H_2 + Cl_2 \rightarrow 2HCl$



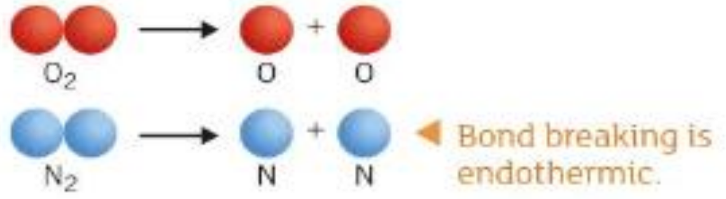
The energy required to break bonds in H_2 and Cl_2 is (436 + 243) = 679 kJ/mol.

The energy released to the surroundings on making bonds in HCl is (2 × 432) = 864 kJ/mol.

Since less energy is needed to break bonds than is released on making new bonds, the reaction is exothermic.

Bond Breaking - ENDOTHERMIC

The reaction of nitrogen with oxygen needs energy to get it started. Heat from the car engine supplies this energy. The energy breaks bonds in nitrogen and oxygen molecules. Bond breaking is endothermic.



Bond Making - EXOTHERMIC

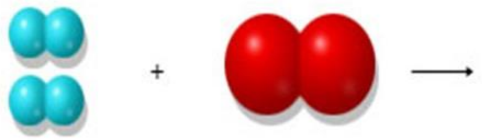
New bonds then form between nitrogen and oxygen atoms. This makes nitrogen monoxide molecules. When new bonds form, energy is transferred to the surroundings. Bond making is exothermic.

Complete the molecular diagram:

REACTANT + REACTANT → PRODUCT

$2H_2 + O_2 \longrightarrow 2H_2O$

MOLECULAR



Complete the word (ext. chemical) equations for the combustion of methane:

Methane + __________ → ___________ + ______________

Describe some examples of renewable fuels:

____

____

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____

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____

____

___________, ___________, _____________, and ___________ are ____________ fuels. They are non-renewable. This is a problem because ________ ______________ __________ _________ ____

6: Reactions TASK 1

Complete the word equations for the following thermal decomposition reactions:

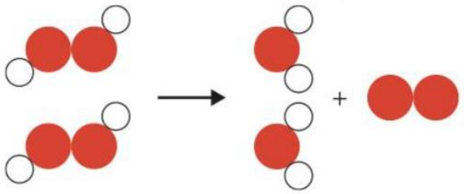
a) Copper carbonate →

b) Lead carbonate →

c) Zinc carbonate →

d) Magnesium nitrate →

The reaction shown below is a decomposition reaction. Explain what happens in a decomposition reaction:



Fill the chemical formula column in the table:

Compound	Formula
Magnesium nitrate	
Calcium nitrate	
Strontium nitrate	

6: Reactions TASK 2

Explain the term 'conservation of mass'. Use a worked example of calculating masses to help you explain:

Balance the following equations:

1. ___ H_2 + ___ O_2 → ___ H_2O
2. ___ Mg + ___ O_2 → ___ MgO
3. ___ Li + ___ F_2 → ___ LiF
4. ___ K + ___ O_2 → ___ K_2O
5. ___ H_2O_2 → ___ H_2O + ___ O_2
6. ___ Al + ___ Cl_2 → ___ $AlCl_3$
7. ___ Ag_2O → ___ Ag + ___ O_2
8. ___ H_2 + ___ N_2 → ___ NH_3
9. ___ Ca + ___ H_2O → ___ $Ca(OH)_2$ + ___ H_2
10. ___ $SeCl_6$ + ___ O_2 → ___ SeO_2 + ___ Cl_2

Key words and definitions:

In a endothermic reaction

____

____

Some examples of endothermic changes are:

____

____

____

Sketch an energy level diagram for endothermic reactions:

Use the data in the table to predict whether the reaction

$H_2 + F_2 \rightarrow 2HF$

Is exothermic or endothermic

Bond	Bond energy (kJ/mol)
H-H	436
F-F	158
H-F	562

In a endothermic reaction

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Some examples of endothermic changes are:

____

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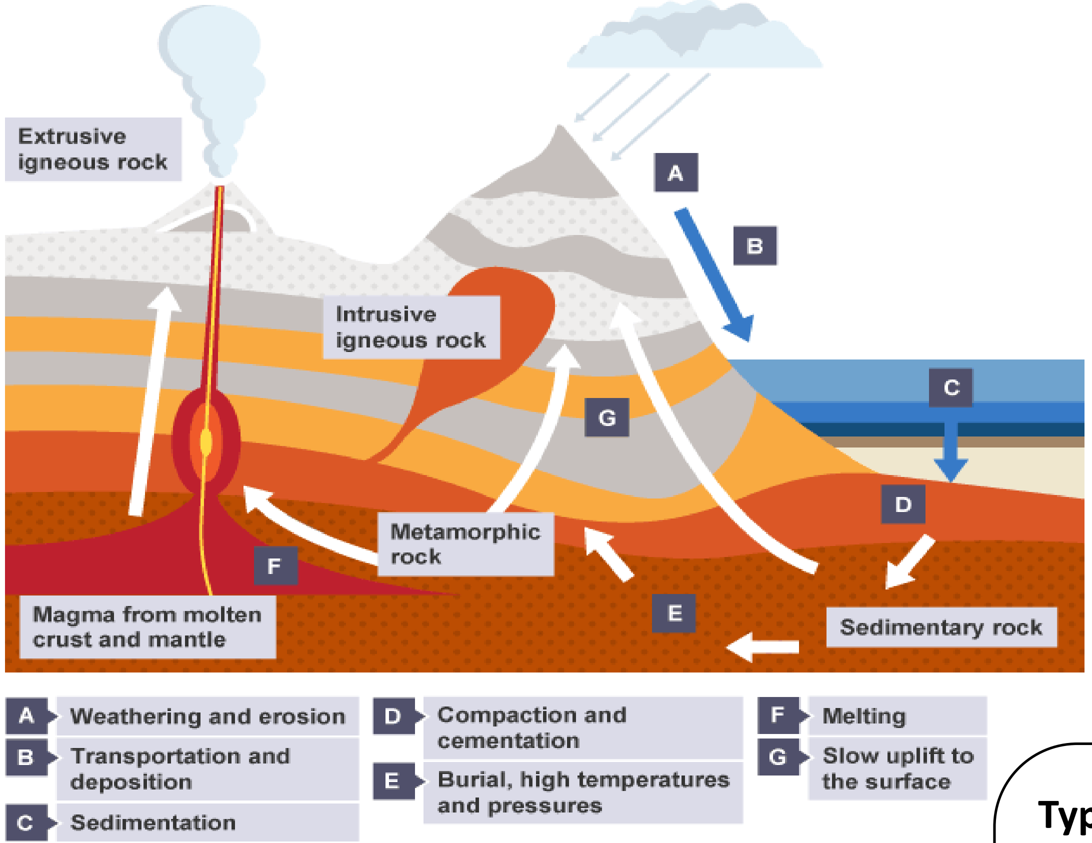
Sketch an energy level diagram for endothermic reactions:

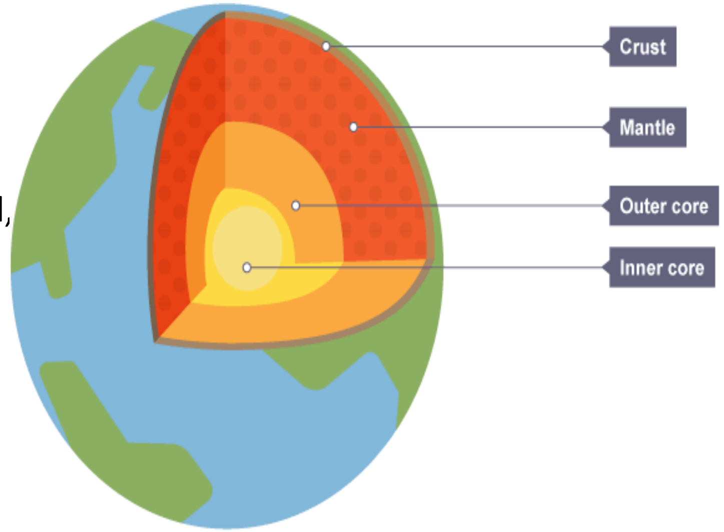


Letter	Description
A	There are 3 types of weathering (biological, physical and chemical).
B	Rivers and streams transport rock particles to other places.
C	Rock particles form layers.
D	This presses the layers and sticks the particles together, forming sedimentary rock.
E	Rocks underground and are changed into metamorphic rock.
F	Rocks melt and turn into magma. When it cools it forms igneous rocks.
G	Areas of rock can move slowly upwards, this is called uplift.

Structure of the earth

The Earth is almost a sphere.
These are its main layers, starting with the outermost:

- Crust (relatively thin and rocky)
- Mantle (has the properties of a solid, but can flow very slowly)
- Core (made from nickel and iron)



Types of rocks

Igneous rocks

Igneous rocks are formed from molten rock that has cooled and solidified.

Sedimentary rocks

Sedimentary rocks are formed from the broken remains of other rocks that become joined together.

Metamorphic rocks

Metamorphic rocks are formed from other rocks that are changed because of heat or pressure. They are not made from molten rock – rocks that do melt form igneous rocks instead.

Years and seasons

A planet's year is the time it takes to make one complete orbit around the Sun. The Earth goes once round the Sun in one Earth year, which takes 365 Earth days.

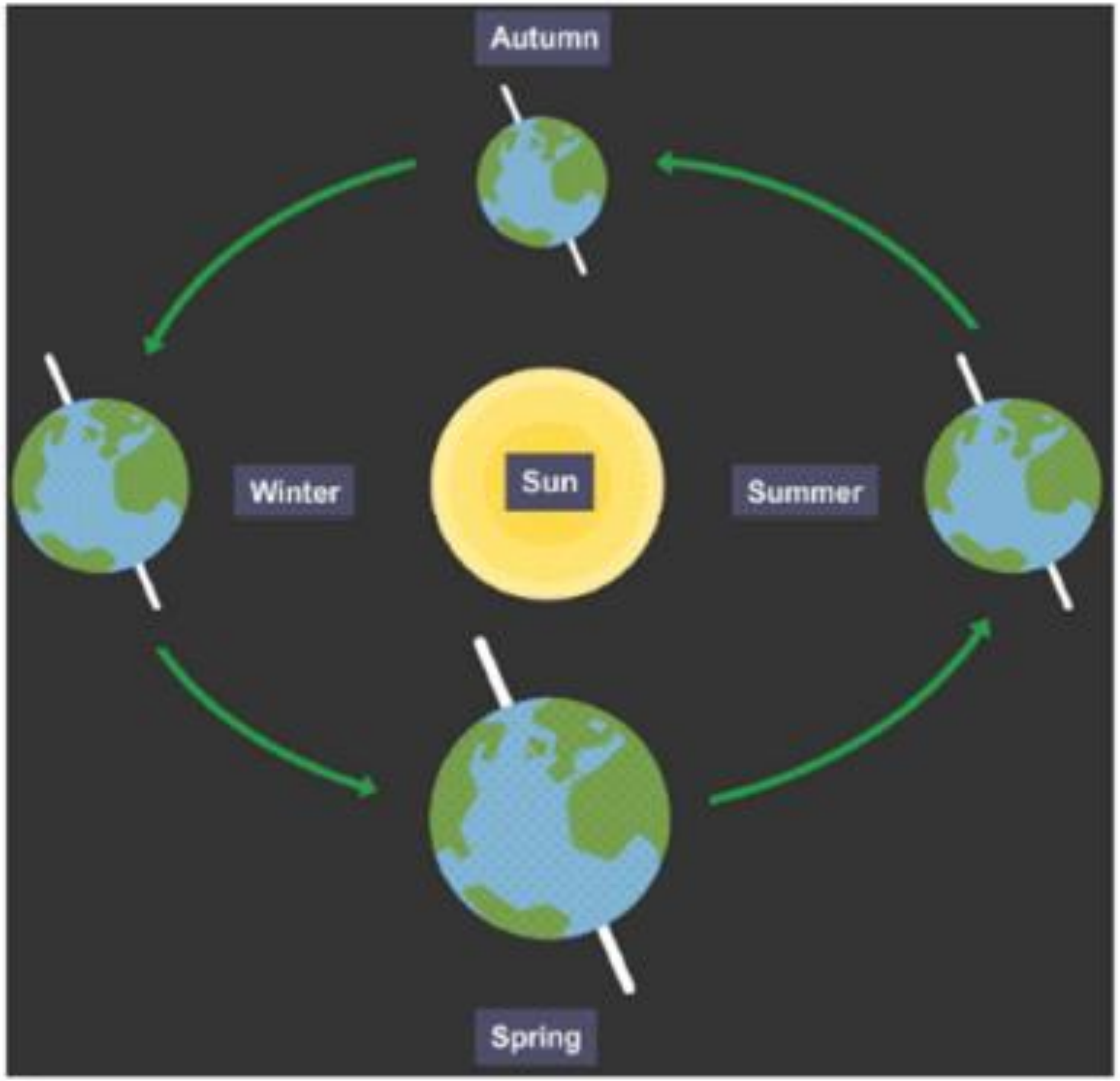
Seasons

The Earth's axis is the imaginary line through the centre of the Earth between the South and North poles about which the Earth rotates. This axis is tilted slightly compared with the way the Earth orbits the Sun.

The Earth's axis is tilted 23.4° from vertical

We get different seasons (winter, spring, summer and autumn) because the Earth's axis is tilted. This is how it works:

- it is summer in the UK when the Northern Hemisphere is tilted towards the Sun
- it is winter in the UK when the northern hemisphere is tilted away from the Sun



When it is summer in the Northern Hemisphere, it is winter in the Southern Hemisphere

Stars and galaxies

Our Sun is a star. It seems much bigger than other stars in the sky because it is much closer to Earth. Stars form immense groups called galaxies. A galaxy can contain many millions of stars, held together by the force of gravity.

Our Sun is in a spiral galaxy called the Milky Way. The Sun is about half-way from the centre of the galaxy, on one of the arms.

Our galaxy contains millions of stars, including our Sun. It is just one of more than 100 billion galaxies in the universe

The light year

The distances between objects in space are huge:

- the distance from one star to another in a galaxy is millions of times more than the distance between the planets in the solar system
- the distance from one galaxy to another is millions of times more than the distance between the stars in a galaxy

This means that the numbers used to describe distances in space become very difficult to understand and to write down. For example, the distance between the Earth and the Sun is about 150,000,000,000 m but the distance to the next nearest star (Proxima Centauri) is 39,900,000,000,000,000 m.

To get around this problem, scientists use the light year as the unit of astronomical distance. It is the distance travelled by light in one year. So, for example:

- Sun to Proxima Centauri distance is about 4.24 light years
- Milky Way to Andromeda (the next nearest spiral galaxy) distance is about 2.5 million light years

It takes light from our Sun about 8 minutes to reach the Earth.

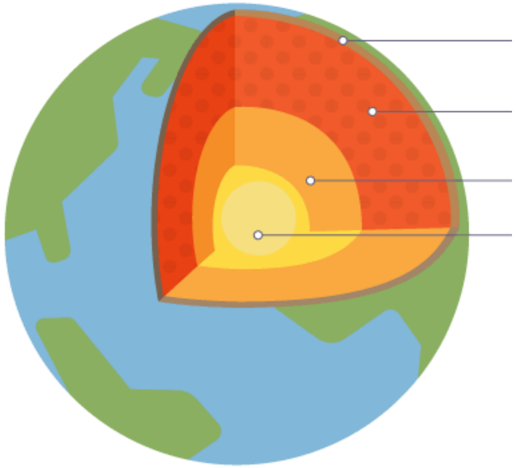
Ceramics
What are Ceramics, give some examples of objects made from this material?

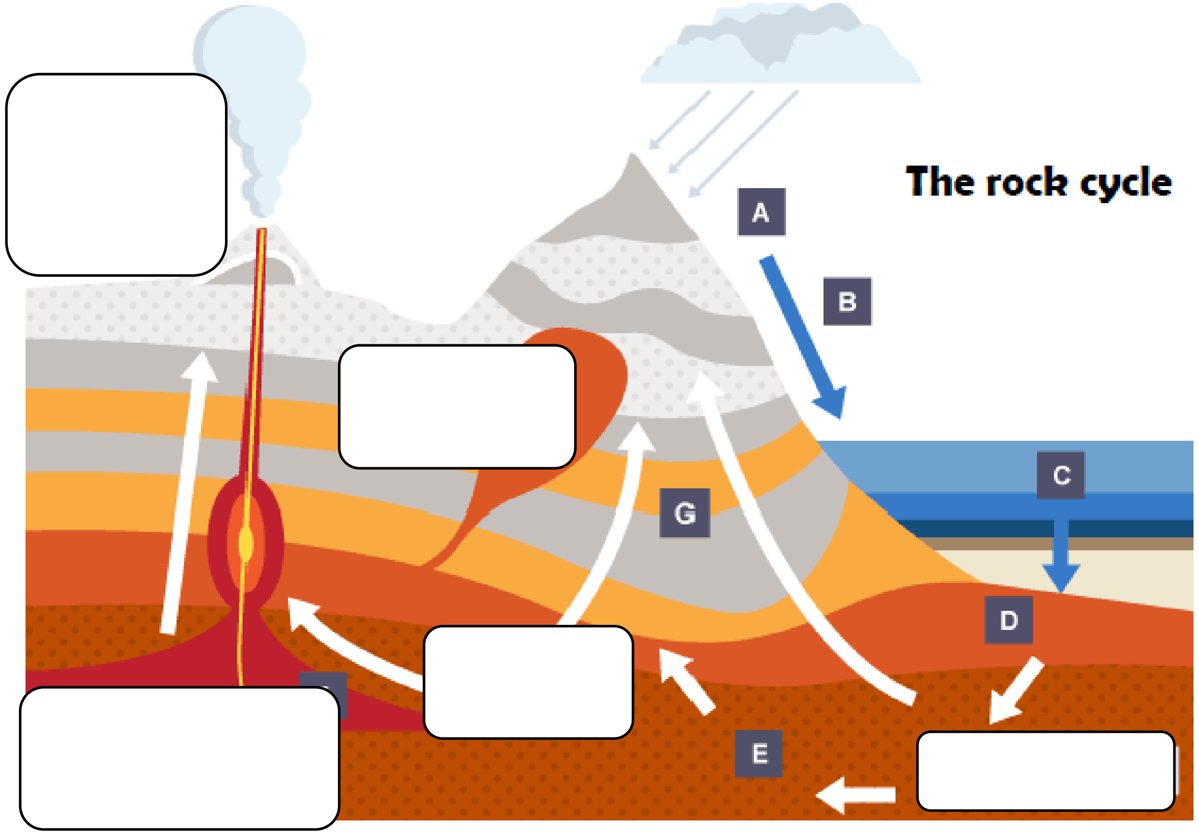
Outline some Advantages and Disadvantages of using Ceramics.

☺	☹

Chapter 7: Earth Task 1

Add the correct labels





1. Describe how each type of rock is formed:

Sedimentary rock

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Metamorphic rock

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Igneous rock

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Chapter 7: Earth - TASK 2

What are the 8 planets in the Solar System and what are their distances from the Sun?

Define these words-
Artificial satellite –
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Natural Satellite–
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Planet–
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Galaxy–
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Orbit–
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Universe–
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Annotate the diagram and explain why the Earth has seasons throughout the year.
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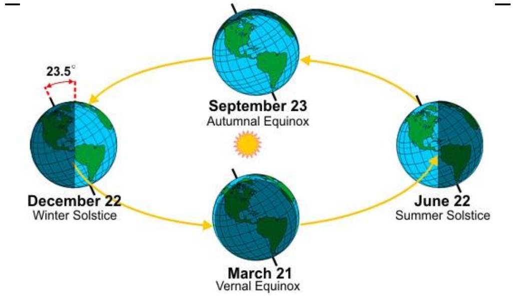

What is a solar eclipse?
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What is a lunar eclipse?
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What are the 4 terrestrial planets?
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Draw a diagram showing why we see different phases of the moon. Label the phases.

What is a the difference between a comet and a meteor?
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What is a the difference between a day and a year in terms of the Earth moving?
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Chapter 7.3 and 7.4 Knowledge Organiser - EARTH

Science Department

RAINFORD HIGH

The carbon cycle

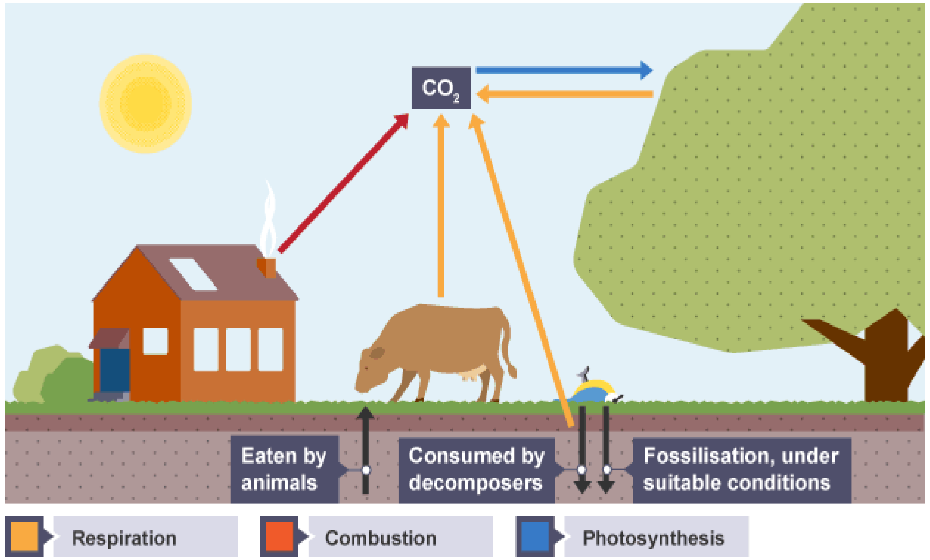
Carbon is being continually recycled on Earth. The processes that release carbon dioxide to the atmosphere include:

- combustion of fossil fuels
- respiration by plants and animals
- Carbon dioxide is taken in from the atmosphere by plants so that they can carry out photosynthesis

Some processes move carbon compounds from place to place, including:

- feeding by animals
- formation of fossil fuels

The model that describes the processes involved is called the carbon cycle:



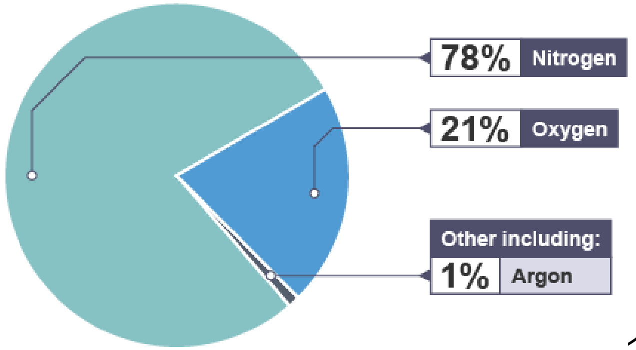
Crude oil, coal and gas are fossil fuels. They were formed over millions of years, from the remains of dead organisms:

- coal was formed from dead trees and other plant material
- crude oil and gas were formed from dead marine organisms

Composition of the atmosphere

The three most abundant gases (the ones with the highest percentages) are all elements:

- 78% nitrogen, N2
- 21% oxygen, O2
- 0.9% argon, Ar



Impact of human activity

Global warming

Extra carbon dioxide in the atmosphere increases the greenhouse effect. More thermal energy is trapped by the atmosphere, causing the planet to become warmer than it would be naturally. This increase in the Earth's temperature is called global warming.

The impact of climate change

Climate change and its effects as a result of global warming includes:

- Ice melting faster than it can be replaced in the Arctic and Antarctic
- The oceans warming up – their water is expanding and causing sea levels torise
- Changes in where different species of plants and animals can live

How to reduce human impact on the environment:

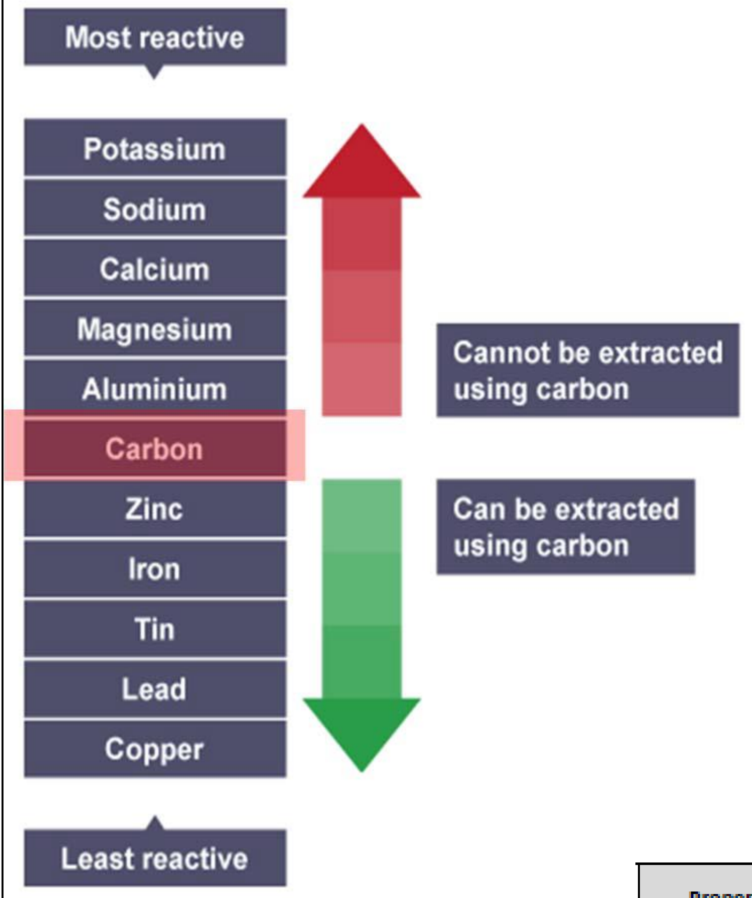
Recycling is an important way to help us achieve sustainable development. We can recycle many resources, including:

Glass **Metal** **Paper** **Plastic**

The Reactivity Series

The reactivity series shows a list of metals in the order of how reactive they are. The metals towards the top of the list react readily with air and water and violently with acid.
The metals towards the bottom of the list do not even react with acid.
The order of the reactivity series can be remembered using a mnemonic.

"Pond slime can make a zoo interesting - the long crinkly sort goes purple.“



Carbon can be placed into the reactivity series.

Metals which are less reactive than carbon can be extracted by reduction with carbon.

Metals that can be extracted by this method are zinc, iron, tin, lead and copper.
The general equation for this reaction is:

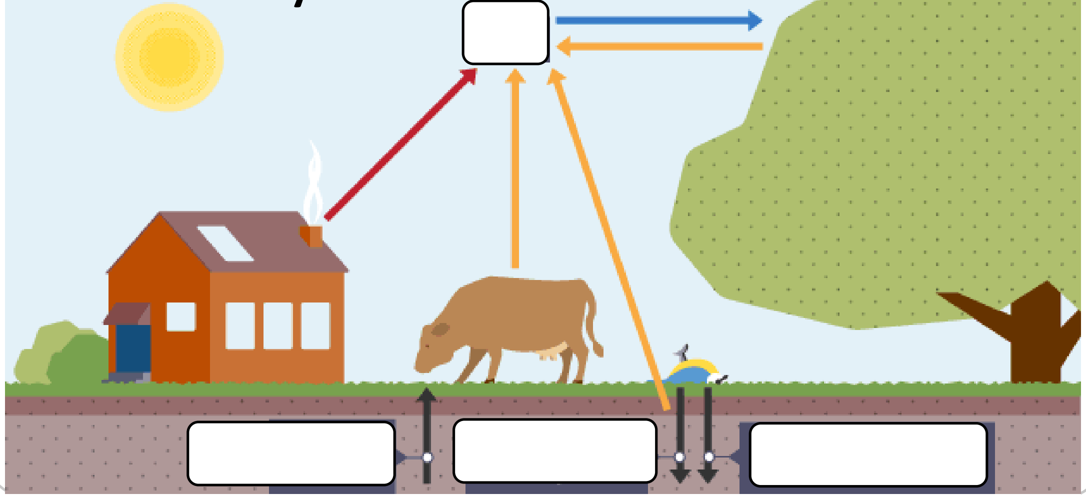
metal oxide + carbon → metal + carbon dioxide

Extraction of metals high in the reactivity series
Metals that are higher than carbon in the reactivity series have to be extracted from their Ores (A naturally occurring rock containing enough mineral worth extracting) by a process known as **ELECTROLYSIS.**
ELECTROLYSIS literally means pulling apart with electricity and can only be done on compounds that have been melted or dissolved in a substance called an electrolyte.
Aluminium us the most common example of a metal extracted by this method.

Property	Metals	Non-metals
Appearance	Shiny	Dull
State at room temp	Solid (except mercury)	Half are solids, half are gases, one is liquid (bromine)
Density	High	Low
Strength	Strong	Weak
Malleable or brittle	Malleable (can bend without breaking)	Brittle (will shatter when hammered)
Conduction (heat/electricity)	Conduct both well	Poor (graphite only non-metal conductor)
Magnetic	Only iron, cobalt and nickel	None

7: Earth
TASK 1

The Carbon Cycle



How can we reduce the impact of humans on the environment? (Using ONE WORD only)

Describe the process of **Global warming**:

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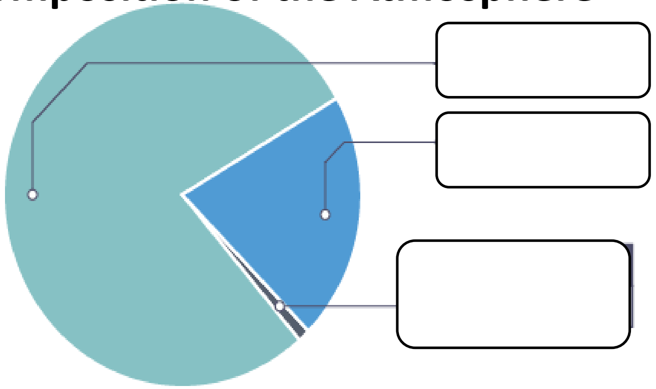
Crude oil, **coal** and **gas** are ________________ __________.
They were formed over ____________________ of years, from the remains of dead organisms:

- ____________ was formed from dead trees and other plant material
- __________ _______ and ___________were formed from dead marine organisms.

Composition of the Atmosphere



Evaluate the impact of **Climate change** on humans and animals:

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The Reactivity Series

Describe the word ORE and give examples

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7: Earth
TASK 2

Extraction of metals high in the reactivity series
Metals that are higher than ______________ in the reactivity series have to be extracted by a process known as **______________________.**
ELECTROLYSIS literally means pulling apart with ___________________ and can only be done on compounds that have been melted or dissolved in a substance called an __________________________.

Compare the Properties of:

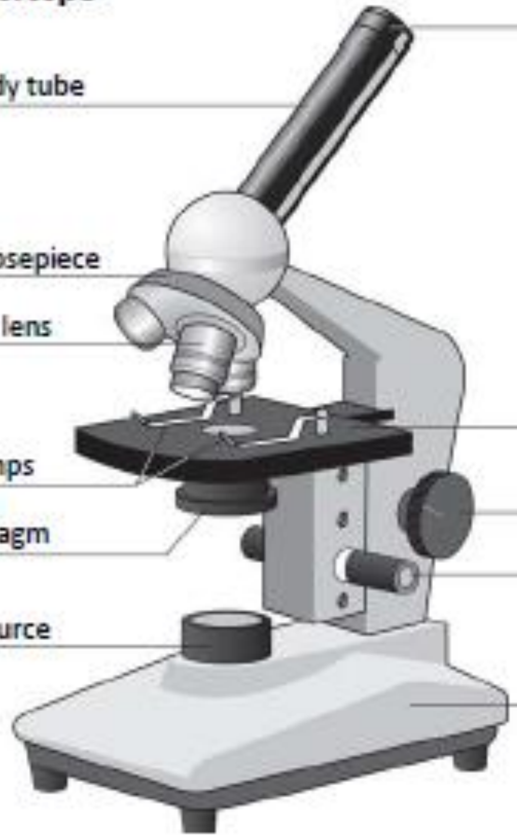
Metals	**Non-metals**

Chapter 8.1 and 8.2 Knowledge Organiser - ORGANISMS

Science Department

RAINFORD HIGH

Parts of a microscope



Magnification

We can use the following equation to calculate the magnification of an object viewed through a microscope:

$$magnification = \frac{image\ size}{actual\ size}$$

Part of microscope	Function
Stage	Area where specimen is placed
Clamps	Hold the specimen still whilst it is being viewed
Light source	Illuminates the specimen
Objective lens	Magnifies the image of the specimen
Eyepiece lens	Magnifies the image of the specimen
Course/fine focus	Used to focus the specimen so it can be seen clearly
Revolving nosepiece	Holds 2 or more objective lenses

Using a microscope

To view an object down the microscope we can use the following steps:

1. Plug in the microscope and turn on the power
2. Rotate the objectives and select the lowest power (shortest) one
3. Place the specimen to be viewed on the stage and clamp in place
4. Adjust the course focus until the specimen comes into view
5. Adjust the fine focus until the specimen becomes clear
6. To view the specimen in more detail repeat the process using a higher power objective

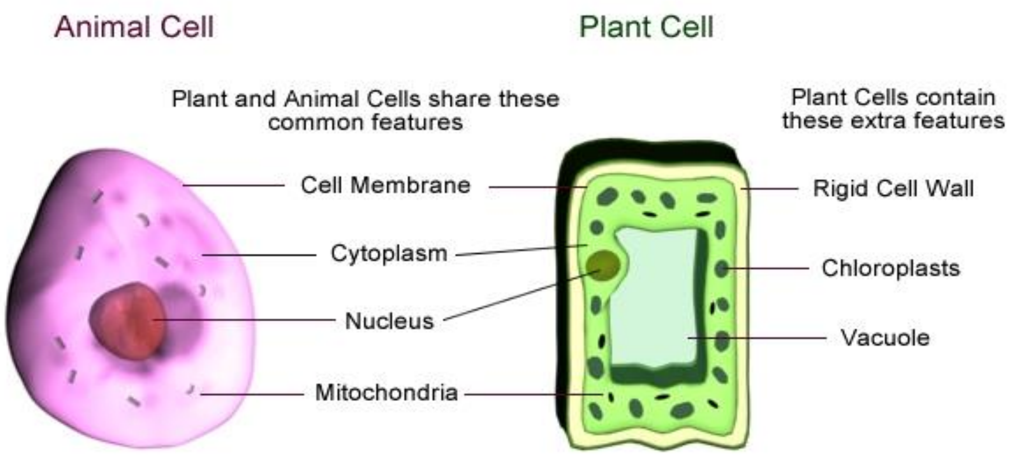
Preparing a microscope slide

To prepare a slide to view onion cells we can use the following steps:

1. cut open an onion
2. use forceps to peel a thin layer from the inside
3. spread out the layer on a microscope slide
4. add a drop of iodine solution to the layer
5. carefully place a cover slip over the layer

Cells

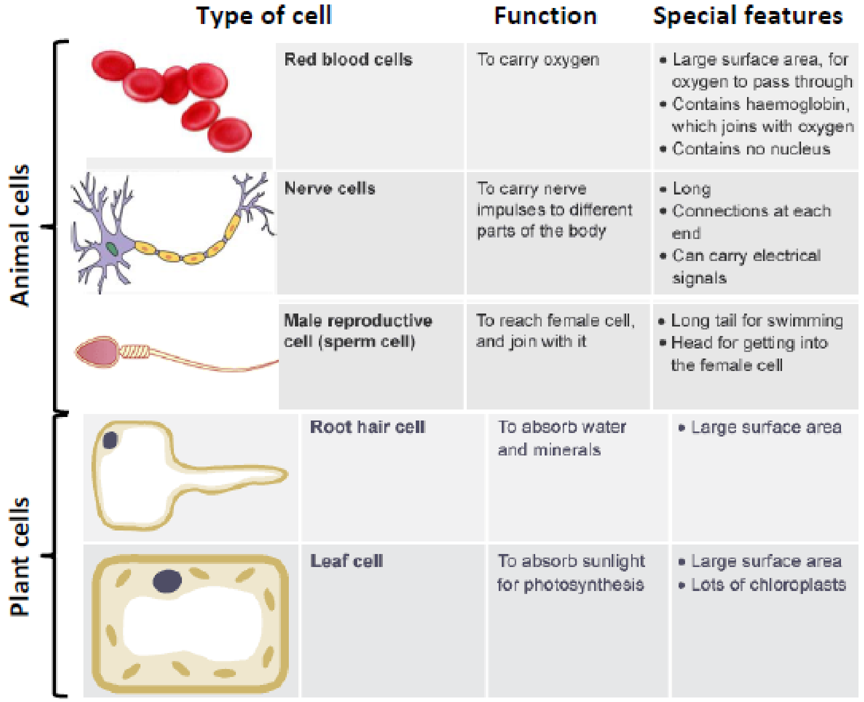
Cells are the building blocks of all living organisms.



Organelle	Definition
Cell wall	Made of cellulose, which supports the cell
Cell membrane	Controls movement of substances into and out of the cell
Cytoplasm	Jelly-like substance, where chemical reactions happen
Nucleus	Contains genetic information and controls what happens inside the cell
Vacuole	Contains a liquid called cell sap, which keeps the cell firm
Mitochondria	Where most respiration reactions happen
Chloroplast	Where photosynthesis happens

Specialised cells

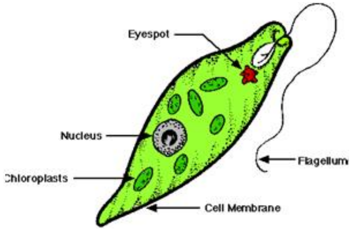
Specialised cells are found in multicellular organisms. Each specialised cell has a particular function within the organism.

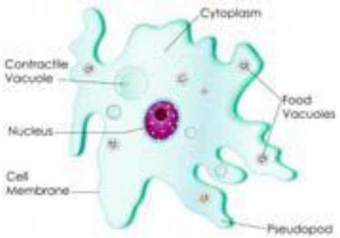


	Type of cell	Function	Special features
Animal cells	Red blood cells	To carry oxygen	• Large surface area, for oxygen to pass through • Contains haemoglobin, which joins with oxygen • Contains no nucleus
Animal cells	Nerve cells	To carry nerve impulses to different parts of the body	• Long • Connections at each end • Can carry electrical signals
Animal cells	Male reproductive cell (sperm cell)	To reach female cell, and join with it	• Long tail for swimming • Head for getting into the female cell
Plant cells	Root hair cell	To absorb water and minerals	• Large surface area
Plant cells	Leaf cell	To absorb sunlight for photosynthesis	• Large surface area • Lots of chloroplasts

Unicellular Organisms

Some organisms are only made of a single cell, these are called unicellular organisms. All the processes needed for the organism to survive happen in that one, single cell. There are no tissues, organs or organ systems. Unicellular organisms often have structural adaptations to help them survive.





The skeleton

Our **skeleton** is made of more than 200 **bones**. Calcium and other minerals make the bone strong but slightly flexible. Bone is a living **tissue** with a blood supply. It is constantly being dissolved and formed, and it can repair itself if a bone is broken.

Function of the skeleton

The skeleton has four main functions:

1. Support - to **support** the body **e.g. Our backbone keep us upright**

2. Protection - Here are some examples of what the skeleton protects:

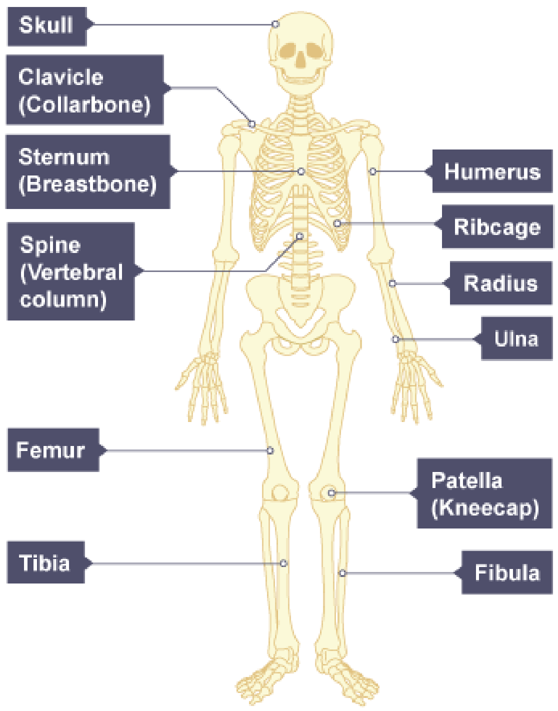
- skull protects the brain
- ribcage protects the heart and lungs
- backbone protects the spinal cord

3. Movement - Some bones are joined rigidly together and cannot move e.g. Bones in the skull. Other bones are joined to each other by flexible joints. Muscles are needed to move bones attached by joints.

4. Making blood cells - There are different kinds of blood cells, including:

- **Red blood cells** - carry oxygen
- **White blood cells** – used in the immune system

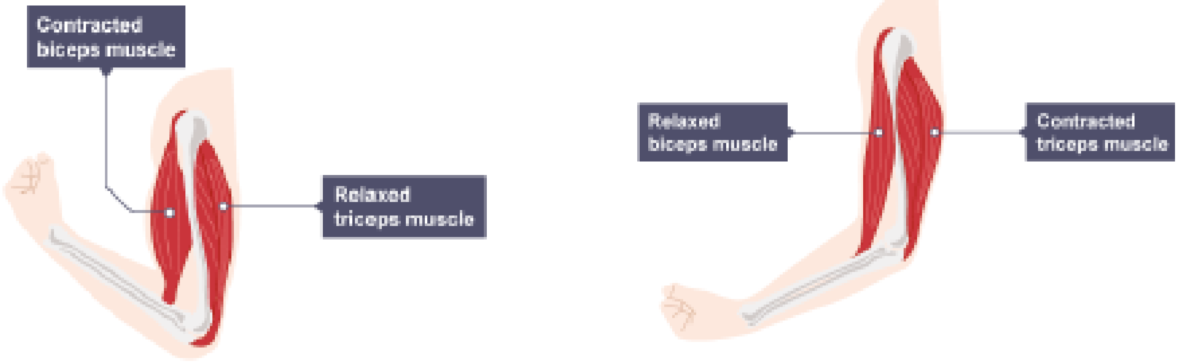
These cells are made in the **bone marrow**. This is soft tissue inside our larger bones which is protected by the hard part of the bone which surrounds it.



Antagonistic muscles

Muscles are attached to bones by strong tendons, they can only pull and cannot push. E.g. your elbow joint has two muscles that move your forearm up or down.

- to raise the forearm, the biceps contracts and the triceps relaxes
- to lower the forearm again, the triceps contracts and the biceps relaxes



Joints - Bones are linked together by joints which allow different parts of the skeleton to move. They are called **synovial joints.**

Type of joint	Example	Movement allowed
Hinge joint	Knee, elbow	Same as opening and closing a door, no rotation
Ball and socket joint	Hip, shoulder	Backwards and forwards in all directions, with rotation

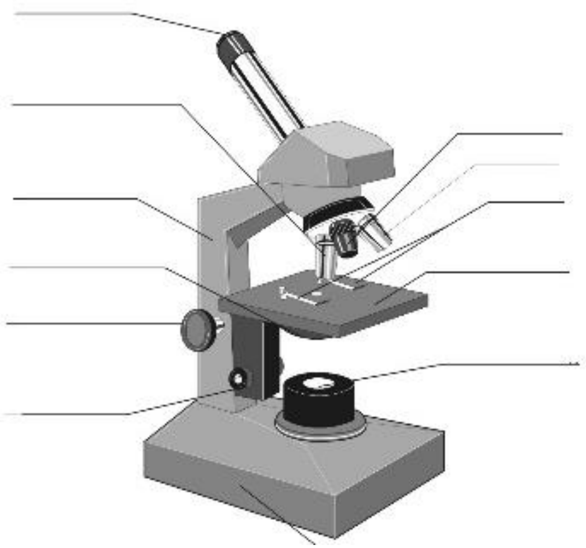
The make up of an organism

Organisms are constructed according to the following hierarchy:

Cell ⟶ Tissue ⟶ Organ ⟶ Organ System ⟶ Organism

Chapter 8 Cells – TASK 1

Label this microscope.



What is the magnification equation?

Draw a plant and animal cell and label all key features. –p17

Write a step by step method describing how to prepare a microscope slide.

What is a specialised cell?

____

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Draw an example specialised cell.

Draw and label a unicellular organism.

Chapter 8 Cells TASK 2

Define these words-

Cell–

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Tissue–

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Organ–

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Organism -

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Joint–

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Muscle–

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Skeleton–

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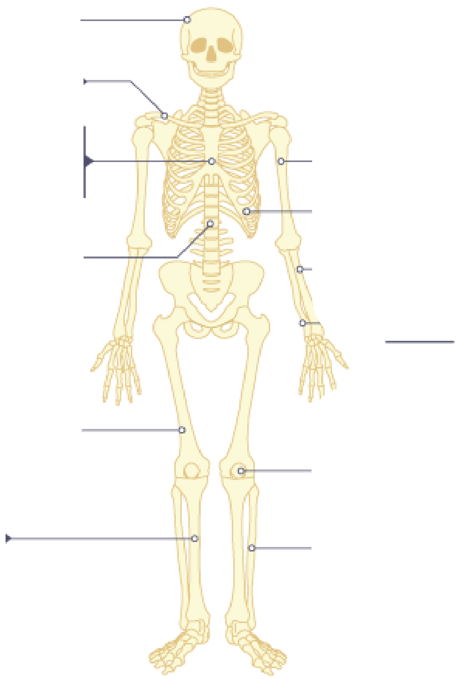

Name as many types of joint as you can.

Give some examples…

Describe the four reasons we need a skeleton.

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Explain why nearly all muscles in the body have to work in pairs. Use the term antagonistic pair at least once.

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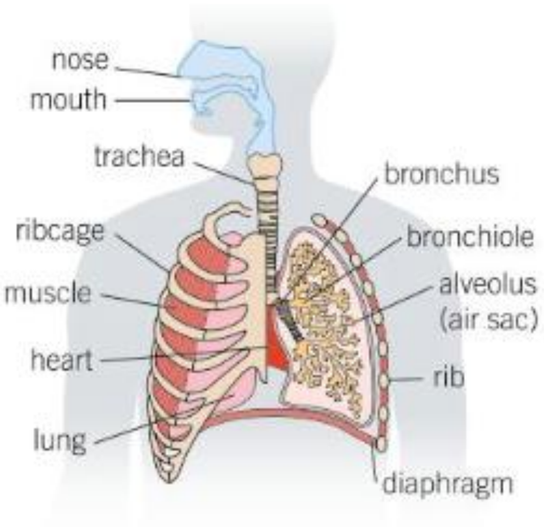
The Respiratory System



Air enters your body through your mouth and nose.

↓

Air moves down the **trachea** (windpipe) – a large tube.

↓

Air moves down a **bronchus** – a smaller tube.

↓

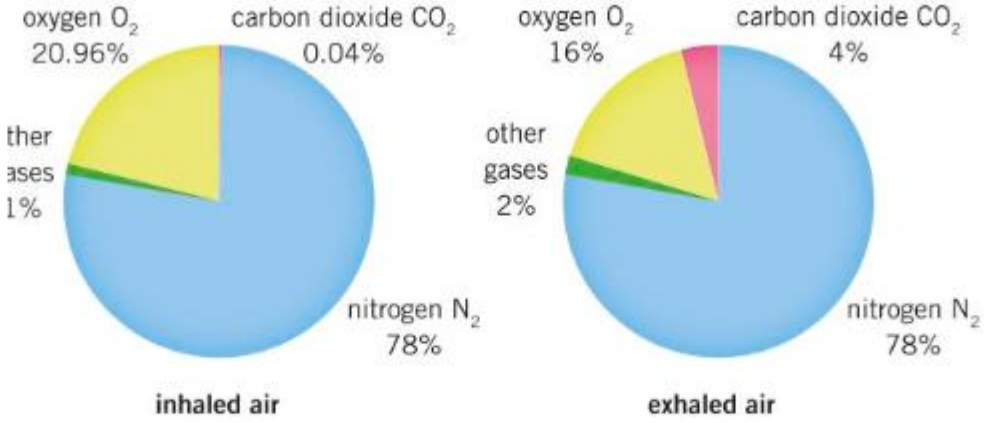
Air moves through a **bronchiole** – a tiny tube.

↓

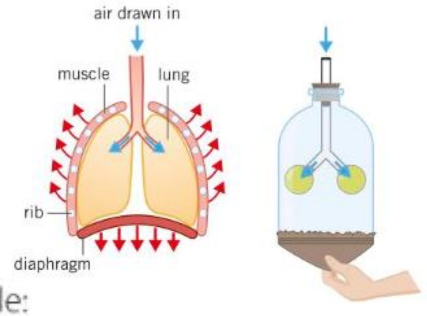
Air moves into an **alveolus** – an air sac.

↓

Oxygen then diffuses into the blood.



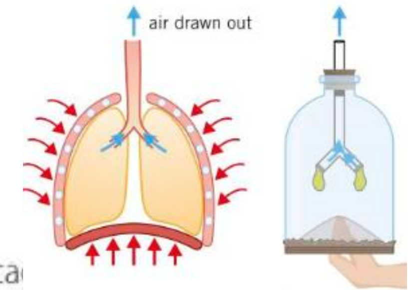
Inhaling – Breathing IN



This is what happens in the body when we inhale:

- The muscles between your ribs contract – this pulls your ribcage up and out.
- The diaphragm contracts – it moves down.
- The volume inside your chest increases.
- The pressure inside your chest decreases – this draws air into your lungs.

Exhaling – Breathing OUT



This is what happens in the body when we exhale:

- The muscles between your ribs relax – this pulls your ribca down and in.
- The diaphragm relaxes – it moves up.
- The volume inside your chest decreases.
- The pressure inside your chest increases – this pushes air out of your lungs.

Smoking
Smoking is very harmful to health. It's estimated that nearly one in every five deaths (of adults aged over 35 in England) is connected to smoking.
Tobacco smoke contains many harmful substances. These include:
- **tar**
- **nicotine**
- **carbon monoxide**

The pictures show a section through a normal lung and one blackened by tar.
It also causes a low birth weight in babies born to mothers who smoke.

Tar - Causes lungs, mouth and throat **cancer.** It coats the inside of the lungs, including the **alveoli**, causing coughing. **It damages the alveoli, making it more difficult for gas exchange to happen.**
Smoke - Cells lining the airways produce sticky mucus. This traps dirt and microbes. **Cilia** (cells with little hairs) then move the mucus out of the lungs. However, hot smoke and tar from smoking damages the cilia. As a result of this, smokers cough to move the mucus and are more likely to get **bronchitis**.
Nicotine - is **addictive** and also increases the heart rate and blood pressure, and makes blood vessels narrower than normal. This can lead to **heart disease.**
Carbon monoxide - is a gas that takes the place of oxygen in red blood cells, reducing the amount of oxygen that the blood can carry. It means that the **circulatory system** has to work harder, causing heart disease.

Drugs
A drug is a substance that has an effect on the body:
- medicines are drugs that help people suffering from pain or disease
- recreational drugs are taken by people because they like the effects they have on their bodies.

Depressants
A depressant slows down messages in the brain and along the nerves.
E.g. Alcohol. heroin and solvents.

Short term effects	**Long term effects**
• Feelings of well being	Damage to the liver, brain and heart
• Lower inhibition	Alcohol – weight gain, damage to the foetus as it passes through the placenta
• Slowed thinking and muscle activity	Solvents – rash around mouth and nose
• Distorted view/hallucinations	Loss of memory and increased risk of mental illness

Stimulants
Speed up messages in the brain and along the nerves, making you feel more alert.
- **Legal stimulants –** nicotine and caffeine make you feel more energetic and alert.
- **Illegal stimulants -** Cocaine, ecstasy and amphetamines also can damage the liver and heart. They can also cause loss of memory and concentration, and bring an increased risk of mental illness.

Food groups

There are 7 major food groups, a balanced diet will contain the correct amounts of all of these for the person's needs, e.g. someone who does a lot of exercise will need a lot more carbohydrate than someone who does not. The seven food groups are summarised below:

Food Group	Example	Function
Protein	Fish, meat, dairy	For growth and repair.
Fat	Butter, oils, nuts	To provide energy. Fat provides a long term store of energy. It also provides insulation for the body.
Carbohydrate	Bread, pasta, sugar	To provide energy.
Fibre	Vegetables, Bran	To help food move through the gut.
Minerals	Dairy (calcium)	Required in small amounts to remain healthy, for example calcium is crucial for healthy teeth and bones.
Vitamins	Oranges (vitamin C), Carrots (vitamin A)	Required in small amounts to remain healthy, for example vitamin D is needed to keep teeth and bones healthy.
Water	Water, fruit juice, milk	Needed to form the cytoplasm of the cells and other fluids.

Deficiency diseases

When the body does not have enough of a certain nutrient deficiency diseases can develop.

Deficiency diseases are most common in more deprived areas of the world such as Africa and in people who have difficultly maintaining a healthy diet such as the elderly.

Disease	Nutrient	Symptoms
Kwashiorkor	Essential nutrients, cause unknown	Inflamed skin, tiredness, poor growth, enlarged stomach, persistent infection
Ricketts	Vitamin D and Calcium	Bone pain, poor growth, deformation of the skeleton
Scurvy	Vitamin C	Muscle and joint pain, bleeding and swelling of the gums
Anaemia	Iron	Tiredness, lack of breath, heart palpitations (noticeable heartbeats), pale complexion

Food Tests

Starch test: Add iodine liquid, if starch is present substance will change to a blue/black colour.

Sugar/Glucose test: Add benedict's solution to the substance. Warm in a water bath. If substance changes green/orange/ red sugar is present.

Protein test: Add Biuret reagent. If substance changes to a purple colour protein is present.

Fat test: Wipe substance on filter paper. If paper becomes translucent fat is present. Alternatively add ethanol and water. Milky white emulsion appears in presence of
fats.

Why is it unhealthy to be overweight?

Some people eat too much, or eat too many fatty foods. If the energy content in the food you eat is more than the energy you use, you gain body mass. This is stored as fat under the skin. If a person becomes extremely overweight, they are said to be **obese**.

Overweight people have an increased risk of:

- heart disease
- stroke
- diabetes
- some cancers.

Why is it unhealthy to be underweight?

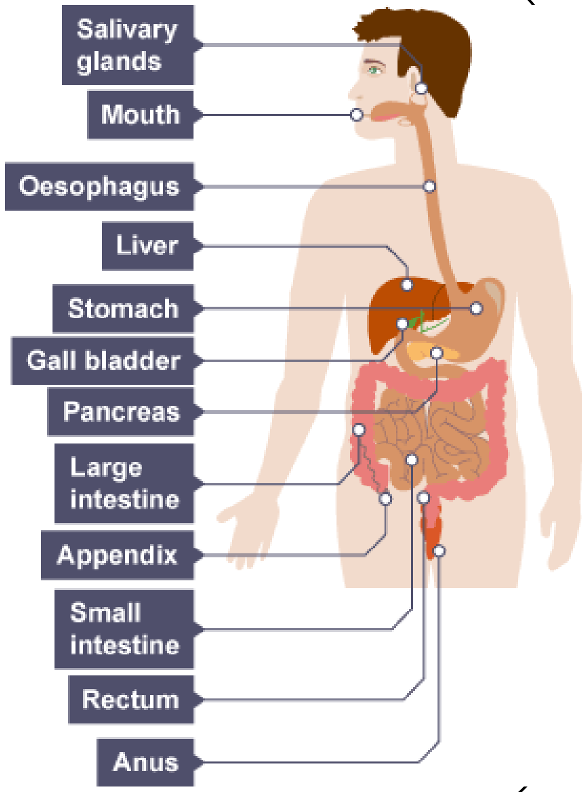
Some people do not eat enough food. In extreme cases this is known as **starvation**. If the energy in the food you eat is less than the energy you use, you will lose body mass. This leads to you being underweight. Underweight people:

- often suffer from health problems, such as a poor immune system
- lack energy to do things, and are often tired
- are likely to suffer from a lack of vitamins or minerals.

The Digestive System

The mouth has teeth that mechanically digest the food, it also has a
salivary gland that releases enzymes to break the food down.

- The oesophagus is a muscular tube that pushes the food into the stomach
- The stomach churns the food up, while also adding acid and enzymes to break the food down.
- In the small intestine, food is broken down further and is absorbed
thorough the walls of the intestine into the blood stream.
- The large intestine absorbs any remaining water
- Finally the food passes through the anus as faeces



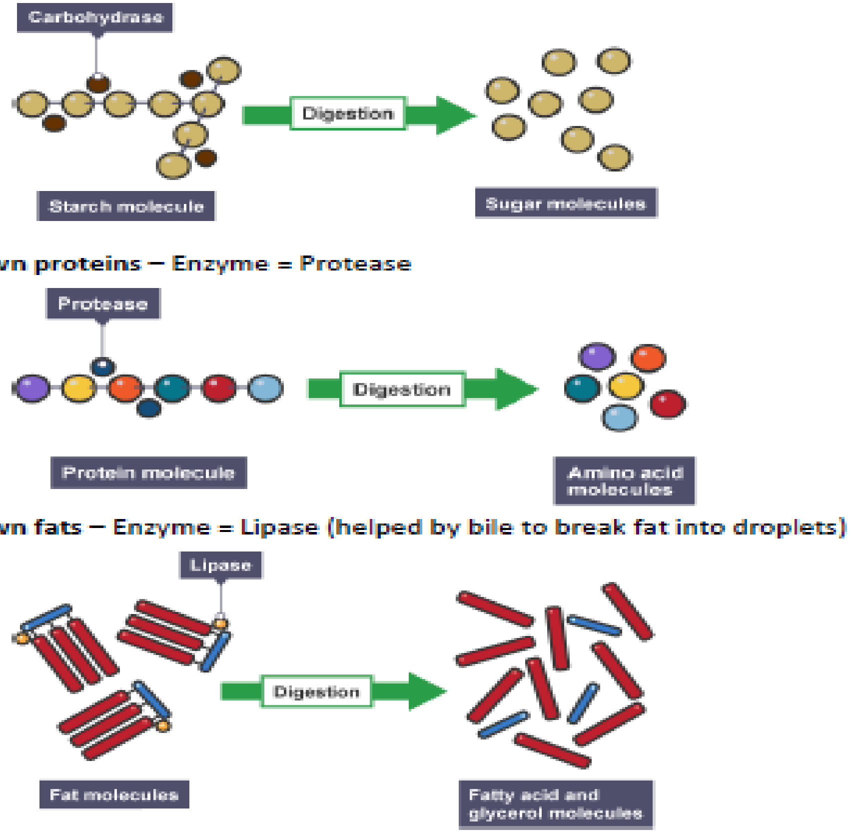
Enzymes

Enzymes are chemicals that help break down food molecules into smaller molecules. This enables the food to be absorbed by the body through the walls of the small intestine.

Breaking down starch (carbohydrates) – Enzyme = Carbohydrase

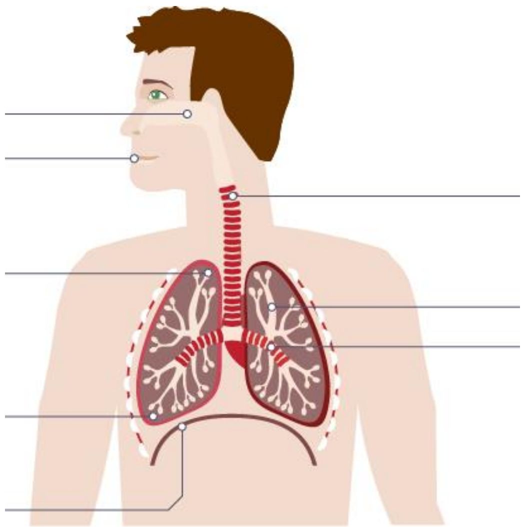
Breaking down proteins – Enzyme = Protease

Breaking down fats – Enzyme = Lipase (helped by bile to break fat into droplets)

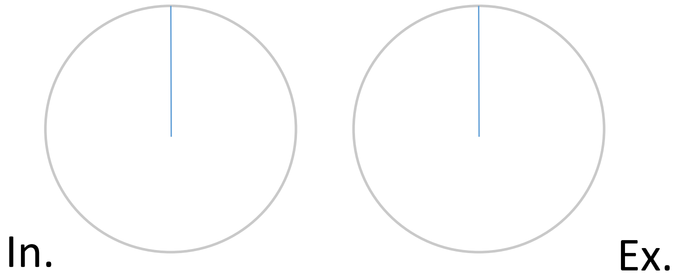


8: Organisms TASK 1

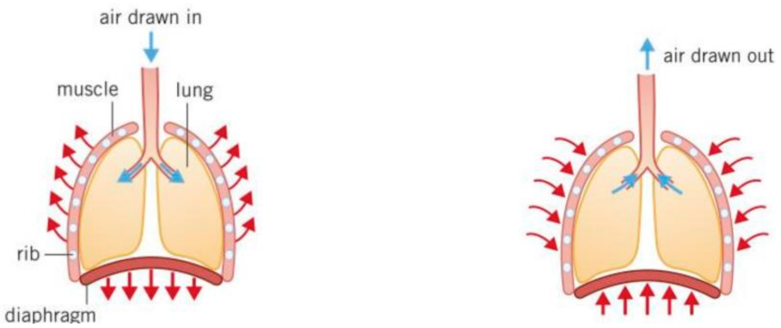
Label the diagram of the human respiratory system:



Complete the pie charts showing the amount of each gas in inhaled and exhaled air. (remember the include labels)



Annotate the diagrams to explain how we inhale and exhale air



Complete the flow chart describing the path of air into the lungs:

Describe an experiment you could do to measure your lung volume:

Medicinal drugs are used ___________ ______________

__ ___ _____________ ____________________________

____

Some examples of medicinal drugs are:

_________________ _____ ___ _____ ______________

_______________ ________________________________

Recreational drugs are used ______ _______ __________

____

___________ ___________________________________

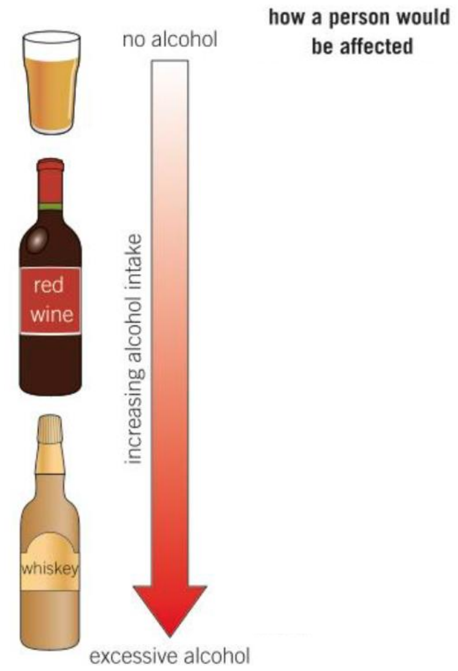
Some examples of medicinal drugs are:

____

____

Complete the sentences and label the diagram showing alcohols effects on the body:

a) Alcohol contains the drug __________
b) It is a ___________ because it slows down the body's reactions
c) People who are addicted to alcohol are called _______________.



Drug addiction is

____
____
____

Symptoms of withdrawal include:

____
____
____

8: Organisms TASK 2

Key words and definitions:

Explain the effects of drinking alcohol during pregnancy:

Explain the harmful effects of the following on the body:

- Tar-
- Nicotine-
- Carbon monoxide-

Describe three examples of smoking-related diseases

1.

2.

3.

8: Organisms
TASK 3

A balanced diet contains the following nutrients. They are needed for… examples of food that contain them are …

- Carbohydrates-
- Lipids-
- Proteins-
- Vitamins-
- Minerals-
- Water-
- Dietary fibre-

Describe the health risks associated with being underweight-

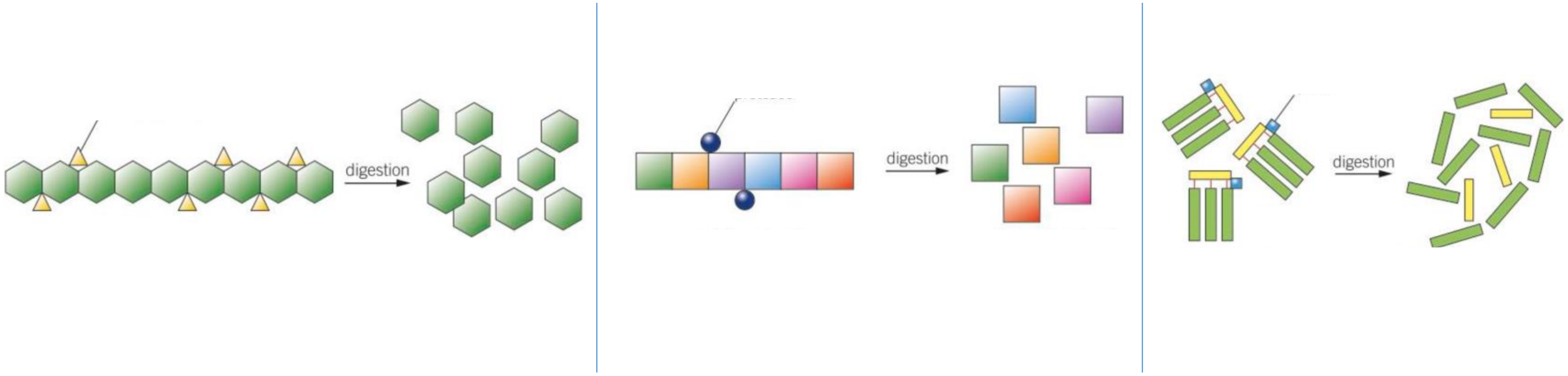
An example of a vitamin deficiency is _____________. It's symptoms include _________________________________ _____________________. An example of a mineral deficiency is _____________. It's symptoms include _________________________________ _____________________.

Describe the health risks associated with being overweight-

Nutrient	Reagents	Method	Colour change if present
starch			
lipids			
sugar			
protein			

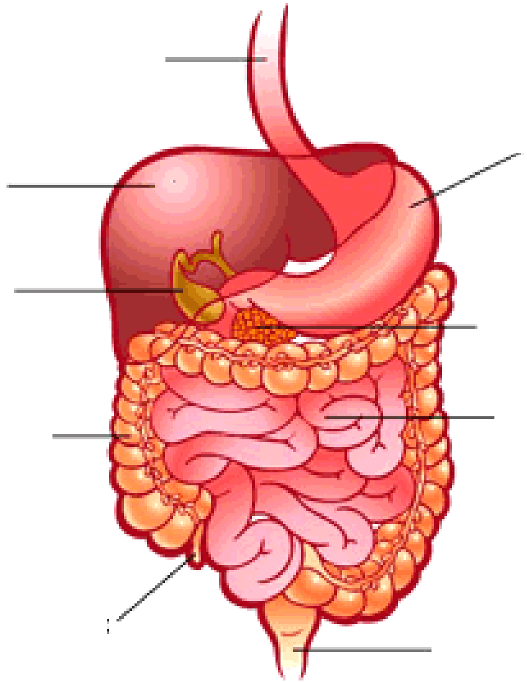
Sketch and label a diagram to show what happens during digestion:

Label and annotate the diagrams showing three classes of digestive enzymes



8: Organisms TASK 4

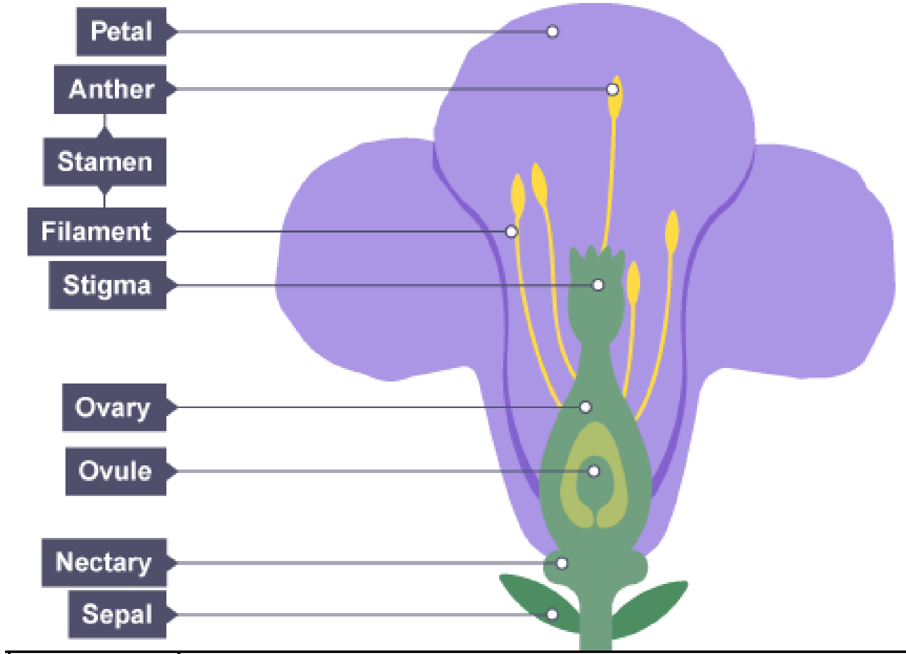
Label the diagram of the digestive system and annotate it to explain the function of the organs



Key words and definitions:

Structure of a flower

The flower is the reproductive organ of many plants



Structure	Function
Sepal	Protects the flower when it is a bud
Petal	These are often colourful to attract insects
Stamen	The male part of the flower (anther and filament)
Anther	Produces male sex cells (pollen)
Filament	Supports the anther
Ovary	Produces female sex cells (ova)
Stigma	Collects pollen grains, this is the top of the female part of the flower

Structure of a flower

Plants reproduce in a process called pollination. Because plants have both male and female reproductive organs , it is possible for a plant to pollinate itself (self-pollination) but this can be problematic as creates little genetic variation between plants.

Cross-pollination is when a pollen from one plant fertilises the ova of another plant. Pollen can be carried between plants by either the wind or insects. Plants have different adaptations depending on the types of pollination they use:

Feature	Insect-pollinated	Wind-pollinated
Petals	Large and brightly-coloured – to attract insects	Small, often dull green or brown – no need to attract insects
Scent and nectar	Usually scented and with nectar – to attract insects	No scent or nectar – no need to attract insects
Number of pollen grains	Moderate - insects transfer pollen grains efficiently	Large amounts – most pollen grains are not transferred to another flower
Pollen grains	Sticky or spiky - sticks to insects well	Smooth and light – easily carried by the wind without clumping together
Anthers	Inside flower, stiff and firmly attached - to brush against insects	Outside flower, loose on long filaments – to release pollen grains easily
Stigma	Inside flower, sticky - pollen grains stick to it when an insect brushes past	Outside flower, feathery – form a network to catch drifting pollen grains

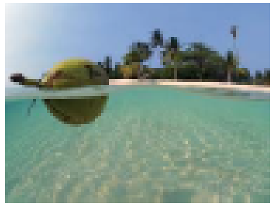
Seed dispersal: When an ova is fertilised by pollen, a seed forms which will eventually grow into a new plant.
However, plants are constantly in competition with one another for:

- Light
- Space
- Water
- Minerals in the soil

To reduce competition, seeds must be **dispersed** (spread away) from their parent plant. There are several method of seed dispersal used by different species of plants.

Water dispersal

- Some seeds are quite spongy so can float.
- They fall off a plant and into water. They are carried by the current to somewhere else and then wash up, allowing them to grow.



Coconut seeds float so are dispersed by water.

Explosions

- Certain seeds are contained in pods. Some of these pods shrivel and become too tight, causing the seeds to burst out of them.
- Others may explode at the slightest touch. When this happens, the seeds are dispersed in different directions.

Pea plants have pods which burst open when ripe, throwing the seeds away from the plant.

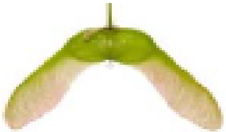
Animal dispersal

- Some seeds are sticky or have small hooks on them to allow them to attach to the skin/fur of animals and get transported.
- Some seeds are held within tasty fruit (the grown ovary) so the animal eats it and the seed passes out at a later date.

Raspberry fruit is eaten and burdock seeds stick to animal fur.

Wind dispersal

- Other seeds are attached quite loosely to the plant.
- With a bit of wind, they become detached and are carried by the wind far away from the parent plant. When they settle, the seed can grow away from the parent plant.



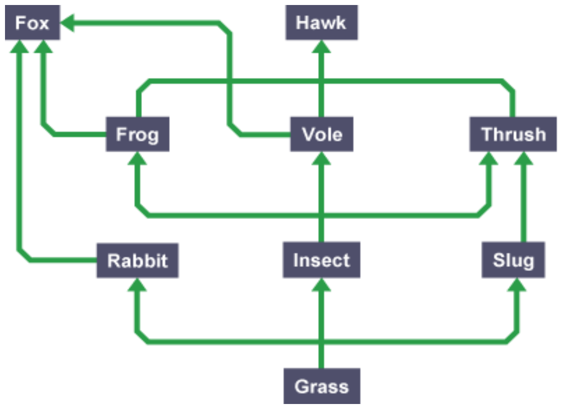
Sycamore and dandelion seeds are dispersed by the wind.

Feeding relationships

A food chain shows the different species of an organism in an ecosystem, and what eats what. Here is an example of a simple food chain:

grass → cow → human

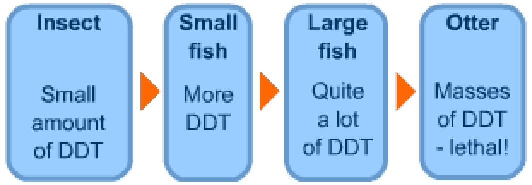
When all the food chains in an ecosystem are joined up together, they form a
food web. Here is an example of a food web:



Factors including changes in the producer, changes in the number of consumers, and the population of pollinating insects all affect the size of populations within a food web.

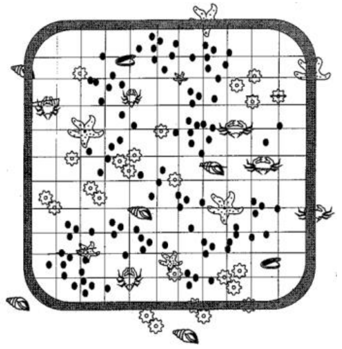
Toxic waste

Some poisonous toxins accumulate in food chains and damage organisms in it, especially predators at the end of the chain because accumulating toxins cannot be excreted.
Examples include mercury and DDT. High levels of mercury can cause damage to the nervous and reproductive systems. DDT causes birds to lay eggs with weak shells.



Term	Description
Environment	All the conditions that surround a living organism
Habitat	The place where an organism lives
Population	All the members of a single species that live in a habitat
Community	All the populations of different organisms that live together in a habitat
Ecosystem	A community and the habitat in which organisms live.
Producer	An organism that makes food – usually a green plant
Consumer	An animal that eats plants or another animal These are divided into: Primary consumer: the first consumer in the food chain Secondary consumer: the second consumer in the food chain Tertiary consumer: the third consumer in the food chain
Carnivore	A consumer that eats other animals
Omnivore	A consumer that eats plants and other animals
Herbivore	A consumer that eats only plants
Predator	An animal that hunts and eats other animals
Prey	An animal that gets eaten by the predator
Interdependence	The name given to the relationship between all organisms in an ecosystem

Sampling



A quadrat (wooden frame) of a known size (e.g. 1m2) is placed several times.
2. Where to put the quadrat should be chosen randomly (by generating co-ordinates using a calculator)
3. Count what is in each quadrat
4. Work out an average number from all of the quadrats
5. Work out the average of the whole ecosystem
e.g. on average there are 20 flowers in 1m2 so in the whole field (1500m) there will be 20 x 1500 = 30,000 flowers

Chapter 9: Ecosystems – TASK 1

Describe how both wind and insect pollination works.

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____
____
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____
____
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Define these words-

Germination –

Fertilisation–

Seed–

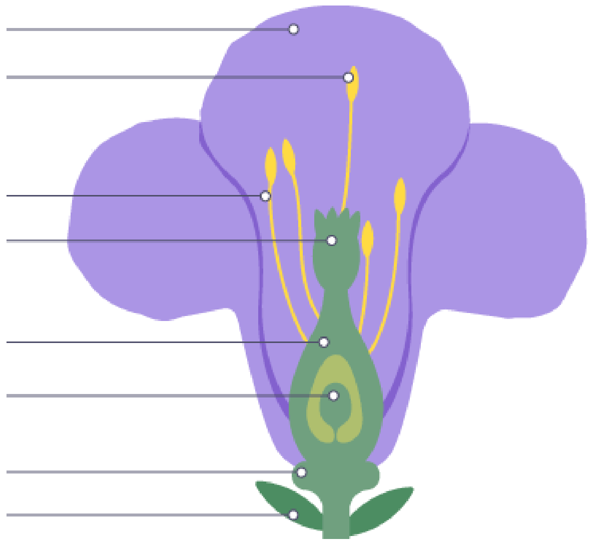
Stigma -

Anther –

Ovary –

Filament –

Label the male and female reproductive organs of this flower.



Structure	Function
Sepal	
Petal	
Stamen	
Anther	
Filament	
Ovary	
Stigma	

Describe the four common forms of seed dispersal below.

Wind Dispersal

____
____
____
____
____

Animal Dispersal

____
____
____
____
____

Water Dispersal

____
____
____
____
____

Explosive Dispersal

____
____
____
____

Food Chain

A food chain shows the different ___________________ of an organism in an ____________________, and what ______what.

Give an example below:

Identify 3 factors that affect the size if populations in a food web.

1)

2)

3)

9: Ecosystems

Task 2

Explain in your own words what a Food web is:

____

____

____

____

____

____

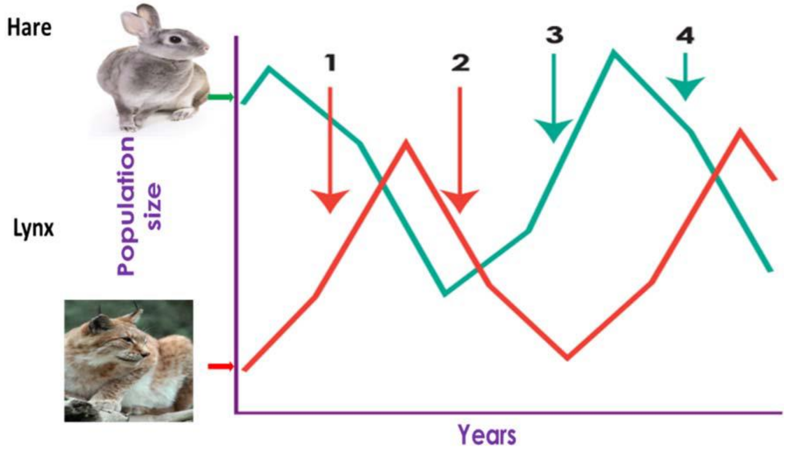
____

____

____

What is a QUADRAT and how is it used?

Competition



Describe the relationship between the Hare and Lynx Population sizes.

____

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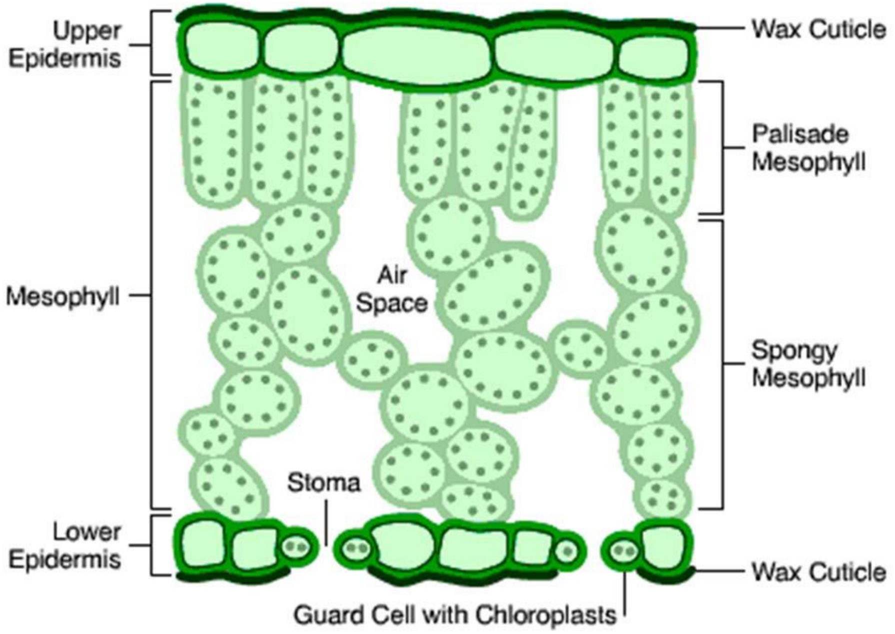
Chapter 9.3 and 9.4 Knowledge Organiser – ECOSYSTEMS

Science Department

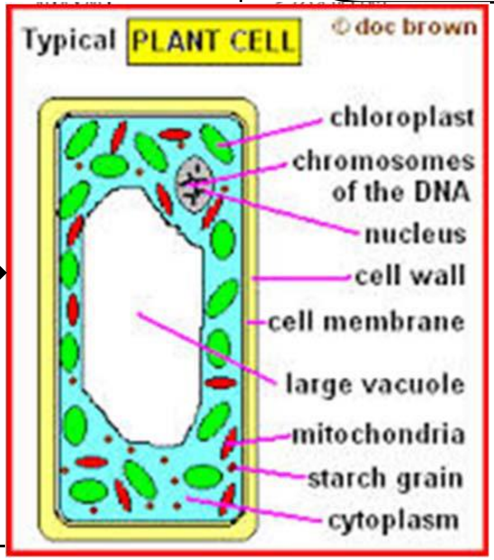
RAINFORD HIGH

Structure of a Leaf



The layers are different *tissues* within a leaf – each has a particular role in this organ (the leaf)

- Upper epidermis: has a waxy cuticle for protection and to prevent water loss.
- Palisade mesophyll: carries out photosynthesis so cells are packed with chloroplasts and cells are arranged upright to use space efficiently.
- Spongy mesophyll: has a large surface area for gas exchange.
- Lower epidermis: has holes called stomata to allow gases to enter and exit the leaf



You need to know what mineral ions a plant needs and what it uses these for:

Mineral	Use	Deficiency symptoms
Nitrate ions (NO_3)	Building proteins and growth	Poor growth and yellow leaves
Phosphate ions (PO_4)	Respiration and growth	Poor root growth and discoloured leaves
Potassium ions (K^+)	Respiration and photosynthesis	Poor flower and fruit growth, discoloured leaves
Magnesium ions (Mg^{2+})	Used to make chlorophyll	Yellow leaves

Proteins are used to make cells

Respiration releases energy used to grow

Respiration releases energy used to grow

Chlorophyll is the green pigment in leaves

Equation for photosynthesis:

Carbon Dioxide + Water $\longrightarrow$ Glucose + Oxygen

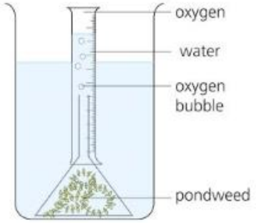
This process takes place in the chloroplasts of plant cells. Light intensity, carbon dioxide concentration and temperature all affect how fast a plant will do photosynthesis.

Photosynthesis Experiments

1) **Testing**

To do this you should first take the leaf you are about to test and, using forceps, place it in a beaker of boiling water to kill it. Then place the leaf into a boiling tube of boiling ethanol to remove all the chlorophyll. Wash the leaf with water to remove the ethanol and soften the leaf, and spread it out on a white tile. Add a few drops of **iodine** solution onto the leaf. If starch is present, the iodine will turn from yellow-brown to blue-black.

1) **Investigating the rate of Photosynthesis**



You can measure how fast a plant is growing by measuring the amount of oxygen it produces in a given time. There are two ways to do this.

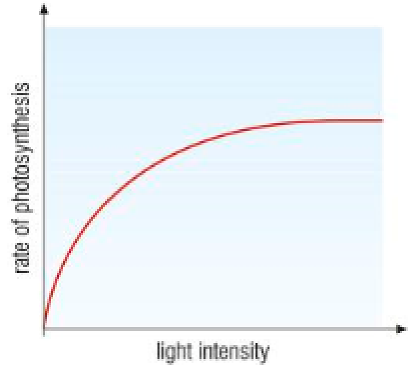
Place an upturned test-tube over an aquatic plant such as pondweed. This will collect the gas given off by the plant. You can then:

- count the number of bubbles given off in a specific time period
- time how long it takes to collect a specific volume of gas.

Limiting Factors

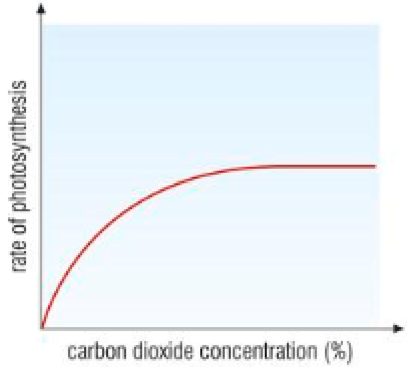
Light

The higher the light intensity, the faster the rate of photosynthesis. It will get faster until photosynthesis reaches its maximum rate. In very low light levels, or if there is no light, photosynthesis stops.



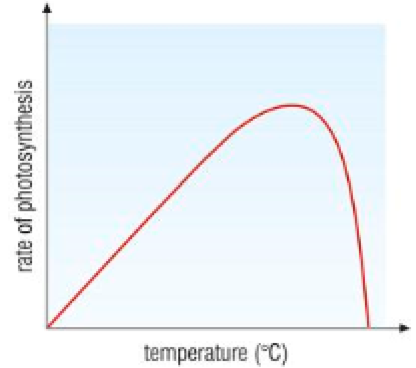
Carbon Dioxide

Carbon dioxide is one of the reactants of photosynthesis. The greater the concentration of carbon dioxide, the faster the rate of reaction.



Temperature

In general, the higher the temperature, the faster the rate of photosynthesis. This is because photosynthesis involves enzymes, which speed up the reaction as the temperature increases. However, at a certain temperature the enzymes stop working, so photosynthesis stops.



Aerobic Respiration

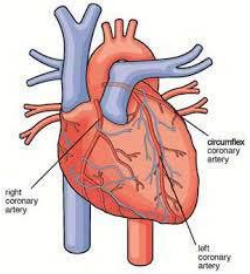
In the mitochondria **aerobic respiration** occurs. This is a reaction that uses **oxygen** to break down glucose into **carbon dioxide** and **water** (which we exhale). This releases energy.

Oxygen (we inhale) + Glucose (from food) → Carbon Dioxide + Water (we exhale) [+ energy]

$$O_2 + C_6H_{12}O_6 \rightarrow CO_2 + H_2O$$

We use this energy constantly to

- keep our bodies warm
- build larger molecules from smaller ones (e.g. building amino acids up into proteins)

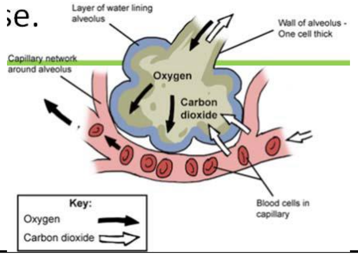


This means that:

• We have to breath more quickly and more deeply to supply our cells with more oxygen.

• Our heart beats quicker to pump blood to the working muscles. Remember, that our blood carries the oxygen and glucose (the reactants for respiration)

• These changes result in a faster rate of respiration and more energy release.



Anaerobic Respiration

During strenuous exercise or a rapid burst of activity the body may not be able to supply the cells with enough oxygen. The cells continue to do respiration but will switch to doing **Anaerobic Respiration.**

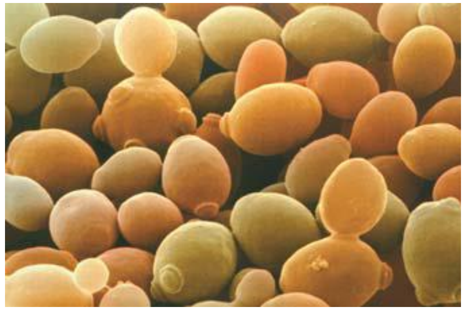
Glucose → Lactic Acid + Smaller amount of energy

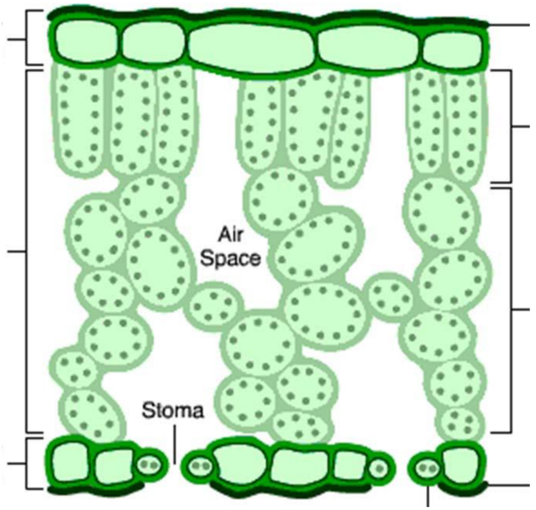
If lactic acid builds up in our muscles this causes cramp.

Fermentation

When a micro-organism called yeast carries out **Anaerobic Respiration** this process is called Fermentation and different products are made. These products are useful in the manufacture of bread and alcohol.

Glucose → Ethanol + Carbon Dioxide + Smaller amount of energy





Complete the Word equation for Photosynthesis:

__________+__________ → __________+_____________

This process takes place in the ________________ of plant cells. ____________ intensity, _____________ ____________ concentration and ________________ all affect how fast a plant will photosynthesise.

9: Ecosystems TASK 1

Mineral Deficiencies – identify the use for each of the minerals below and describe the deficiency symptoms (include a diagram to go with each).

Describe the role of:

Upper Epidermis:

____

____

____

Palisade Mesophyll:

____

____

____

Spongy Mesophyll:

____

____

____

Lower Epidermis:

____

____

____

Nitrate	Phosphate	Potassium	Magnesium

Write a step by step method describing how to carry out a Starch test on a leaf.

A limiting factor is

____

____

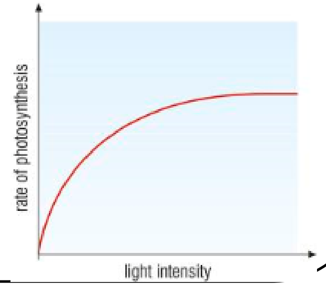
____

____

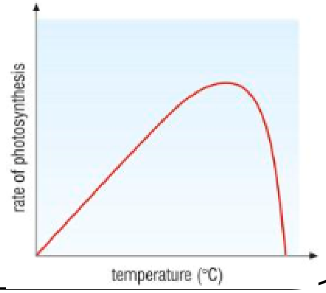
____

9: Ecosystems
TASK 2

Explain what this graph shows:



Explain what this graph shows:



Identify the following when investigating the rate of reaction in pondweed.

Independent variable:

Dependent variable:

Control variable:

AEROBIC Respiration

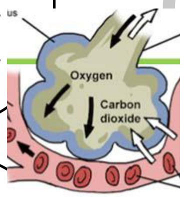
Describe the changes that take place in our body during AEROBIC RESPIRATION

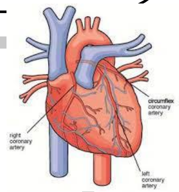
____
____
____
____
____
____
____
____
____
____

Complete the Word/symbol equation for Respiration:

__________+__________ __________+__________

In the ________________**aerobic respiration** occurs. This is a reaction that uses ____________ to break down glucose into ________ __________ and ___________ (which we exhale). This releases ________.





9: Ecosystems

TASK 3

ANAEROBIC Respiration

Describe the changes that take place in our body during ANAEROBIC RESPIRATION

____
____
____
____
____
____
____
____
____
____

Fermentation

When a micro-organism called yeast carries out **Anaerobic Respiration** different products are made.

Identify some examples of products:

1)

2)

3)

Key words and definitions:

Mitochondria:

Lactic Acid

Inhale

Exhale

Amino Acids

Variation

Variation can occur *within* or *between* species.
For example, you may have a different eye or hair colour to your friend. Therefore there is variation amongst the human species.
There is more variation between different species, such as between a human and a dog.
Causes of variation can be genetic (inherited from your parents) or environmental (caused by your surroundings). Here are some examples of the types of variation:

Inherited	Environmental
Blood group	Language
Eye colour	Hair length
Genetic diseases	Weight
Natural hair colour	Tattoos
Skin colour	Scars
Ability to roll tongue	Piercings

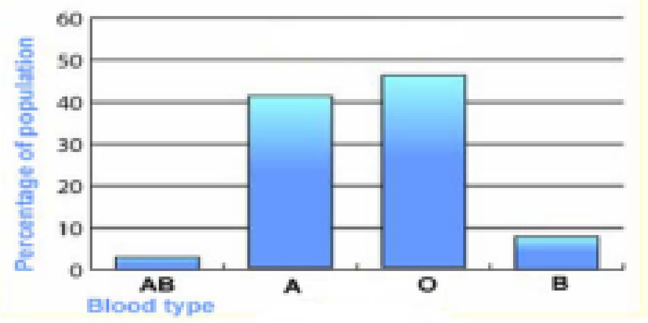
Continuous variation

Continuous variation is when any value is possible within a range.
For example, a person's height can take **any** value between that of the shortest person and of the tallest person in the world.
Other examples of continuous variation include weight, heart rate and hand span.

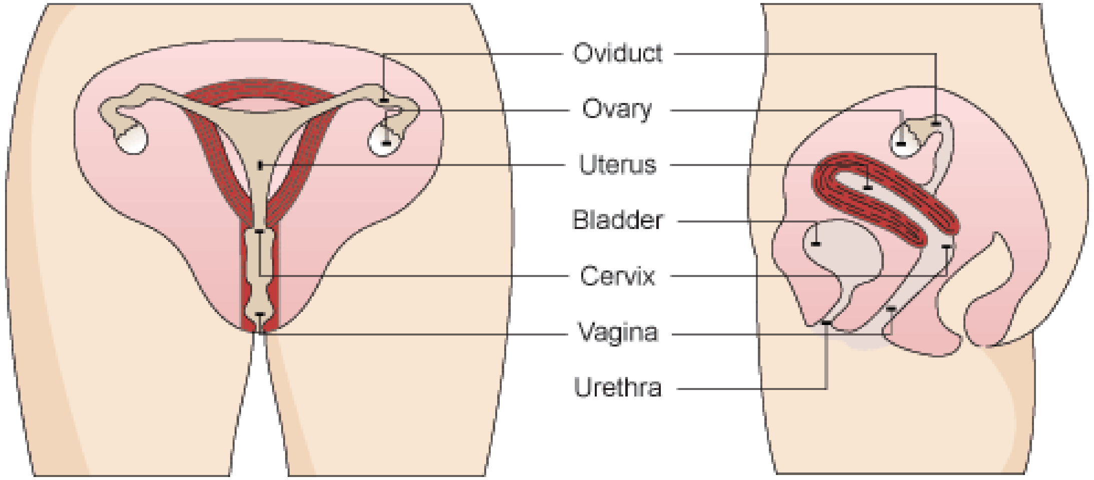
As there is no limit on the value that can occur within a population, continuous variation is often represented with a line graph:

Discontinuous variation

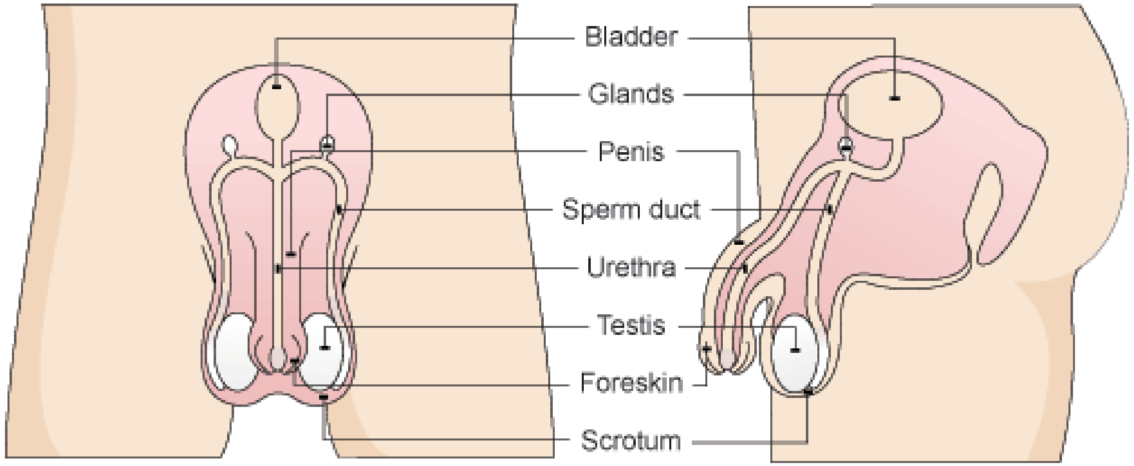
Discontinuous variation is a when a characteristic can only have a certain value. For example, your blood group could only be A, B, AB or O. There is no in between value.
Other examples of discontinuous variation include gender, ability to roll your tongue and eye colour.
A bar chart can be used to represent discontinuous variation:



Female reproductive system



Male reproductive system



Practice: Cover up the labels in the diagrams, can you remember each organ? What about their functions?

Functions of female reproductive organs

Structure	Function
Ovary	Contain undeveloped gametes (sex cells) called ova (or eggs). Every month, an egg matures and is released from the ovary.
Oviduct	Connects the ovaries to the uterus. Their cells are lined with cilia, tiny hairs that help waft the egg along to the uterus.
Uterus	A muscular bag with a soft lining, this is where an unborn baby develops.
Cervix	A ring of muscle which keeps the baby in place while the woman is pregnant.
Vagina	Muscular tube leading from the cervix to the outside of the woman's body. The vagina is where a man's penis enters during sexual intercourse.

Functions of male reproductive organs

Structure	Function
Testes	To produce gametes (sex cells) called sperm. Also makes male sex hormones.
Penis	Passes urine and semen out of the man's body.
Urethra	Tube inside the penis which carries urine and semen.
Sperm Duct	Sperm passes through these and mix with fluids produced by the glands, creating semen.
Glands	Produce fluids to provide the sperm cells with nutrients.

Continuous variation is when any __________ is possible within a _________.
Give some examples:

Discontinuous variation is a when a _________________ can only have a certain ______________.
Give some examples

Sketch a graph to show Continuous Variation

10: Genes
Task 1

Sketch a graph to show Discontinuous Variation

- **Circle the INHERITED characteristics**
- **Underline the ENVIRONMENTAL characteristics**

Tattoo

Ability to roll tongue

Blood Group

Skin Colour

Genetic Disease

Scars

Eye Colour

Language

Hair Length

Chapter 10: Genes – TASK 2

List all the things that can happen during puberty to your body (boy or girl).

Define these words-

Adolescence–

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Intercourse–

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Foetus (Fetus)–

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Gestation-

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Menstruation–

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Contraception–

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Pollination–

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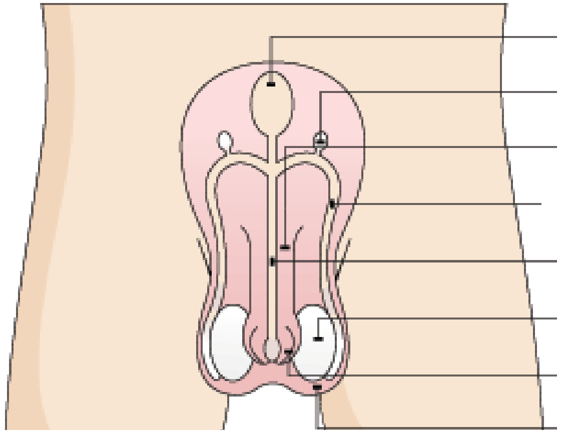
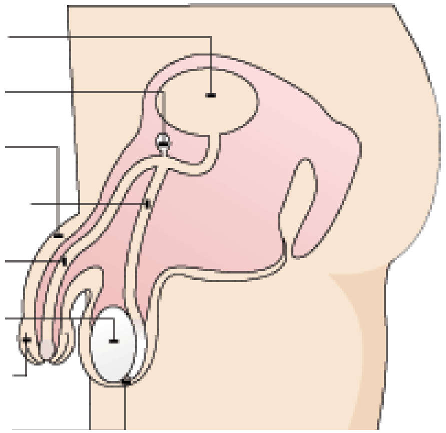
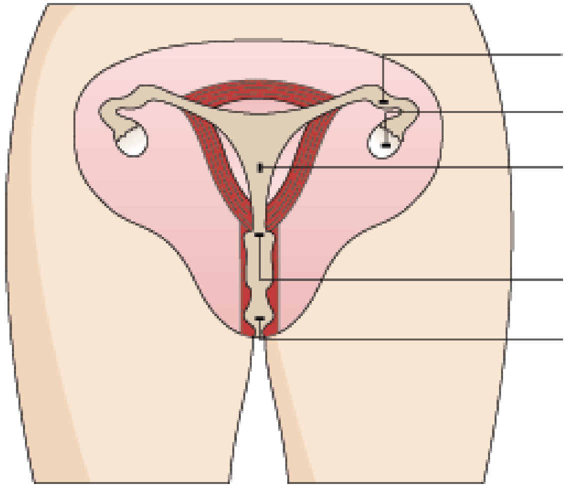
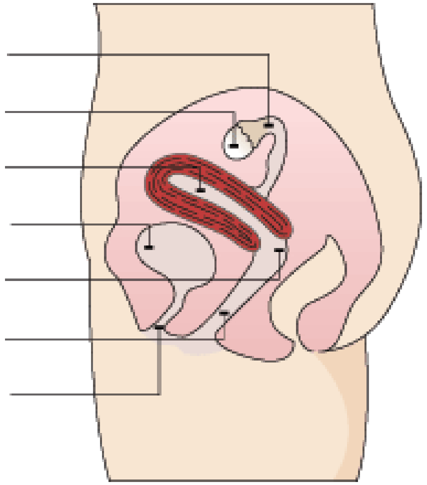
Label the male and female reproductive organs.









Explain where a baby grows and the stages of development it goes through and at what times.

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What happens during intercourse and how do sperm reach the egg?

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Explain in detail what the Menstrual cycle is and what days things generally happen.

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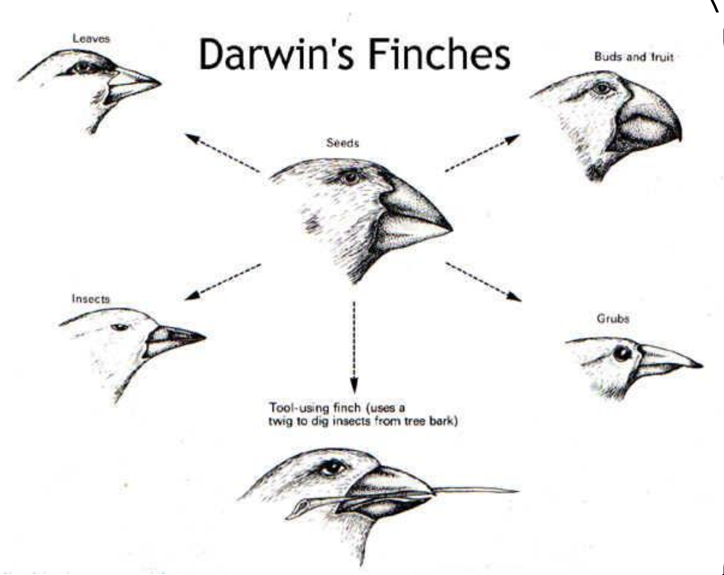
Chapter 10.3 and 10.4 Knowledge Organiser - GENES

Science Department

RAINFORD HIGH

Charles Darwin observed variation in the shape of beaks of finches on different Galapagos islands. The different shapes allowed the birds to access different food sources.



Term	Description
Species	A group of individuals that are physically similar that can produce fertile offspring
Variation	The presence of differences between living things of the same species
Competition	Interaction between groups of organisms seeking to access limited supplies of factors required for life e.g. light, space, food
Natural selection	A process that causes populations to change over time.
Evolution	The change in species over long periods of time
Gene	The basic units of genetic material inherited from our parents. A gene is a section of DNA which controls part of a cell's chemistry - particularly protein production.

Charles Darwin's work was checked by other scientists this is called PEER REVIEW

Natural selection

A theory proposed by Charles Darwin to explain evolution . It states that:

- Individuals in a species show a wide range of variation.
- Inherited variation is due to differences in their genes.
- Individuals with the features that are best suited to the environment are more likely to survive and reproduce.
- The genes that allow these individuals to be successful are passed to their offspring.
- Individuals that are poorly adapted to their environment are less likely to survive and reproduce. This means that their genes are less likely to be passed to the next generation.
- Over many generations these small differences add up to the new evolution of species.
- Given enough time, a population may change so much it may even become a new species, unable to reproduce successfully with individuals of the original species.

What causes extinction?

A species becomes extinct when there are no more individuals of that species left. Changes in the environment may leave individuals less well adapted to compete successfully for resources such as: food, water and mates.

Some of the changes in the environment that can cause a species to become extinct are:

- a new disease
- a new predator
- a change in the physical environment, such as climate change
- competition from another species that is better adapted, including
- competition from humans.

How can we maintain biodiversity?

Conservation measures of endangered animal species such as:
education programmes captive breeding programmes legal protection and protection of their habitats making artificial ecosystems for them to live in
Some plant species are also endangered.

Term	Description
Biodiversity	The range of animals and plants in a given area.
Endangered species	Animals that are close to extinction because of their low numbers.
Gene bank	A store of genetic material such as sperm, embryos or seeds

What is a seed bank and what is it used for?

Conservation measures for plants. Seeds are carefully stored so new plants can be grown in the future. Seed banks are an example of a gene bank. Gene banks are increasingly being used to preserve genetic material for use in the future. A cryobank is another type of gene bank. Embryos, sperm or eggs are stored at very low temperatures in liquid nitrogen (which is at a very chilly –196 °C). They can be thawed out later for use in breeding programmes

Why is biodiversity important?

Biodiversity is essential in maintaining environments, feeding relationships and providing sources of medicines and other scientific opportunities to support life on Earth.

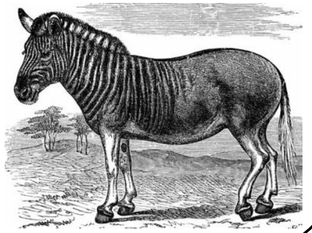
Importance	Example
Food	Fish, wheat etc.
Medicines	Morphine from opium poppy
Raw materials	Wood, cotton etc.
Recreation	Hill walking, diving etc.
Genetic material	Disease-resistant crops

Conservation measures

An endangered species is at risk of becoming extinct. For example, the panda and gorilla are endangered and may become extinct. A species can become endangered for several reasons, including:

the number of available habitats falls below a critical level
the population of the species falls below a critical level

For example, the South African quagga was a type of zebra that became extinct because of hunting. The last wild quagga was shot in the late 1870s. However, a lone female quagga later died in a zoo in Amsterdam in 1883, the last of her species.

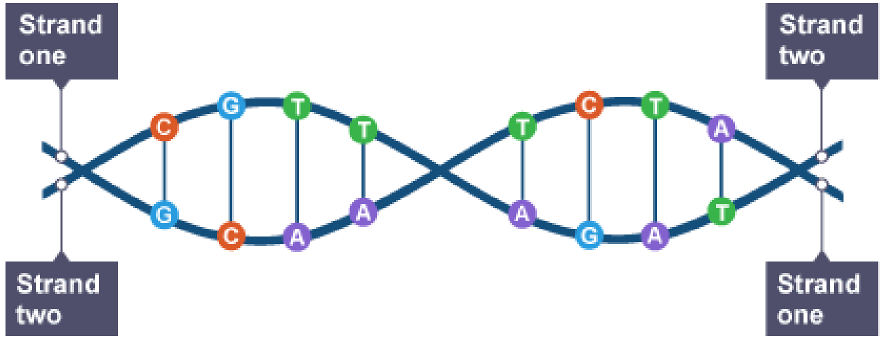


Structure of DNA

Genetic information is passed from one generation to the next. This is called **heredity** and why we resemble our parents. The genetic information is in molecule called **DNA** . Scientists worked out the structure of DNA in the 1950s.

Name	What they did
Rosalind Franklin	Made X-ray diffraction images of DNA
James Watson & Francis Crick	Used information from one of Franklins images to work out a model for the structure of DNA
Maurice Wilkins	Supported their model

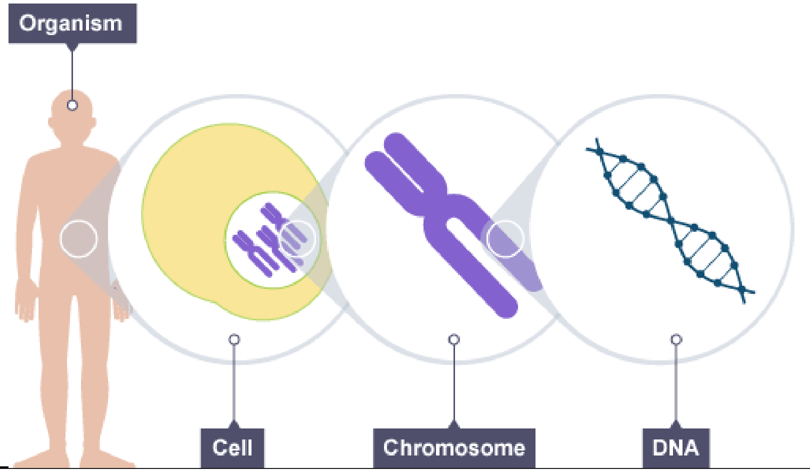
Watson, Crick and Wilkins were awarded the 1962 Nobel Prize in Physiology or Medicine for their discovery. Franklin had died before then and so could not be awarded it with them.



- there are two strands
- the strands are twisted around each other to form a double helix
- the strands are held together by bonds between base pairs

Chromosomes, DNA and genes

The DNA in all of your cells is approximately two metres long. Because it is so long it is very thin and coiled into structures called **chromosomes**. The chromosomes are found in the **nucleus** of each cell.

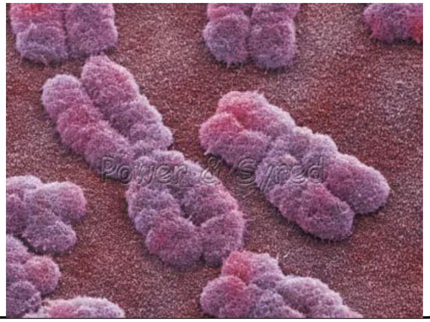


The heredity process

Human body cells each contain 23 pairs of chromosomes, half of which are from each parent. So, human **gametes (eggs and sperm)** each contain 23 chromosomes. When an egg is fertilised by a sperm, it becomes a cell with 23 pairs of chromosomes. ***This is why children resemble both their parents – half of their chromosomes and DNA come from their mother, and half from their father.***

A **gene** is a section of DNA that is responsible for a characteristic like eye colour or blood group. DNA makes up genes, which makes up chromosomes.

One copy of all your chromosomes is called your **genome.**

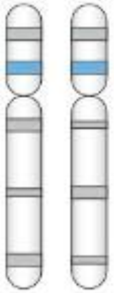


Alleles

For each characteristic, like blood group or eye colour, you have two genes. One gene is inherited from your mother, and one from your father. These two genes may be the same, or different. Different forms of the same gene are called **alleles**.

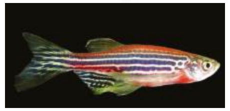
Some alleles will always produce a characteristic in an organism. These are called **dominant** alleles. You only need one copy of a dominant allele for the characteristic to appear in the organism. This allele is said to be 'expressed' in the organism.

The allele for blue eye colour is a **recessive** allele. You need two copies of a recessive allele for the characteristic to be expressed in the organism.



Genetic Modification

Scientists are now able to alter an organism's genes to produce an organism with desired characteristics. For example, crops can be produced that are resistant to disease. This is called **genetic modification** (or genetic engineering).



Punnett Squares

Scientists use a **Punnett square** to show what happens to the alleles in the genetic cross. In this example, a mother with blue eyes (bb) is crossed with a father with brown eyes (BB).

Mother: blue eyes

bb

eggs b b

Father: brown eyes

BB

sperm B B

A sperm and egg cell only contain one copy of each gene.

A Punnett square is actually a simple table. To produce a Punnett square, put the possible alleles from one parent across the top of the square, and the alleles from the other parent down the side.

Father

		B	B
Mother	b		
	b		

Use the square to work out the possible combinations of alleles in the offspring.

Father

		B	B
Mother	b	Bb	Bb
	b	Bb	Bb

In this example, all offspring produced will have brown eyes. This is because the dominant allele is present in all possible combination of the parents' alleles.

Offspring = 100% Brown eyes (This could be written as a ratio, percentage or fraction.)

Genetic engineering has some potential advantages, such as being able to produce organisms with desired features quickly. On the other hand, it has some potential risks, for example, the inserted genes may have unexpected harmful effects.

There are ethical issues involved in genetic modification. For example, some people are concerned about the health risk of genetically modified food. Others think it is wrong to create new life forms, or to move genes between different species, especially if this causes harm.

Complete the flow diagram explaining the stages in Natural Selection.

What is the evidence for natural selection and evolution?:

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10: Genes
TASK 1

Explain the importance of Charles Darwin's work and why it was an example of peer review:

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Case study: The peppered moth
The peppered moth is often used as a case study for explaining natural selection. Complete the case study…

List some causes of extinction:

List some species that have become extinct (E) and some that could become extinct soon (S)

Key words and definitions:

Explain why it is important to preserve biodiversity:

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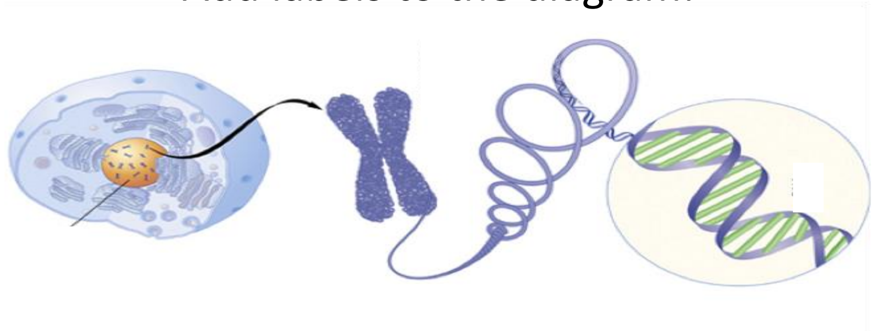
10: Genes
TASK 2

Explain how conservation helps to preserve biodiversity:

Explain how captive breeding helps to preserve biodiversity:

Explain how gene banks help to preserve biodiversity:

Add labels to the diagram:



Describe the three main features of DNA:

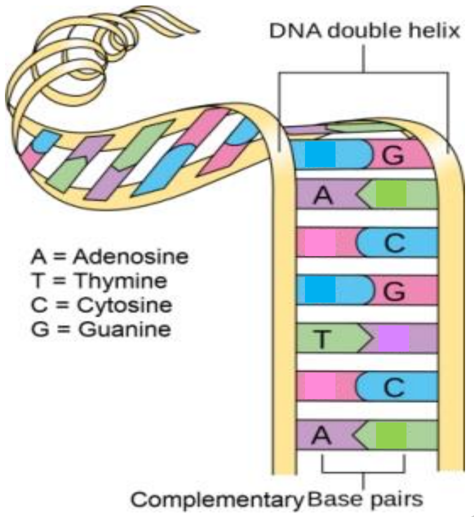
1. ______________________________________
____
2. ______________________________________
____
3. ______________________________________
____

Make a list of the scientists involved in the discovery of DNA. Rank them in order of who you think made the most important contribution:

Add labels and annotations to the diagram showing what happens during fertilisation (you should include information about the chromosomes):

10: Genes
TASK 3

Complete the complementary base pairing in the diagram:



Draw and label a diagram showing a pair of recessive alleles.

Describe one method of genetic modification:

Key words and definitions:

Allele:

Dominant:

Recessive:

Punnet Square:

10: Genes
TASK 4

Describe some advantages and disadvantages of genetic modification:

Complete the following Punnet squares.
Describe the ratio of Brown: Blue eyes

	B	**B**
b		
b		

	B	**b**
b		
b		

	B	**b**
B		
b		