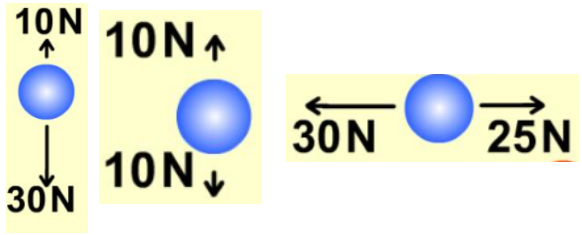
1. Why is it harder to stop larger, faster objects?
Moving objects have **momentum**. Larger and faster objects have more momentum and so it's is more difficult to stop them or change their direction.
For example, a lorry at 30mph has much more momentum than a motorbike at 10mph

2. What can forces do?
Forces are pushes pulls that are measured in Newton's (N).
Force can change an object speed, direction or shape. Forces are also required to start and stop the movement of an object.
If we apply a bigger force to an object, we will see a bigger change to it.

3. What is the name of that force?
Contact force- a force that requires contact between two objects to act
e.g., Upthrust, friction, air and water resistance
Non-contact force- a force that can act at a distance without contact
e.g., magnetism, static , weight

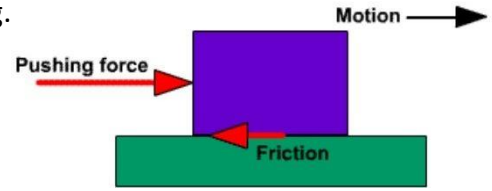
4. How can we represent forces on a diagram?
We use arrows to represent forces. The size of the arrow shows the size of the force and the direction of the arrow shows the direction of the force.



5. How big is the force?
We can measure the size of a force using a Newton meter

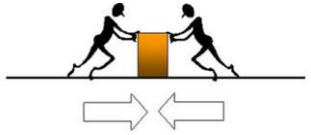
Big idea 1- Forces
Stage 1

6. What is friction?
Friction is a force that acts in the opposite direction to motion.
Friction occurs due to microscopic bumps in surfaces making it hard for objects to slide past one another.
We can reduce friction using a lubricant such as oil.
Frictional forces act on stationary objects, preventing them from moving.

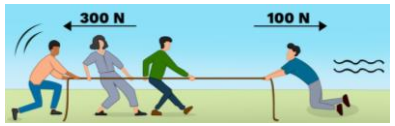


7. How many forces are acting?
Forces always act in pairs in opposite directions to each other

8. Balanced or unbalanced force?
If a pair of forces are the same size they are said to be **balanced.**

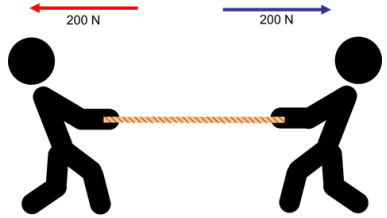


If a pair of forces are different sizes they are said to be **unbalanced.**



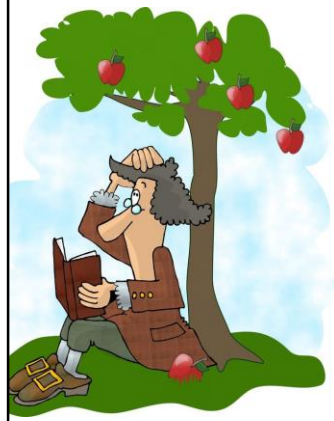
9.Resultant force is the overall force acting on a object.
Resultant force = larger force – smaller force

Resultant force = 300 – 100
Resultant force = 200N Left



Resultant force = 200 – 200
Resultant force = 0 N

10. How does the resultant force affect an object?
If the forces acting on an object are **unbalanced** it is either changing speed, direction or shape
If the forces acting on an object are balanced it is either stationary (not moving) or moving at a steady speed (a speed that is not changing.)



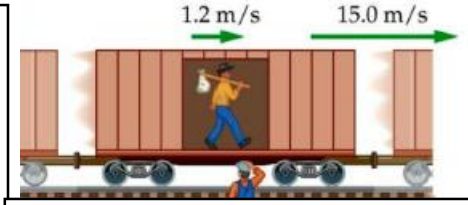
Big idea 1- Forces
Stage 2

1. What is speed?

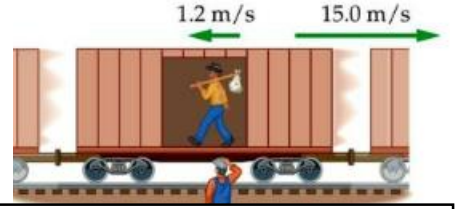
Speed is a measure of how far an object travels in a given time.
If an object is traveling at a faster speed, it can travel further in the same amount of time.
The units for speed in science are m/s (meters per second) this tells us how many meters an object can move in a second.
The equation to calculate speed is….
Average speed = Distance ÷ Time

2. What is relative motion??

Relative motion is when we compare the speeds of two objects. We calculate relative motion differently depending on if the objects are moving towards or away from one another
Relative motion for objects moving in the same direction = Speed 1- Speed 2
Relative motion for objects moving in opposite directions = Speed 1 + Speed 2



Relative motion = 15- 1.2= 13.8 m/s



Relative motion = 15 +1.2= 16.1 m/s

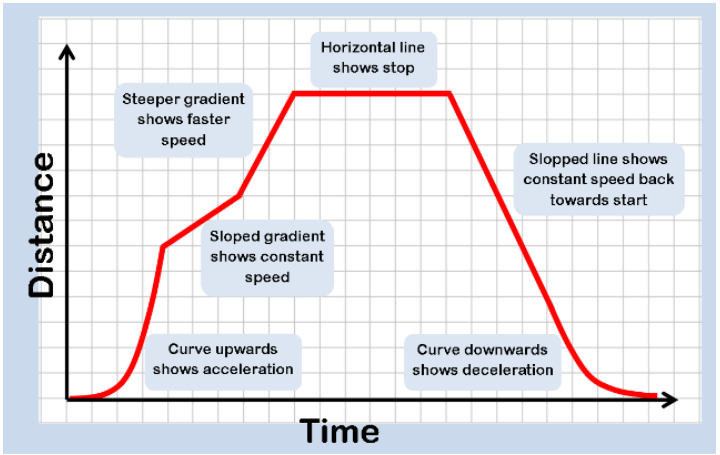
3. What is average speed?

Objects do not travel at a **constant speed** for a whole journey. At the start of any journey, an object is at 0m/s and must increase its speed. At the end of a journey, an object must slow back down to 0m/s. The term **average speed** describes the steady speed an object could travel at to complete the same journey in the same amount of time.

4. What is acceleration?

Acceleration –Change in speed
Positive acceleration – Increase in speed
Negative acceleration or deceleration – slowing down

5. How can a journey be represented on a graph?

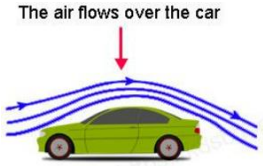


6a. What is drag?

Friction also acts when an object moves through liquids **(water resistance)** or gases **(air resistance).** These forces are known as **drag.**
Drag occurs as the object slides past the particles in the gas or liquid.
Liquids are **denser** than gases and so the object must slide past more particles. This makes drag in liquids bigger than in gases.
When an object travels faster it comes into contact more particles causing a larger drag force.

6b. What is drag?

Drag can be reduced through streamlining. This is when we shape objects in a way that allows the air to move smoothly over the object.



7. How do forces affect motion?

Objects **accelerate** when the forward force is bigger than the drag force. (unbalanced)
Objects **decelerate** when the drag force is bigger than the forward force**.** (unbalanced)
Objects move at a **steady speed** when the forward force and frictional force are equal, (balanced)

8. How does a parachute allow a safe landing? The forces acting on a skydiver change during the jump.

1. Weight is bigger than drag so the diver accelerates (unbalanced forces)
2. Drag increases and so the acceleration slows (unbalanced forces)
3. Drag and weight become equal and so the diver moves at a steady speed. (balanced forces)
4. The parachute opens and drag increases to be bigger than weight so the diver decelerates. (balanced forces)

Big idea 2- Energy Stage 1

1. What is an energy store?

Kinetic store of energy – Contained in moving objects

Chemical store of energy – Contained in chemicals found in food, fuel and batteries

Thermal store of energy –when the temperature of a material increases, so does the amount of energy in the thermal store

Gravitational store of energy – Contained in objects that are high off the ground

Elastic store of energy – Contained in an elastic object that is stretched or compressed

2. How is energy transferred?

Energy cannot be made or destroyed but it can be transferred from one store to another.

For example.

Wind-up toy elastic store -> kinetic store of the car

Battery-powered fan Chemical store of the battery -> Kinetic store of the fan

Ball rolling down a slope Gravitational store -> Kinetic store of the ball

Hot water cooling Thermal store of the water -> Thermal store of the air/surroundings

3. How much energy is in food?

We measure the amount of energy in a store using the unit **Joules (J)**

1 Kilojoule (KJ) = 1000J

We can burn food and use the thermal energy released to heat up a set **volume** of water.

We can get an idea of how much energy is stored inside the food by measuring the temperature increase of the water with a **thermometer.**

4. How do humans use the energy that is stored in food?

Humans use the energy stored in food to do **work.**

Work is done when a force is applied to move an object a distance.

We can calculate work done using this equation

Work done (J) = Force (N) x Distance (m)

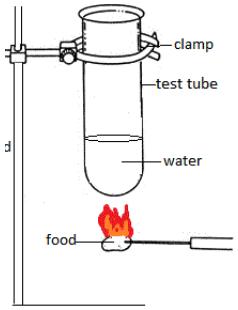
5. How is energy transferred in a spring?

Springs do work when they are stretched or compressed. Work being done on a spring results in a increase in the elastic energy store inside the spring.

The bigger the force applied to a spring the further is moves and so the more work is done.

8. How much energy do appliances need?

Appliances transfer different amounts of energy from the **mains.** Each appliance has a **power** rating in **Watts (W). Power is a measure of how much energy an appliance transfers every second. Energy transferred to the device (J) = Power of the device (W) x time the device is used for(s).**



6. What is a non-renewable energy resource?

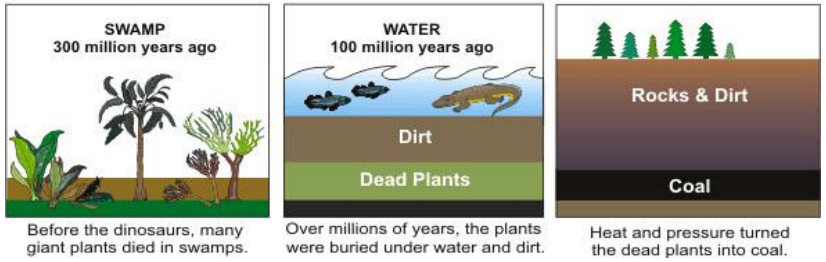
The original source for much of the energy in the home comes from **coal, crude oil, and natural gas**. These are known as **fossil fuels**. Fossil fuels are **non renewable-** this means they are used at a faster rate than they can be made and so are at risk of running out.

7. How is the energy stored in fossil fuels obtained?

Energy for the home is generated in a **Power Station.**

1. Fuel burns and used to heat water
2. Steam created
3. Steam turns turbine
4. Generator generates electricity

HOW COAL WAS FORMED



9.What is a renewable energy resource?

Renewable energy sources are ones that can be replenished. Examples include wind, solar, hydroelectric, and biomass. Each energy resource has advantages and disadvantages.

Solar and wind- unreliable, expensive to set up

Solar, wind, and hydroelectric – do not produce pollutant gases

Wind- noisy, unsightly

Hydroelectric- building dams is expensive, large areas that are inhabited by plants, animals, and humans may need to be flooded.

Biomass- requires lots of land to crop

Coal, crude oil, and natural gas – produce pollutant gases but are reliable

Crude oil- often carried in ships or pipes under the sea, if oil is spilled this affects plants, animals, and humans.

Big idea 2- Energy Stage 2

1. How do machines do work?
We can rearrange the work done equation to get the following equations.

Work done (J) = Force (N) x Distance (m)

Force (N)= Work done (J) ÷ Distance (m)

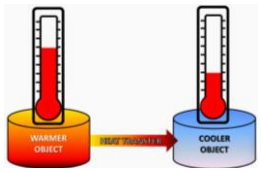
Distance (m) = Work done (J) ÷ Force (N)

To convert from KJ to J we must x 1000.

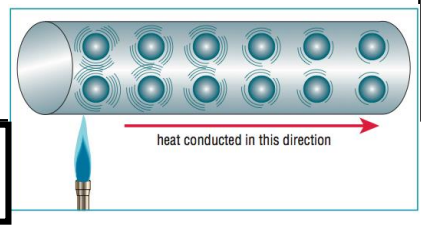
2. How does heating affect particles?
When particles are heated they gain more energy in the kinetic store. They move more, pushing away from one another and making the gaps between them larger. This causes the **volume** (space the matter takes up) to increases.
Temperature is an indicator of the average speed of the particles in a substance.

3. What is the difference between thermal energy and temperature?
The units for temperature in the UK are **(°c) degrees Celsius.**
Body temperature = 37°c,
Boiling point of water =100°c,
Freezing/melting point of water = 0°c
The amount of energy in the thermal store of a material is dependent on its temperature and its mass.

4. How does energy move?
When materials of differing temperatures come into contact energy always moves from warmer to cooler objects.
The bigger the difference in temperatures the faster the transfer occurs.
This energy transfer will continue until the material reaches the same temperature as the environment, the term for this is **thermal equilibrium.**

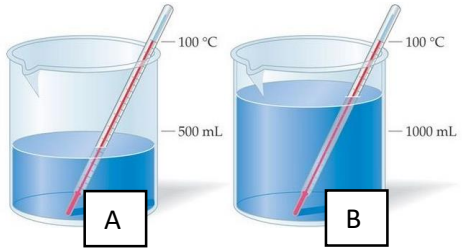


5. How is energy transferred by conduction?
Some materials are good **conductors** –They allow heat to travel through them quickly e.g. metals
Some materials are **insulators** – Heat travels through them slowly e.g. wood, plastic
In conduction
-The particles closest to the heat source gain energy and vibrate more
-The particle collides with neighbouring particles, passing energy along and causing them to vibrate more.
Solids are the best conductors.



6. How can insulators be used to slow down energy transfer?
Materials that contain pockets of trapped gases such as wool and fluff are good insulators. Gases are poor conductors of heat as the particles are further apart. This slows down the energy transfer.

B contains more thermal energy as there is a bigger mass of water



7. How does the sun heat the Earth?
Heat from the sun is transferred to the Earth**.**
Space is a vaccum (an area with no particles) and so conduction is not used to heat the Earth.
The sun heats the Earth via **radiation.** This is when waves of infra red radiation are emitted from the sun and hit the Earth and warm it.

8. How is energy wasted?
During energy transfers energy is often wasted into the surroundings as light, heat or sound.
Whenever a drag force is acting, small amounts of energy are wasted as heat as particles in the air or liquid come into contact with the moving object. This wasted heat is usually too small to notice.

9.How much energy is transferred?
During energy transfers energy is always conserved
Energy input = Energy output

10. How do we reduce wasted energy in the home?
People reduce heat loss from the home using insulation. People want to reduce heat loss from the home to save money on fuel bills.
Double glazing, curtains, carpets, loft insulation, and radiator foil are all methods of insulation that reduce the amount of heat lost in the home.
Most insulation methods trap pockets of air

Practical knowledge
A **hypothesis** is an idea about how something works that can be tested using an experiment.
We **repeat investigations** 3 x and calculate a mean. We repeat an investigation 3x to allow us to spot **unexpected results**.

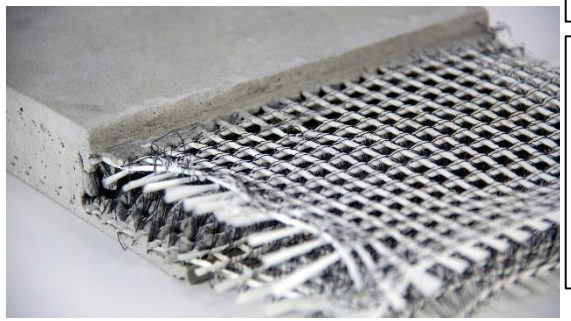
Big Idea 3
Matter Stage 1

1. What are the properties of metals?
Matter is any substance that takes up space and can be categorised as either metals or non-metals. Different materials have different properties which are characteristics that help us to identify it.

Physical properties can be observed without changing the material into something new. For example; shiny, hard, malleable, conductors of heat and electricity and density.

2. What groups of non-metal matter exist?
The 2 types of non-metal matter that need to be known are ceramic and polymers. Ceramics are made from clay and is hardened by heat. They are hard, brittle, poor conductors of heat and do not conduct electricity.
Polymers are man-made from crude oil. They are strong, poor conductors of heat and do not conduct electricity.

3. What are composite materials?
Composites are materials made up of more than one type of material. Composites are designed for a purpose and take on the properties they are made from.



4. What are the properties of matter in the solid or liquid state?
Properties of solids include:
- Fixed shape
- Cannot flow
- Cannot be compressed

Properties of liquids include:
- Take the shape of the container
- Can flow
- Difficult to compress

5. What is matter made from?
Scientists have a theory that matter is made from particles, which are tiny spheres that are too small to see. This theory is called the particle model of matter. In the solid state; particles are arranged in a regular pattern, tightly packed and vibrate in a fixed position. In the solid state, there are strong forces of attraction between the particles. This is a non-contact force.

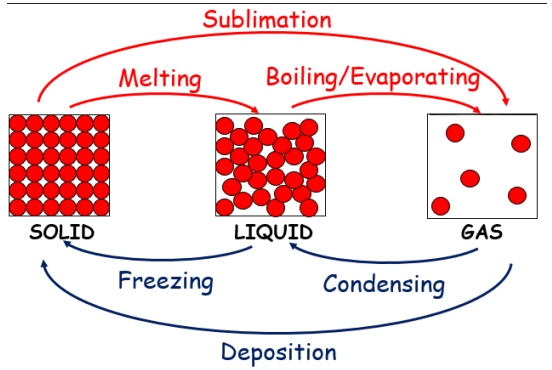
6. How does the arrangement of particles change when materials in their solid state are heated?
When a solid is heated, it melts and turns into a liquid. In the liquid state, particles are not arranged in a regular pattern, are still touching but not bound tightly and are able to move over one another.

7. Why does the arrangement of particles change when materials in their solid state are heated?
Energy is transferred when a state change occurs. When a solid is heated, the energy is transferred from the thermal store to the kinetic store of the particles. The particles vibrate more, with enough energy that they can overcome the force of attraction that hold them together. Different matter melts at different temperatures. For water, this occurs at 0 °C.

8. What happens if we continue to heat matter in the liquid state?
Matter in the gaseous state will flow to take the shape of the container, can increase in volume to fill a container and can be compressed. Gases can be compressed because there is empty space between the particles. In a gas, the particles move quickly in random directions.

As liquid matter is heated, particles gain more kinetic energy and vibrate more. The particles are pushed away from each other with a force bigger than the force of attraction holding them together. This pushes the particles away from each other.

9. What happens if we cool matter down?
State changes are physical changes. No new substance is made so it is reversible, the arrangement and movement of the particles is the only thing that changes.



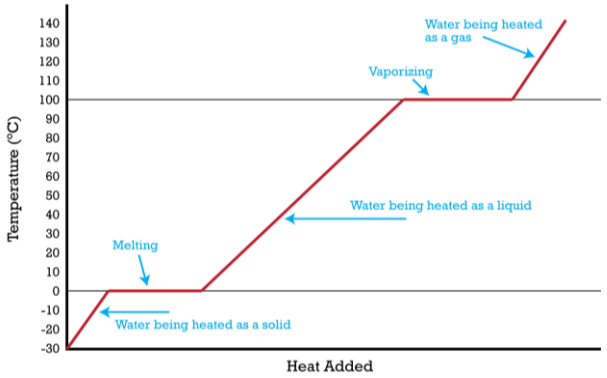
10. In which state is matter the densest?
Mass describes how much matter something is made from and is measured in kilograms (kg). When there is a state change, the volume of a substance changes. Density is a measure of how heavy something is for its size, where solids are the densest as there are more particles packed in a smaller volume.

11. Are all particles the same?
The smallest type of particles that exist are called atoms. There are 118 different types of atoms found on the periodic table. Atoms have names and symbols, usually 1 or 2 letters linking to the atoms name. The first letter is always a capital. Everything is made up of atoms.

Big Idea 3
Matter Stage 2

1. At what temperature do state changes occur?

State changes occur over a period of time and during this time, the temperature of the matter does not change. This happens for melting and evaporating. Different types of matter melt and boil at different temperatures. There is a variation due to the strength of the force of attraction.

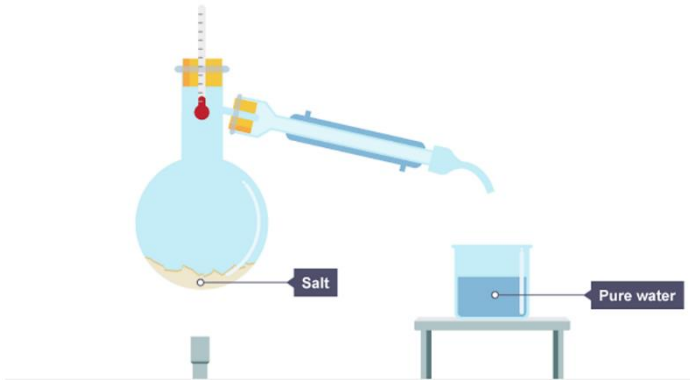


2. What is a pure substance?

A pure substance contains only one type of atom or compound. If matter is made up of more than one type of atom or compound, it may be a mixture. This would be impure.

3. How can we test to determine if a sample is pure or a mixture?

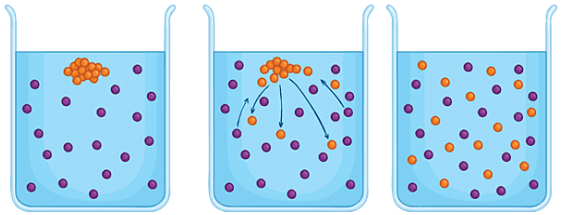
Pure substances melt or boil at exact temperatures whereas impure substances melt or boil over a range of temperatures. This is how we can determine if a sample is pure or not. Therefore, state changes in impure substances occur over a range of temperatures due to the forces of attraction.



4. What is a solution?

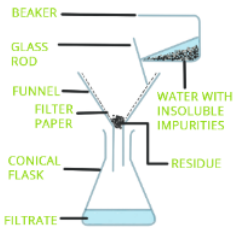
Some solids will dissolve when they are added to a liquid. Solids that can dissolve are called soluble and solids that cannot dissolve are called insoluble. We say a substance has dissolved when we can no longer see it in the liquid. Some solids may be insoluble in water but soluble in other solvents. For example; nail varnish.

Definitions:
Solute – Solid that dissolves
Solvent – Liquid that the substance dissolves in
Solution – Created after dissolving has occurred



5. How can we remove insoluble substances from liquids?

Insoluble substances can be removed from liquids using filtration. Liquid passes through the filter paper and the insoluble material is left in the filter paper as the residue. This is because filter paper has small holes allowing liquid to pass through.



6. Where does the solute go?

The total mass of a solution is the total mass of the solute and the solvent. In a solution, the solute particles are widely spaced out in the solvent particles meaning we can no longer see it. Dissolving can be speeded up by heating or stirring to separate the particles more quickly.

7. How can we separate solutions using chromatography?

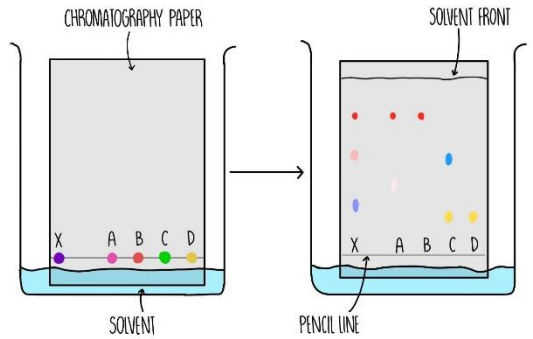
Some solutions can contain more than one solute. For example; inks and dyes. Chromatography is a technique used to separate mixtures of soluble substances and identify the components of the mixture. The solvent carries the solute up the paper separating the mixture out. The start line must be drawn in pencil as it is insoluble in water.

8. How can we separate solutions using evaporation?

When a solution is heated, the solvent evaporates but the solute is left behind. Therefore, this can separate a solution leaving the dissolved substance in the container.

9. How can we separate solutions using distillation?

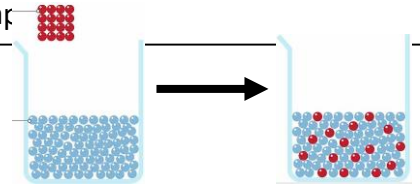
When we want to separate a solution and be left with the solvent, distillation should be used. For example; if you want to get pure water out of salty water. Distillation evaporates the solvent and then cools and condenses it back into the liquid state.



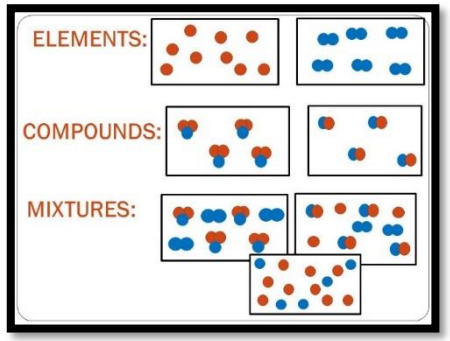
Big Idea 4 Chemical Reactions Stage 1

1. Are there different types of particles?

A **physical change** is when the particles themselves do not change only their arrangement. Examples of a physical change are dissolving and evap



Particles are made up of atoms. An **element** is made up of one type of atom. A **molecule** is more than one atom joined together. A **compound** is when different types of atom are joined together. A **mixture** is two or more substances not joined together.



4. How do we show what's happening in a chemical reaction?

New substances are formed in a chemical reaction. The starting materials are known as **reactants** and the chemicals formed are known as the **products**. When we write chemical equations they are wrote as so:

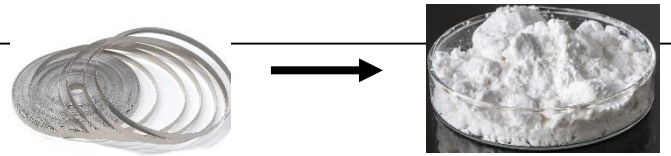
Reactants → Products

If there is more than one reactant or product, we write them with a + between them as they are coming together. We also use an arrow instead of an equals because an arrow shows that something new is forming.

5. What is combustion?

When we burn something, we cannot get what we started with back. It is **irreversible**. The 3 requirements to burn something are **oxygen, fuel and heat**. Burning is an important chemical reaction in everyday life.

The scientific term for burning is combustion. When something reacts with oxygen, a chemical reaction can be observed because there is a colour change. Oxygen reacts with the reactant to create something new.



Before Combustion | **After Combustion**

2. What happens in a chemical reaction?

When carrying out chemical reactions, we must remember the risks and hazards we could encounter. Observations are made when a chemical reaction takes place such as:

- Colour change
- Heat loss or production
- Bubbles

In physical changes, particles themselves are still the same but they have a different arrangement. In a chemical reaction, the **rearrangement** of particles to form a new substance.

3. What happens to mass?

During a chemical reaction, there are the same number of particles at the start and the end of a reaction, they have just rearranged themselves. Therefore the **mass** stays constant.

This means we can work out unknown masses in a chemical reaction by looking at how much of each substance we have.

6. What are the products of combustion?

Combustion word equation:

Fuel + Oxygen → Carbon Dioxide + Water

If there are impurities, other products may form. When we burn something, mass may appears to increase because the substance has reacted with oxygen in the air

7. What is thermal decomposition?

Combustion produces heat which can be used to break other substances down. This is called thermal decomposition

.

E.g. Calcium Carbonate → Calcium Oxide + Carbon Dioxide

The mass appears to decrease because a gas is formed. **Limewater** can be used to test for carbon dioxide as it goes cloudy.

Particles in a chemical reaction

Chemicals reacting

10g Magnesium | 4g oxygen

Chemicals forming

14 g Magnesium oxide

Big Idea 4 Chemical Reactions Stage 2

1. What is an acid

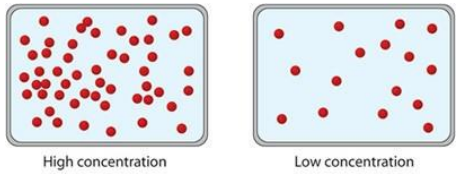
Some solutions are acids. If a solution contains free hydrogen particles dissolved in water, it is an acid

Indictors are substances that changes colour in the presence of certain chemicals. They can be used to determine if a solution is an acid.

Litmus paper is an example of an indicator

2. Are acids all the same?

All acids contain free hydrogen. The pH of a substance is a measurement of the amount (concentration) of hydrogen atoms free in solution. The higher the concentration of free hydrogen, the lower the pH. Universal indicator can be used to test the strength of a acid.



Concentration

The mass of solute dissolved in a certain amount of solvent

3. What does it mean to neutralize an acid?

Acids can be neutralised in chemical reactions called neutralisation reactions. Neutralisaton reactions involve adding other substances to the acid. In a neutralisation reaction, the free hydrogen becomes joined to other particles forming a compounds that are now neutral (no longer acidic).

Universal indicator turns green in the presence of neutral substances and that this is known as pH 7.

4. Which substances can neutralise acids?

Base – An insoluble substance that reacts with an acid to neutralize it

If a base is dissolved in water it is called an alkali.

Alkali – A soluble base

Soluble – Can dissolve

Insoluble – Cannot dissolve

5. Which compounds are produced in a neutralisation reaction?

Water and a salt is produced in all neutralisation reactions.

Acid + Alkali -> Salt + Water

We can name the salt made by looking at the reactants we have used

sodium hydroxide	reacts with	hydro**chloric** acid	to make	**sodium chloride**
copper oxide	reacts with	hydro**chloric** acid	to make	**copper chloride**
sodium hydroxide	reacts with	**sulf**uric acid	to make	**sodium sulfate**
zinc oxide	reacts with	**sulf**uric acid	to make	**zinc sulfate**

6. What does oxidation mean?

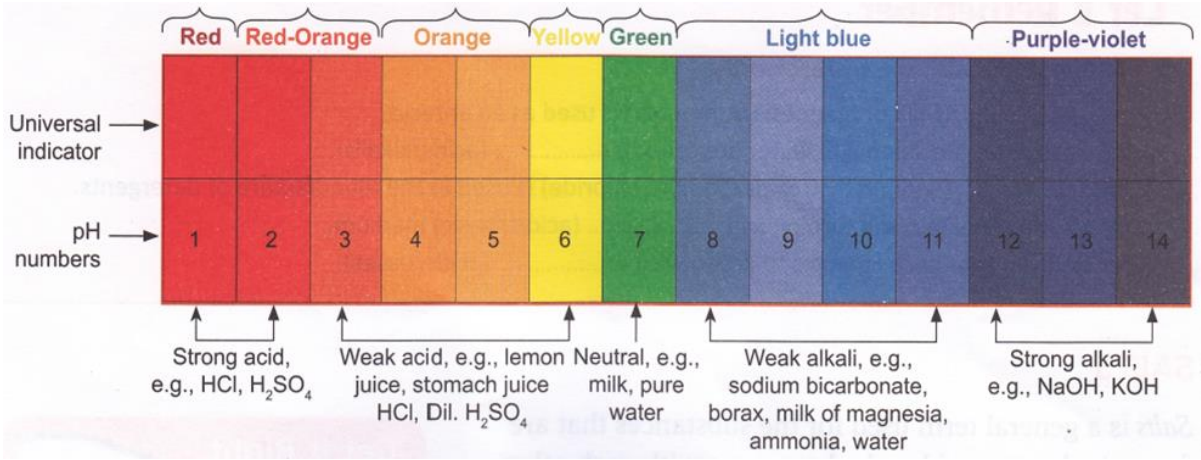
Oxidation is a chemical reaction when oxygen has been added to another element. The element that has gained the oxygen has been oxidised.

Word equation example:

Magnesium + Oxygen → Magnesium Oxide

Rusting is a type of oxidation we see in everyday life.

The pH Scale



Big Idea 5 Organisms Stage 1

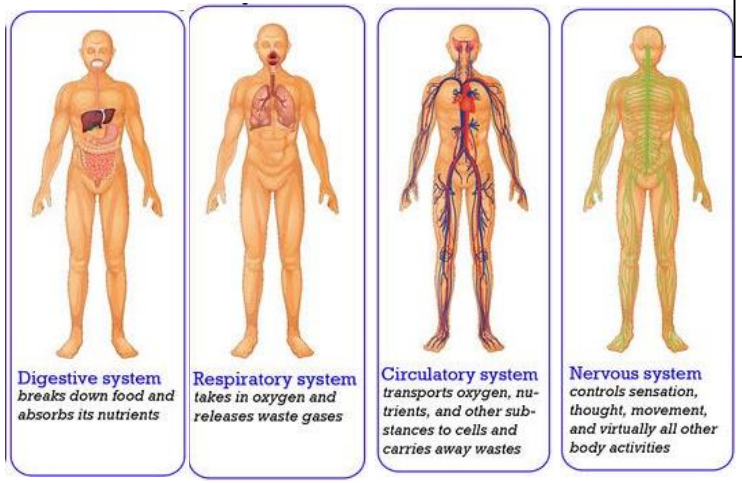
1. What is an organism?

Organisms are living things and microorganisms are very small living things.
The 7 life processes can be remembered using MRS GREN; movement, respiration, sensitivity, growth, reproduction, excretion and nutrition.

Don't forget; breathing is when animals take in air and respiration is a chemical reaction that released energy from food.

2. How do we carry out the life processes?

Organisms are made up of **organ systems**. Organ systems are a group of **organs** that work together to carry out a common function. **Organs** are made up of **tissues.** Examples of organ systems are below

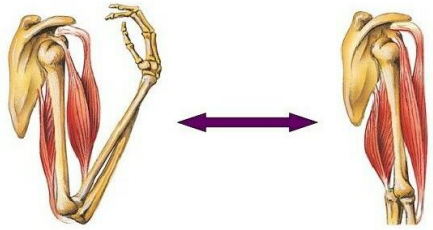


3. What is the role of the skeleton?

The function of the **skeleton** is to support our body, protect our organs and allow movement. Bones are alive as they are able to grow and repair themselves and contain **bone marrow**, which is a jelly like substance that creates new blood cells. **Joints** are where two bones are joined.

4. What is the role of muscles?

Muscles are attached to bones by **tendons**. **Muscles** cause movement of the body by pulling the bones in different directions. When a muscle contracts, they become shorter and when they are relaxed, they are become longer. Muscles always work in pairs called **antagonistic** pairs.



- Biceps muscles contract.
- This pulls the forearm up.
- Triceps muscles are relaxed.

- Triceps muscles contract.
- This pulls the forearm down.
- Biceps muscles are relaxed.

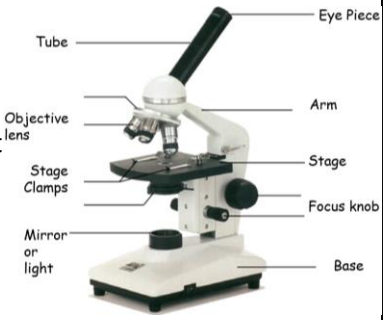
5. How can microscopes be used to view very small structures?

Microscopes allow us to see very small structures we cannot see with the naked eye. The **lenses** magnify the specimens so we can see what they look like.

Image size = actual size x magnification

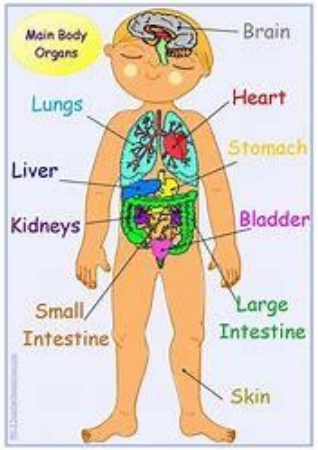
How to use a microscope:

- Place the specimen on the stage
- Secure it with the clips
- Turn to the lowest magnification first
- Move the stage as close to the lens as you can
- Look down the eye piece
- Turn the focus knob until the
- image comes into focus
- Change to a higher magnification if desired
- You may need to refocus



9. How are organisms organised?

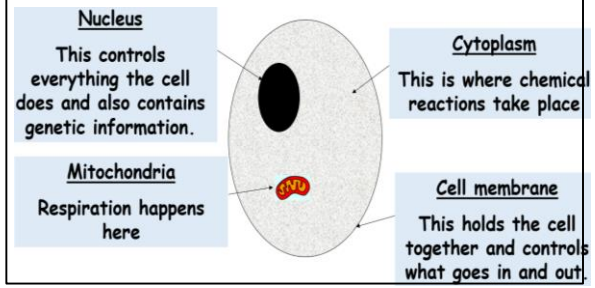
Organisms are organised in the following way: cells make up tissues; tissues make up organs; organs make up organ systems and organ systems make up organisms.

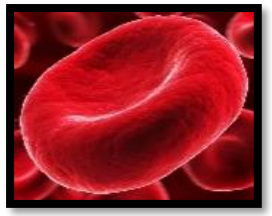


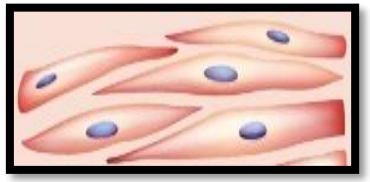
6. What are tissues made of?

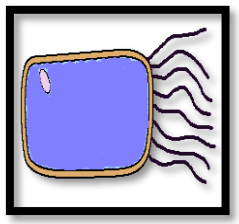
Tissues are made up of small structures called **cells**.
Cells contain organelles, small structure that have specific functions in the cell.

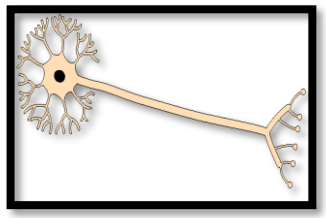
7. What are animal cells like?











8. What are specialised cells?

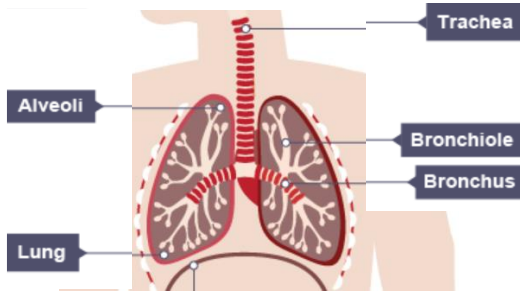
Specialised cells are cells in the body that are adapted for their functions. This means they have special features that make the good at their job.
Red blood cells- Carry oxygen around the body. They have no nucleus to make extra room to carry oxygen and are flexible to squeeze through blood vessels.
Muscle cells- Contract to move the skeleton
They have lots of mitochondria to transfer lots of energy to power the contraction.
Nerve cells- Carry signals from the brain and spine to the muscles of the body-
They are long so they can connect distance parts of the body.
Ciliated cell- A cell that lines the airways and moves **mucus** (snot/flehm) away from the lungs.
They have **cilia** (microscopic hairs) on its surface that can waft backward and forward.

Big Idea 5 Organisms Stage 2

1. What is the structure of the respiratory system?

Respiration is a life processes. It is a chemical reaction of glucose with oxygen that transfers energy. The role of the **respiratory system** is to obtain oxygen from the air and to remove carbon dioxide from the body.

Alveoli are the site of this gas exchange and are sometimes known as air sacs and are covered in **capillaries**, both of which are one cell thick. Another adaptation is that alveoli have a large surface area.



2. Why do organism need oxygen?

The word equation for respiration is:
Glucose + Oxygen → Carbon Dioxide + Water

The symbol equation for respiration is:
$C_6H_{12}O_6 + O_2 \rightarrow CO_2 + H_2O$

The purpose of this reaction is to release energy. Glucose is provided by the food we eat in the digestive system and oxygen is provided by the air we breathe in the respiratory system.

Respiration takes place in the **mitochondria** all cells of the body, the number of **mitochondria** a cell has is linked with its energy requirement.

3. How and why does exercise affect the breathing and pulse rate?

During exercise our muscles need to transfer more energy in respiration.
Our breathing rate increases to supply extra oxygen for this increased respiration rate.

Oxygen is carried to the cells in the blood. During exercise the heart rate increases to increase blood flow to the muscle cells. This allows the oxygen to be supplied at a faster rate.

4. What is physical and mental health in humans?

Health is how well your body can cope with life both physically and emotionally. **Physical health** is related to the condition of the body and **mental health** is related to the condition of the mind. Health can be maintained through lifestyle choices.

5. How do drugs affect the respiratory system?

Smoking cigarettes can increase the risk of many diseases including cancer, gum disease, stroke and premature ageing of skin. Cigarettes contain **tar** which causes **cancer** and **nicotine** which causes addiction. Chemicals in the smoke **paralyse the cilia** that waft **mucus** containing dust and bacteria away from the bottom of the lung.

6. How do diseases affect the breathing system?

During an **asthma** attack, the airway constricts, reducing the amount of air that can enter the lungs leaving the person breathless. This can be fatal if not treated with an inhaler which relaxes the airways.
COPD is a disease caused by smoking. The **alveoli** become damaged decreasing the **surface area** available for **oxygen** to pass through.

7. How does exercise keep us healthy?

Regular exercise leads to a shorter **recovery time** meaning the heart rate returns to normal in a shorter time period.

8. What is a balanced diet?

A balanced diet is made up of appropriate amounts of **proteins** for growth and repair. **Carbohydrates** and **fat** for energy. **Fats** are also for making cell membranes. **Vitamins and minerals** keep bones and teeth strong and prevent diseases. **Fibre** to preventing constipation.
Reagents can be used to test for different substances in food.

Testing for starch

Procedure:

1. Use a dropper to add two or three drops of **iodine solution** to the food mixture.
2. Gently shake the test tube from side to side to mix the contents.

Result:

A **dark blue-black** colour shows that the food contains starch.

Testing for protein

Procedure:

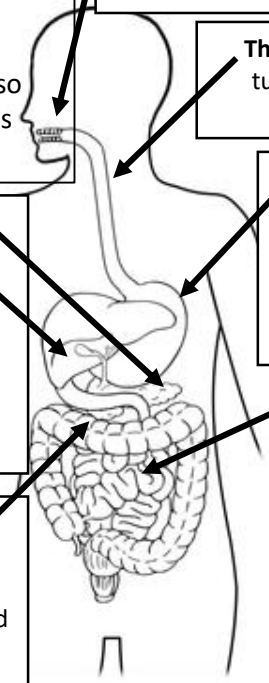
1. Use a dropper to add two or three drops of **biuret solution** to the food mixture.
2. Gently shake the test tube from side to side to mix the contents.

Result:

A **purple** colour shows that the food contains protein.

9. How is food digested?

The digestive system breaks down the molecules in food so they are small enough to pass into the blood.



The mouth, the teeth break the food into pieces, the food is mixed with saliva, so it's easier to be swallowed.

The oesophagus, a long tube connected to the stomach

In the **stomach** the food is mixed with acid to kill any bacteria and other chemicals called **enzymes** that help to digest the food.

The **pancreas** and the **liver** produce enzymes and bile, chemicals required for digestion.

The **small intestine** where even more enzymes and bile which helps to digest fat are added to the food. Digested food molecules pass across the wall and are absorbed into the blood

The **large intestine** where water from the food is absorbed into the blood.

10. How much energy do we need?

Calories are a unit used when measuring the energy content in food.

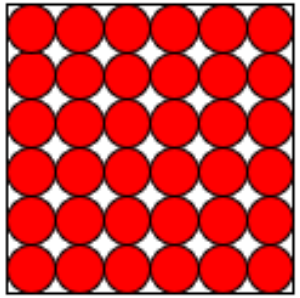
11. What are the consequences of a diet that is not balanced?

Being overweight can lead to cancer, heart disease and diabetes. Being under weight can lead to starvation, decreased fertility and a weaker immune system. **Deficiency diseases** are when a diet lacks a vitamin or mineral. Examples include anemia and rickets.

Big Idea 6 Sound and Light Stage 1

1. What causes sound?

Sound is caused by vibrations, which are not always seen by the human eye. The pitch of sound is how high or low a sound is and the volume is how loud or quiet it is. Louder sounds are caused by bigger vibrations, meaning the back-and-forth motion moves further. Higher pitched sounds are caused when vibrations are more frequent.



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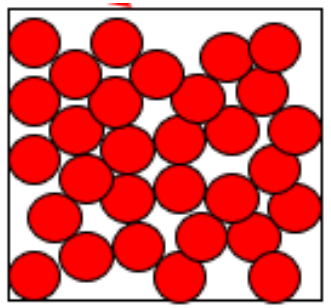

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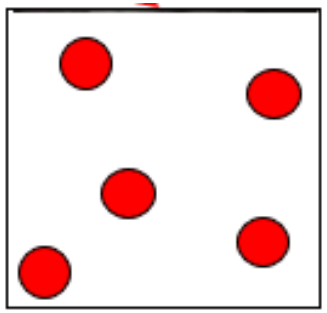


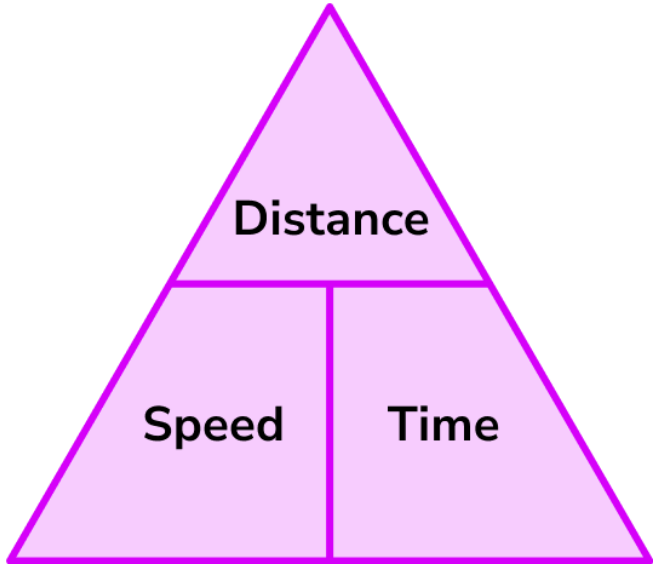
GAS

2. How does sound travel?

Energy is transferred through matter often via sound. Particles in the air vibrate and pass energy from one particle to the next so that we can hear sound. The size of the vibration is proportional to the amount of energy the particle has (a larger vibration has a larger amount of energy). When the kinetic store is full, a particle vibrates more. The ear drum is the part of the ear the vibrates and messages are sent to the brain. Microphones work in a similar way, detecting vibrations and changing them to electrical signals that can be interpreted by a speaker.

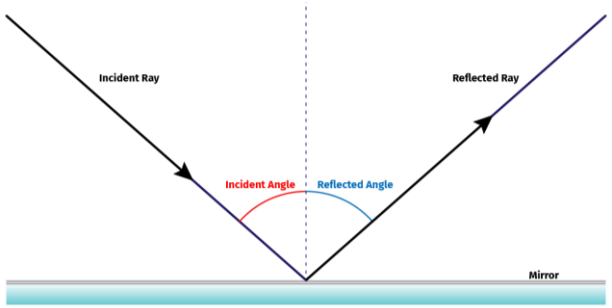
6. How do we see?

Light is necessary for us to see. Objects are either luminous, meaning they give out light or non-luminous meaning they do not emit light. The pupil is a hole that allows light to enter the eye. Light travels from a light source into our eyes so we can see. To see a non-luminous object, light must reflect off an object and into the eye. Arrows on ray diagrams show the direction light travels in.



3. How does sound travel in different mediums?

Sound travels *faster* through a solid and liquid compared to a gas as the particles are much closer together meaning the vibrations are passed along more easily. However, sounds travels *further* in gases. A vacuum is an area with no particles meaning sound cannot pass through a vacuum. An echo is when sound reflects and bounces back off a smooth, solid surface in a similar way to how water waves bounce off a surface. Using the speed, distance, time equation, we can estimate the speed of sound in air. Speed = Distance ÷ Time



4. How does light travel?

Light rays' travels through air in straight lines and cannot be seen. A beam of light contains many rays. When light is blocked, a shadow forms.

5. What happens when light hits a surface?

Transparent materials allow light to be transmitted through. Translucent materials allow some light to be transmitted through. Opaque materials do not allow light to be transmitted through. Light can be reflected from most surfaces, but shiny, smooth materials are the best reflectors. The law of reflection states that the angle of incidence is the same as the angle of reflection.

Big Idea 6 Sound and Light Stage 2

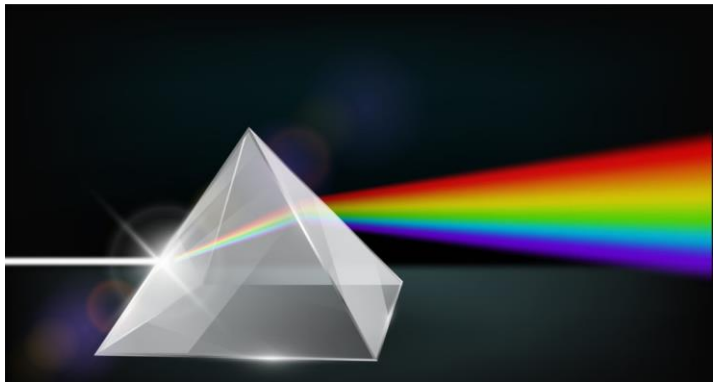
1. How can colours of light be made?

Light comes in lots of different colours. Just like paint, colours of light can be mixed to make new colours. Blue, red and green are the primary colours of light, meaning they are only made of one colour. These colours can be mixed to make other colours.

2. What is white light?

Sunlight appears yellow because of the earths atmosphere. The sun can appear different colours at different times of the day and year. Daylight and sunlight are the same thing and are both examples of plain light. Plain light is light that does not have a colour. Most bulbs we use give out plain light.

Plain light is made up of a mixture of different colours of light called the spectrum and a prism can be used to separate plain light into all its colours. The colours of the spectrum in order are red, orange, yellow, green, blue, indigo and violet. These different colours are mixed to form plain light known as white light. Rainbows form when white light from the sun is separated into all the colours by raindrops in the same way a prism can be used to separate a beam of light.



3. Why do objects appear to be different colours?

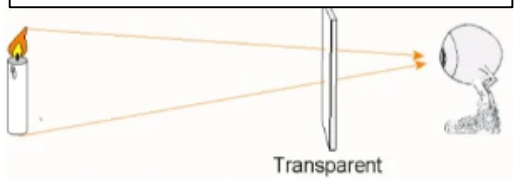
When light falls on an object, some colours are reflected and others are absorbed (taken in). The reflected colours are the ones we see and is why objects appear different colours. Objects appear white when all the light is reflected and objects appear black when all the light is absorbed by the object.

4. How do we draw more accurate ray diagrams?

Light travels in all directions from the source of light, however on a light ray diagram we tend to draw just one pathway that the light may take. Light rays are drawn with straight lines and an arrow showing the direction of light. Sometimes we draw ray diagrams with two rays, one from either end of the object.

5. How does light travel through a pin hole?

A pin hole is a very small hole, like what would be made with a pin. Images are inverted when viewed through a pin hole. This means that they are upside down. This happens because only a small amount of light is able to pass through the hole and the light from each end of the candle passes through the pin hole at different angles. The light rays then cross over and inverts the image. The eye work in the same way forming photosensitive material which allows the images to be sent to the brain.

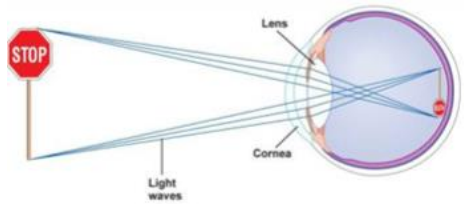


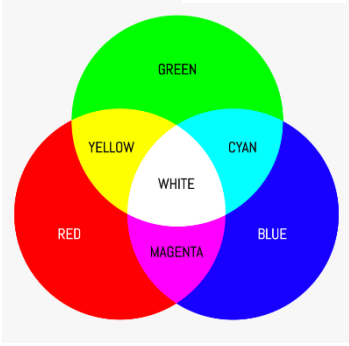
6. What is refraction?

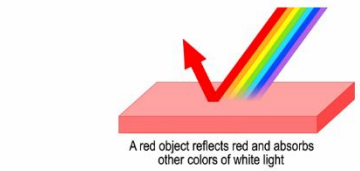
Light travels through different speeds through different mediums. Light travels the fastest through air as it is a gas and is less dense. Light travels more slowly through a solid as it is more dense. When light hits a solid at an angle, one side slows down before the other causing a shift in direction of light, also known as refraction. Refraction can make water appear shallower than it is and this can be a danger when swimming!

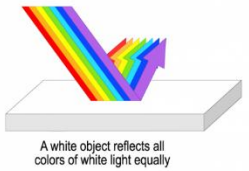
7. How do lenses work?

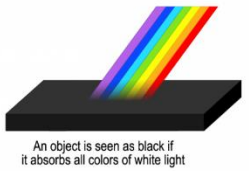
A lens is a piece of transparent material that is shaped in a way to refract light so that images can be focused. A convex lens bulges outwards and is the type of lens we have in the eye. The lens in the eye enables light to be focused onto the retina, which is the part of the eye that is light sensitive. Just like a pin hole camera, the image formed on the retina is inverted and the brain flips the image so we see it the correct way around.







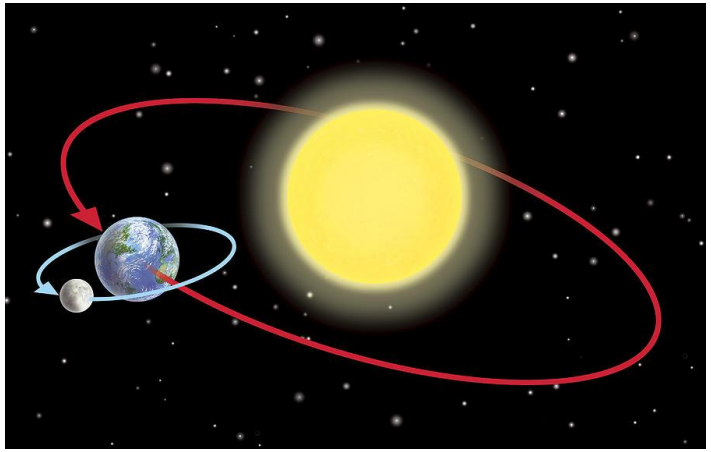




Big Idea 7 Earth in Space Stage 1

1. What is a year?

A year is 365 days long. This is because it takes the Earth 365 days to **orbit** the sun. Well, it actually takes 365 and a quarter days, we add these quarters up and every 4 years have a **leap year** with an extra day.



2. Why do we have seasons?

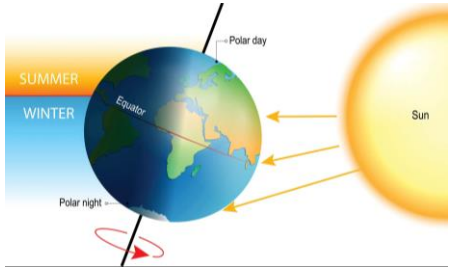
The **equator** is an imaginary line around the middle of the Earth. The area of Earth above the equator is called the **northern hemisphere** and the area below the equator is called the **southern hemisphere**.

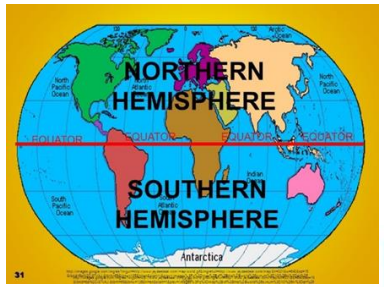
The northern and southern hemispheres have opposite seasons so when it is summer in the north it is winter in the south and vice versa.

As the Earth rotates on its **axis**, it is **tilted.**

This leads to the geographical north/south pole not being directly at the top/bottom of the Earth.

When the northern hemisphere is tilted towards the Sun, it is summer in the north and winter in the south.





3. Why is it warmer in the summer?

In the summer that part of the Earth is **tilted** towards the Sun and therefore spends a longer time in the 24 hour day facing towards the Sun this leads to warmer weather and longer days

4. What a galaxy?

Stars are made from hydrogen and helium gas. Chemical reactions that occur in the Sun transfer energy from the chemical store of the Sun to the Earth via heat and light.

The Sun is the same as all the other stars that can be seen in the night sky but these stars look much smaller than the Sun as they are much further away.

Most stars have at least one planet orbiting them but that they are more difficult to see as they are **non-luminous** unlike the stars that are **luminous**.

A group of stars is called a **galaxy** and our galaxy is called the **Milky Way**. The Milky Way contains at least 100 billion stars. Scientists estimate there are at least 100 billion other galaxies and that all the galaxies together make up the **universe**

5. How big is space?

Space is very, very big its hard to imagine how big it actually is.

A kilometer is 1000 meters, the symbol of kilometers is **km.**

The Sun is very, very far away from us (15 million kilometers). It would take around 180 days for a person to count to 15 million aloud.

Other **stars** and **galaxies** are much further away from Earth than this.

A km is not an appropriate way to measure these very large distances and so instead **astronomers** (a scientist who studies space) use a unit of distance called a **light year.**

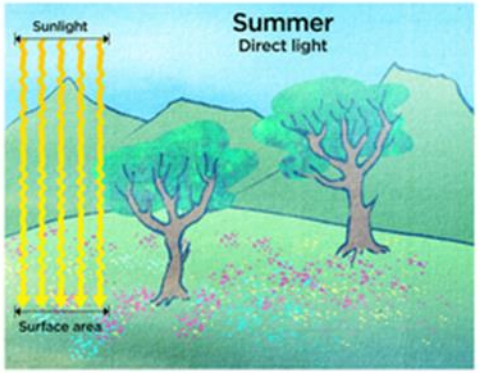
A light year is a measure of distance rather than time.

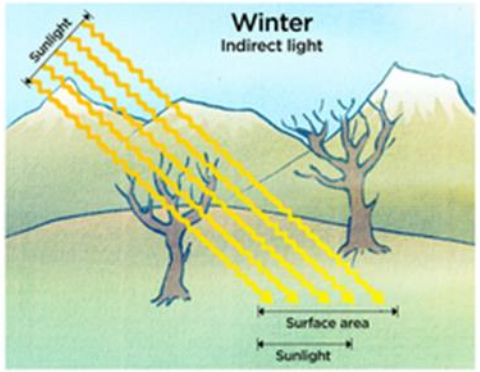
A light year is the distance that a ray of light can travel in a year.

Due to distance from earth, some space objects can only be observed using special **telescopes** from Earth and in space.

There are likely to be many areas in the universe that we are unable to study as technology has not yet been invented that can see this far.

We are confident that there is no other life in our solar system but we cannot be sure about the whole universe.



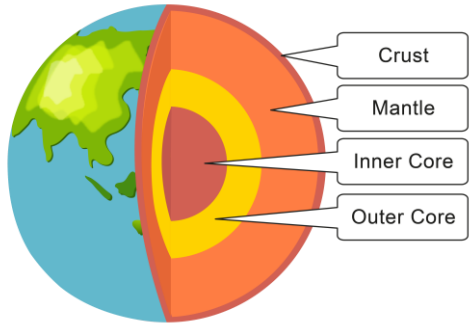


Big Idea 7 Earth in Space Stage 2

1. What is the structure of the Earth?

The core of the Earth contains **radioactive** materials. Radioactive materials contain a store of energy called the **nuclear store**. This radioactive material **breaks down or decays** and when this happens energy transfers to the **thermal store** of the core and this is why the core is hot. The core heats the mantel via conduction.

The mantel is **semi- molten** this means it is made from solid rock that is very close to its melting point and that this allows it to flow very, very slowly.

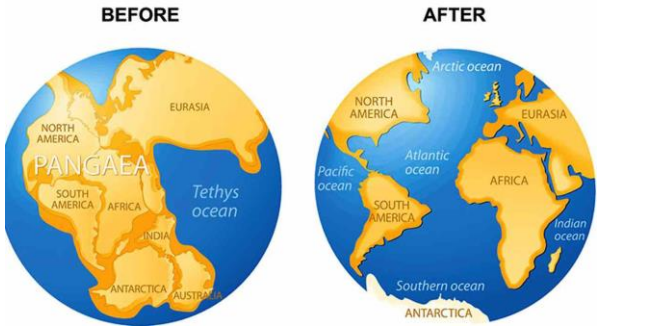


2. Why does the land move?

The **crust** is split into different sections called **tectonic plates.** The hot core causes movements in the **mantel** that result in the movement of the tectonic plates. There is continual movement of the tectonic plates, not just during earthquakes.

Scientists believe that at one point most of the land mass on Earth was in one piece in a giant continent called **Pangea** the movement of the tectonic plates caused the land mass to separate.

Evidence for this is the jigsaw shape of the continents and the discovery of fossils of the same species on land that is now separated by ocean



3. What else is in the crust of the Earth?

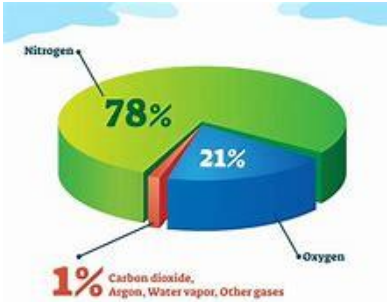
As well as rock there are other useful materials in the crust of the Earth.

Fossil fuels, oil coal and gas, are found in the **crust** of the Earth. Fossil fuels are formed when the remains of animals or plants get trapped in the layers of **sediment** that form sedimentary rocks.

Crude oil is mainly formed from **plankton (microscopic organisms found in the sea)**

Metals ores (impure metals) are **mined** from the **crust** of the Earth.

Metals are a **non-renewable** resource that formed in the crust when the Earth first formed. Unlike fossil fuels, new metals are not being formed in the crust of the Earth and so unlike fossil fuels, even if we slow down the rate at which we extract them, we will still eventually run out of new metal ores.



4. What is the atmosphere?

The **atmosphere** is the layer of gases that surrounds our planet.

The atmosphere is made of many layers and that the layer. **Air** is a **mixture** of gas. Air is made from 78% nitrogen and the symbol for nitrogen is N_2, 21% oxygen and 1% other gases.

These other gases as, carbon dioxide (CO_2), Argon (Ar) methane (CH_4) and water vapour H_2O.

Oxygen, and nitrogen are **diatomic molecules (di- two)** this means they are never found as individual atoms instead they are always found as two atoms joined together.

3. Why recycle?

We **recycle (produce a new item from an old one)** metals so that **metal ores** last longer.

There are advantages and disadvantages of recycling metals.

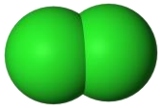
Advantages

- Recycling metals means that less new **metals ores** need to be extracted from the crust.
- Recycling metals means that fewer mines and quarries are needed.
- Recycling metals means that less waste goes into **land fill (**a large hole in the ground which we fill with the waste that we are not recycling)

Disadvantages

- Used metals must be collected and transported to the recycling center.
- Used metals must be sorted into their different types before they can be recycled

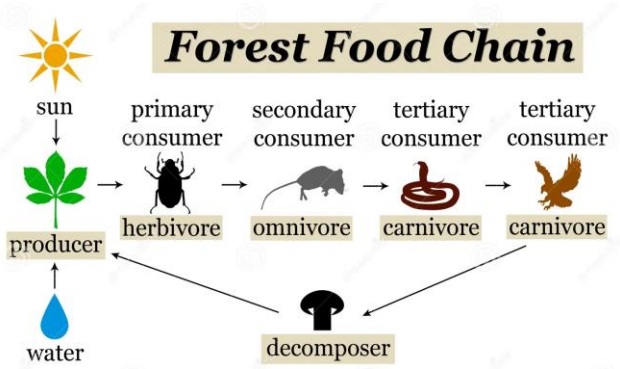
H_2 → Hydrogen
N_2 → Nitrogen
F_2 → Fluorine
O_2 → Oxygen
I_2 → Iodine
Cl_2 → Chlorine
Br_2 → Bromine



Big Idea 8: Energy for life (Stage 1)

1. What does a food chain show?

All energy within a food chain is originally provided by the Sun. This energy is transferred to Earth as light which plants then use to make a **compound** called **glucose ($C_6H_{12}O_6$)** which is a type of sugar. The arrows in a food chain show the transfer of energy from one organism to another. Food chains represent **populations** of a species rather than individuals. In biology a **community** is a group of different species in an area that interact and so a food chain shows a community.



2. How do toxins build up through a food chain?

Humans use **toxic** chemicals to kill organisms that cause them problems. Examples of this could be mice in a person's kitchen, insects feeding on a farmer's crop, weeds growing on your drive. **Insecticides** are chemicals used to kill insects, **herbicides** are chemicals used to kill weeds, **pesticides** are chemicals used to kill pests.

Some chemicals cannot be **excreted** by organisms and so remain in their bodies leading to **bioaccumulation.** This is when organisms lower down the food chain consume small amount of the toxins.

Organisms higher up the food chain eat multiple preys all containing toxins, this results in the toxins accumulating. Eventually in animals higher up the food (often the top predator) the toxins accumulate in high enough levels to kill them.

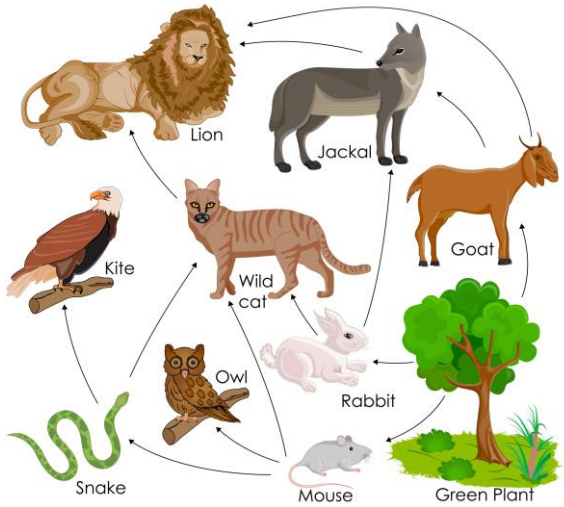
3. What is a food web?

In nature animals rarely have one source of food or are preyed upon by one species and so the feeding relationships we see in food chains are not so simple in real life. **Food webs** show multiple interconnected food chains that exist in a community. Changes in one population can affect many other populations in the same community.

For the food web below

- If the rabbits population decreased the wild cat and the jackal population would also decrease as they would have less food.
- If the mouse population increased the population of owls and snakes would increase as they would have more food.

Populations of organisms in a habitat are continually changing but it would be rare that a population would completely die out.



4. What is the role of microorganisms in food chains?

When organisms die, their remains **decompose/decay** this means **break down.**

Decay is a process that is carried out by **microorganisms**, specifically **bacteria and fungi.** The general term for microorganisms that cause decay is **decomposers.**

Organisms are made of **compounds** and during decomposition microbes break these compounds down into the **elements** that they are made from. The amount of these elements on Earth is fixed and so decay is very important as it releases these elements so that they are available for use by other organisms. Some of these elements form minerals in the soil, these minerals are then taken through the roots of plants and passed along the food chain as consumers feed.

5. How do non-living factors affect populations?

An **ecosystem** is all the living things in an area and their surroundings.

The surrounds in an ecosystem are **non-living factors**. Examples of non living factors in the desert are the sand, the lack of water, the hot temperatures and the rocks. Examples of non living factors in the rainforest are the warm temperatures, low light intensity on the forest floor and heaving rainfall. Changes in non living factors in an ecosystem can affect the populations of the organisms that live there .

For the food web below

-If the weather became too hot the plant population could decrease, this could lead to a decease in rabbit and mouse populations as they would have less food.

6. How can we measure the impacts of non-living factors on populations?

In most **ecosystems** the **populations** are too large to count to overcome this, ecologists use a method called **sampling** to **estimate** population size. In sampling, ecologists count the number of individuals in a small part of the habitat. They may use a **quadrat** if they are sampling plant populations.

Sampling a plant population

1. Use a marked-out grid of the habitat
2. Use a random number generator to select the area of the habitat you will sample
3. Place the quadrat in the selected part of the habitat and count the number of individuals in the quadrat
4. Sample multiple times (at least 10) and then calculate the mean.

Big Idea 8: Energy for life (Stage 2)

1. Which substances do plants need for life?

As well as light and water, plants also need carbon dioxide (CO_2) to survive. Plants absorb carbon dioxide gas from the **atmosphere** through their leaves. The surface of a leaf has microscopic pores (holes) called **stomata** that allow carbon dioxide gas to enter.

We can use a **microscope** to view the stomata and use the following equation to calculate the image size.

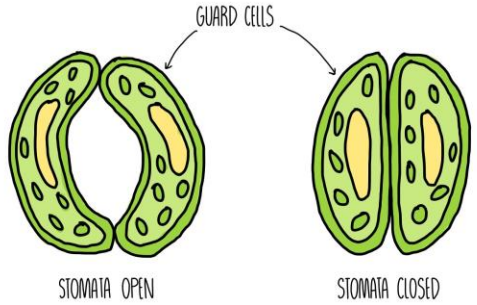
Image size = Actual size x Magnification

If we need to calculate the actual size or magnification we would need to change the subject of this equation.

Actual size = Image size ÷ Magnification

Magnification = Image size ÷ Actual size

The stomata is a hole and that the two cells either side of the stomata are called guard cells, the guard cells open and close the stomata.



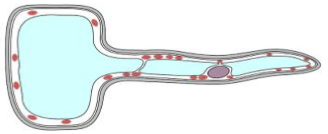
2. What do plant cells look like?

Like all organisms, plants are also made from microscopic units called cells. Plant cells have some **organelles** in common with animal cells.

Organelle	Function	Found in plant or animal cells?
Nucleus	Where the DNA is stored	Both
Cell membrane	Controls what moves in and out of the cell	Both
Cytoplasm	Where the chemical reactions happen	Both
Mitochondria	Where energy is released in respiration	Both
Rigid cell wall	Provides support to the plant	Plant only
Chloroplast	Contains a green pigment called chlorophyll which absorbs the light that plants need	Plant only
Permeant vacuole	A storage space which contains a liquid called cell sap that keeps the cell firm.	Plant only

3. How do plants obtain water?

Water and minerals are absorbed through the roots of the plants. The root of the plant is made of **specialised cells** called **root hair cells.** This is a diagram of a root hair cell.



The root hair cell is adapted to its function. The shape of the root hair cell ensures it has a large surface area so that it can absorb more water and minerals from the soil.

4. How do plants make glucose?

Glucose is produced by plants in a **chemical reaction** called **photosynthesis.**

The **reactants** for **photosynthesis** are **carbon dioxide** and **water.**

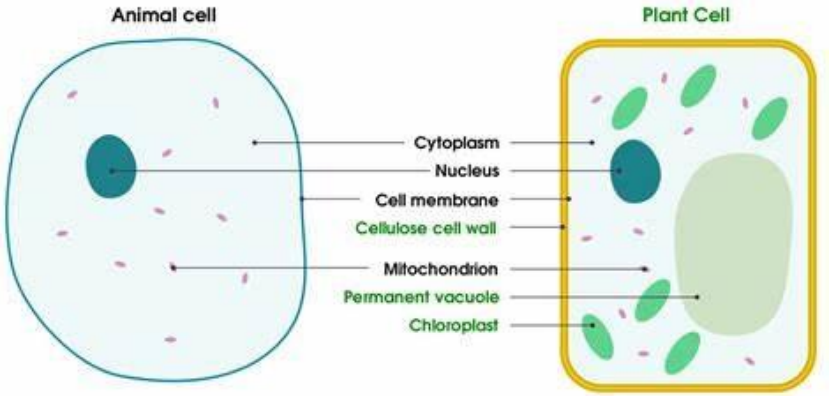
Light is not a reactant in photosynthesis but it is needed as it provides the energy required for the reaction. The glucose plants produce in photosynthesis is used by plants to transfer energy in **respiration.** The reaction of photosynthesis also produces oxygen (O_2), plants need some of this oxygen but that a large percentage of it is not required so is **excreted** through the stomata.

Photosynthesis happens in the chloroplast of all plant cells but that most photosynthesis occurs in the leaf.

We can summarise photosynthesis using these equations.

Carbon dioxide + Water -> Oxygen + Glucose

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



5.Why is photosynthesis so important?

Photosynthesis is very important for all life on Earth. Through photosynthesis, plants transfer the suns energy into the chemical store when they make glucose, this energy is then transferred to animals when they eat plants.

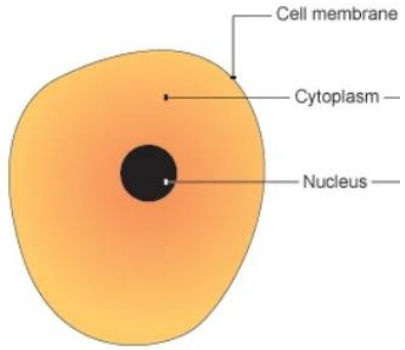
Animals then transfer the energy to other energy stores such as the kinetic store when they move and the thermal store as they produce heat. The oxygen excreted in photosynthesis is used by other organisms for respiration.

Big Idea 9: Diversity of life (Stage 1)

1. What is in the nucleus of cells?

One of the **organelles** found in both plant and animal cells is the **nucleus.** Inside the nucleus of the cell is where we find the DNA. DNA is the instructions for all the **internal workings** of the organism and the **external features**. Apart from identical twins, every individual has their own unique DNA.

Every cell of an organism contains the same DNA. The entire DNA of an organism is called its **genome.** The DNA is a code made of 4 different types of chemicals called **bases** the bases are **A,T,C and G**. The human genome is very long (around 3 billion bases) and different sections of the DNA codes for different **traits.** A section of DNA is called a **gene**. 50% of an organisms genes come from their mother and 50% from their father**.**



Animal Cell

2. What is variation?

A **species** is a group of organisms with similar **characteristics**. There are differences in characteristics within a species, these differences are called **variation.** Some variation is caused by differences in **genomes** between individuals and some variation is caused by differences in the **environments/lifestyles of individuals.**

We all have genes that may **predispose** (increase our chances) of having certain features such as high intelligence, being overweight, having heart disease but that our environment/lifestyle can influence the outcomes of these genes.

Examples of variation controlled by …..		
Genes	**Both**	**Environments/lifestyles**
-Natural eye colour -Natural skin colour -Blood type -Zebra's stripes -Deer's antler size	-Height -Weight -Intelligence	-Scars -Accent -Tattoos

3. What do organisms compete for?

To survive animals require food, mates and territory and plants require light, space, water and minerals.

As there is **variation** between individuals of the same species this means that some individuals have features that give them an advantage over others when it comes to obtaining resources

Features which mean an individual has a better chance of survival are called **adaptations.**

A very famous British scientists called Charles Darwin called this struggle for survival **'survival of the fittest'**

4. How are organisms adapted?

When thinking about adaptations we must be able to **describe and explain.** Describing the adaptation is saying what it is, explaining the adaptation is to say how it increases the chance of survival. The table shows some examples of variation and adaptations in different organisms

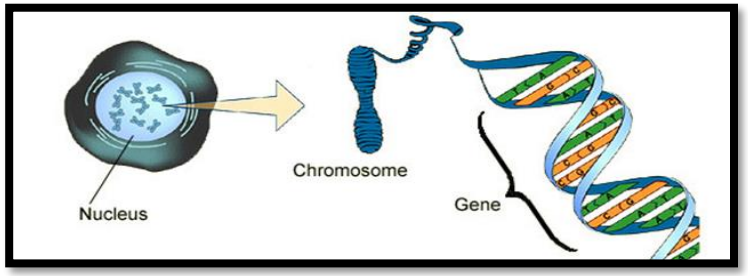
Variation	Adaptation	Explanation
Penguins have different body shapes	The more **streamlined** a penguin the better a swimmer it is	Faster swimmers can catch more prey and escape more predators
Some plants grow longer roots than others	The plant that can grow longer roots can obtain more water	Plants require water to survive
Moths have different colours of wings	Moths that are more camouflaged will blend into their environment more easily.	Camouflaged moths have a better chance of escaping predators
Male deer (stags) have different sizes/strength of antlers	Males with bigger/stronger antlers are better fighters	They can win more fights and claim more territory and so have more food to eat/more females to mate with

Streamlined- A shape that reduced air resistance and allows an object/individual to move through the air or water more easily

Diversity of life - stage 2

1. What is DNA like?

DNA strands are very, very thin but that they are also very, very long. DNA has to be 'packed' inside the nucleus so that it remains organised.
The DNA in each cell is split into 46 different pieces that are then coiled to form **chromosomes.** The nucleus holds the 46 chromosomes. The chromosomes are coils of DNA. Sections of the DNA are called genes.
Below is a list of these structures biggest -> smallest.
Cell -> Nucleus -> Chromosomes -> Gene



2. How does DNA pass from parent to offspring?

Animals, including humans, pass their **genes** onto their offspring through **sexual reproduction.** This is reproduction that involves two individuals, a male and female. The aim of sexual reproduction is for a **sperm cell** from a male to join with the egg cell of a **female** as this creates an **embryo** (a ball of cells that can grow into offspring). When a sperm joins with an egg this is called **fertilisation.** Sperm and egg cells are called **sex cells.** Each sex cell contains 23 random chromosomes from the parents 46. Sex cells are **speciliased cells**. Which means they are adapted to their function. The adaptations of the sex cells are listed below.

Adaptations of a sperm cell

1. A tail so they can swim to the egg cell
2. Lots of **mitochondria** to provide lots of energy for the long swim
3. A package of **enzymes (chemicals)** in the head to help break through the egg **cell membrane**

Adaptations of the egg cell

1. It is a very large cell so that is can hold food to sustain the developing embryo

3. What is the reproductive system like?

The males and female reproductive systems are different they work together to produce **offspring.** Some organs of the reproductive system are described below.

Male reproductive system

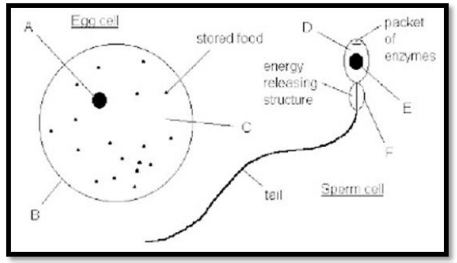
- Testicles – Produce and store sperm until it is ready to be released
- Penis- Delivers sperm into the vagina during sex

Female reproductive system

- Uterus/womb- where a foetus develops
- Ovaries- Stores and releases the egg cells
- Fallopian tubes- A tube in which the sperm and the egg join
- Vagina- Where the penis is placed and the sperm cells are deposited during sex
- Cervix- Separates the uterus from the vagina

4. What happens during sexual reproduction?

In some animals such as mammals, **internal fertilisation** occurs. The penis of the male is inserted into the vagina of the female. The male releases millions of sperm cells into the vagina during **ejaculation.** The female releases an egg cell from the ovary **in ovulation.** The sperm swim up to the fallopian tube where one sperm joins with the egg in **fertilisation.** In some animals such as fish and amphibians, **external fertilisation** occurs. The female releases egg cells into the environment, the male then releases sperm which fertilise these eggs.



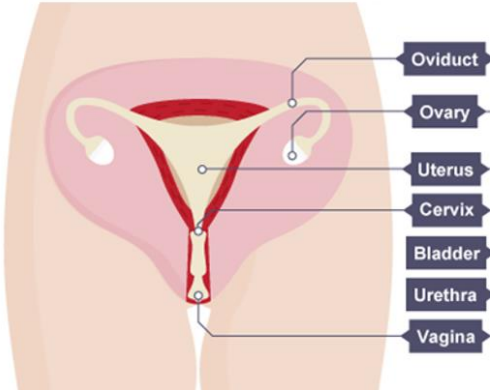
5. What does it mean to be fertile?

The term **fertile** means able to produce offspring. Young animals/**juveniles** (including humans) are not fertile as they as their bodies are not yet developed enough to produce sex cells. Their bodies must become **sexually mature** in a process which in humans is called **puberty.** After they have become sexually mature, individuals of the same species can breed (reproduce together) and produce offspring that are fertile.

6. What is the menstrual cycle?

After internal fertilisation, the fertilised egg must **implant** (fix) into the uterus/womb lining. The **womb lining** (a layer on the inner surface of the uterus) is made of layer of blood that must be replaced every month. An egg cell only has a life of around 2 days and if it is not fertilised it must be replaced by a new egg. The **menstrual cycle** is a 28 day cycle of the female reproductive system in which the egg and the womb lining are replaced. The menstrual cycle consists of the following stages

Day 1-7. A woman has her period, the old womb lining is shed. At the same time an egg is maturing (getting ready to be released) inside the ovary.
Day 7-14. The womb lining builds back up again forming a thick layer of blood.
Day 14. Ovulation occurs, an egg is released from an ovary.
Day 14-28. The womb lining remains thick and waits for a fertilised egg to implant.
These are rough timings and that they exact time of each stage different between females.



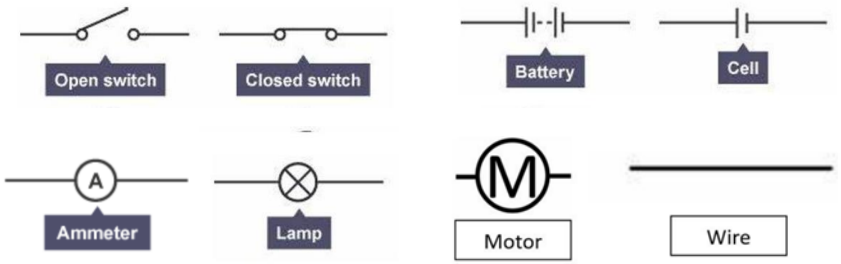
Big Idea 10: Electricity and Magnetism (Stage 1)

1. Can we build circuits?

All electrical appliances contain **circuits**. A circuit is a closed loop around which electricity can flow. Circuits must be made of **conducting material** (usually metal wires), there must be no gaps in the loop and they must be connected to a power source (often a battery) to work. Circuits usually contain other **components** such as bulbs, switched and buzzers.

2. How can we represent circuits?

We use symbols to represent the components in a circuit so that circuit diagrams can be universally understood.

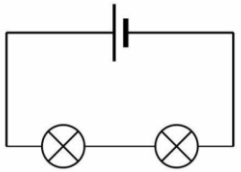


A **cell** is a single unit that can provide energy to a circuit, **batteries** usually contain multiple cells working together.

Motors are found in circuits for devices that have moving parts such as a fan or blender. The motor spins when the circuit is switched on. A motor **transfers energy** from the **chemical store** of the battery to the **kinetic store** of the moving part.

Rules for drawing circuit diagrams

-Use a sharp pencil and a ruler for every straight line in a circuit symbol.
-All circuit symbols are correctly drawn.
-There are no gaps in the circuit diagram.
-Every wire exactly touches each component.
-The corners of the circuit exactly touch.
-The diagram is drawn with a rectangular shape



3. What is current?

Metals contain extremely tiny particles called **electrons.** These electrons are able to move through the metal when it is attached to a battery. Electrons carry an **electric charge.** The battery applies a force which pushes the electrons and the electric charge they are carrying around the circuit. **The flow of electric charge around a circuit is called the current**. As the electrons flow around the circuit they transfer energy from the battery to the components in the circuit.

The units for current are amps (A). Current can measured at a certain point in a circuit using an **ammeter.**

- Current is not used up in a circuit
- Current is the same at all points in the circuit

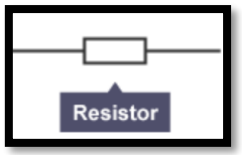
4. What is resistance?

Resistance is a force that opposes the flow of electrical current.

The wires and the components add resistance to a circuit.

When resistance is bigger the current is smaller. If we add more bulbs to a circuit the resistance increases, the current decreases and the bulbs become dimmer.

We can reduce the current in a circuit by adding **fixed resistors**. These are components which provide a set amount of resistance. To the circuit and so reduce the current. We might find these in a circuit which needed a dimmer bulb or a quieter buzzer.



5. Which materials are magnetic?

Magnets have two ends that we call **poles:** a **north pole and a south pole.** If two of the same poles **(like poles)** are brought close to each other, they **repel**. If two **opposite poles** are brought close to each other, they **attract**.

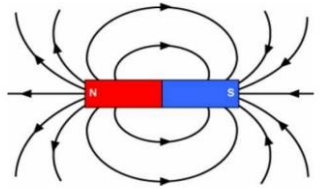
If you put a magnet next to some plastic, nothing happens. This is because plastic is not magnetic. If you put a magnet next to a piece of iron, the piece of iron will be attracted to the magnet. This is because the iron is magnetic, it isn't a magnet itself, but it can still be attracted to magnets. Nickel and cobalt (and steel, which is a type of iron) can also be attracted to magnets. A material is classed as a **permanent magnet** if it can attract and repel other magnets. Materials that can only be attracted are called **induced magnets.**

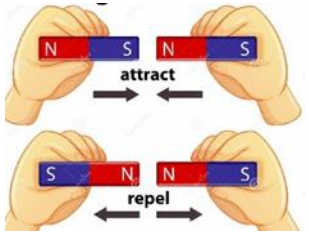
6. What is a magnetic field?

The area around a magnet, where magnetic force can act, is called the **magnetic field.**

We cannot see magnetic fields but if we could we would see that they have lines, these lines show us how the magnetic field works, they always go from north to south. The closer together the magnetic field lines the stronger the magnetic force.

The magnetic field around a bar magnet is shown below.





7. How does a compass work?

The Earth also has a magnet field around it, this magnetic field is caused by the iron that we find in the centre of the Earth.

A compass can indicate which direction is north or south. A compass contains a tiny permanent magnet that is free to rotate, the tiny magnet inside the compass is affect by the Earth magnetic field and it will align with the magnetic north and south pole of the Earth.

If we place a permanent bar magnet near to a compass, the compass no longer aligns with the magnetic field of the Earth. Instead the compass aligns with the magnetic field around the permanent bar magnet. We can use a very small compass called a plotting compass to plot the magnetic field around a bar magnet.

Big Idea 10: Electricity and Magnetism (Stage 2)

1. What does a battery do?

Batteries 'push' current around a circuit from the **negative** to the **positive terminal** of the battery. If multiple cells or batteries are placed into a circuit, they must all be placed so that they are all working to move the current in the same direction. If a cell is added in the wrong direction, the circuit will not work as the batteries
work against each other rather than together. You will know the circuit symbol for a cell and battery from stage 1. The longer side of the diagram is the positive terminal and the shorter one is the negative terminal. Looking at circuit diagrams, you will be able to see in which direction the current is flowing.

2. What is voltage?

Without a battery or power source, a circuit would not work. Batteries come in different strengths. The 'strength' of a batteries push, also
known as the **voltage, is measured in volts (V).**
We can increase the voltage in the circuit by swapping to a higher volt battery or by adding multiple batteries into the circuit. For example, if we use 3x 10 volt batteries, the total voltage in the circuit would be 30 volts.
In a circuit there is a link between the **voltage and the current**. If the voltage is increased there is a bigger push force from the battery, this results in a greater current/ flow of electrical charge around the circuit. If the current is greater, more **energy is transferred** to the bulbs and so they are brighter.

3. How does a battery work?

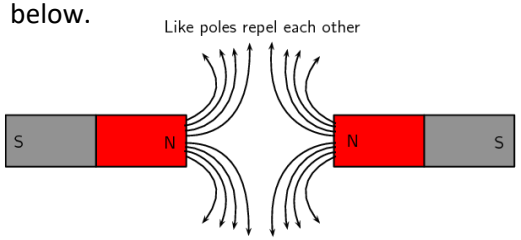
Work is done if a force is applied to move something a distance.
Work done (J) = Force (N) x Distance (m)
In a circuit the battery applies a force to move the electrons around the circuit and so is therefore doing work.
Batteries with bigger voltages push harder and so move the electrons a larger distance. As they are applying a bigger force and moving the electrons a larger distance we can say they are doing more work.
Batteries are filled with chemicals that allow a circuit to work, this is a **chemical energy store.** The larger a battery is, the more chemicals it contains. As the battery does work these chemicals are used up until eventually they 'run out'. Energy is transferred to the moving charges from the battery and then to the components in the circuits.

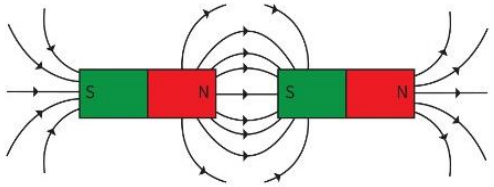
4. How does voltage affect resistance?

Resistance is a force in a circuit that opposes the flow of current. When we have a higher **voltage** in a circuit the **electrons** are pushed around the circuit with a bigger force. This means they move faster and so there is a bigger current. As the electrons move faster through the wires there is more resistance.
The higher voltage in a circuit the bigger the resistance.
We add very thin wires into circuits on purpose, this thin wire is called a **fuse**. If there is a fault in the circuit that causes too much current to flow the resistance gets so high that, the fuse blows and the appliance is protected. This is the circuit symbol for a fuse.

5. What other types of magnetic fields are there?

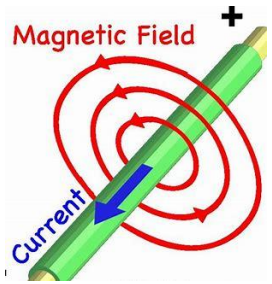
Magnetic fields are areas around a magnet where the magnetic force can act.
Magnetic fields can act around an individual magnet or two interacting magnets. Some magnetic fields are shown below.





Attraction between opposite poles

When current flows through a wire the wire becomes magnetic, this magnetic force is usually too small to notice but there will be a magnetic field is created around the wire. If the current is not flowing through the wire, there is no magnetic field.



6. What is an electromagnet?

An **electromagnet** is created by **coiling** a wire around an **iron core.**
When a current flow through the wire a magnet is created.
Electromagnets are useful as when the current is switched off they are no longer magnetic. This means they can be used pick up magnetic material move it and then drop it somewhere else.
We can increase the strength of an electromagnet by
-Increasing the number of turns per cm
-Increasing the current flowing through the wire
-Using an iron core

7. What happens when two magnetic fields interact?

Circuits inside an appliance with a moving part contain a **motor**. A motor **transfers** energy from the **chemical store** of the battery to the **kinetic store** of the moving part, such as the blades of a fan.
Inside a motor is a coil of wire between the poles of a magnet.
When the current flows through the coil of wire, a magnetic field form around it. The magnetic field of the wire then interacts with the magnetic field of the magnet causing the coil to rotate.