Year 9 Biology Knowledge Organiser

Composite title	Essential knowledge	Key words
What can you remember about cells?	See below	Cell Organelle Nucleus Cytoplasm Cell membrane Chloroplast Vacuole Neurone Myelin sheath Microvilli

Essential knowledge

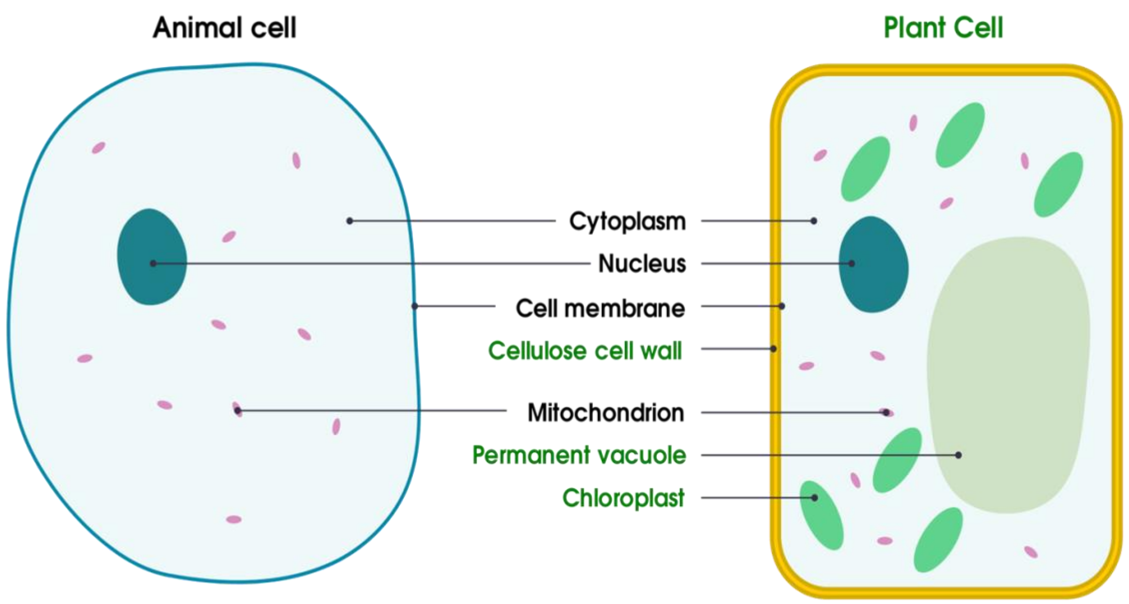
All living organisms are made up of cells.

Animal Cell structure include:

- Nucleus
- Membrane
- Cytoplasm
- Ribosome
- Mitochondria

Plant cell structure include organelles above plus:

- Cell wall
- Chloroplast
- Vacuole



Function of the cell structures.

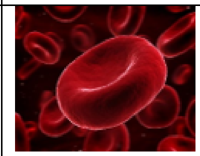
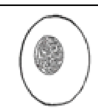
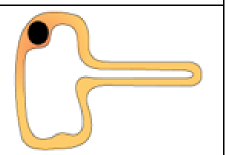
- Cytoplasm - Chemical reactions occur here
- Nucleus - Contains the genetic information. Controls the cells activity
- Cell membrane - Controls what enters or leaves the cell
- Mitochondria - Carry out respiration to release energy
- Chloroplast - Photosynthesis occurs here.
- Vacuole - Contain cell sap to keep cell swollen.
- Cell Wall - Provides structure and support.

These cells can differentiate into specialised cells

Multicellular organisms consist of many cells.

Specialised cells are cells that have a specific function. They are well adapted to carry out their function in a number of different ways.

(Recap examples of specialised cells on the right)

Cell	Function	Adaptations	Image
Red blood cell	To carry oxygen around the body	Large surface area to carry oxygen. Haemoglobin to carry oxygen. No nucleus for plenty of space for haemoglobin.	
Sperm cell	To reach female egg cell and fertilise it (fuse with it)	Tail for swimming. Acrosome with digestive enzymes to help break through egg cell. Mitochondria to provide energy.	
Egg cell	To be fertilised by a sperm cell	Only allows one sperm cell through membrane. Contains yolk which provides a large store of nutrients	
Root hair cell	to absorb water from the soil for the plant.	Thin membrane and a large surface area to speed up the rate of diffusion.	

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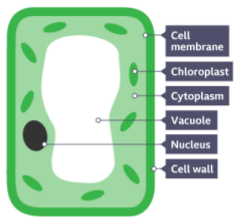
Other specialised cells include:

a) Palisade cells – which contains lots of chloroplasts for photosynthesis
b) Neurone – contains myelin sheath to insulate the neurone
c) Cells with microvilli – provide a large surface area
d) Ciliated epithelial cells - cilia on the surface which move substances along

a)



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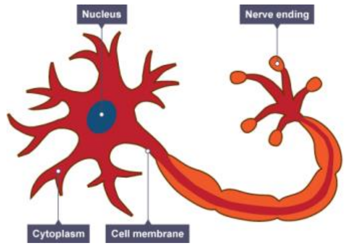
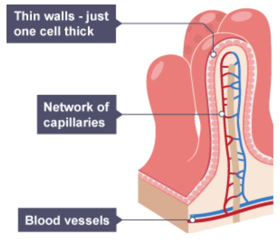


c)



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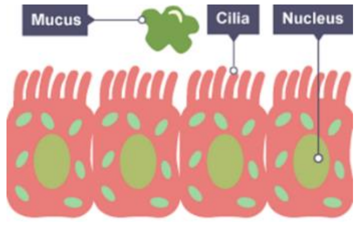
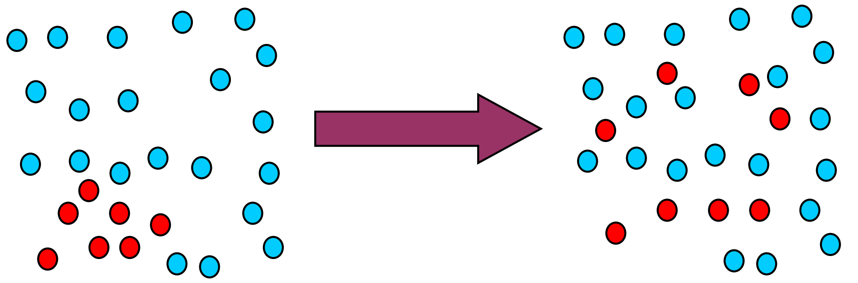
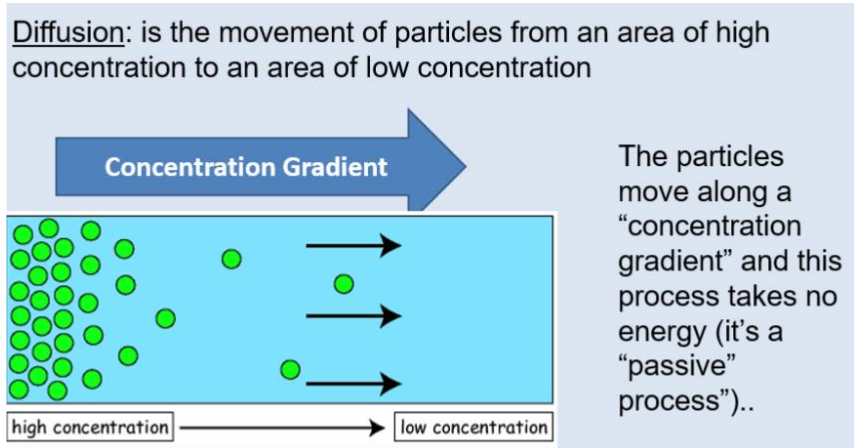


How are substances transported?

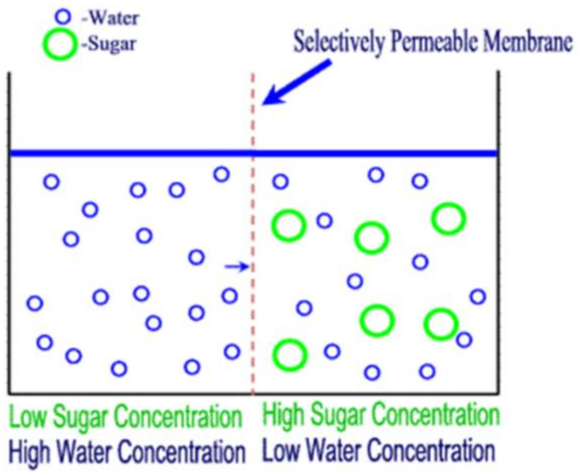
Recap: **Diffusion** is the movement of particles from an area of high concentration to an area of low concentration

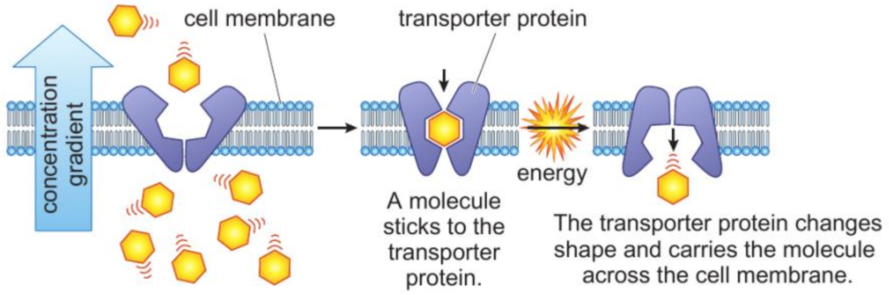
A **concentration gradient** is the difference between the concentration in two areas.





Osmosis is the movement of water from high water concentration to low water concentration through a partially permeable membrane





Active transport is the movement of particles from a low concentration to a high concentration across a membrane, requiring **energy**.

Concentration
Gradient
Diffusion
Osmosis

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What are enzymes?

Enzymes are biological catalysts – speed up reactions, unchanged at the end.

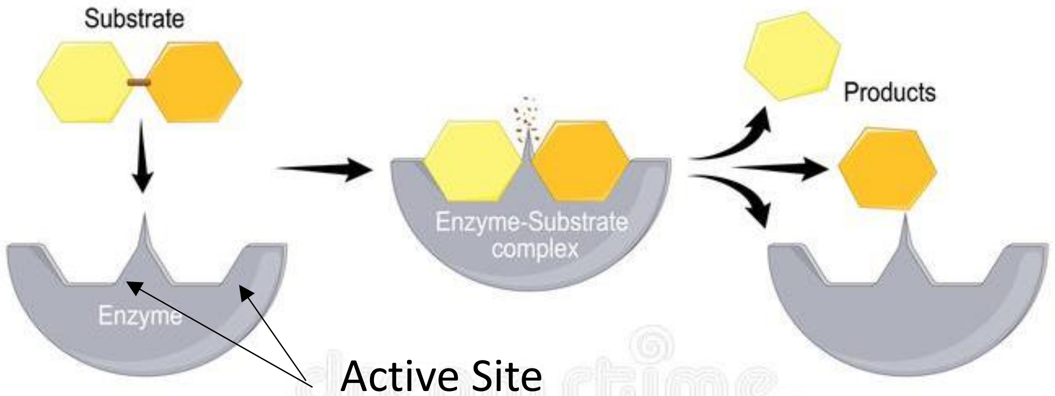
Examples of enzymes in the digestive system; Protease breaks down proteins into amino acids, Lipase breaks down fats into fatty acids and glycerol, Amylase breaks down starch into glucose

Enzymes can also synthesise molecules (make larger molecules from smaller ones)

e.g. starch synthase in plants.

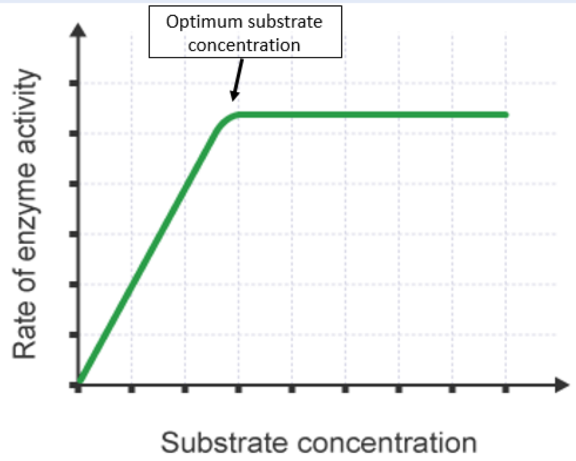
Enzyme	Large insoluble molecule → small soluble molecule	Where found?
Amylase	Starch → Glucose	Mouth Pancreas Small intestine
Protease	Protein → Amino Acids	Stomach Pancreas Small intestine
Lipase	Fats → fatty acids + glycerol	Pancreas Small intestine

Enzymes:



Enzymes are highly specific. An enzyme will only work one type of substrate. (like a lock and a key)

Optimal substrate concentration



- As the substrate concentration increases so does the rate of enzyme activity
- The optimum substrate concentration is where the rate of enzyme activity is at its highest
- After the optimum substrate concentration the rate of enzyme activity remains the same because there are not enough enzymes for the substrates.

Effect of substrate concentration on enzyme activity

Enzyme
Protease
Amino
Amylase
Synthesis

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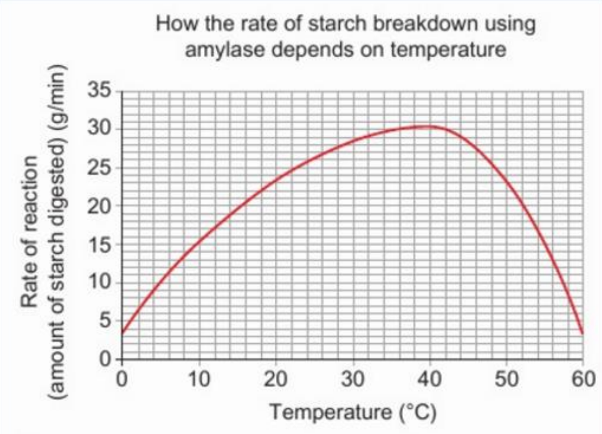
Optimal temperature

- All enzymes work best at a particular temperature.
- The **optimum temperature** is where the optimum (fastest) rate of reaction occurs.
- In humans, enzymes work best at 37°C. They have evolved to do this.



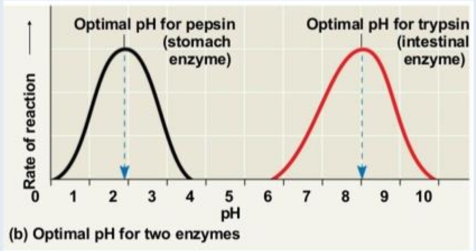
B the data in graph A shown as a rate of reaction gr

Effect of temperature on enzyme activity

Above the optimum temperature enzymes **denature** – this is where the enzymes active site changes shape so no longer works.

Optimal pH

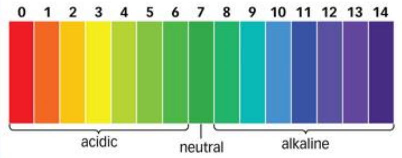
- All enzymes work best at a particular pH. The **optimal pH** is where the optimal (fastest) rate of reaction occurs.



Effect of pH on enzyme activity

Above or below the optimum pH enzymes denature

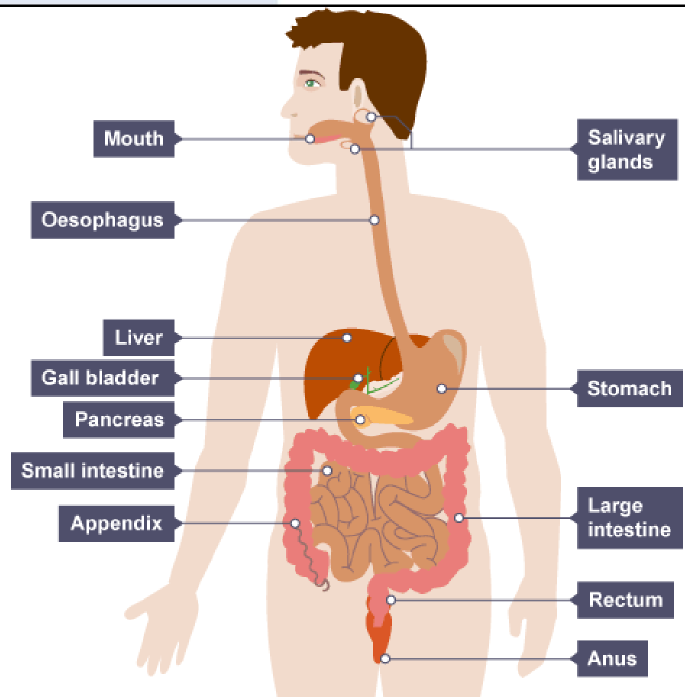
Amylase Optimal pH = 7
Stomach Protease (pepsin) Optimal pH = 2.4
Pancreatic Protease (trypsin) Optimal pH = 8.5
Lipase Optimal pH = 8



How is our body adapted for food absorption?

Recap: Organs involved in the digestive system and their function:

- **Mouth** –Break-down of food by force (known as mechanical breakdown). Mixes food with saliva, which contains enzymes which break down carbohydrates
- **Oesophagus** – Pushes food down to the stomach (peristalsis – uses smooth muscle)
- **Stomach** – Contains hydrochloric acid (and also contains enzymes that break down proteins)
- **Liver** – produces bile to neutralise stomach acid and emulsify lipids.
- **Small intestine** – absorbs nutrients and contains enzymes that break down lipids and carbohydrates
- **Large intestine** – absorbs water
- **Rectum** – stores poo (faeces)
- **Anus** – ring of muscle allows the removal of waste (egestion) from the digestive system.



Oesophagus
Stomach
Pancreas
Villi
Diffusion

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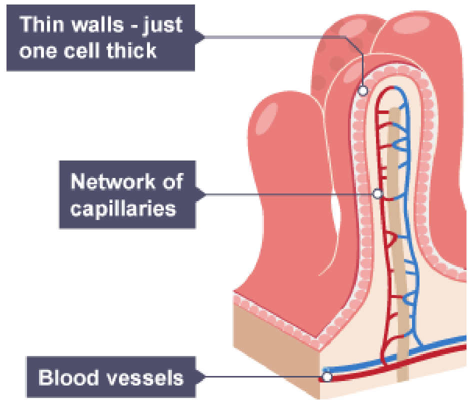
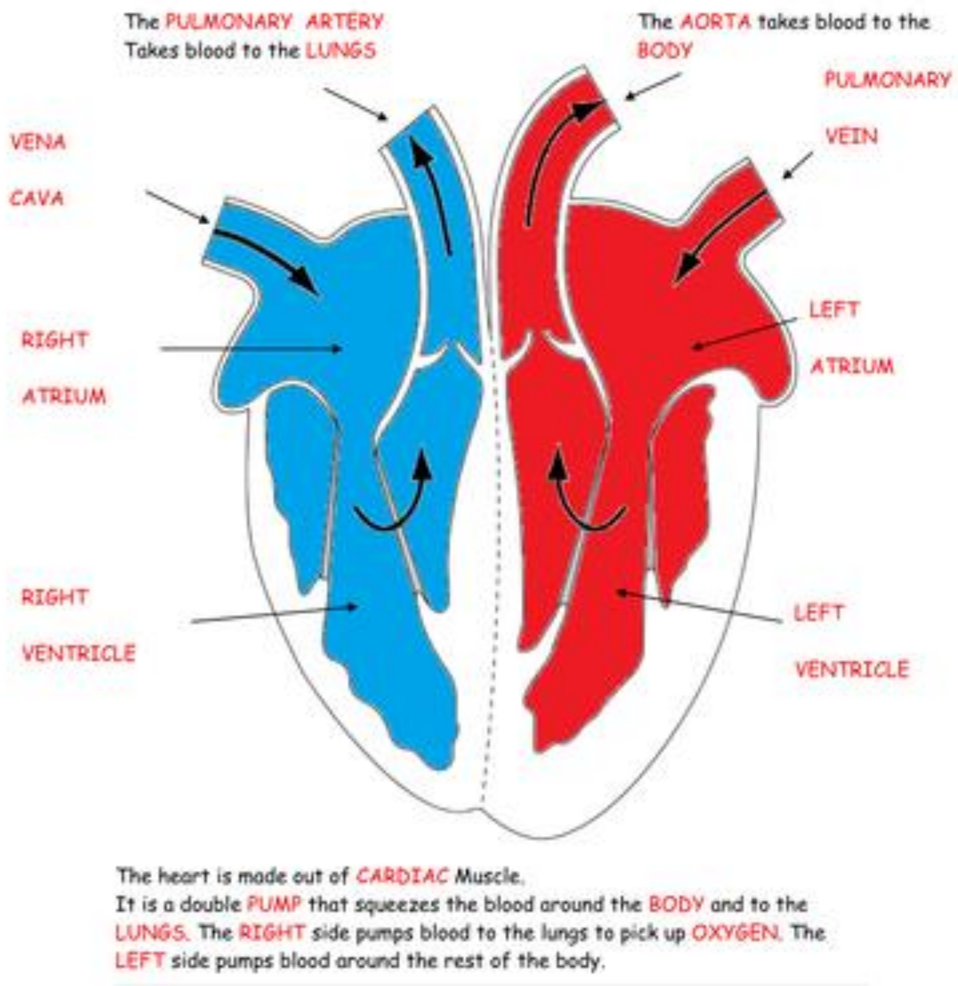
Small intestines contain specialised cells with micro-villi. These have a large surface area, thin walls, short diffusion distance, moist lining and good blood supply



How does blood travel around our body?

The **circulatory system** includes the heart and blood vessels



The heart is a pump that pushes blood around the circulatory system.

The right hand side of the heart pumps the **deoxygenated** blood to the lungs.

The left side pumps **oxygenated** blood to the working muscles (body).

Blood vessels:

Arteries take blood from the heart

Veins take blood into the heart

Capillaries connect arteries and veins and are where exchange happens between the blood and cells

Deoxygenated means there's no oxygen in the red blood cells. Oxygenated means there is.

Atrium
Ventricle
Aorta
Vena cava
Pulmonary
Artery
Vein
Platelets

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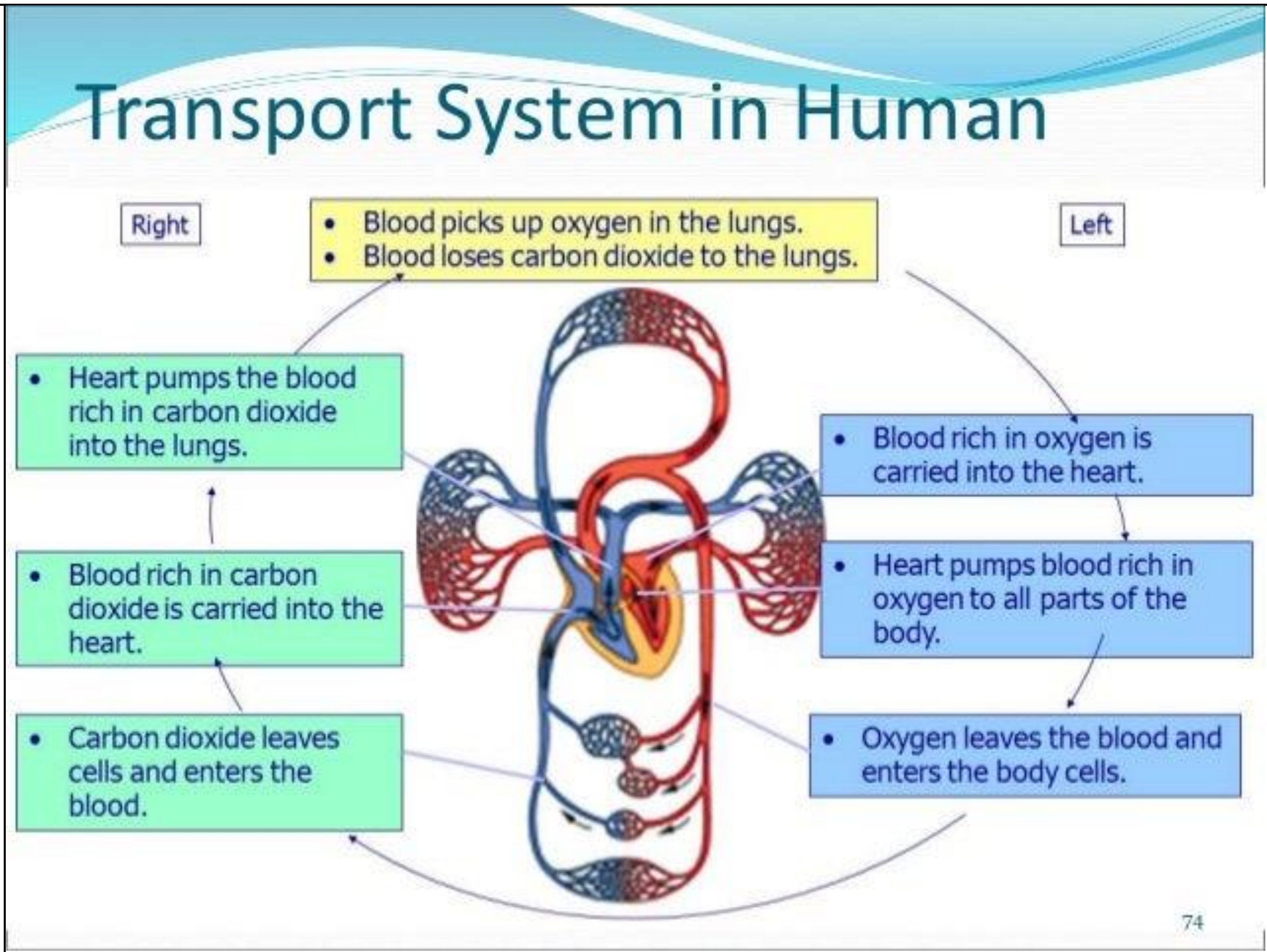

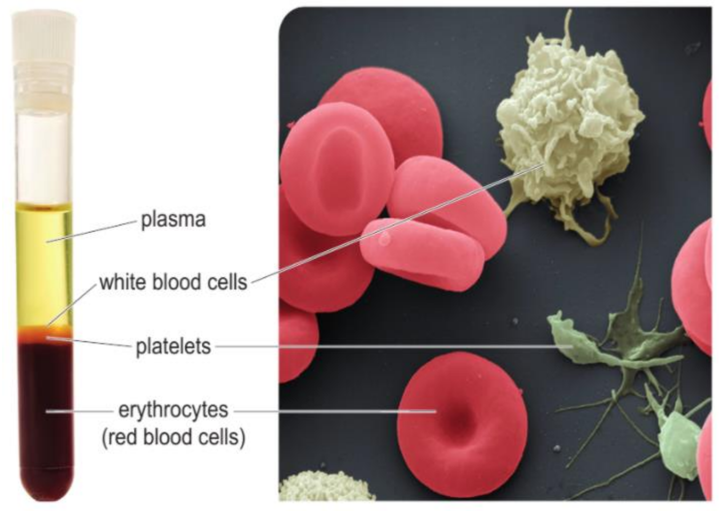

C the components of blood

Blood

Blood is a mixture of cells carried in a liquid called **plasma**. Plasma transports dissolved substances such as glucose and carbon dioxide.

There are three main types of blood cell. Each has a different function.

- **Red blood cells** (**erythrocytes**) contain the red pigment **haemoglobin**. Haemoglobin carries oxygen.
- **White blood cells** include **phagocytes** and **lymphocytes**. They help the body to attack infections.
- **Platelets** are tiny pieces of larger cells. They help blood to clot if a blood vessel is damaged.

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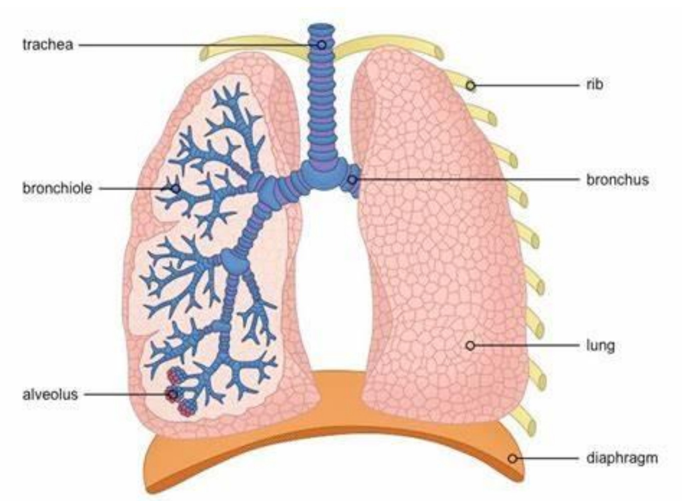
What is respiration?

Recap:

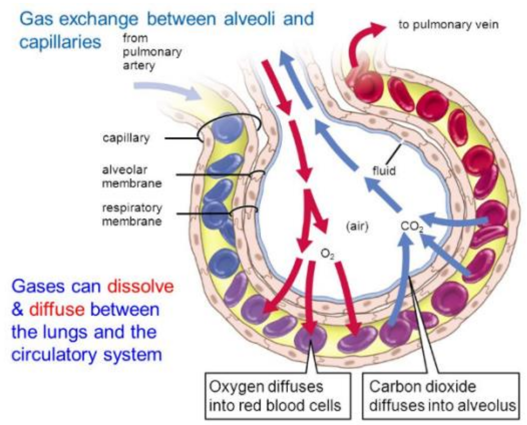


Structure of the lungs:

Process of breathing:

Inhaling – diaphragm contracts, intercostal muscles contract, volume thorax increases, pressure decreases

Exhaling – diaphragm relaxes, intercostal muscles relax, volume thorax decreases, pressure increases



The structure of **alveoli** is like a bunch of grapes.

Alveoli adaptations include large surface area, thin walls and moist lining

This means gaseous exchange is fast and there is always a big difference in concentrations of gas in the blood and lungs (a steep diffusion gradient)

Conditions linking to the respiratory system include asthma, bronchitis and emphysema

Respiration is a chemical reaction which releases energy. **It is NOT the same as ventilation or breathing!!**

Aerobic respiration is the process where oxygen breaks down the glucose to release energy.

The glucose comes from the food we eat that is broken down in the digestive system.
The oxygen is breathed in by the respiratory system. That travels around our blood via the circulatory system.

Glucose + oxygen → carbon dioxide + water (+ energy)

Reactants

Products

The carbon dioxide dissolves into blood plasma, is carried around by the circulatory system to the lungs and then breathed out.

During extreme exercise, your body cannot always provide the muscles with enough oxygen. The cells need more energy so they start to use ***anaerobic respiration***.

Glucose → Lactic Acid (+ Less Energy)

Reactants

Products

Asthma
Bronchitis
Emphysema
Aerobic
Anaerobic

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How does exercise effect our bodies?

Short term affects of exercise include:
- increased heart rate
- Increased breathing rate
- Increased respiratory rates

Long term affects include:
- build-up of lactic acid
- oxygen debt

- The body's tolerance of lactic acid is limited
- When a period of exercise is over the lactic acid must be removed
- Oxygen is required to do this
- The amount of oxygen required to remove the lactic acid, and replace the body's reserves of oxygen, is called the **oxygen debt**.
- When someone who has been exercising pays back an oxygen debt, it can take from a few hours for normal exercise, to several days after a marathon.

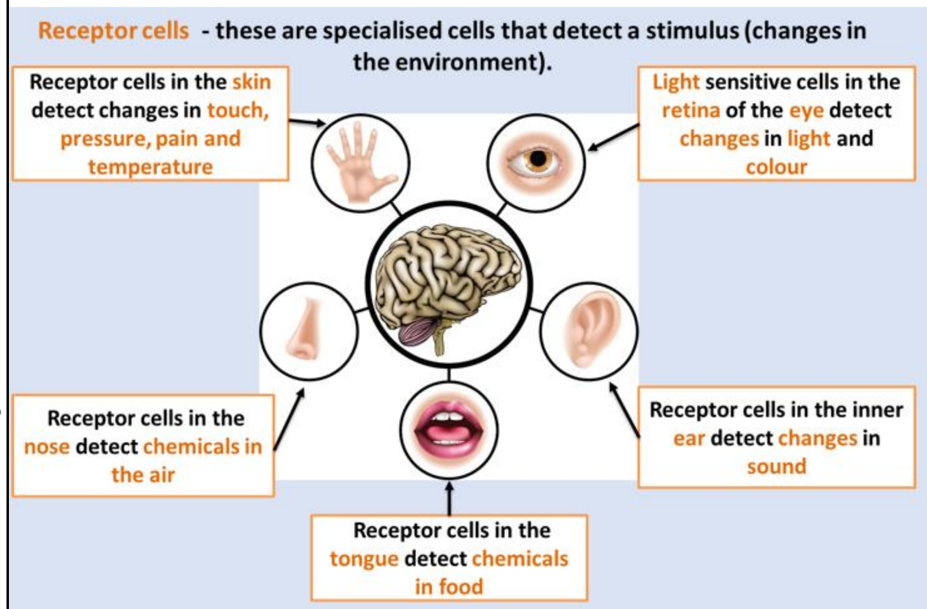
Glucose → **Lactic Acid + (little) Energy**

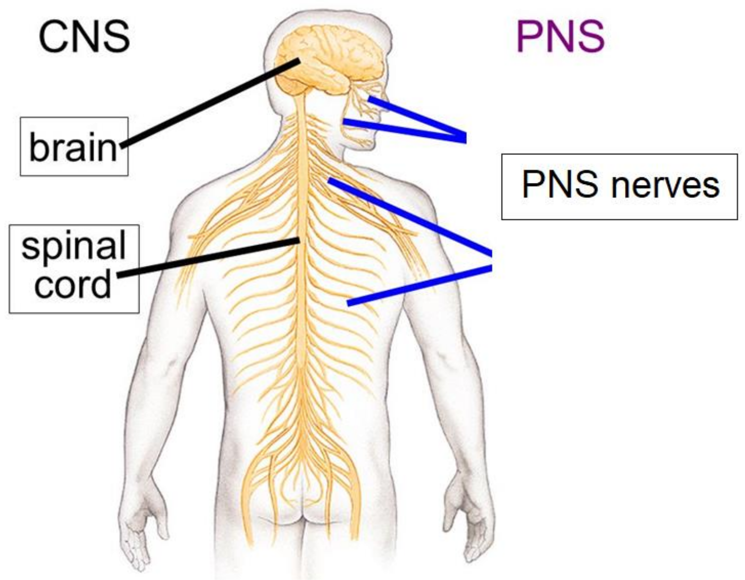
Lactic

How do we respond to our environment?

The central nervous system (**CNS**) consists of the brain and spinal cord
The peripheral nervous system (**PNS**) is all the other nerves which carry electrical impulses around the body

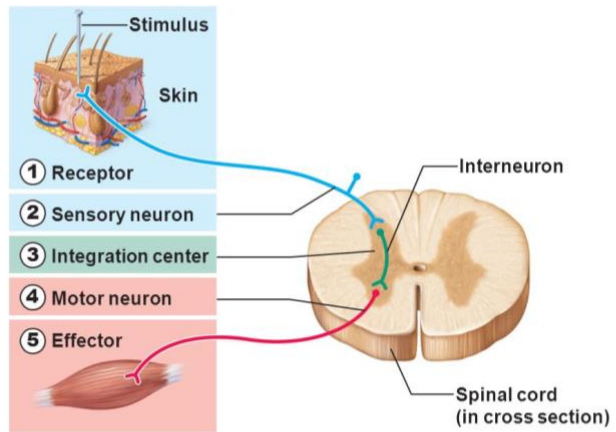
Receptor cells, that detect stimuli are found in sense organs (e.g. skin, eyes, nose)





Reflex actions are **automatic** and **rapid**; they do not involve the conscious part of the brain. The path that a reflex action takes is called a **REFLEX ARC**.

Reflex arc:
- **Receptor cells** detect a stimuli
- **Sensory neurones** carry electrical impulses from receptors to the relay neurone
- **Relay neuron** to carry electrical impulses from the sensory neurone to the motor neurone
- **Motor neurone** to carry electrical impulses from the relay neurone to the effectors.
- **Effectors** carry out a response. They are glands or muscles.



Spine
Neurones
Stimulus
Receptor
Impulse

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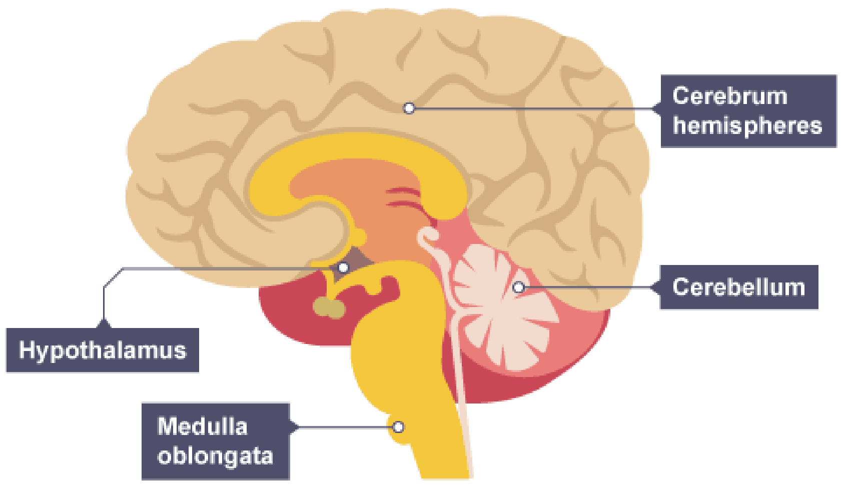
<table>
<tr>
<td>What is the brain?</td>
<td>Main parts of the brain:

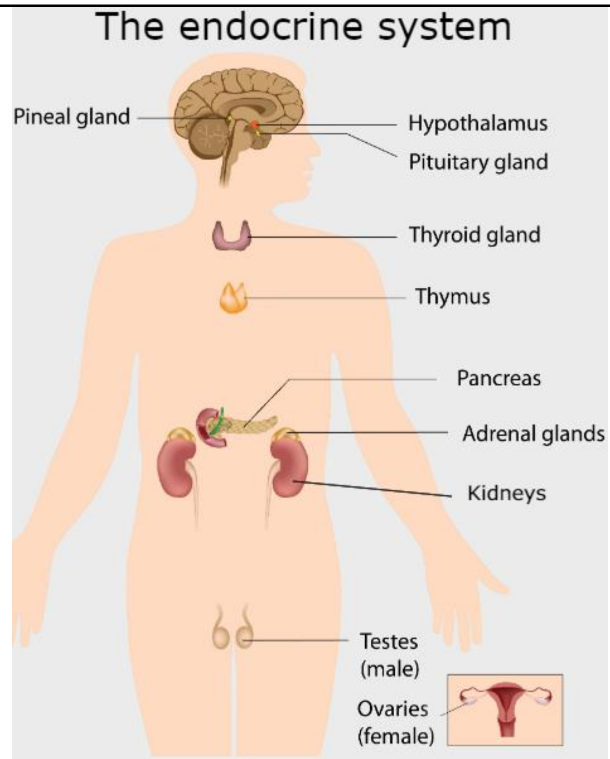
• Medulla oblongata – connects brain to spinal cord. Controls reflexes such as sneezing, vomiting, swallowing

• Cerebellum – controls balance and posture, coordinates timing and fine control of muscle activity

• Cerebral cortex – controls most of our senses, language, memory, behaviour consciousness etc. left and right hemispheres. Right side is generally used for facial recognition and musical appreciation. Left is generally used for mathematical ability, language and reasoning


</td>
<td>Medulla oblongata
Reflex
Cerebellum
Cerebral cortex
Hemisphere</td>
</tr>
<tr>
<td>What do hormones do?</td>
<td>Hormones are chemical messengers which help to control what happens in the body

Key endocrine glands and the hormones they secrete:
○ Pituitary gland secretes growth hormone and FSH and LH.
○ Thyroid which releases thyroxine
○ Adrenal gland releases adrenalin
○ Pancreas releases insulin
○ Testes releases testosterone
○ Ovaries release progesterone and oestrogen

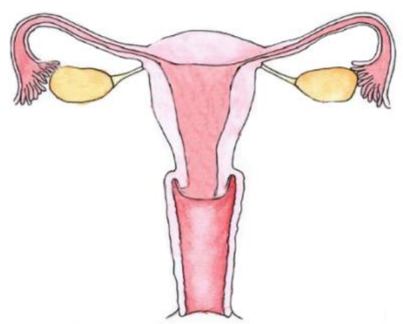


Endocrine vs nervous system; endocrine system works more slowly and the effects are longer lasting, endocrine system transports chemical messages in the blood, nervous system transports electrical impulses via neurones.

Recap days of the menstrual cycle:

The menstrual cycle:

An important part of puberty for girls is the beginning of their monthly cycle. This is known as the menstrual cycle.
The menstrual cycle involves the preparation of the uterus lining so that it is able to receive a fertilised egg.
If an egg is fertilised, it can implant itself in the prepared uterus lining.
If it is not fertilised, the lining of the uterus breaks down and is lost from the body. This is called menstruation or a period.
• Day 1-7 - Uterus wall breaks down, the woman bleeds, this is a period.
• Day 7-13 - Around day 7 the blood flow stops. Uterus wall builds up again. An egg matures in the ovaries
• Day 14 - On the 14^{th} day, the egg is released from the ovary (ovulation)
• Day 14-17 - Egg travels down the oviduct, It can last for around 3 days. If it meets a sperm in the duct, it becomes fertilised
• Day 18-28 - If the egg is not fertilised, the uterus wall breaks down and the cycle starts again.

</td>
<td>Hormone
Endocrine
Pituitary
Thyroid
Adrenal
Menstrual
Progesterone
Artificial
Contraception</td>
</tr>
</table>

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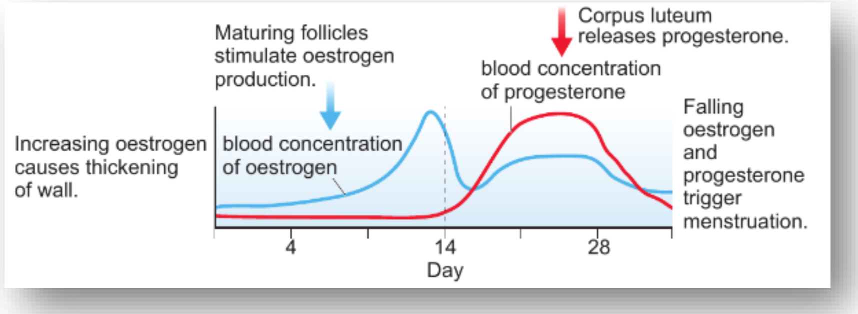
Hormonal control of menstrual cycle:

- FSH stimulates follicle to mature (**FSH** bold)
- **Oestrogen** builds uterus wall lining
- **LH** stimulates ovulation
- **Progesterone** maintains the uterus lining



- If the egg is fertilised the progesterone levels remain high to maintain the lining and menstruation stops

ART – Artificial Reproductive Technologies. E.g.

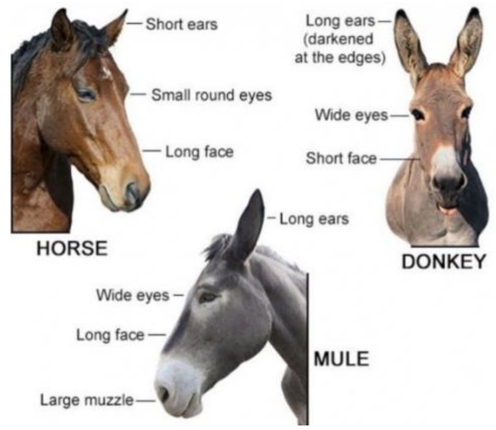
- Clomifene therapy contains FSH and LH
- IVF – when an egg is fertilised outside the body and is then implanted back into the uterus

Contraception = the prevention of fertilisation

- Hormonal contraception – the pill and implant
- Barrier contraception – condom and diaphragm

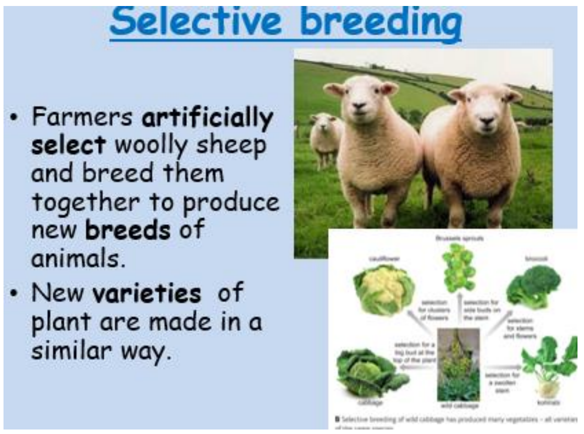
How can we modify an organism?

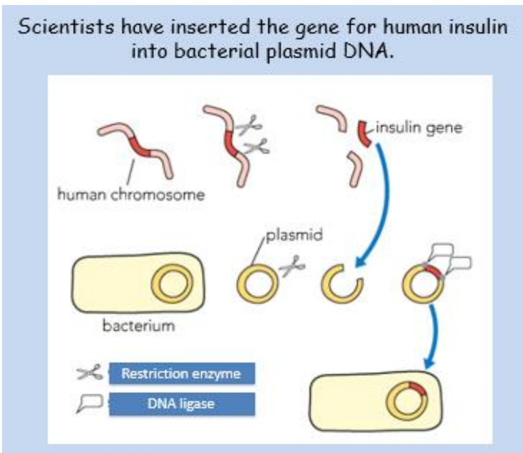
A **species** ia a group of organisms which can breed to produce fertile offspring



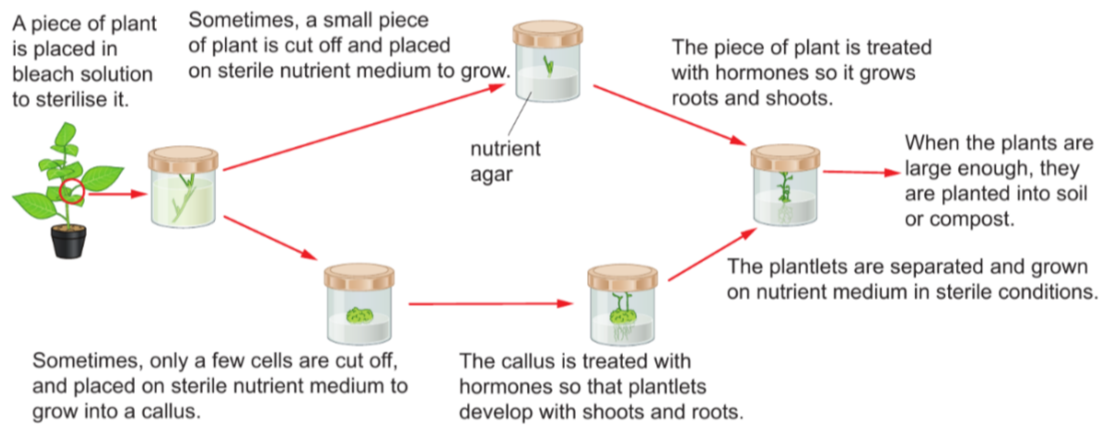
Hybrid species cannot produce fertile offspring e.g. a horse and donkey can breed to produce a mule but the mule is infertile.

Selective breeding – organisms bred based on their desirable characteristics





Genetic modification – changing an organism's genome, usually by inserting a gene.



Cloning – placing a nucleus from a body cell into a zygote and implanting this into a surrogate. E.g. Dolly

Tissue culture – growing cells on agar. Used for drug tests and studying viruses

Cuttings - used to produce clones of plants, e.g. where species are endangered, for species which are hard to grow from seed, to grow lots of new individuals quickly and cheaply.

Species
Offspring
Hybrid Characteristics
Genetic
Genome Cloning
Nucleus
Zygote
Surrogate

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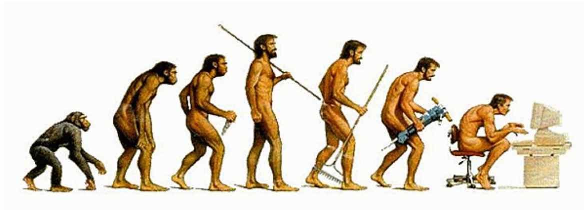
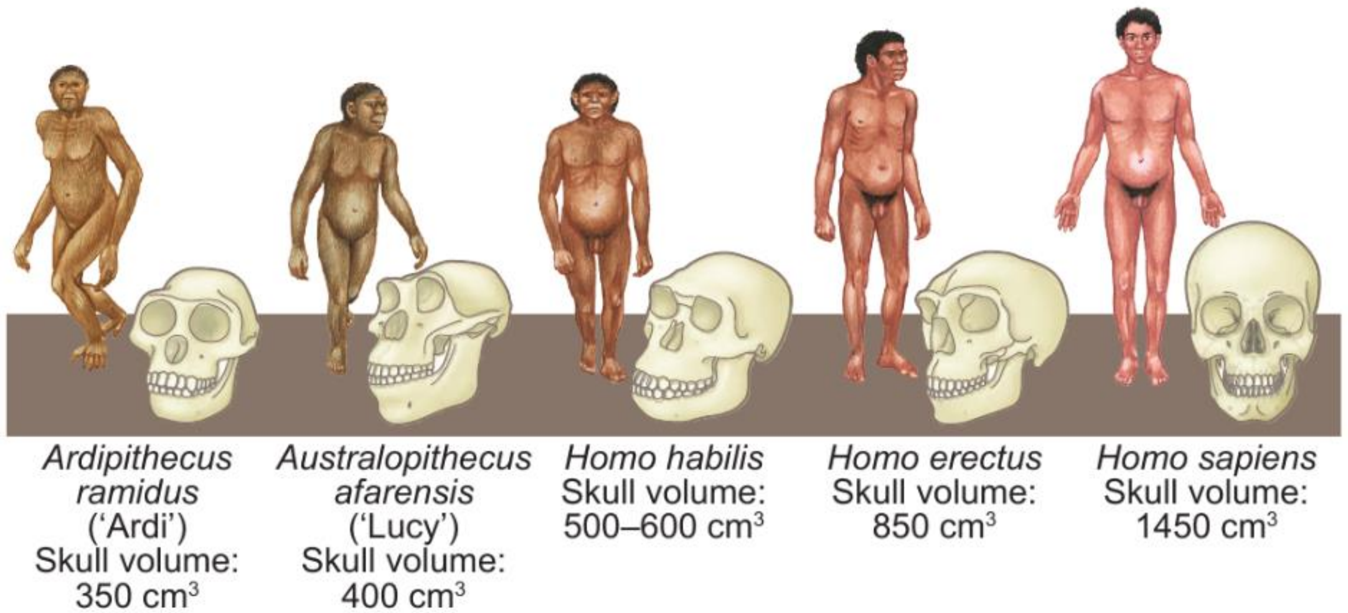
How do organisms evolve?

Evolution is the gradual change in the characteristics of species over time



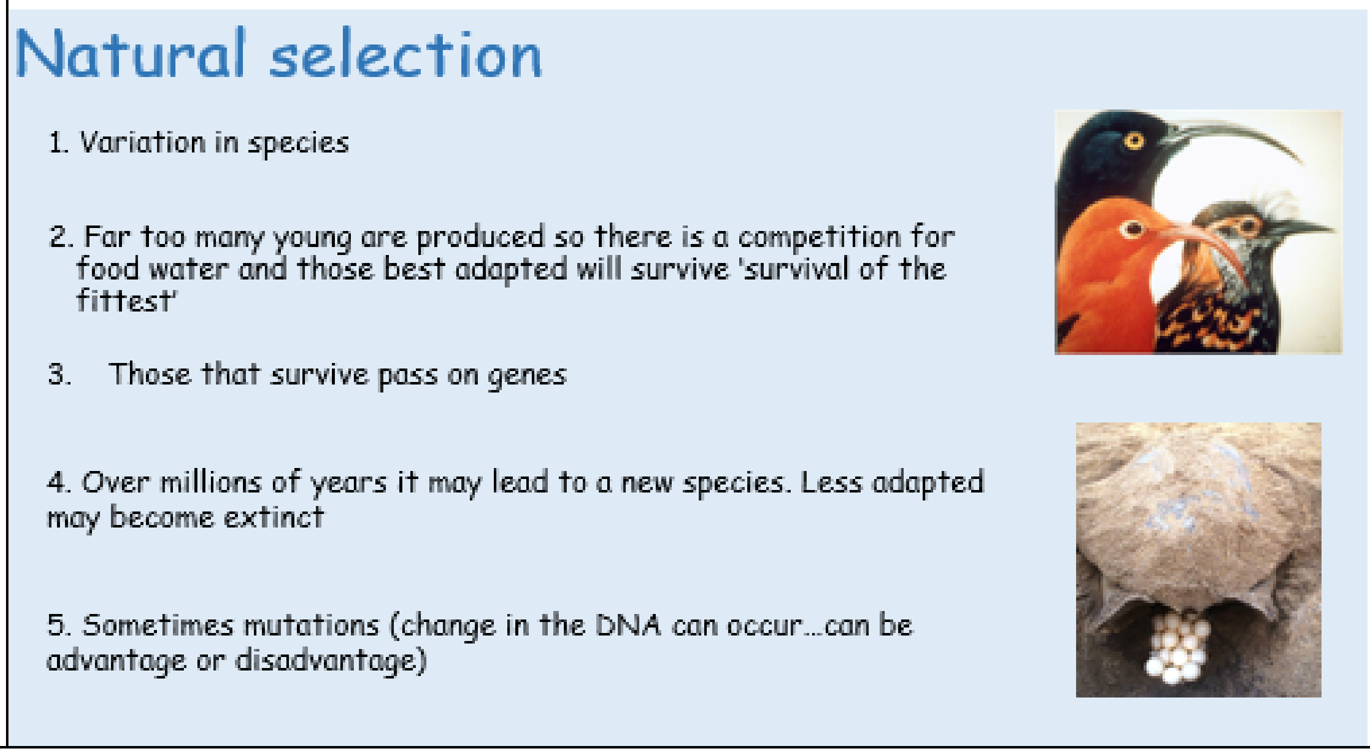
Evidence for human evolution includes fossils and stone tools (however, the fossil record is incomplete)

Human evolution and human-like species:
Ardi, Lucy, Homo habilis, Homo erectus and homo sapiens. Changes to the species include: skull volume, height, spinal curvature, toe length etc…



We can predict fossil age linked to rock layer (deeper rock, older fossil)

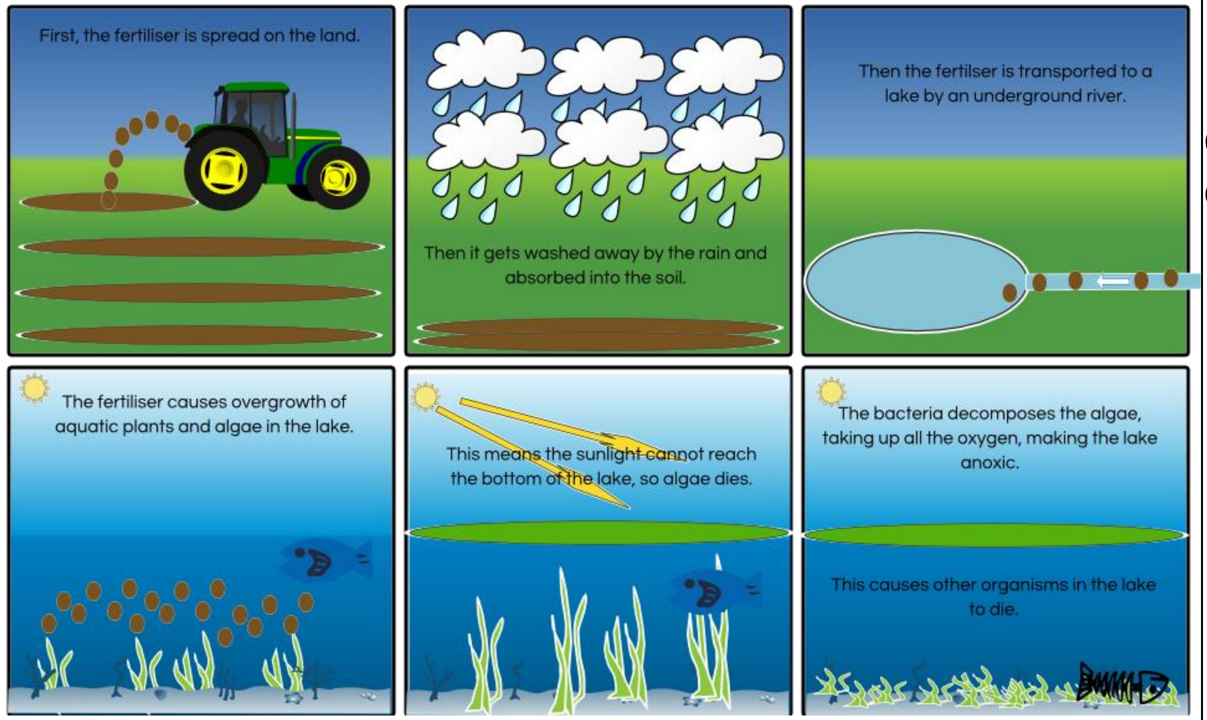
<u>Charles Darwin's Theory of Natural selection</u>



Extinction can occur as a result of being outcompeted by other species.

Evolution
Fossil
Ardipithicus
Australopithicus
homo
habilis
erectus sapiens
extinction

Year 9 Biology Knowledge Organiser

How do species interact?	**Interdependence** – organisms depending on each other for survival **Biodiversity** - is the number of different species of organisms in an area Negative human effects on ecosystems. • **Deforestation** (large scale tree removal). • **Invasive species** (introducing species from other places) • **Fish farming** (large scale farming of fish – pollutes environment) • **Eutrophication** • **Bioaccumulation** (the build up of chemicals in living organisms). These all link to reducing biodiversity and could potentially lead to extinction Positive human effects on ecosystems • **zoos** and **conservation** • **reforestation** • **gene banks** These all link to preserving biodiversity 	Interdependence Biodiversity Ecosystem Eutrophication Bioaccumulation Conservation Gene
How can we use microorganisms?	**Microorganisms** are very small living things Main types of microorganism include: Bacteria, viruses, fungi (yeast), protist. Not all microorganisms cause disease!! Many are useful to us. Reminder: All living things can carry out the 7 life processes. **M**ovement **R**espiration **S**ensitivity **G**rowth **R**eproduction **E**xcretion **N**utrition **MRS GREN**  **Biotechnology (uses of microoganisms)**: • Food production (Quorn production, cheese, yoghurt, fermentation for the production of alcohol) • Bio washing powders • Biofuels • In farming	Microorganism Fermentation Alcohol

Year 9 Biology Knowledge Organiser

How are we protected from microorganisms?

Some microorganisms are **pathogens –** Pathogens are microorganisms that cause disease.

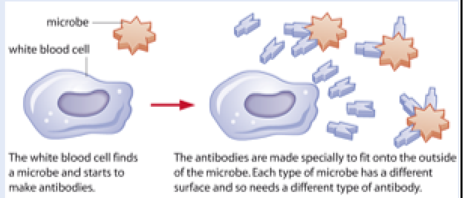
The immune system –
Once a pathogen enters the body it is killed by white blood cells. Some white blood cells engulf pathogens other produce **antibodies**.

All pathogens contain **antigens** (markers on their surface) which triggers an immune response causing the production of **lymphocytes** (the type of white blood cell that produces antibodies).

Antigens also trigger production of **memory lymphocytes** – these stay in the blood and can divide and produce antibodies quicker and in higher quantity if exposed to the same pathogen again.

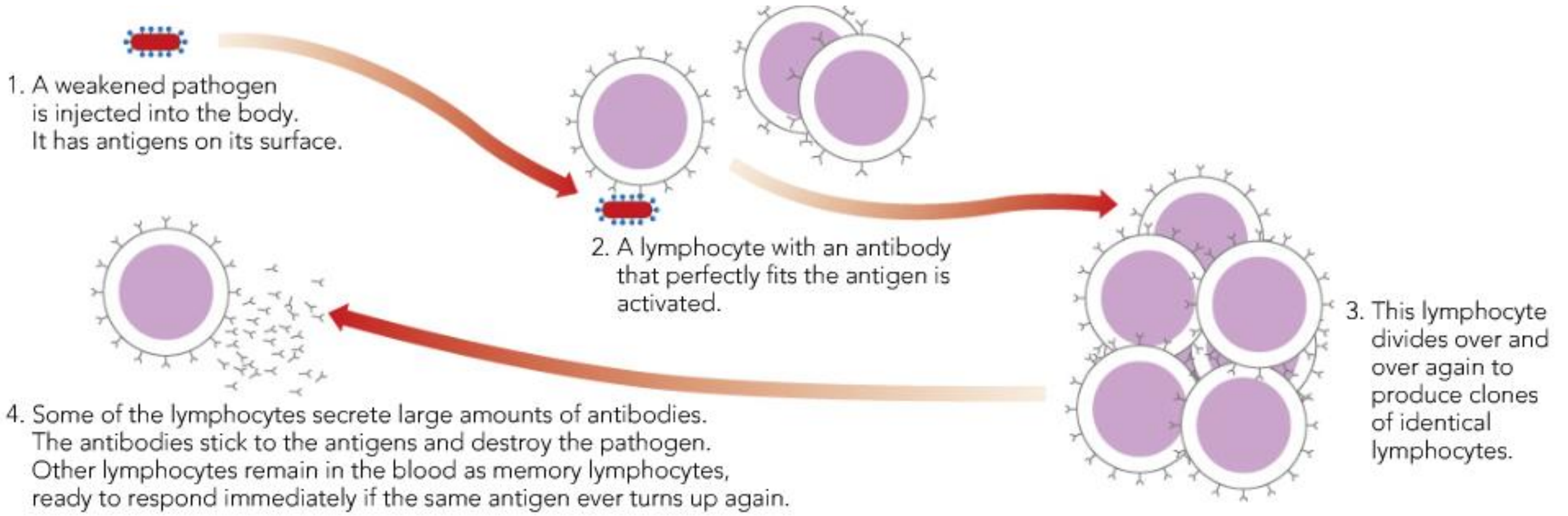
If microbes enter our blood, they are destroyed by **white blood cells.**

Some white blood cells make **antibodies** that tag microbes or cause the microbes to burst open.



Some white blood cells engulf the microbes and kill them.

Vaccinations – contain a dead or weakened version of the pathogen. Triggers immune response without symptoms. Memory lymphocytes produce lots of antibodies quickly.



Some of the lymphocytes used to destroy the pathogen become **memory lymphocytes**. If the same pathogen re-entered the body, the memory lymphocytes would respond very **quickly**. This means that we don't usually catch the disease a second time, and are now **immune** to it.

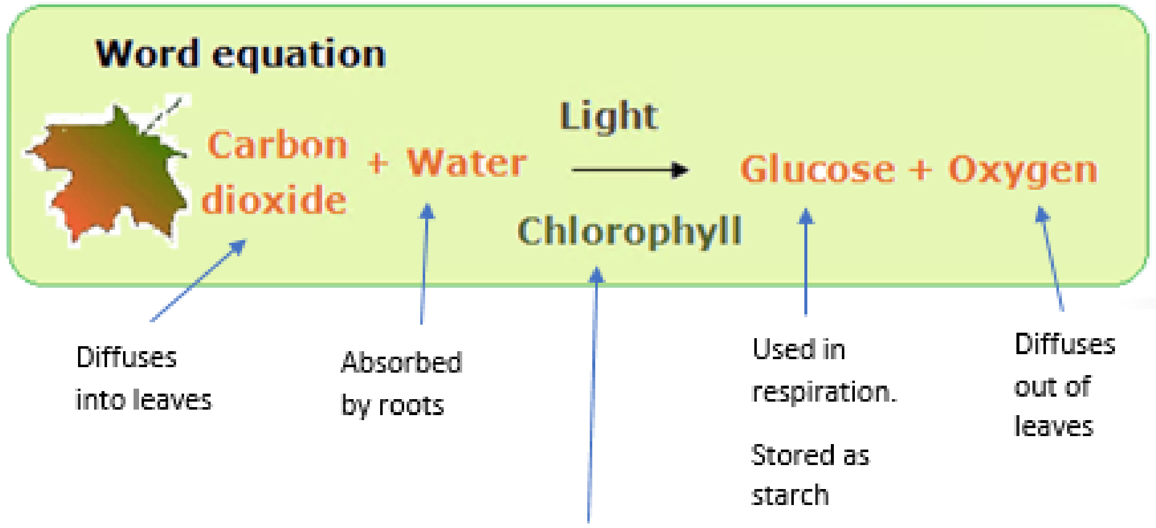
Antibiotics are used to destroy bacterial infections (they do not work against viruses.
Antibiotic resistance is a problem caused from people not finishing antibiotic courses
Antibiotic resistance used as evidence for evolution.

Pathogens
Immune
Antigen
Lymphocytes
Antibody
Vaccination
Antibiotics

Year 9 Biology Knowledge Organiser

How are substances transported in plants?

Photosynthesis is the chemical reaction that plants use to make glucose (their food).



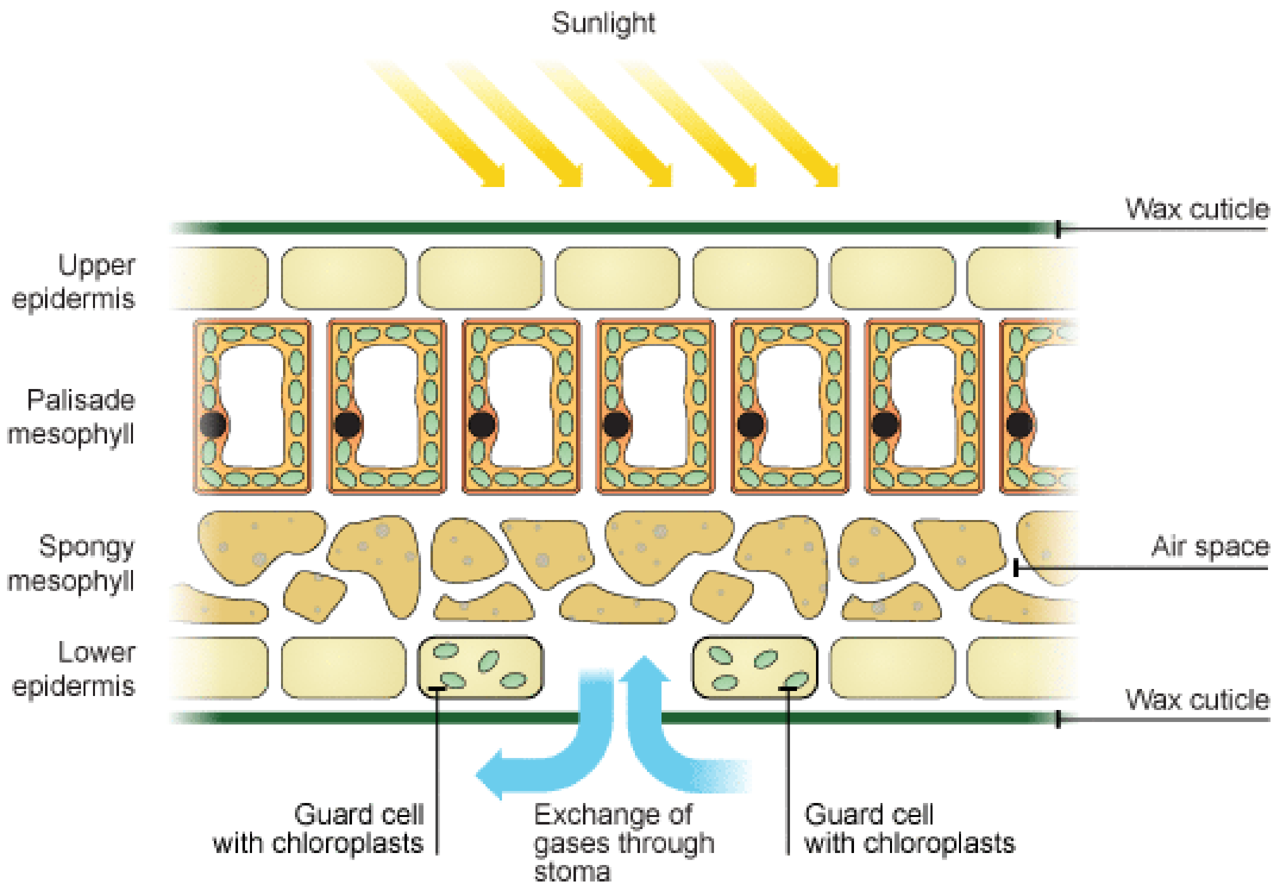
Light – from the sun

Chlorophyll – pigment found in chloroplasts

Recap: Leaf adaptations include; Flat, large surface area, thin, stomata and palisade cells

The layers and their functions in a cross section of a leaf:

- **waxy cuticle** as a waterproof layer
- **upper epidermis** few organelles to allow light to travel through
- **palisade layer**-packed full of chloroplasts
- **spongy layer** – air gaps for diffusion
- **lower epidermis** – containing guard cells and stomata (open in the day for photosynthesis, closed at night when not photosynthesising)

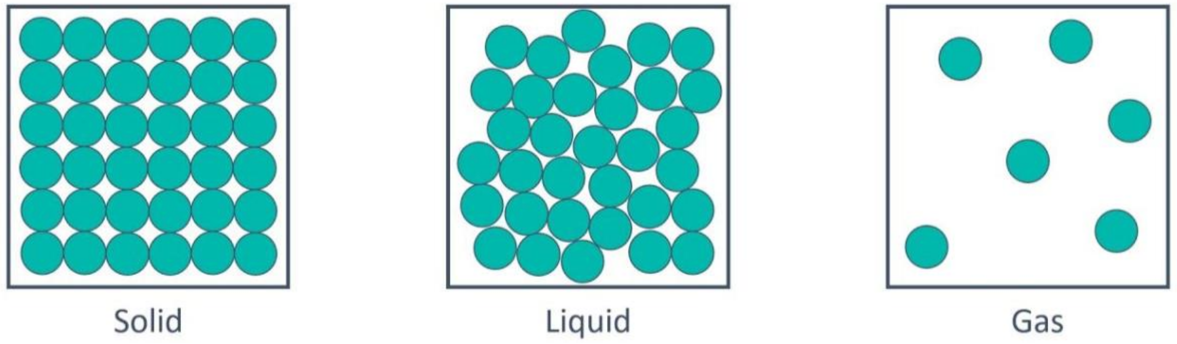
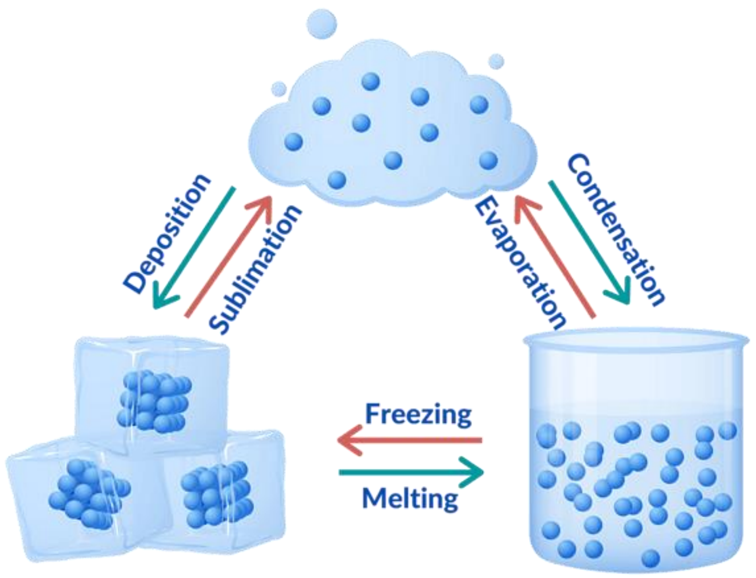
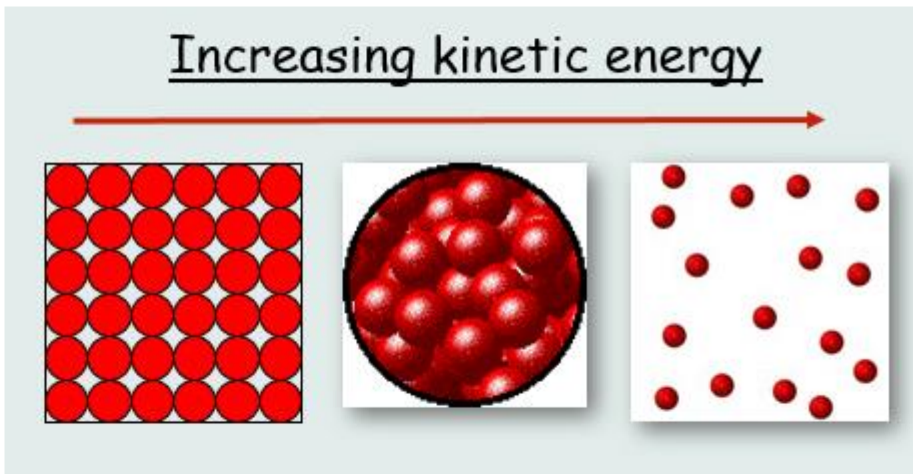


Transpiration - movement of water through the roots up the xylem, out of the stomata.

Translocation – movement of sucrose around the plant via the phloem

Photosynthesis
Adaptation
Epidermis
Palisade
Transpiration
Stomata
Xylem
Translocation
phloem
potometer

Year 9 chemistry knowledge organiser

Lesson/ composite title	Essential knowledge	Key words
What is kinetic theory?	**Matter** is the material from which everything is made. It can exist as three states: Solid, liquid and gas Particle diagrams:  Particles in solids vibrate Particles in liquids can move over one Particles in gases are spaced out. They move quickly and randomly State changes are **physical changes**. They can be **reversed.** **Changes in state**  **Kinetic theory.** All matter stores kinetic energy. Kinetic energy is stored in anything that is moving.  	Particles State Kinetic Energy

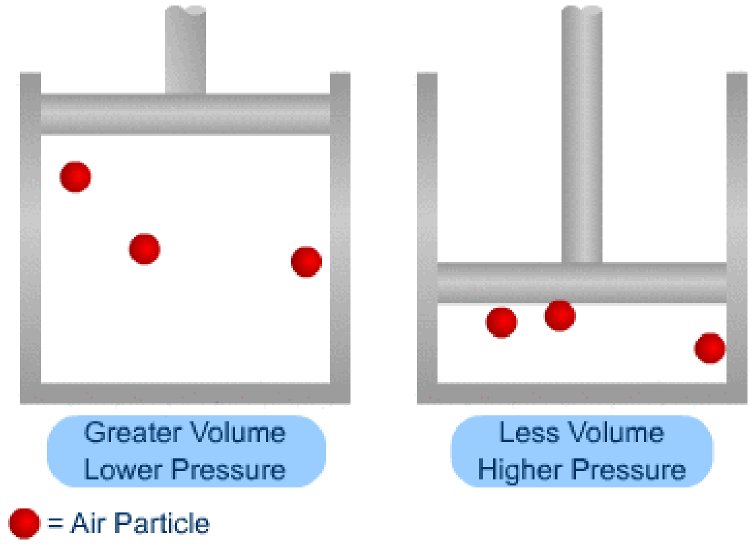
Year 9 chemistry knowledge organiser

How close are particles together?

Concentration is the number of particles in a certain volume of solution.

Concentration = mass ÷ volume

Gas Pressure is also the number of particles in a certain volume.



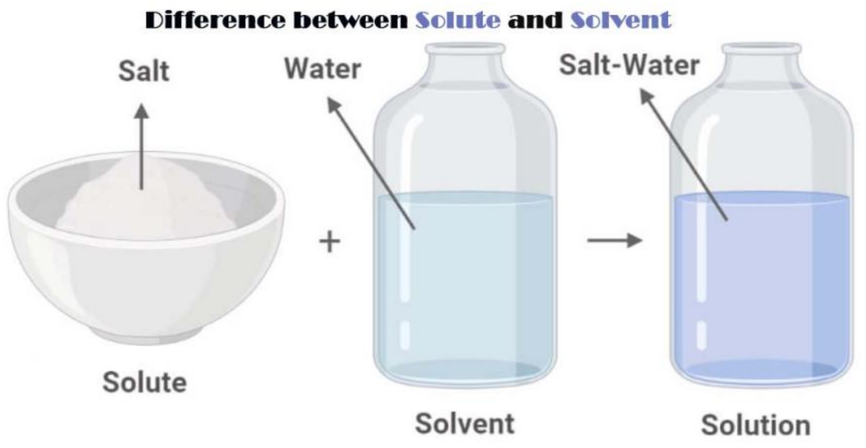
Pressure
Volume
Concentration
Solution
Mass

What is solubility?

Soluble = can dissolve
Insoluble = cannot dissolve

Solute = Something that dissolves into a solvent
Solvent = The liquid that dissolves the solute
Solution = The mixture of the solute dissolved into the solvent

In a solution the solute particles fill the gaps between solvent particles.



Saturation is where maximum amount of solute is dissolved at that temperature.

Solubility rules:

Soluble in water	Insoluble in water
• all common sodium, potassium and ammonium salts	
• all nitrates	•
• most chlorides	• silver chloride, lead chloride
• most sulfates	• lead sulfate, barium sulfate, calcium sulfate
• sodium carbonate, potassium carbonate, ammonium carbonate	• most carbonates
• sodium hydroxide, potassium hydroxide, ammonium hydroxide	• most hydroxides

Solute
Solvent
Solution
Dissolve
Soluble
Insoluble
Saturated

Year 9 chemistry knowledge organiser

How can we model the atom?

We cannot see the structure of the atom and therefore we need to use models

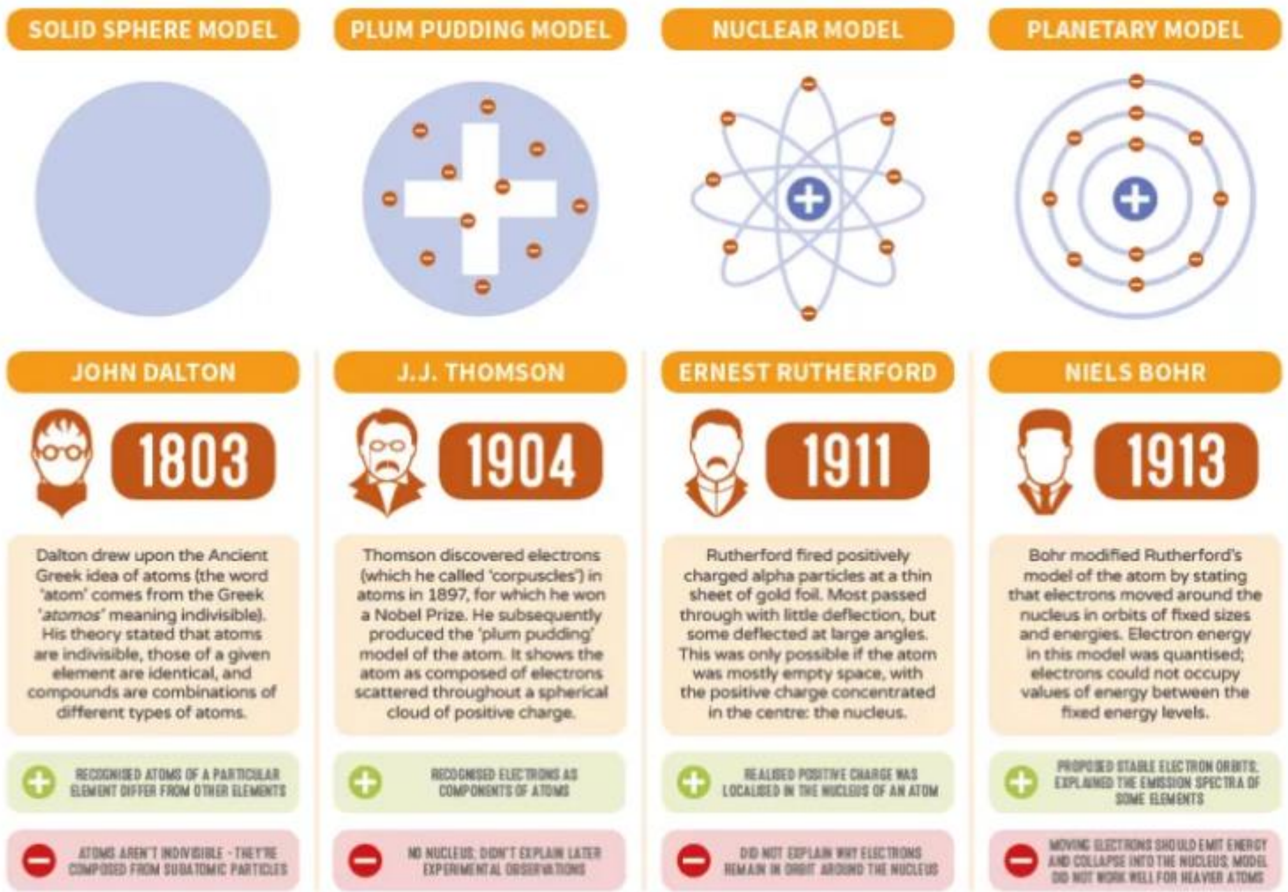
Evolution of the atom (and key scientist involvement)

J. Dalton - solid sphere model.
Dalton suggested all atoms were solid sphere that could not be broken down.

J.J Thomson – Plum pudding model.
Thomson suggested that the atom was a positive sphere with negative electrons scattered throughout

E. Rutherford – Nuclear model
Rutherford discovered that atoms have a positive nucleus in the centre. And that atoms are mostly empty space!

N. Bohr – Planetary model
Bohr discovered that electrons travel around the nucleus in distinct orbits.



Rutherfords gold foil experiment

Rutherford shot alpha particles at a thin layer of gold foil. If Thomson's model was correct they would expect all alpha particles to pass through. However, they found that approximately 1 in 8000 alpha particles bounced back. Suggesting there had to be some mass that the particles bounced back off (nucleus) and that atoms are mostly empty space.

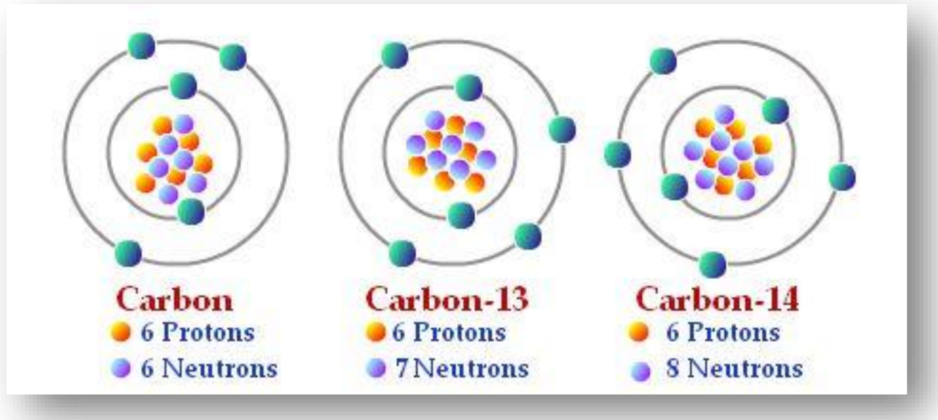
Atom
Nucleus
Proton
Electron
Neutron
Charge
Orbit

Year 9 chemistry knowledge organiser

How do atoms differ?

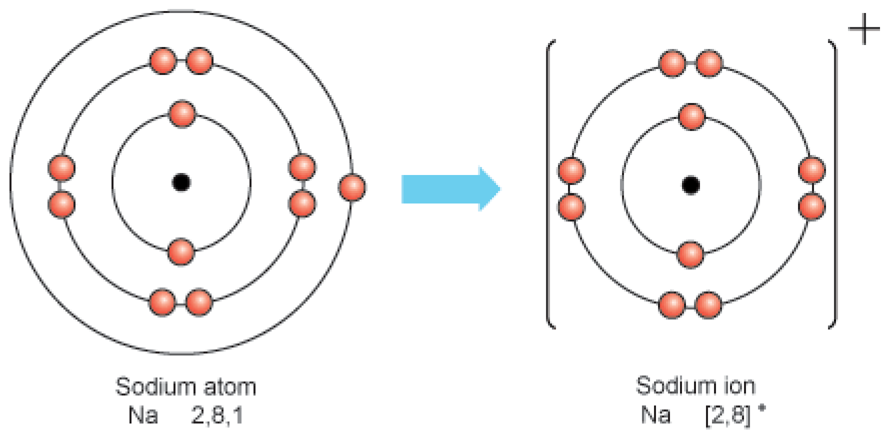
Isotopes are atoms of the same element with different number of **neutrons**

Isotopes of carbon:



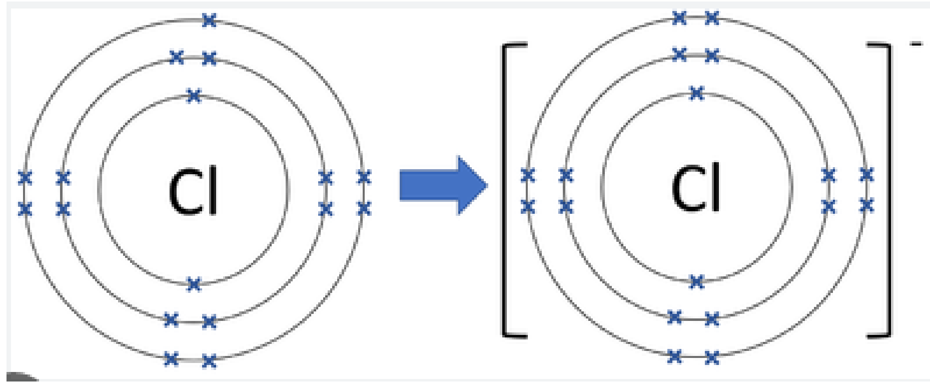
Atoms are most stable when they have a full outer shell of electrons:

Ions are atoms that have a charge
Ions form when atoms loose or gain electrons.



Sodium atoms lose an electron to form a positive ion..

Positive ions are also known as **cations**

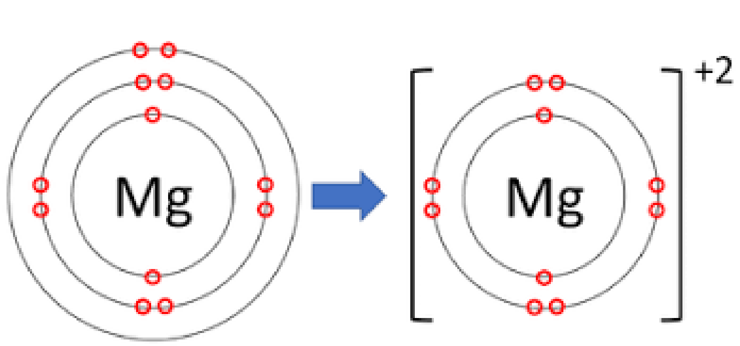


Chlorine atoms gain an electron to form a negative ion..

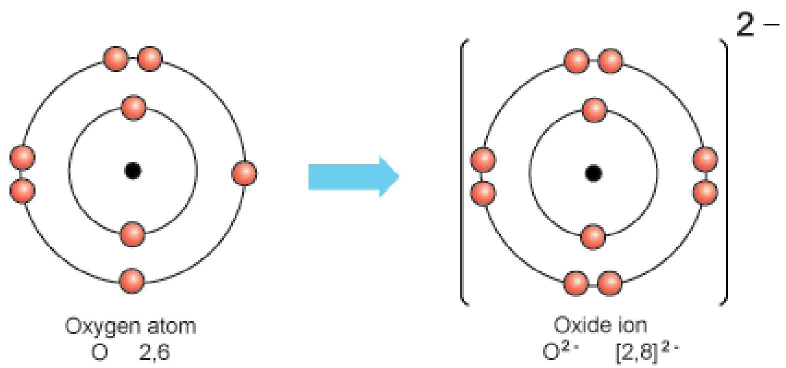
Negative ions are also known as **anions**

Ions are shown by drawing square brackets around them.

Some atoms can loose 2 electrons to form a 2+ ion e.g. magnesium



Some atoms gain two electrons to form a 2- ion e.g. oxygen



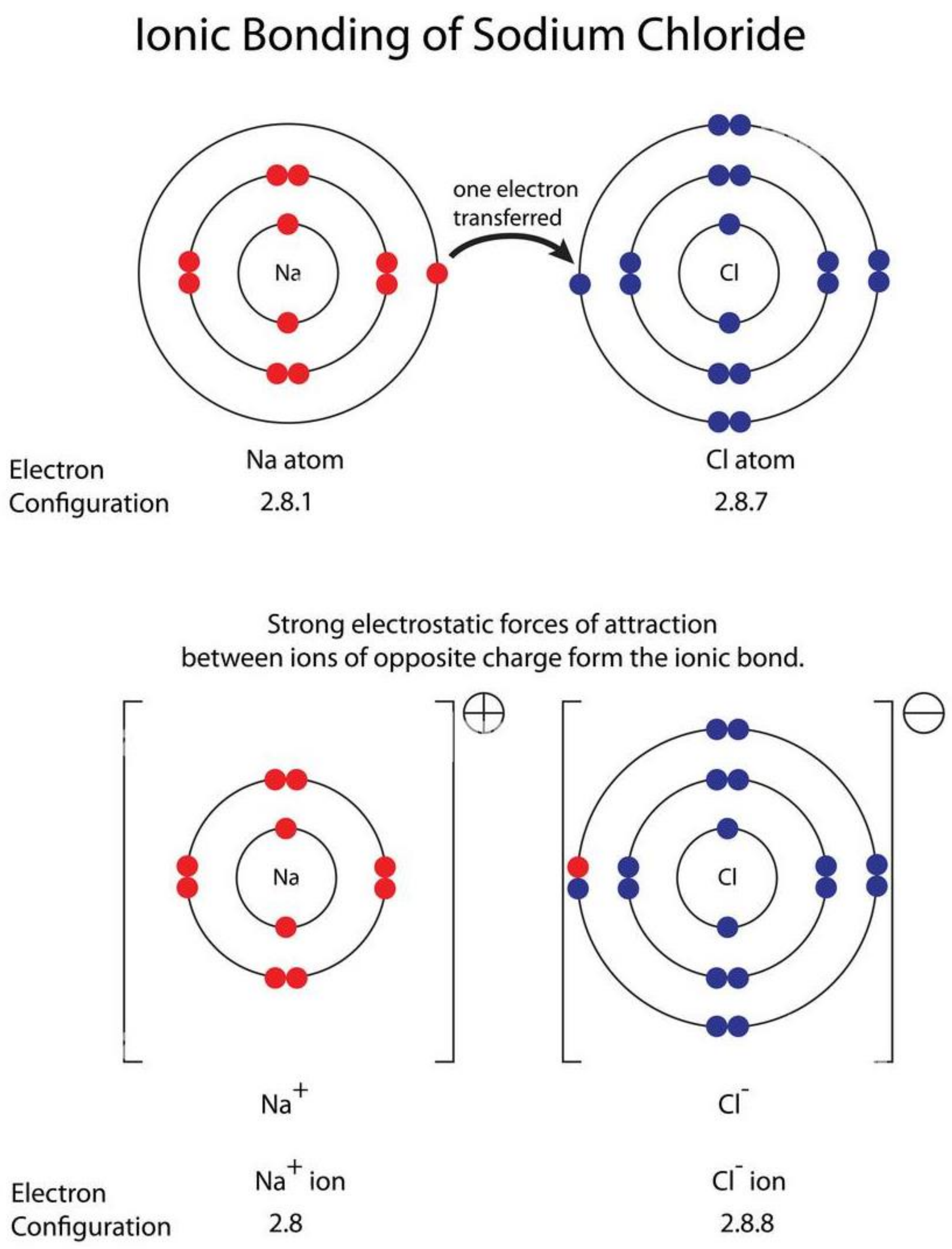
Element
Isotope
Ion
Charge

Year 9 chemistry knowledge organiser

What is an ionic bond?

Ionic bonds form between **metal** and **non-metal**
Ionic bonds involves the transfer of electrons from metal to non-metal.

For example – sodium chloride:



Metals form positive ions (cations)

Non-metals form negative ions (anions)

Sodium transfers one electron to chlorine.

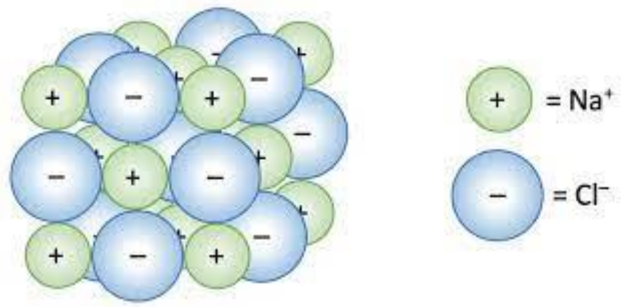
Sodium becomes a positively charged ion.

Chlorine becomes a negatively charged ion.

Opposite charges attract.

Oppositely charged ions are attracted by strong **electrostatic** forces – this is an ionic bond!

Ionic compounds form lattice structures (regular, repeating patterns)



Ionic compounds have high melting and boiling points and are good conductors when molten or aqueous.

Electrostatic
Ionic
Lattice

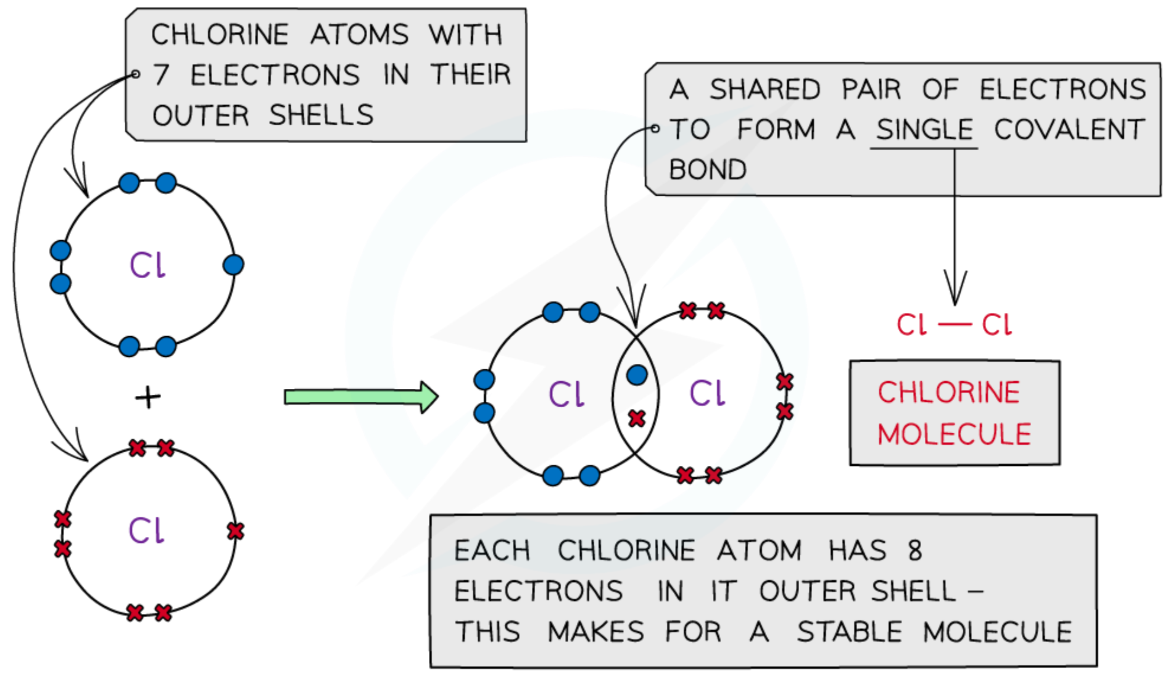
Year 9 chemistry knowledge organiser

What is a covalent bond?

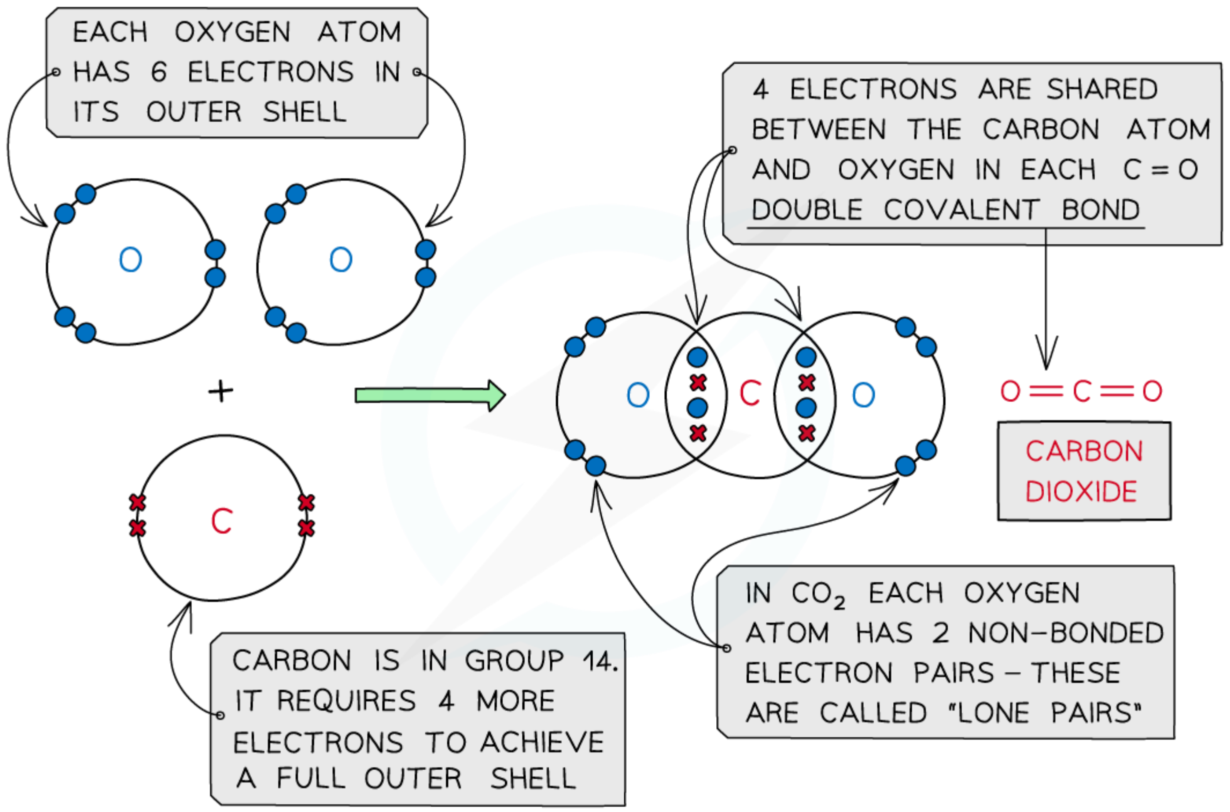
Covalent bonds form between atoms of two or more **non-metals**

Covalent bonds involve the **sharing of pairs of electrons** to achieve complete outer shells for all.

Example 1: Chlorine molecule:



Example 2: Carbon dioxide molecule.



A **molecule** is a group of atoms covalently bonded.

Properties of covalent molecules

- low melting & boiling points – covalent bonds are strong but there are also weak forces of attraction between the molecules. These weak forces of attraction do not take much energy to overcome.
- Do not conduct electricity – because there are no charged particles.

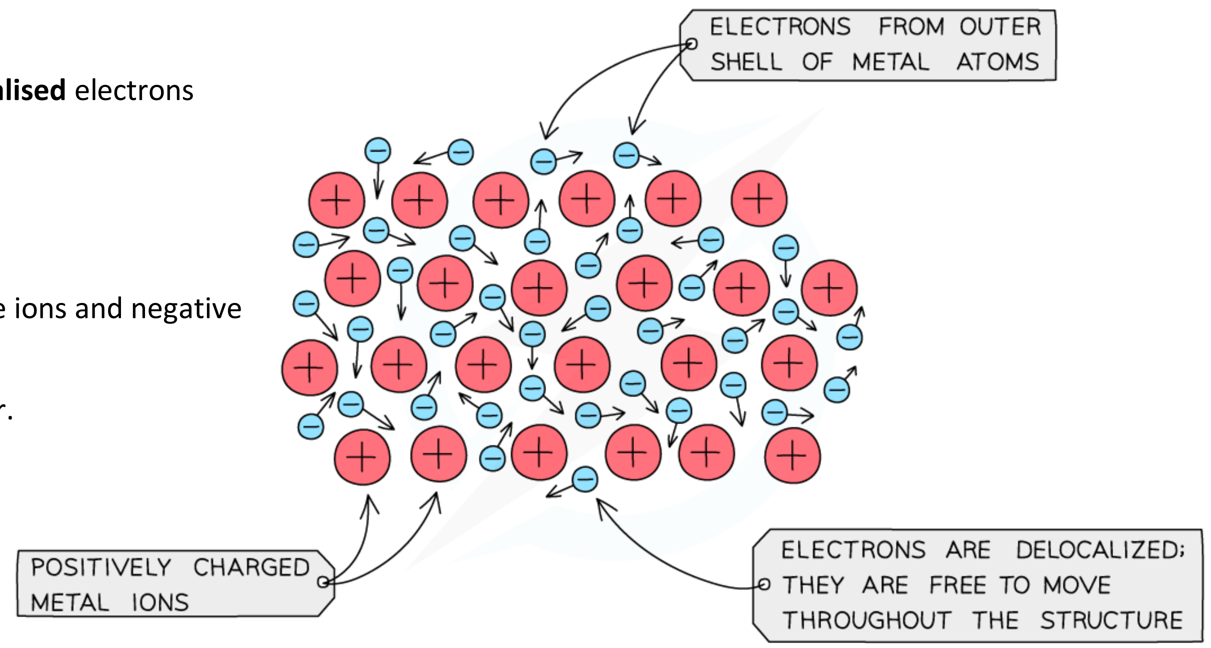
Covalent Molecule

Year 9 chemistry knowledge organiser

<table>
<tr>
<td>What does the structure of a metal look like?</td>
<td>
Metals form a lattice structure -
Regular arrangement of positively charged ions surrounded by a ‘sea’ of delocalised electrons

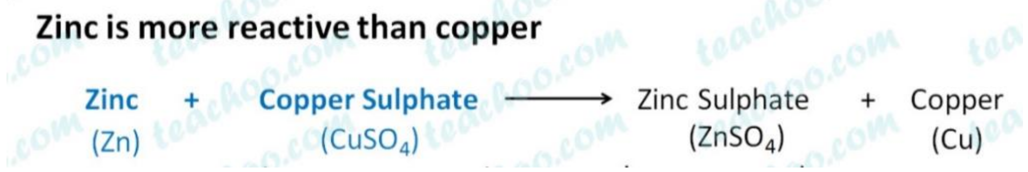
Key properties of metals:

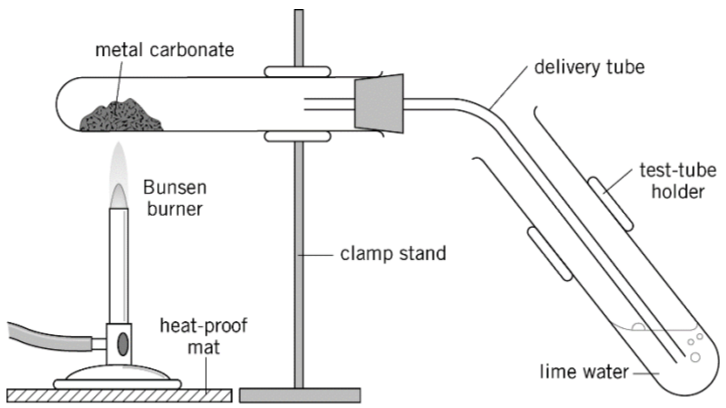
High melting and boiling points – strong attraction between the positive ions and negative delocalised electrons
Malleable (bendy) – the layers of ions are able to slide over one another.
Good conductor of electricity – delocalised electrons are able to move
Ductile (can be drawn into wires)



</td>
<td>Delocalised
Metallic
Malleable
Ductile</td>
</tr>
<tr>
<td>What happens in a chemical reaction?</td>
<td>
During a chemical reaction new products are always formed.
Chemical reactions are an irreversible change
The three main observations you can make to observe a chemical reaction are – a colour change, temperature change, effervescence (bubbling).

There are lots of different types of chemical reaction, including:

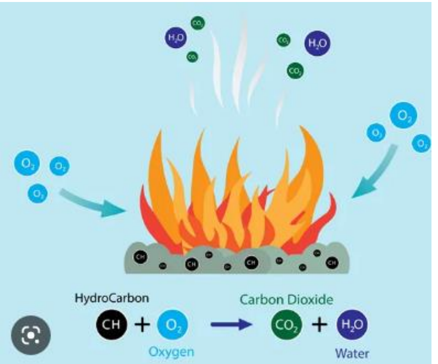
Displacement – when a more reactive substance takes the place of a less reactive substance from its compound.


Thermal decomposition – When heat is used to break down a substance into smaller compounds/elements.


Zinc carbonate → Zinc oxide + Carbon dioxide gas
$ZnCO_3 \rightarrow ZnO + CO_2$

</td>
<td>Chemical Reaction
Irreversible
Effervescence
Displacement
Thermal Decompositio n
Combustion
Neutralisation
Equation</td>
</tr>
</table>

Year 9 chemistry knowledge organiser



3. Combustion (burning)

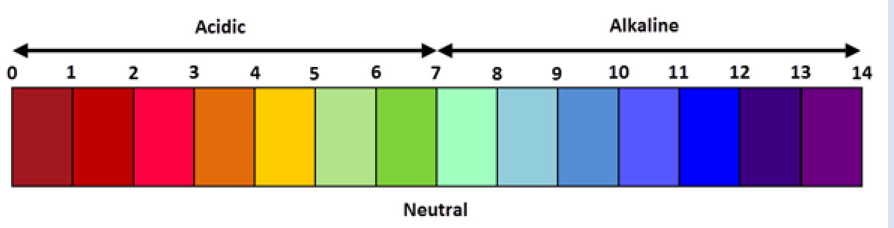
Fuel + Oxygen → Carbon dioxide + Water

4. Neutralisation – An acid and a base reacting to form salt and water.

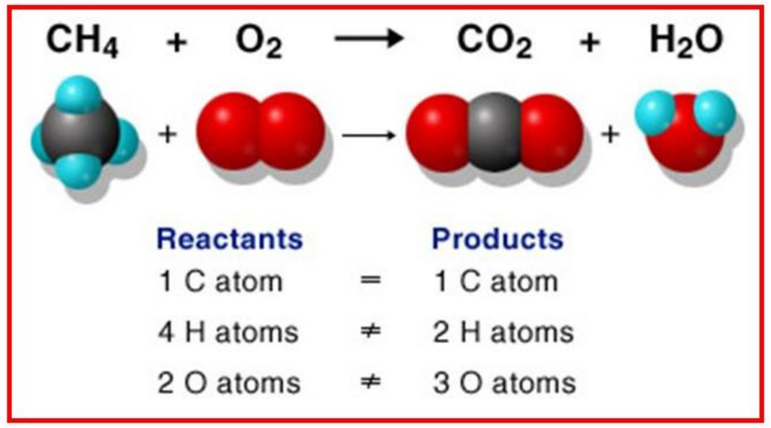
What is neutralisation?

When an acid and alkali are mixed together, they undergo a CHEMICAL REACTION to form a new NEUTRAL substance.

ACID + ALKALI → a SALT + WATER



Balancing chemical equations:

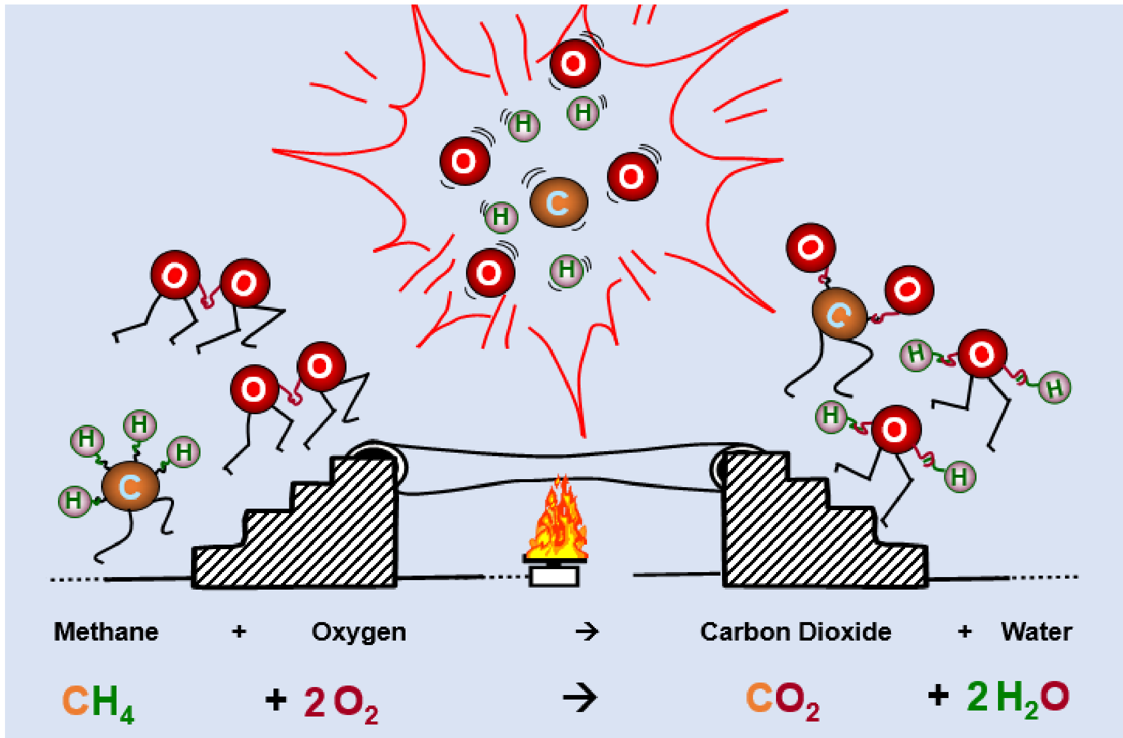


There needs to be the same number of atoms of each element in the reactants and products.

This equation is not balanced.

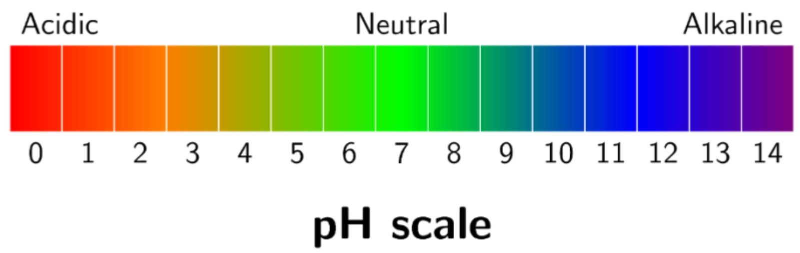
Rules: You cannot change the small numbers of only add big numbers (multiples) in front of the molecules.

Balanced.



Year 9 chemistry knowledge organiser

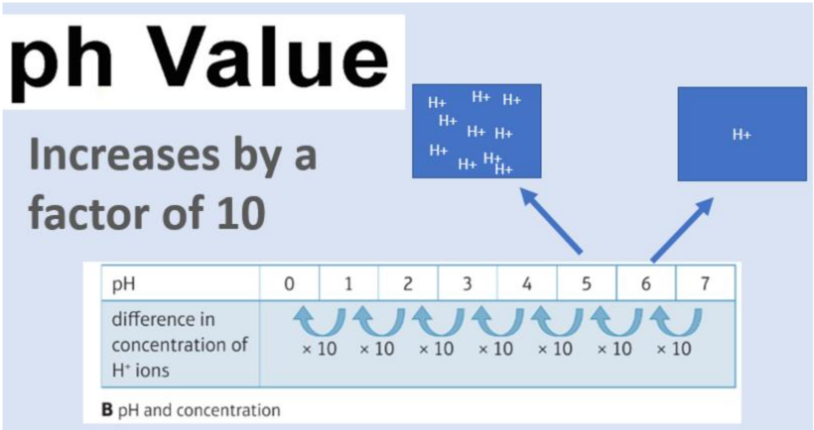
What is an acid?



pH 0-6 = acidic

pH 7 = neutral

pH 8-14 = basic/alkaline

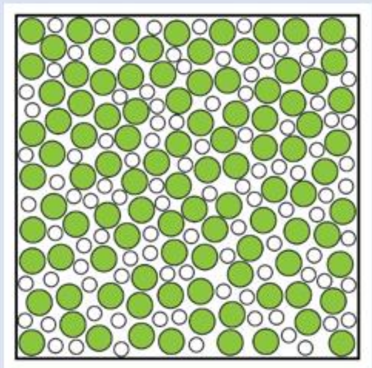


All **acids** contain H^+ ions which can dissociate (split up) in solution

The **pH** of an acid is a measure of the concentration of dissociated hydrogen ions
- as the pH decreases by one the concentration of H+ ions increase by a factor of 10.

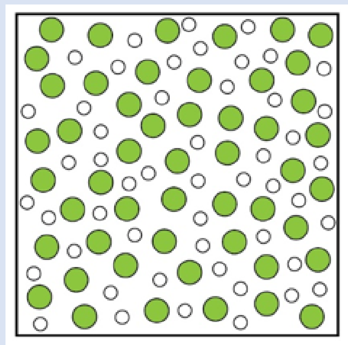
Concentrated vs dilute acids.

Concentrated acid



A concentrated acid contains a large number of particles in a given volume of solution.

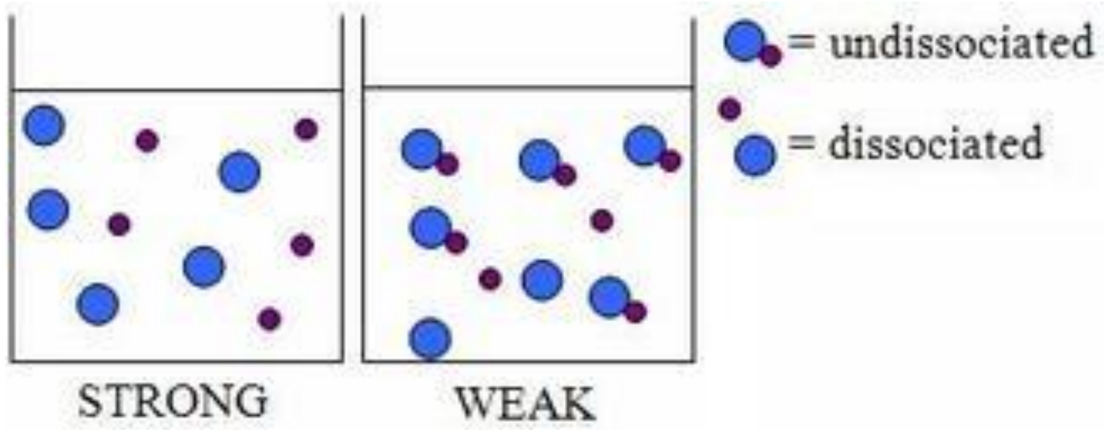
Dilute acid



A dilute acid contains a smaller number of particles in the same volume of solution.

Strong vs weak acids

In a strong acid all molecules are able to dissociate (split) into H+ ions.
In a weak acid only some molecules are able to dissociate into H+ ions.

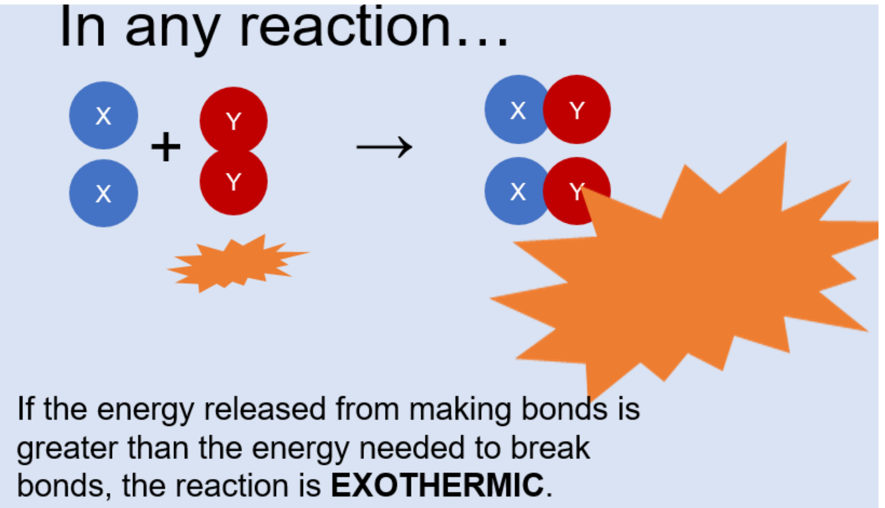


Dissociate
Concentrated
Dilute
Strong
Weak

Year 9 chemistry knowledge organiser

What energy changes happen in a chemical reaction?

Exothermic reactions release energy by transferring the energy from the chemical bonds to the surroundings

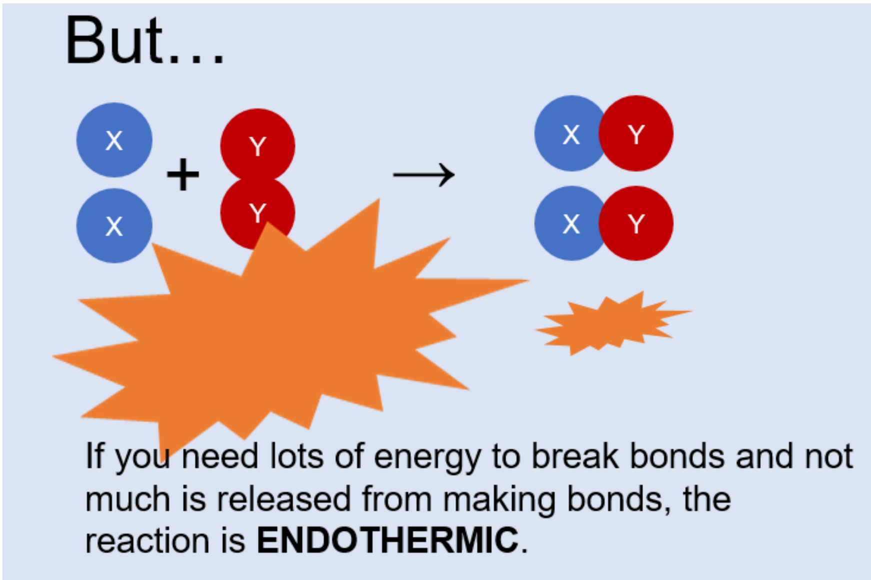


Exothermic reactions heat up their surroundings

Hint:

Think – in **EX**othermic reactions energy **EX**its the reaction

Endothermic reactions transfer energy from the surroundings into the chemical bonds.



Endothermic reactions cool down their surroundings

Hint:

Think – in **EN**dothermic reactions energy **EN**ters the reaction

Exothermic
Endothermic

Year 9 chemistry knowledge organiser

What is displacement reaction?

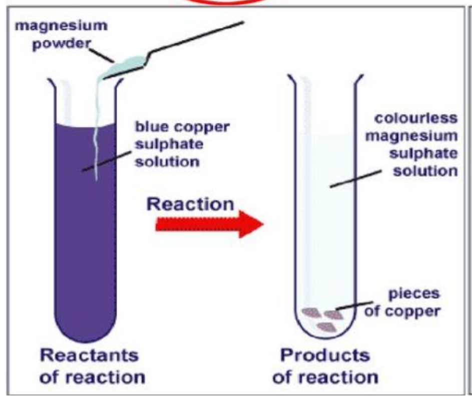
Displacement reaction – when a more reactive element replaces a less reactive element in a compound or solution

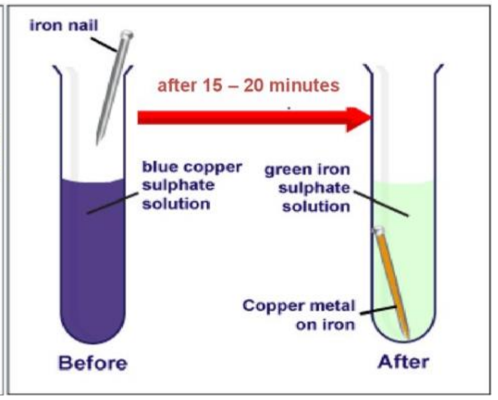
For example some metals are more reactive than others so more reactive metals can displace less reactive metals from their solutions

Displacement reaction

Zinc displaces copper from copper sulfate solution: $Zn + CuSO_4 \longrightarrow ZnSO_4 + Cu$

Iron displaces copper from copper (II) sulfate: $Fe + CuSO_4 \longrightarrow FeSO_4 + Cu$





potassium	most reactive	K
sodium		Na
calcium		Ca
magnesium		Mg
aluminium		Al
carbon		C
zinc		Zn
iron		Fe
tin		Sn
lead		Pb
hydrogen		H
copper		Cu
silver		Ag
gold		Au
platinum	least reactive	Pt

Displace

How do we obtain a metal?

An ore is a mineral (or rock) which contains sufficient metal to make it commercially viable to extract.

Haematite is an ore that contains iron.

Reactivity series:

potassium	most reactive	K
sodium		Na
calcium		Ca
magnesium		Mg
aluminium		Al
carbon		C
zinc		Zn
iron		Fe
tin		Sn
lead		Pb
hydrogen		H
copper		Cu
silver		Ag
gold		Au
platinum	least reactive	Pt

Metals above carbon in the reactivity series are extracted by **electrolysis**

Metals below carbon can be extracted by heating with carbon. This is because carbon can **displace** the metal (as it is more reactive)

METAL OXIDE + CARBON ⟶ METAL + CARBON DIOXIDE

COPPER OXIDE + CARBON ⟶ COPPER + CARBON DIOXIDE

$2CuO + C \longrightarrow 2Cu + CO_2$

The least reactive metals are found pure in the Earths crust

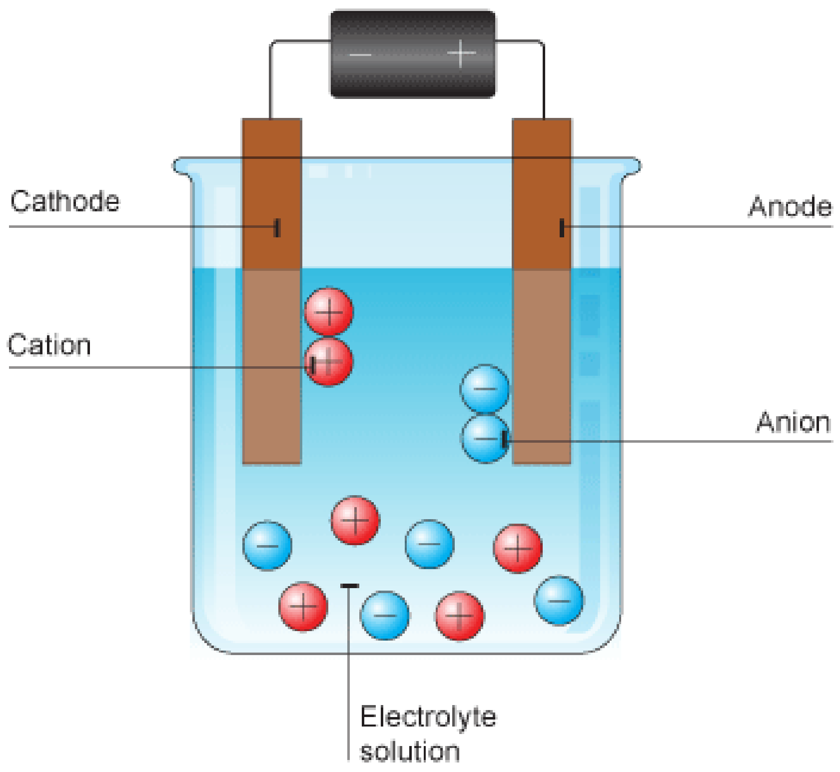
Ore

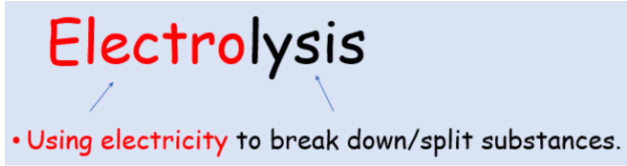
Extract

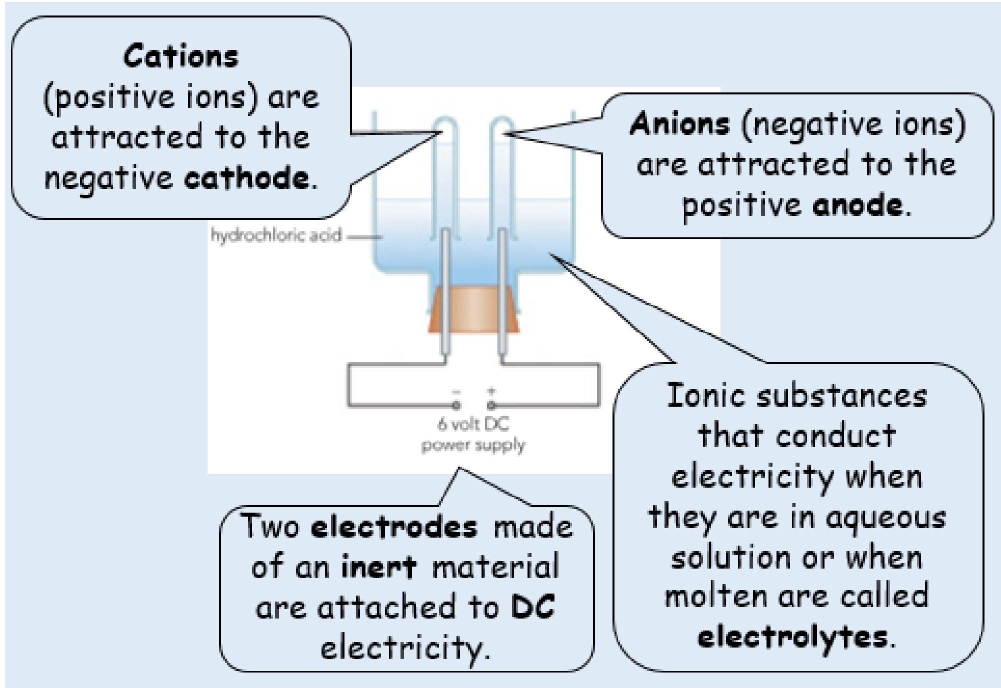
Unreactive

Year 9 chemistry knowledge organiser

<table>
<tr>
<td>What is electrolysis?</td>
<td>
Electrolysis is a method of splitting a substance using an electric current
Electrolysis can be used to extract a metal from an ore (as above).

The basic set up an electrolysis cell includes:


Ions are separated and then turned back into atoms at the cathode/anode.


Reminder: Ions are atoms with a charge.
Positive ions are called cations
Negative ions are called anions


</td>
<td>Electrolysis
Cathode
Anode
Electrolyte
Current</td>
</tr>
<tr>
<td>What is a fuel?</td>
<td>
Fuels are substances that can be burnt to release energy

Combustion (burning) is an exothermic reaction where a fuel reactions with oxygen (oxidation) to form carbon dioxide and water.

General word equation for complete combustion of a fuel: Fuel + oxygen → carbon dioxide + water.

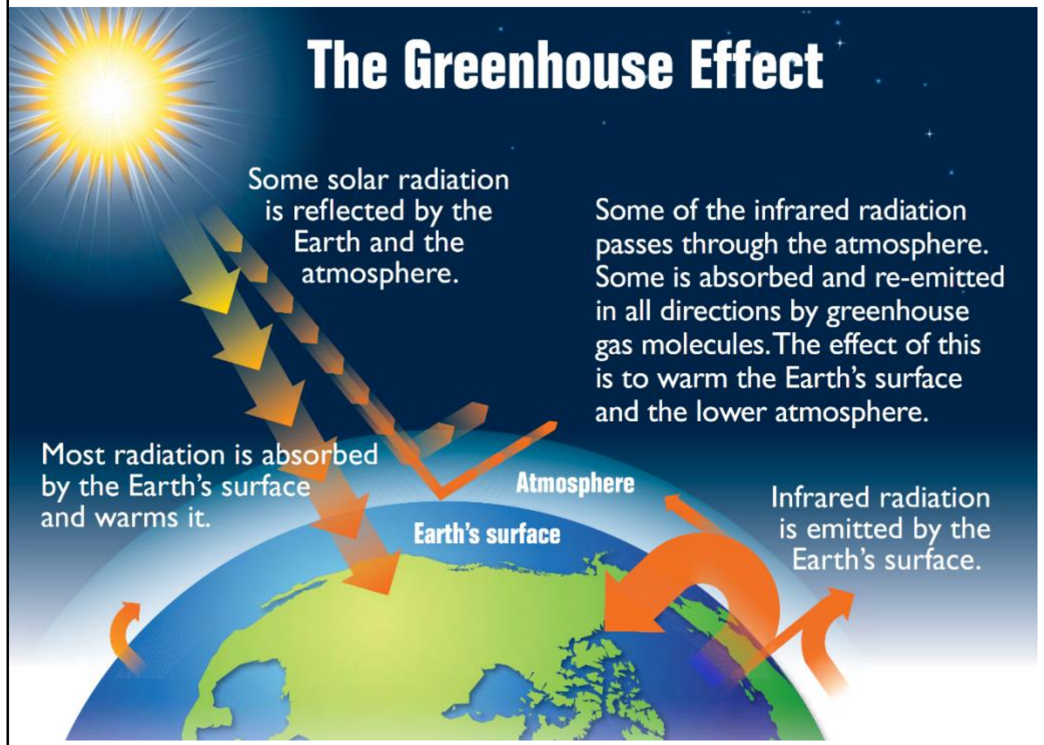
Incomplete combustion occurs in lack of oxygen and forms carbon monoxide or carbon (soot).

Complete combustion occurs when there is plenty of oxygen.
Incomplete combustion occurs when there is limited oxygen
</td>
<td>Oxidation
Fuel
Energy</td>
</tr>
</table>

Year 9 chemistry knowledge organiser

<table>
<tr>
<td>What problems can burning fuels cause?</td>
<td>
Problems with burning fossil fuels.

1. Climate change



Greenhouse gases, such as carbon dioxide absorb and reemit heat radiation back down to Earth. Burning fuels (for transport, electricity production, industry and agriculture etc..) adds more carbon dioxide into our atmosphere.
Contributing to climate change.

Forecasted effects of climate change include:
•Increased global temperatures
•Sea ice melting
•Loss of habitats
•Reduced biodiversity.

Solutions could include green energy, recycling, electric vehicles, carbon neutrality.

2. Acid rain from combustion of impurities in fuel which produces sulfur dioxide and nitrogen oxide. These dissolve in clouds to produce sulfuric and nitric acid (carbonic acid is also produced naturally and always has been).

3. Carbon monoxide and soot from incomplete combustion
- Carbon monoxide is a colourless and odourless toxic gas.
- Soot can cause blocked pipes, blackened building and can cause some respiratory problems if breathed in.
</td>
<td>Climate
Pollution
Combustion</td>
</tr>
<tr>
<td>How has the atmosphere changed?</td>
<td>
The early atmosphere was formed from volcanic gases including carbon dioxide, methane, ammonia and water vapour (little or no oxygen)

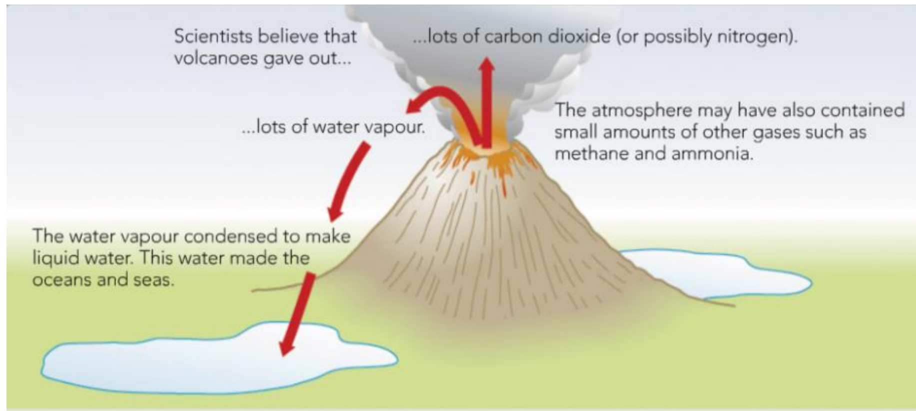
Condensation due to temperature decrease formed oceans – the oceans dissolved lot of the carbon dioxide in the atmosphere.

As plants evolved, they reduced CO_2 further and produced O_2 because they photosynthesised

This has led to the composition of gases in today's atmosphere
• 78% Nitrogen
• 21% Oxygen
• 1% Argon
• 0.04% Carbon dioxide

Test for oxygen gas:

Place a glowing splint over the gas. If it relights the split it is oxygen!



C The gases in Earth's early atmosphere came from volcanoes.

However, human activity continues to change.
</td>
<td>Atmosphere</td>
</tr>
</table>

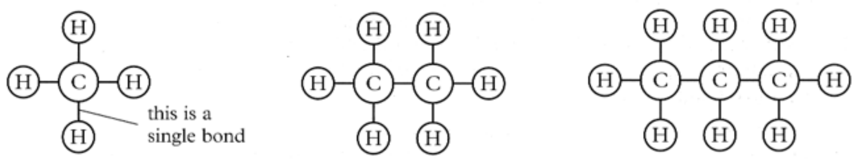
Year 9 chemistry knowledge organiser

What is a hydrocarbon?

A **hydrocarbon** is a compound which contains hydrogen and carbon only.

There are two main groups of hydrocarbons - **Alkanes** and **alkenes**

Alkanes



Methane — CH_4

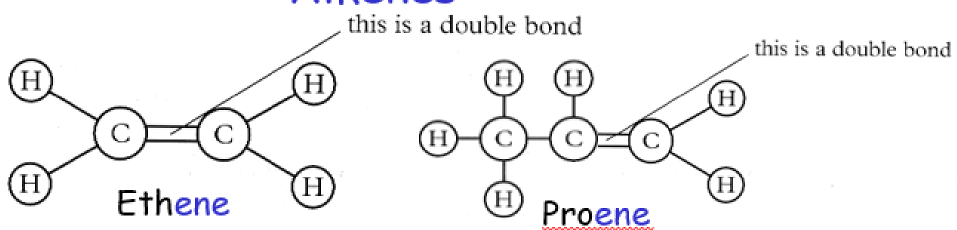
Ethane — C_2H_6

Propane — C_3H_8

These hydrocarbons are said to be *saturated.*

(They have single bonds between carbon atoms).

Alkenes



Ethene — C_2H_4

Proene — C_3H_6

Alkenes are said to be unsaturated

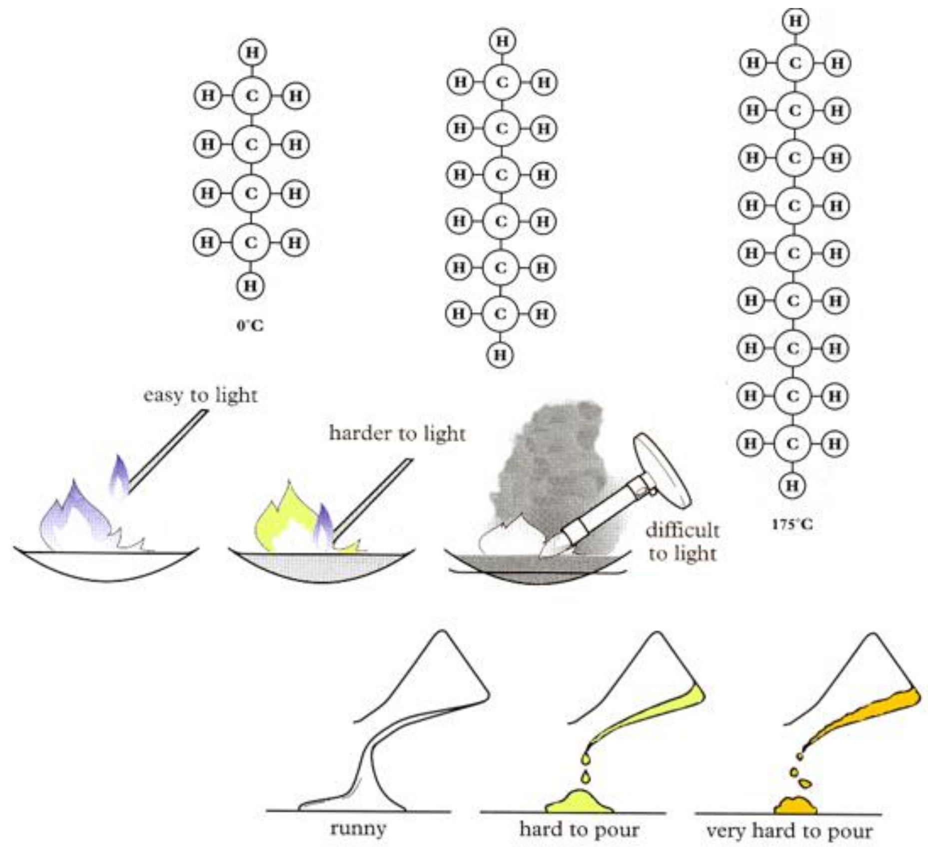
They have a double bond

Alkanes and alkenes are both examples of **homologous** series

A homologous series is a family of compounds Same general formula (carbon & hydrogen only), have a gradual variation in physical properties, similar chemical properties but differ in number of carbon atoms

Hydrocarbons can all be used as fuels in combustion

Hydrocarbons vary in their number of carbons. The more carbons the longer the chain length. The longer the chain length the less flammable (harder to ignite) and more viscous (harder to pour) they become



Alkanes and alkenes are examples of organic molecules (they have a framework of carbon atoms)

Other organic molecules include:

Carboxylic acids, alcohols and polymers.

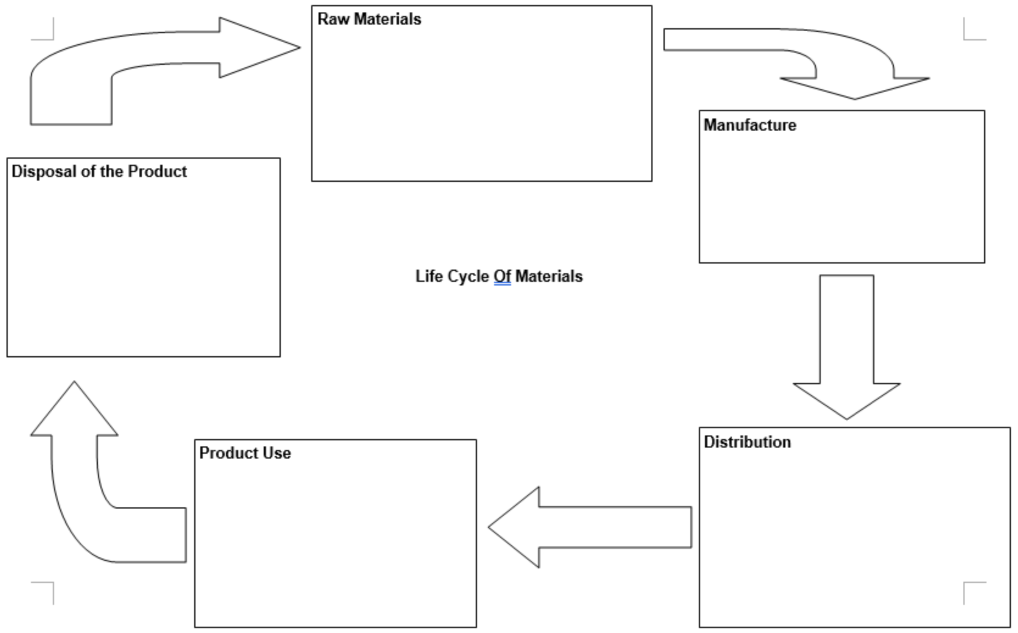
Hydrocarbon
Alkane
Alkene
Flammable
Viscosity
Saturated
Unsaturated
Homologous

Year 9 chemistry knowledge organiser

How do we choose which material to use?

When deciding on materials to use the following things must be considered:

- Raw materials needed
- The manufacture of the product
- The distribution of the product
- The use of the product
- The disposal of the product.



Composite materials:
A composite material consists of two or more materials with different properties. They are combined to produce a material with improved properties.

Examples:

- MDF
- Plywood
- Fibreglass
- Concrete.

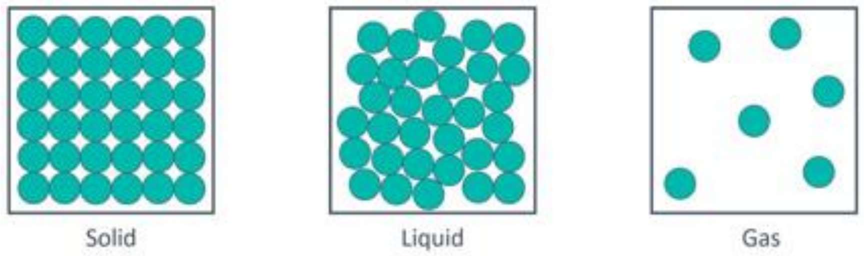
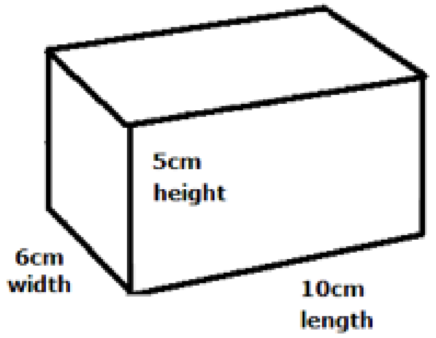
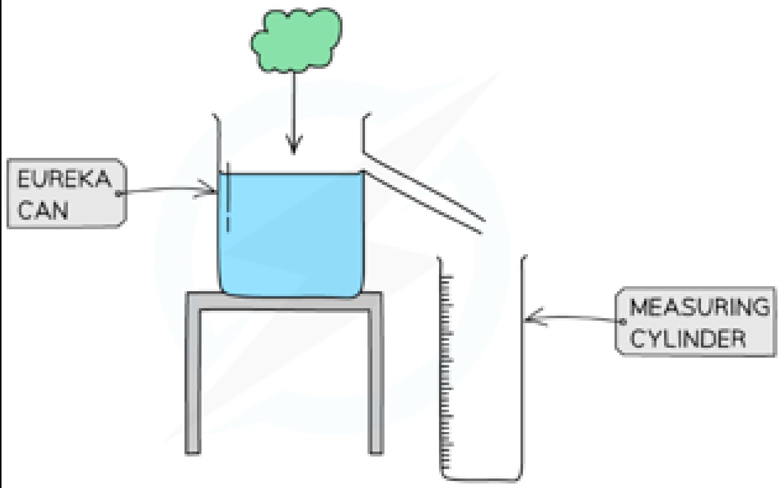
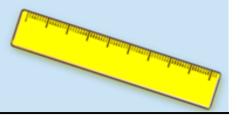
Polymers
Long chains of repeating monomers (individual units).

Examples:

Polymer	Properties	Uses
Low density poly(ethene), LDPE	Flexible, unreactive, can be made into films	Most carrier bags, bubble wrap
High density poly(ethene), HDPE	Strong, flexible, resists shattering, resists chemical attack	Plastic bottles, pipes, buckets

Extraction
Polymer
Composite

Year 9 physics knowledge organiser

Composite title	Essential knowledge	Key words
What is density?	The **density** of an object is the **mass** of the object compared to its **volume** measured in kg/m^3 Solids are the most dense state of matter because there more particles in a given volume  Calculation of density: $\boxed{\text{Density} = \frac{\text{mass}}{\text{volume}}}$  e.g. volume = 5 x 6 x 10 = 300cm^3 density (kg/m^3) = mass (Kg) / volume (m^3) Volume of regular shaped objects can be calculated using: volume = length x width x height. Volume of irregular shaped objects can be found using eureka cans (displacement cans)  The volume of water in the eureka can is the volume of the objects - An object less dense that water will float. - An object more dense than water will sink Buoyancy is the ability to float in a liquid. Upthrust is the upwards force that keeps an object floating.	Density Mass Volume Upthrust Buoyancy Float Sink
What are vectors and scalars?	**Scalar** quantities only require magnitude (size) to describe them. Examples include: - Speed - Distance - Time - Mass - Energy Magnitude means we can put a numerical value to it and that is enough to describe the quantity. A physical quantity is something that can be measured. There are two types: 1. Scalars 2. Vectors  	Vector Scalar Magnitude Direction Speed Distance Time

Year 9 physics knowledge organiser

<table>
<tr>
<td></td>
<td>

Vector quantities require a magnitude and direction to describe them. Examples to include:

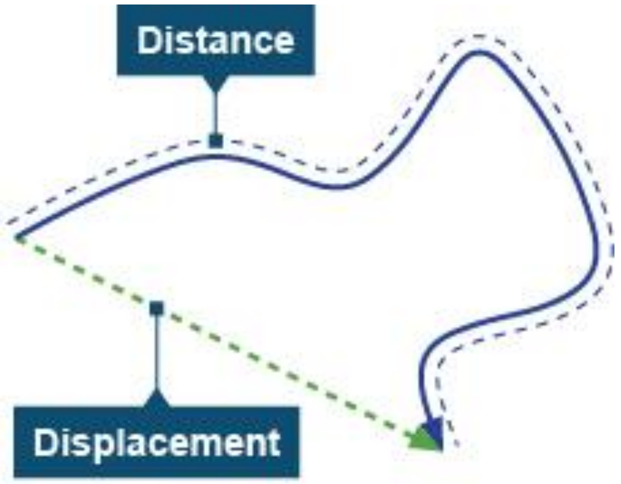
- Displacement
- Velocity
- Acceleration
- Force
- Weight
- Momentum

Distance – how far something has travelled (scalar)

Displacement - the distance travelled in a straight line (vector)

Speed - how fast an object is travelling (scalar)

Velocity - the speed in a given direction (vector)



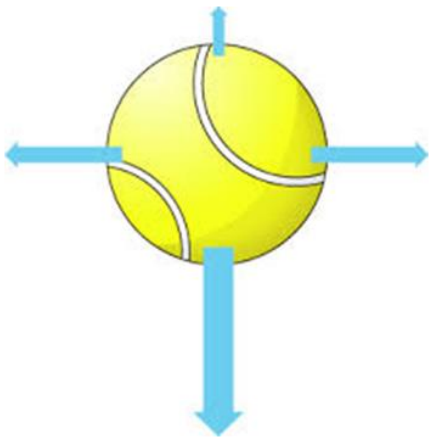
</td>
<td>Mass
Velocity
Displacement
Force</td>
</tr>
<tr>
<td>What is Newton's 1st Law?</td>
<td>

Forces are a **push** or **pull** which can change the speed, direction or shape of an object. All forces are measured in **Newtons (N)**

Types of forces include: Air resistance, Water resistance, Upthrust, Friction, Static electricity, Magnetism

We cannot see forces so we need to use diagrams to represent them.
FREE BODY DIAGRAMS show the forces acting on an isolated object.

Free body diagram:

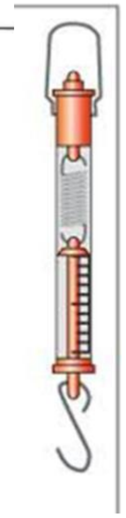


Free body diagrams…

- Use arrows to represent forces.
- The direction of the arrow shows the direction of the force.
- The size of the arrow represents the size of the force.

Forces are measured in **NEWTONS** using a **FORCE METER**.

Objects can be hung from the hook at the bottom of the force meter the scale will show the strength of the force in Newtons.



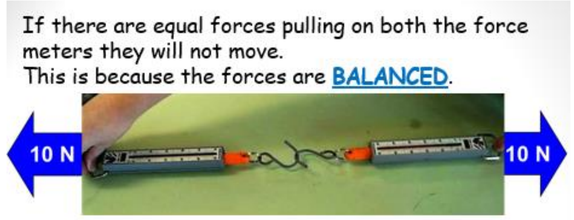
</td>
<td>External force
Newtons
Stationary
Balanced
Unbalanced</td>
</tr>
</table>

Year 9 physics knowledge organiser

Forces acting on a single object can be **balanced** or **unbalanced**.

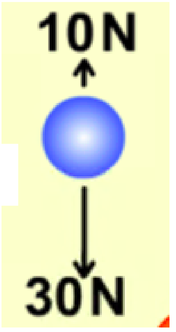
If forces are **balanced** the motion of an object will not change – the object will be **stationary** (still) or will be travelling at a **constant speed**.

Unbalanced forces cause the objects motion to change e.g. accelerate or decelerate.

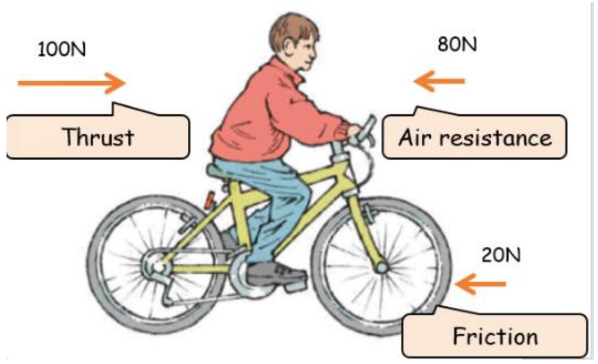


Calculating **resultant** forces:
The resultant force is the overall effect of the forces acting on an object.

Resultant force = 20N down



Resultant force = 0N



If forces are acting in opposite directions you subtract the numbers.

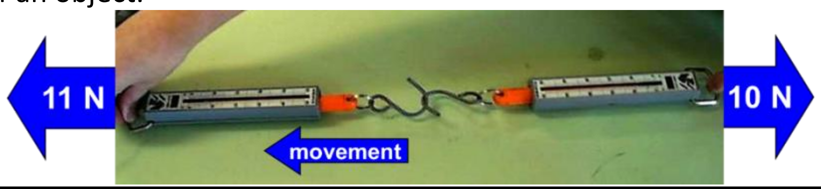
If the forces are acting in the same direction you add them together.

Newton's first law:

- an object will continue to move at the same speed and direction unless an external force acts on it.
- A stationary object will remain stationary unless an external force acts on it.

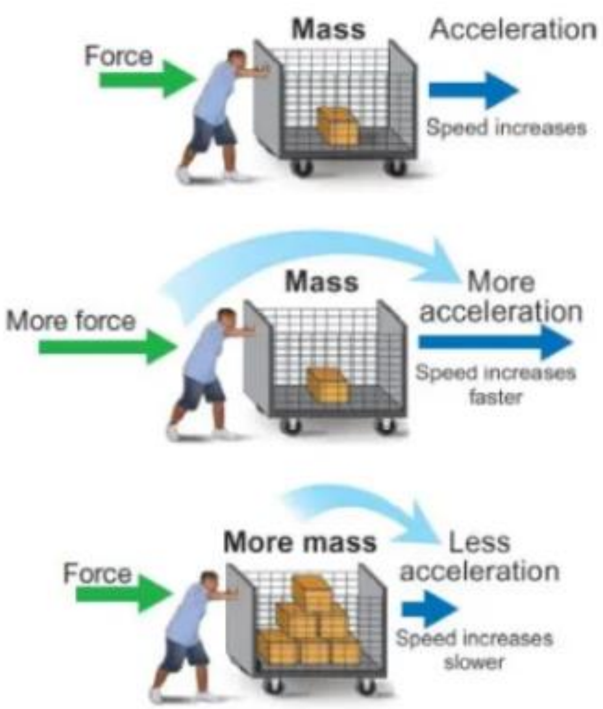
Balanced forces produce a resultant force of zero, therefore no acceleration/change in motion.

Unbalanced forces change the speed or direction of an object.

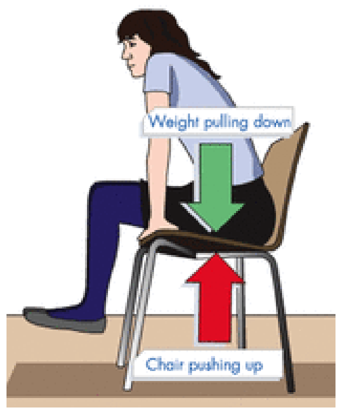


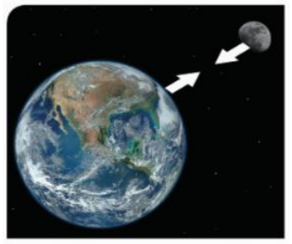
Year 9 physics knowledge organiser

<table>
<tr>
<td>What is Newton's 2nd Law?</td>
<td>
Newton's 2nd law:
- an unbalanced force on an object causes it to accelerate.
- The acceleration will depend on the size of the force and the mass of the object

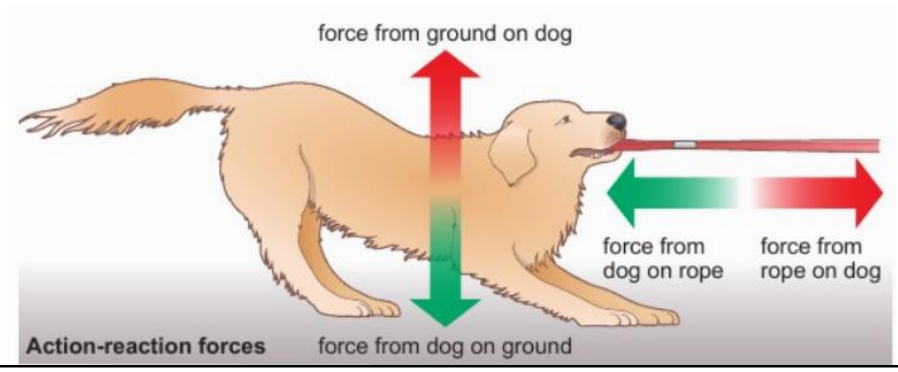


Calculating force using:
Force (N) = mass (Kg) x acceleration (m/s^2)
Example:
4 A car has a mass of 1200 kg. Calculate the force needed to make the car accelerate at 3 m/s^2.
5 A cyclist and her bicycle have a mass of 70 kg. She accelerates at 0.5 m/s^2. Calculate the force she is putting on the pedals.
4 force = 1200 kg × 3 m/s^2 = 3600 N
5 force = 70 kg × 0.5 m/s^2 = 35 N
</td>
<td>Force
Mass
Acceleration</td>
</tr>
<tr>
<td>What is Newton's 3rd Law?</td>
<td>
Newtons third law: Whenever two objects interact they exert equal and opposite forces on each other (every action has an equal and opposite reaction).
- This can happen when objects touch e.g. when a person sits on a chair




B The Earth attracts the Moon with the same force as the Moon attracts the Earth.
Or at a distance e.g. the gravitational pull between the Earth and the Moon.

The pairs of forces acting on two interacting objects are called action-reaction forces
- They are always equal in size and opposite in direction.
- An equilibrium situation is when nothing is moving.



</td>
<td>Action-reaction
Equal
Opposite
Force
Equilibrium</td>
</tr>
</table>

Year 9 physics knowledge organiser

How do we apply Newton's Laws?

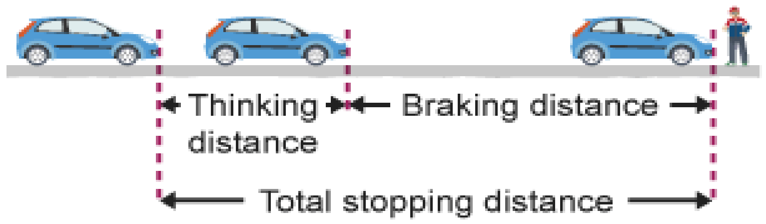
Stopping distance = thinking distance + braking distance.

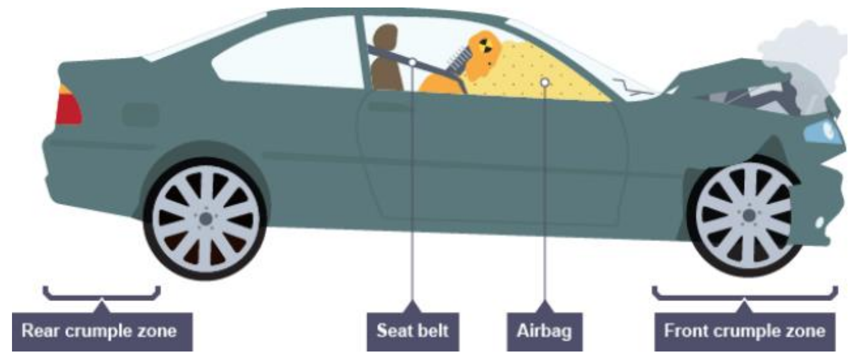
- **Thinking distance** as the distance travelled whilst reacting to hazard/stimuli.
- Factors affecting thinking distance to include; alcohol, distractions, tiredness.

- **Braking distance** as the distance travelled once brakes have been applied.
- Factors affecting braking distance to include; tyres, brakes, road conditions, mass of vehicle.

Car safety features designed to increase deceleration time examples:

- **Crumple zones**. These increase the time taken for the car to come to a stop reducing the force.
- **Air bags**. Increase the time taken for the persons head to collide with the dashboard. Reducing the force on the person.
- **Seat belts**. Applies a force to hold the person in the car.





Stopping distance
Thinking distance
Braking distance
Reaction time
Crumple zones

How can we describe waves?

Recap from Y7+8:

A **wave** is the transfer of with no overall transfer of matter

There are 2 different types of wave.

1. Transverse waves

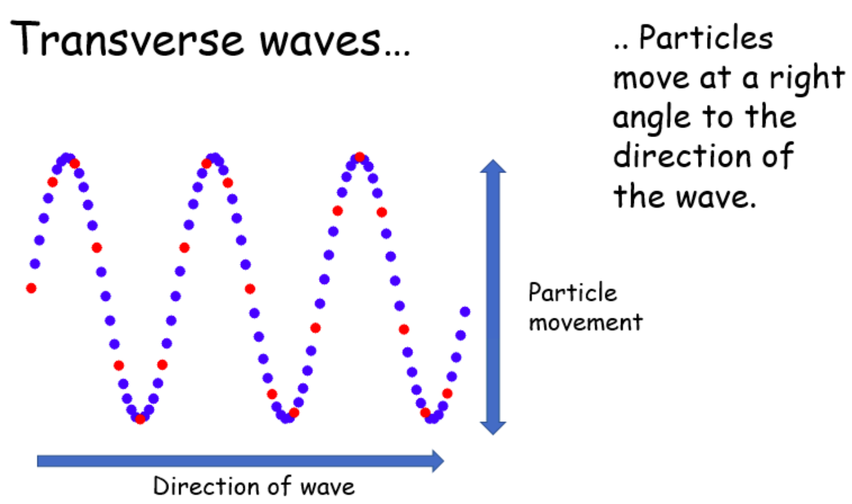
In transverse waves particles vibrate up and down. The direction of the wave is from left to right. Therefore, transverse waves are defined as 'a wave where particles travel at a right angle to the direction of the wave.'

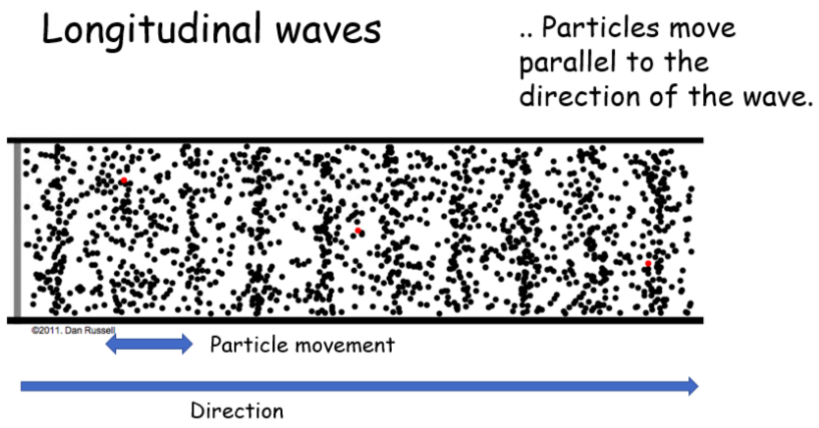
Examples of transverse waves include:
Light waves, water ripples, x-rays, radio waves, microwaves.

2. Longitudinal waves

In longitudinal waves particles vibrate back and forth, the direction of the wave goes from left to right. Therefore, longitudinal waves are defined as 'a wave where particles move parallel to the direction of the wave.'

Examples of longitudinal waves
Sound waves, seismic waves (shock waves from earthquakes)

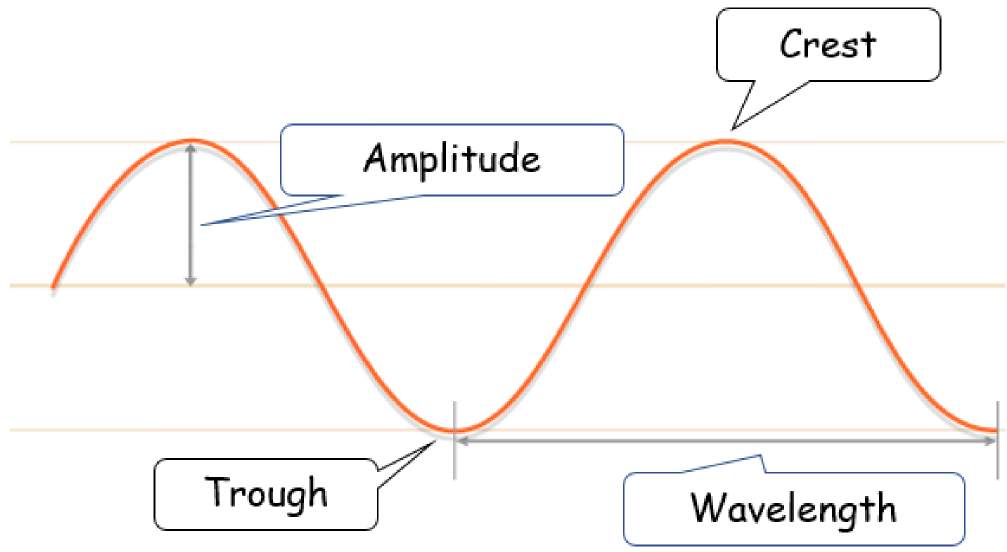




Wave
Speed
Distance
Time
Frequency
Wavelength

Year 9 physics knowledge organiser

Labelling a transverse wave:



Crest – highest point in a wave

Trough – lowest point in a wave

Amplitude – distance from the centre line to a crest or trough (measured in metres)

Wavelength – length of one full wave (easiest to measure from one peak to the next. Or from one trough to the next (measured in meters).

Frequency is the number of complete waves per second. Frequency is measured in hertz (Hz).
Period – time taken for one complete wave

Wave speed can be calculated in two ways:

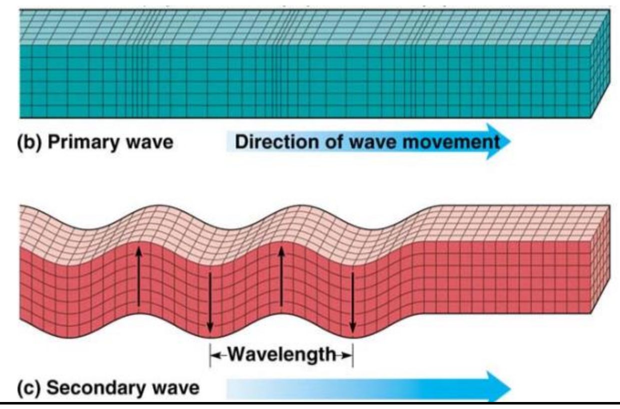
- Wave speed (m/s) = distance (m) / time (s)
- **Wave speed (m/s) = frequency (Hz) x wavelength (m)**

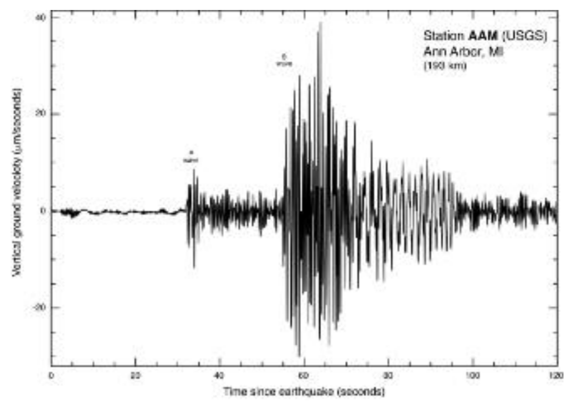
What are seismic waves?

Earthquakes produce shockwaves called seismic waves.
All earthquakes are measured on the **Richter scale**. It is measured using a machine called a seismometer, which produces a seismograph.

There are two types of seismic waves.
Primary (P) and Secondary (S) waves.

- P waves travel faster so arrive first.
- P waves can travel through the Earth
- S waves are slower so arrive second.
- S waves travel along the surface of the Earth.





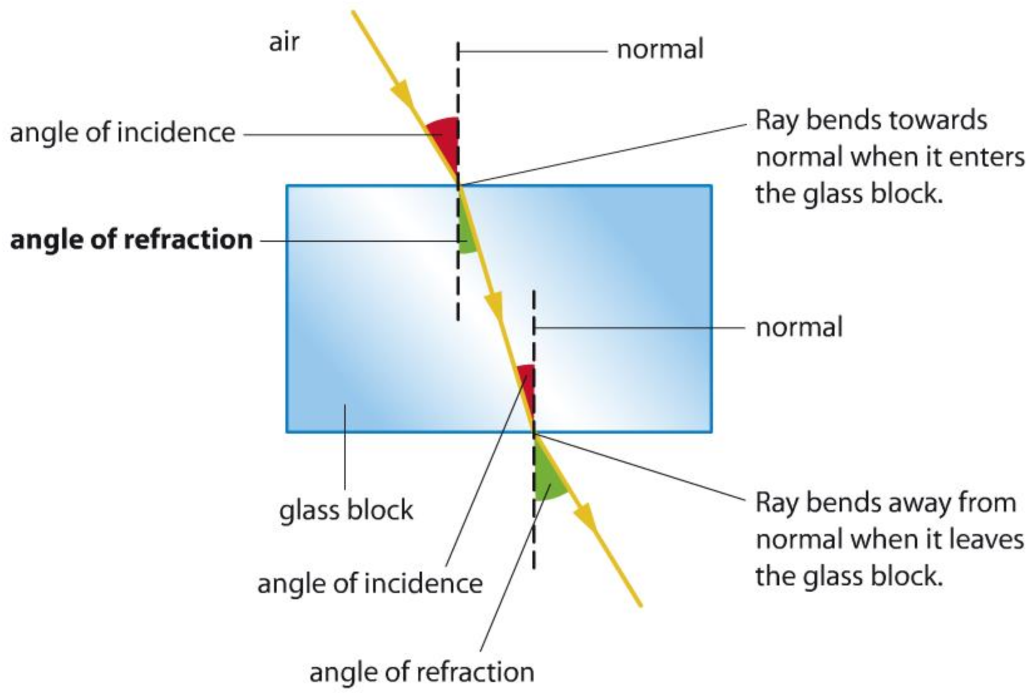
Seismic wave
Seismographs
Primary
Secondary

Year 9 physics knowledge organiser

How do we get coloured light?

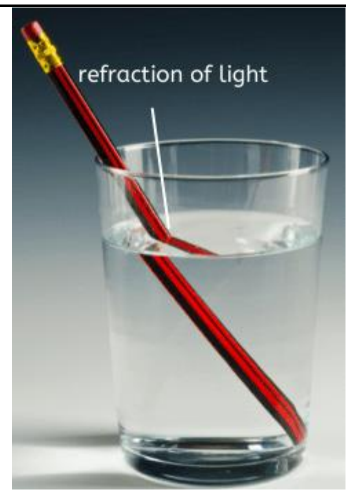
Refraction is the changing of a light ray's direction as it passes through different substances. Refraction is due to light changing speed in different materials.

Construction of ray diagrams to show refraction of light through a glass block:



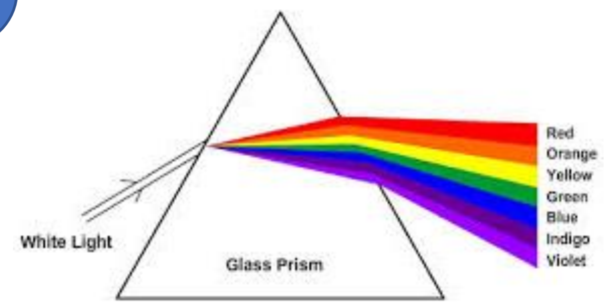
When light enters a more dense material (e.g. air to glass) it bends **towards** the normal

When light enters a less dense material it bends **away** from the normal.



White light can be split into its constituent colours by refracting through a prism.

- Different frequencies of colours cause them to be refracted by different amounts (violet most, red least).
- Order of colours in light: Red, orange, yellow, green, blue, indigo, violet (ROYGBIV)
- The colours have different wavelengths. Red has the longest wavelength, violet has the shortest.
- Infrared cannot be seen but exists before red light.
- Ultraviolet exists after violet.



We can see colour because objects absorb and reflect the different frequencies of light
e.g. a blue object appears blue because the object absorbs all the colours in white light and reflects blue.

Refraction
Frequency
Wavelength
Colour
Absorb
Reflect

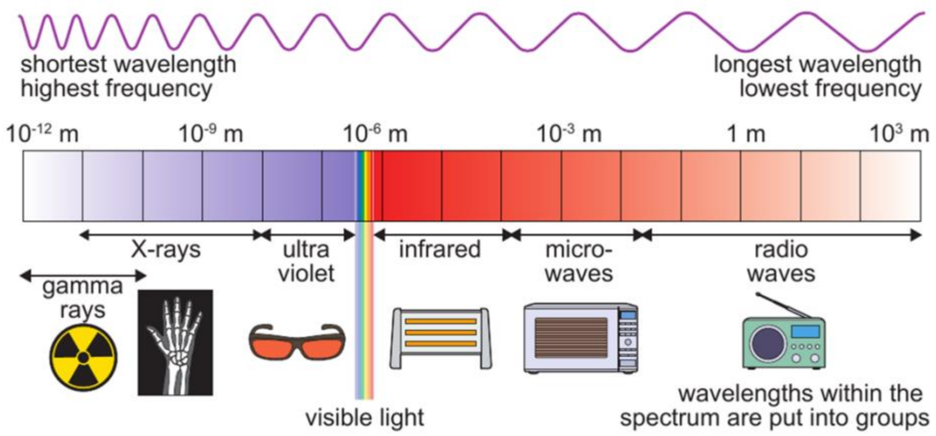
Year 9 physics knowledge organiser

What is the electromagnetic spectrum?

All **electromagnetic** waves transfer energy, are transverse and travel at 300,000,000m/s through a vacuum

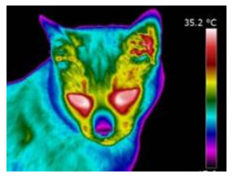
Waves of the electromagnetic spectrum are; radio, microwaves, infrared, visible, ultraviolet, x-rays, gamma rays.
The waves in the electromagnetic spectrum vary in frequency and wavelength.

- Radio waves have the longest wavelength and lowest frequency. Gamma rays have the shortest wavelength and highest frequency.



Uses of each of the different types of wave.

- Radio: can be used in communication/TV
- Microwaves: Used to heat up food, communication between mobile phones
- Infrared: Short distance communication e.g. remote controls.
- Visible light: In photography
- UV: Used to sterilise water.
- X-ray: Medical imaging (to see bones)
- Gamma: Cancer treatments and to sterilise medical equipment



Dangers of the EM spectrum

- UV, X-ray and gamma are ionising.
- Prolonged exposure can cause DNA mutations which can lead to cancers.

Electromagnetic Spectrum
Radio wave
Microwave
Infrared
Visible
Ultraviolet
X-ray
Gamma

What is energy efficiency?

Energy is defined as "something that is needed to make things happen or change"

Energy is always measured in **Joules (J)**

Energy stores include:

- Chemical (e.g. stored in fuels, foods, batteries)
- Kinetic (stored in anything that is moving)
- Thermal (stored in anything that has heat)
- Strain/Elastic potential (stored in stretched springs, or stretched elastic objects)
- Gravitational potential (stored in anything above ground level)
- Nuclear (stored in the nucleus of atoms)

Energy transfers include:

- Mechanical (transferred when a force makes something move)
- Heating (transferred via conduction, convection and radiation – see next lesson)
- Light (Transferred by anything giving off light)
- Sound (Transferred by anything giving off sound)
- Electrical (Transferred where there is electricity e.g. around a circuit)

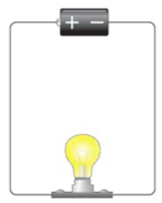
The law of conservation of energy:

Energy cannot be created or destroyed it can only be stored or transferred.

Energy transfer diagrams

When processes happen energy can be transferred from one form to another.

This can be shown on an energy transfer diagram.

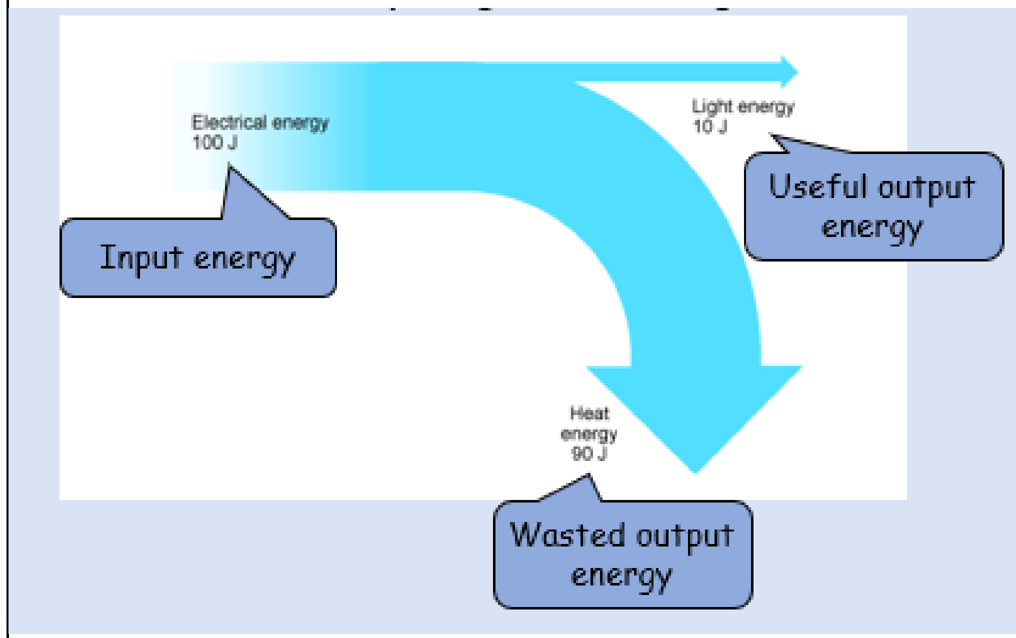


Chemical → Electrical → Light

Energy
Joules
Efficiency

Year 9 physics knowledge organiser

Sankey diagrams are used to show energy transfers. Sankey diagrams identify the useful and wasted energy.



The input energy is equal to the total output energy (useful + wasted).

This is because energy cannot be created or destroyed!

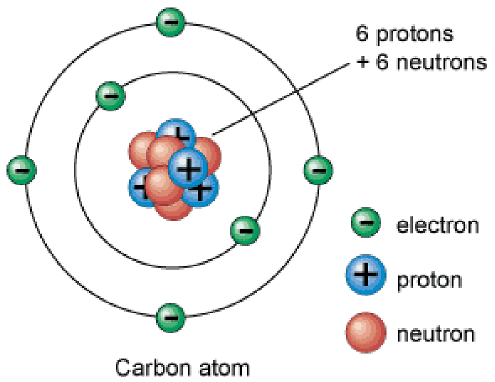
Calculating energy efficiency

$$\textbf{efficiency} = \frac{\text{useful energy transferred by the device}}{\text{total energy supplied to the device}} \times 100\%$$

- Payback time of energy saving appliances as the time required to recoup the funds from the original investment

What is ionising radiation?

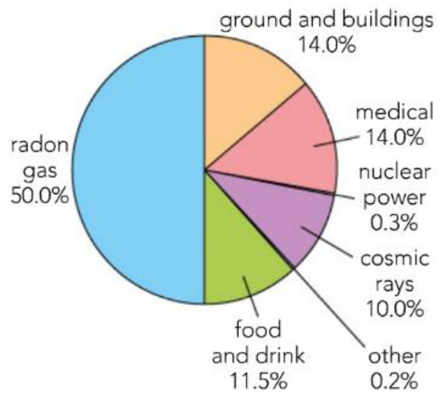
Recap structure of the atom:



Ionising radiation is the emission of high energy subatomic particles or waves which have the ability to ionise atoms (by removing electrons)

Background radiation

-Background radiation as the radiation we are exposed to all the time at a safe level.
-The majority of background radiation comes from radon gas.
-Other sources include medical facilities, ground/rocks, buildings, cosmic rays, food and drink.



Radioactivity is measured with a Geiger-muller tube.

Radioactive decay is measured in Becquerels (Bq). 1 Bq = 1 decay per second.

Ionising
Radiation
Decay
Alpha
Beta
Gamma
Becquerels
Geiger-muller

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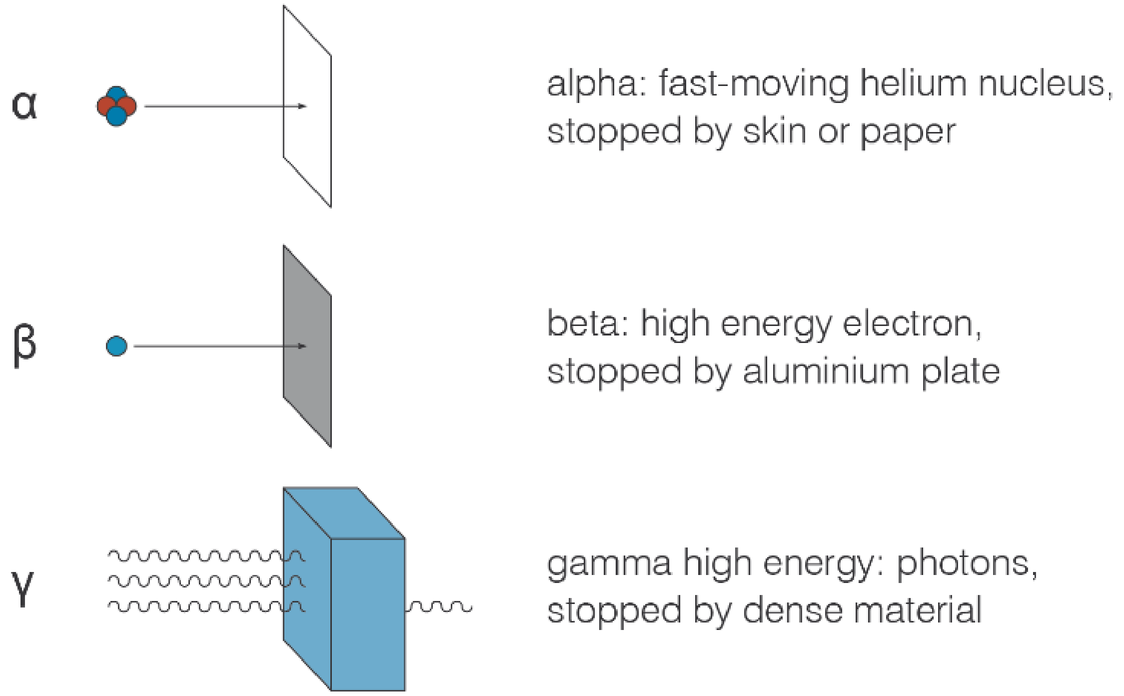
Properties of alpha, beta and gamma.

- Alpha: Made up of 2 protons and 2 neutrons. Mass of 4. Charge of 2+.
- Beta negative: High energy electron. Mass of 1/1835 (negligible). Charge of -.
- Beta positive: High energy positron. Mass of 1/1835 (negligible). Charge of +.
- Gamma: High energy electromagnetic wave. Mass of 0. Charge of 0.
-



Uses of radioactivity

- Alpha – smoke detector
- Beta – checking paper thickness
- Gamma – Radiotherapy.

Dangers of Ionising Radiation

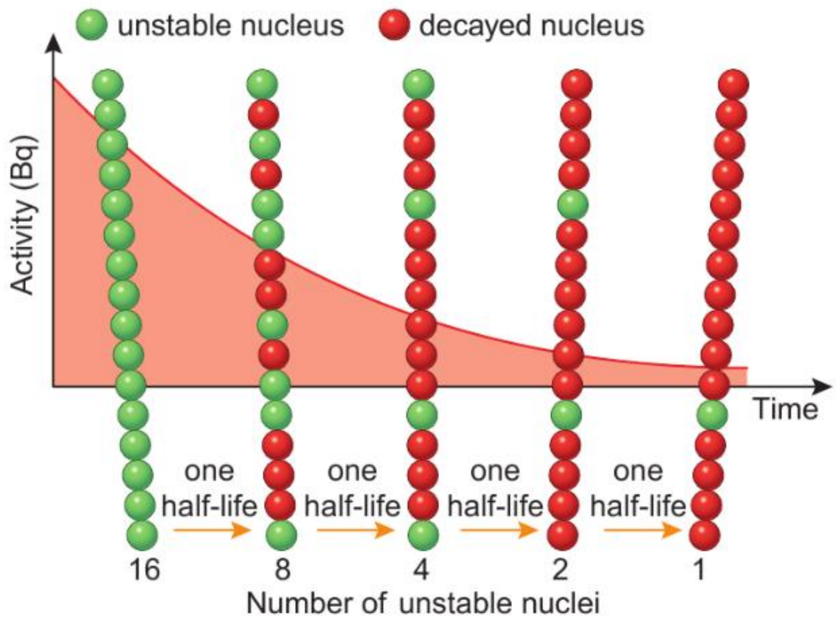
- All ionising radiation can cause mutation in DNA which can lead to cancers.

Safety

- Limit/monitor exposure
- Use tongs
- Do not directly point sources at peoples
- Protective clothing.

Half-Life

- Is the time taken for half the unstable nuclei to decay OR the time taken for the activity of a sample to half.



B After each half-life the number of unstable nuclei halves.

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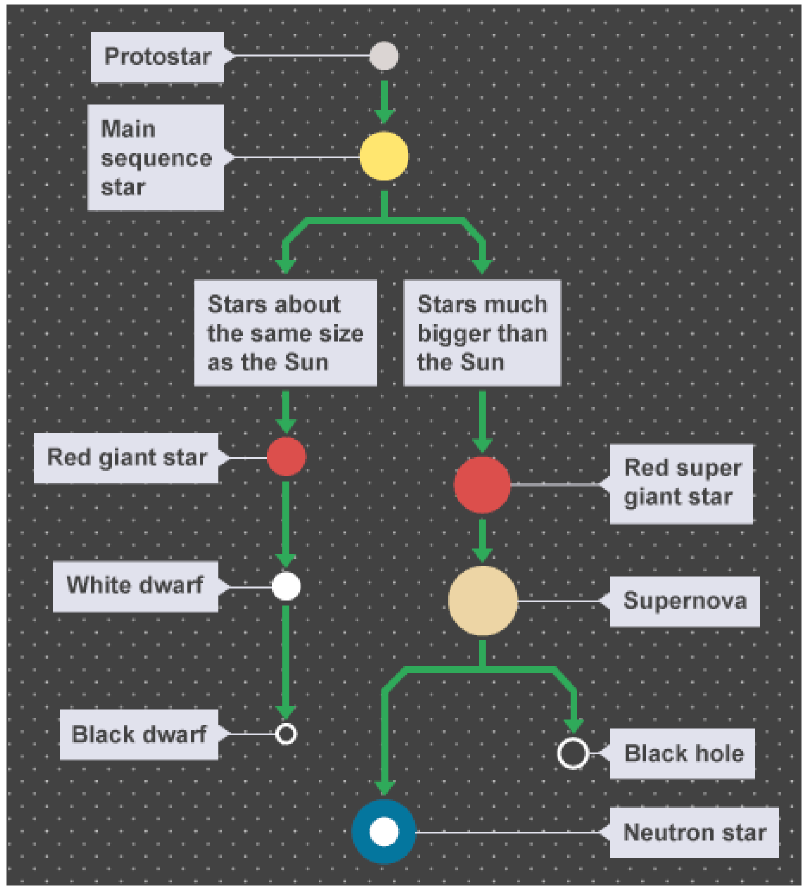
<table>
<tr>
<td>How can we explore the universe?</td>
<td>
We use space probes and telescopes to explore the universe.

Life cycle of a star.

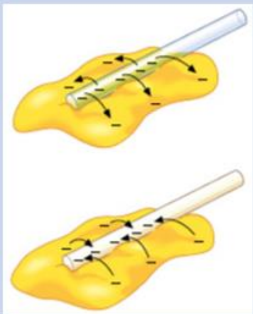


Stars similar size to our sun
- Starts as a nebula (huge cloud of dust and gas – mostly hydrogen)
- The gravitational pull causes the nebula to form a protostar.
- When the pressure from the hot gases balances gravity it forms a main sequence star which is stable (our Sun is in this stage)
- Eventually the star collapses the outer layer expands and forms a red giant.
- Eventually the red giant throws off a shell of gas
- This collapses to form a white dwarf.
- It cools over a billion years to form a black dwarf.

Stars much larger than our sun
- Starts as a nebula (huge cloud of dust and gas – mostly hydrogen)
- The gravitational pull causes the nebula to form a protostar.
- When the pressure from the hot gases balances gravity it forms a massive main sequence star.
- Eventually the star collapses the outer layer expands and forms a red supergiant.
- The Supergiant explodes in a supernova.
- Gravity pulls the left overs from the supernova into a neutron star or black hole.

Light year as the distance light travels in one year.
</td>
<td>Gravitational pull
Nebula
Protostar
Main sequence star
Red giant
White dwarf
Black dwarf
Red supergiant
Supernova
Neutron star
Black hole</td>
</tr>
<tr>
<td>How can we use static electricity?</td>
<td>
If you rub two insulating materials together, electrons maybe transferred from one material to the other.

Protons cannot move but electrons can!



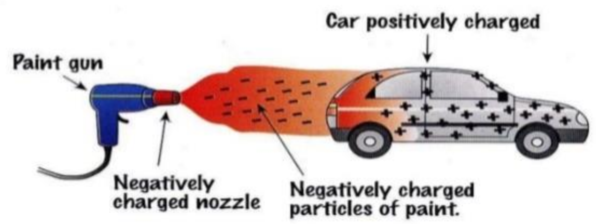
Insulators like plastic can gain a charge.

Electrical charges can be positive or negative

Static electricity is caused by the movement of electrical charge (electrons), when two insulators are rubbed together.

Attraction and repulsion of charges;
- opposite charges attract
- like charges repel.

The paint is charged as it comes out of the nozzle.
The paint is attracted to the car.
The car must be earthed or connected to a positive voltage.



Uses of static electricity e.g.
- car spraying: paint particles given a charge to make the paint spread out evenly and attract to the car.
- crop spraying: insecticide particles given a charge to make the spray spread out evenly and attract to the crop.
</td>
<td>Static
Charge
Attract
Repel</td>
</tr>
</table>

Year 9 physics knowledge organiser

<table>
<tr>
<td></td>
<td>

- photocopier: oppositely charged copying plate and toner used to make the ink ‘stick’ to the paper.

Dangers of static electricity e.g.

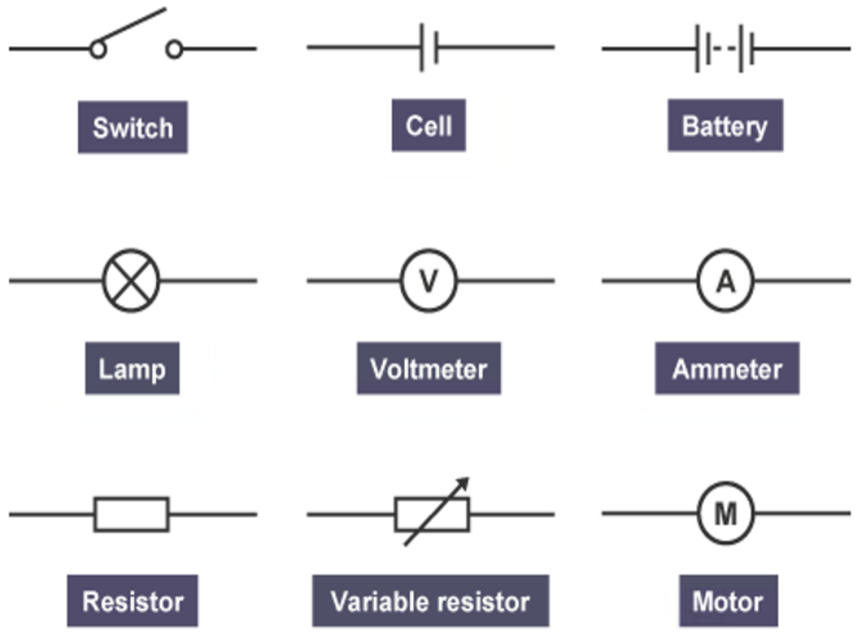
- refuelling
- lightening
- All dangerous due to the build up of charge on objects causing electric shock/ignition of combustible materials.

</td>
<td></td>
</tr>
<tr>
<td>What is resistance?</td>
<td>

Recap

Electrical energy is transferred around circuits. The most basic circuits consist of a power source, wires and other components (like a bulb)

To make it easier for us to draw circuits we use circuit symbols. Some are shown:

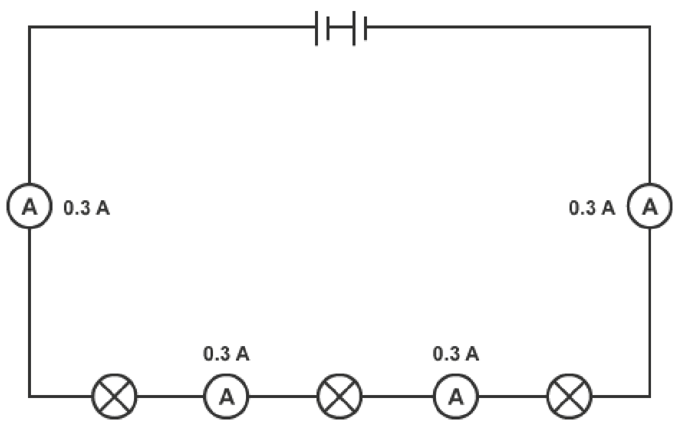


In physics a cell is a single unit that stores chemical energy – what we would normally call an individual ‘battery.’ Two or more cells is known as a battery.

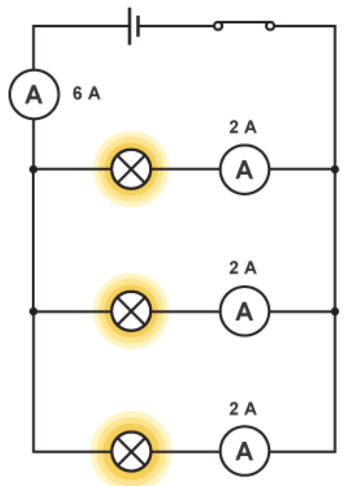
Difference between series and parallel circuits.

- Series circuits only have one path for electricity to flow
- Parallel circuits have more than one path for electricity to flow.

Series circuit



Parallel circuit



</td>
<td>Current
Potential difference
Resistance
Ohms</td>
</tr>
</table>

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Current

- Current as a flow of charge (electrons) around a circuit.
- Current is measured in amps with an ammeter.
- Current is conserved/stays the same around a series circuit
- Current splits at a junction in parallel circuits.

Voltage/potential difference

- Voltage as potential difference in energy across a component.
- Potential difference is measured in volts
- Potential difference is measured with a voltmeter.
- Potential difference is shared across components in a series circuits.

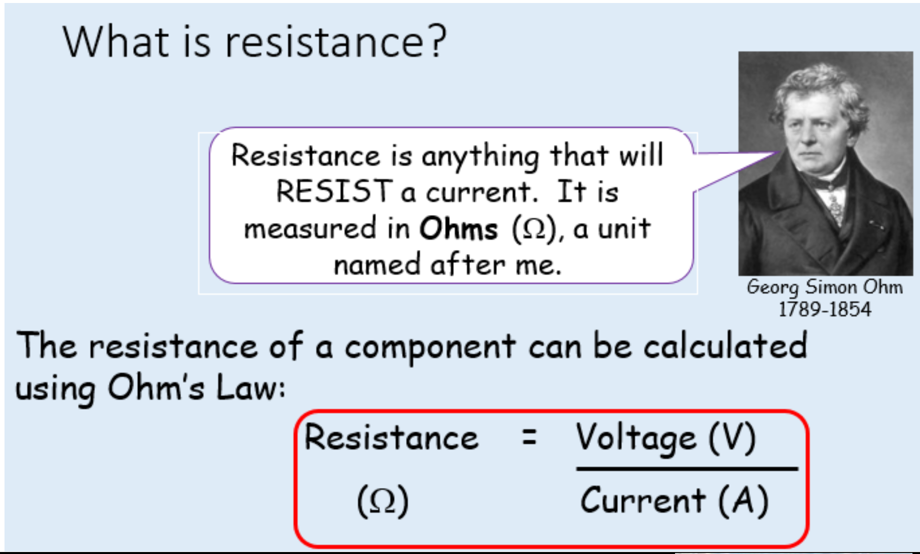
Potential difference stays the same across the strands in a parallel circuit.

Resistance as how difficult it is for current to flow.

- Resistance is measured in Ohms (Ω).
- Fixed resistors have a fixed resistance
- Variable resistors can have their resistance changed.
- All components in a circuit have some resistance.

Ohm's Law: Voltage (V) = current (A) x resistance (Ω)

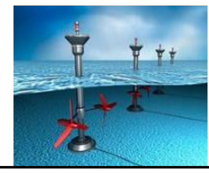
- When using a fixed resistance the relationship between current and potential difference is directly proportional.



How do we pay for electricity?

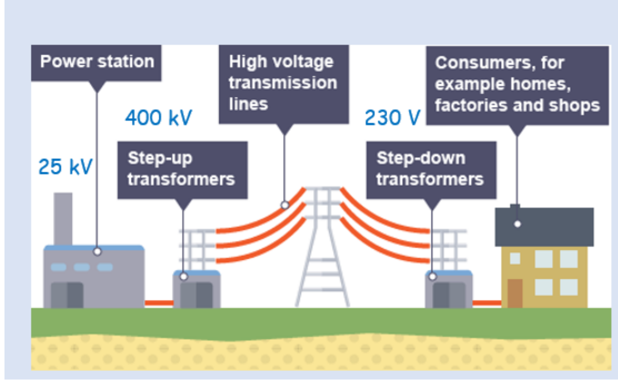
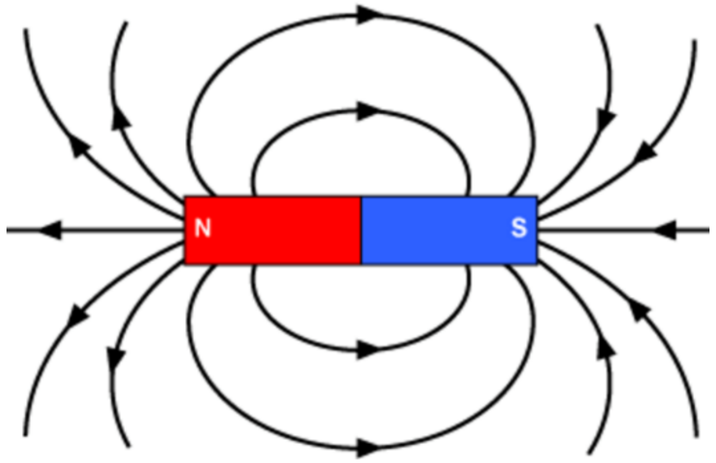
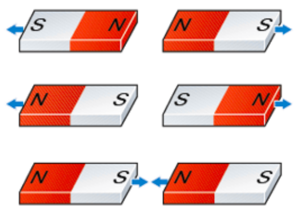
Recap from year 8

- **Non-renewable** energy are resources that are being used quicker than they are being replaced. E.g. coal, oil, natural gas, nuclear
- **Renewable** energy are resources that will not run out e.g. wind, solar, hydroelectricity, geothermal



Electricity

Year 9 physics knowledge organiser

	Electricity enters out home via a series of cables called the national grid. Units of electricity kWh. Electricity meters measure the amount of electricity used per household. - Calculating the cost of running different appliances. Electricity meters measure the number of units of electricity used in a home or other building. The more units used, the greater the cost. units used (kWh) = power (kW) × time (h) At present (Nov 2022) the cost per unit is 34p. The national grid 	
How do motors work?	Recap on magnetism from Y7+8 Magnetism: an invisible force that pushes or pulls magnetic materials. Magnetic materials are materials that are attracted to a magnet, but do not attract or repel each other. There are only three magnetic elements, they are: Iron, Nickel and Cobalt Non-magnetic materials are not affected by magnets this includes metals such as gold, aluminium, silver and copper. A magnet has two poles. Pole – part of the magnet with strongest magnetic force. The poles are called North pole and South pole Magnets have a magnetic field around them. This is the area where they can attract or repel a magnetic material. These can be shown on a diagram using field lines  Field lines always go out of the North pole and into the South. This is shown by arrows. **Law of magnets** If you bring 2 bar magnets close together… TWO OPPOSITE POLES ATTRACT TWO LIKE POLES REPEL 	Magnetism Magnetic field Current Force Uniform

Year 9 physics knowledge organiser

Uniform magnetic fields

- A uniform magnetic field is produced between two magnets.

A current flowing through a wire produces a magnetic field around the wire.

Motor effect

- a wire carrying a current will experience a force when in a uniform magnetic field.
- Use of Flemmings left hand rule to identify the direction of the force experienced by the wire.