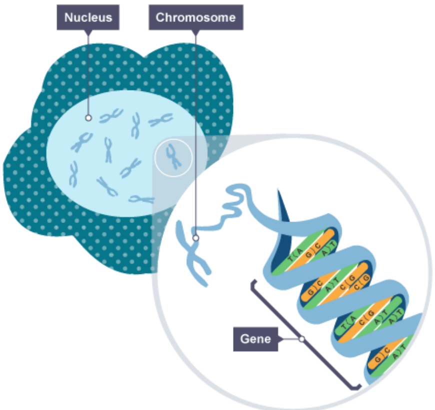
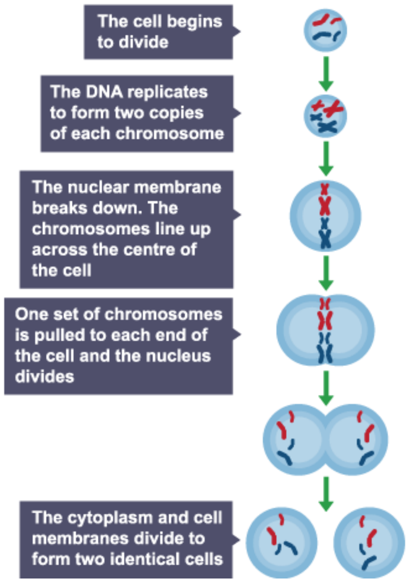
Key points to achieve at least L4:

Biology – paper 1

- **4.1.2 Cell division**
    - Chromosomes
    - Mitosis and cell cycle
    - Stem cells

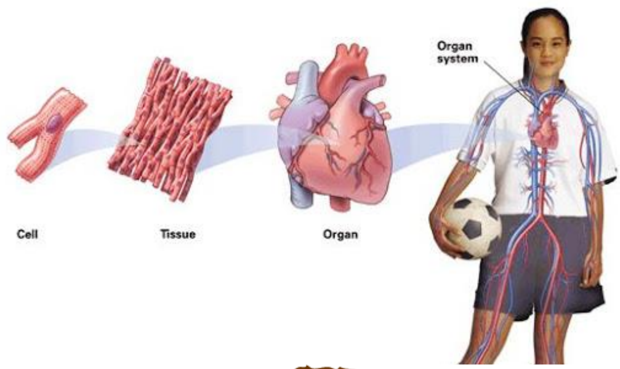


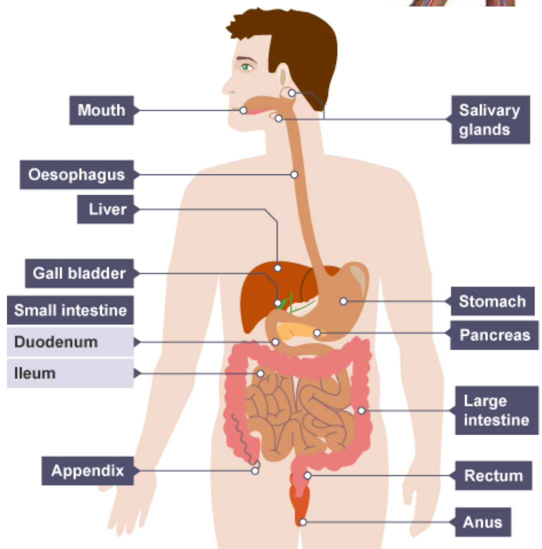
Each of your cells has a **nucleus** that contains **chromosomes**. **Chromosomes** carry genetic information in a molecule called **DNA**.



Stem cell	Embryonic	Adult bone marrow	Meristem
Where it is found?	Inner cells of an embryo	Inner part of the bone	Plants – stem and roots
How can it be used?	Differentiate to make any cell	Make mainly blood cells	Differentiate to make any cell
Any problems?	Embryo is damaged or destroyed	Painful to extract and limited use	None

- **4.2.2 Animal tissues, organs and organ systems**
    - Human digestive system
    - Heart and blood vessels
    - Blood
    - CHD: a non-communicable disease
    - Health issues
    - Effect of lifestyle on some non-communicable disease
    - Cancer



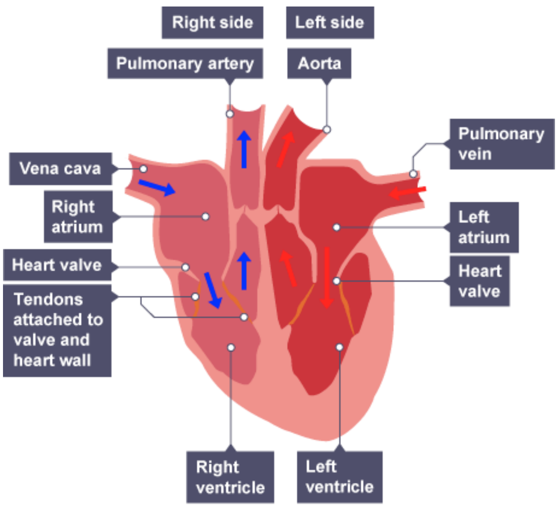


Carbohydrates – broken down by carbohydrase, e.g. **amylase**, into glucose. This is produced in saliva, pancreas and small intestine.

Proteins – broken down by protease, e.g. **protease**. This is produced in stomach, pancreas and small intestine.

Fats – broken down by lipase. This is produced in the pancreas and small intestine.

Region	Function
Mouth	Begins the digestion of carbohydrates
Stomach	Begins the digestion of protein; small molecules such as alcohol absorbed
Liver	Produces bile, which helps in digestion of lipids
Small intestine - Duodenum	Continues the digestion of carbohydrates and protein; begins the digestion of lipids
Small intestine – Ileum	Completes the digestion of carbohydrates and proteins into single sugars and amino acids; absorption of single sugars, amino acids and fatty acids and glycerol
Large intestine	Absorption of water; egestion of undigested food



From the body:

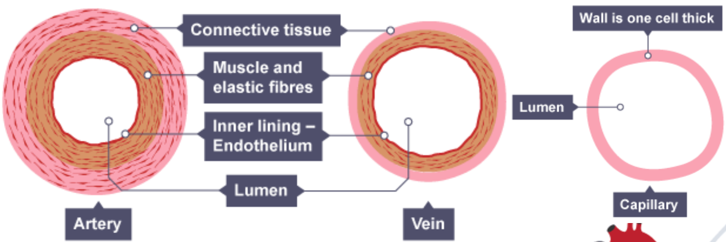
- Blood enters from **vena cava** into the **right atrium**
- The atria fill, followed by the ventricles
- Blood is prevented from flowing back by **heart valves**
- Blood **leaves** the heart in the body's main artery – the **pulmonary artery**, and **to the lungs**

From the lungs:

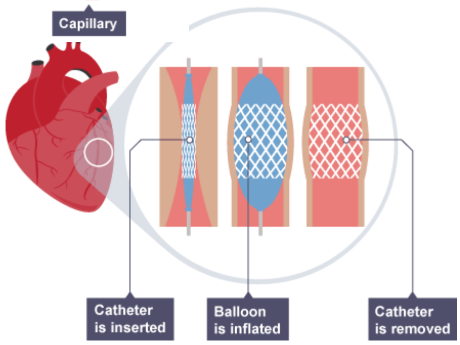
- Blood from the **pulmonary veins** enters the **left atrium**
- The atria fill, followed by the ventricles
- Blood is prevented from flowing back by **heart valves**
- Blood **leaves** the heart in the body's main

Blood is carried around your body in three main types of blood vessels, each adapted for a different function:

- **Arteries**
- **Veins**
- **Capillaries**

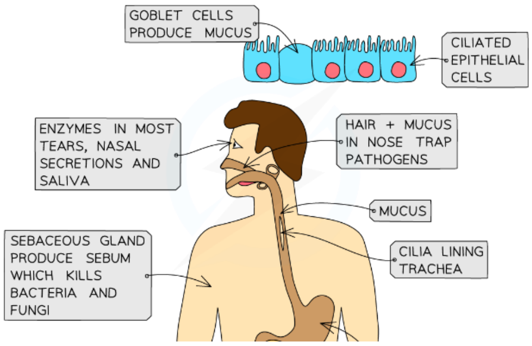


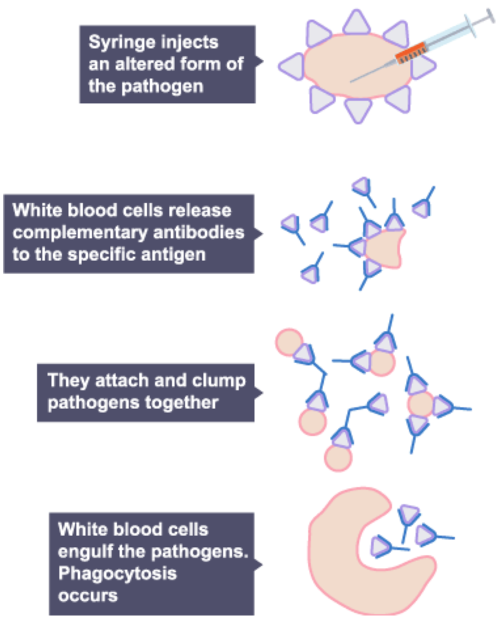
Coronary heart disease (CHD) can be caused by build-up of fatty material on the lining of the vessels. It is a non-communicable disease and can be prevented by exercise and a healthy diet.
Doctors often solve the problem of CHD with a stent – a metal mesh that is placed in the artery.

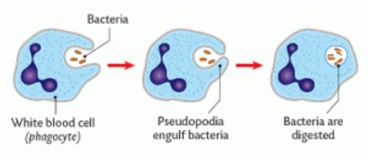
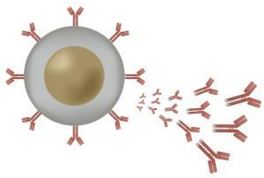
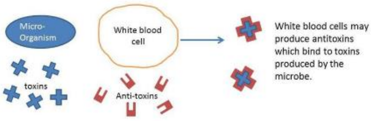


- **4.3.1 Communicable diseases**
    - Communicable (infectious) diseases
    - Viral diseases
    - Bacterial diseases
    - Fungal diseases
    - Protist diseases
    - Human defence system
    - Vaccination
    - Antibiotics and painkillers
    - Discovery and development of drugs

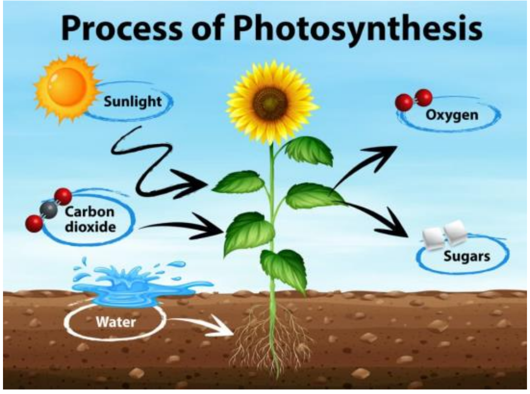
Viral diseases	Bacterial diseases	Fungal	Protist
Measles – fever and red skin rash	**Salmonella** - cramps, sickness and diarrhoea	**Athletes foot** – rash and sores in between toes	**Malaria** – passed on by mosquitoes
HIV – mild flu-like symptoms. **AIDS** – attacks immune system	**Gonorrhoea** – burning pain when urinating and thick, yellow discharge	**Rose black spot** – black/purple spots on leaves	
Tobacco mosaic virus – infects chloroplasts			





Role of white blood cell	How it protects you against disease
Ingesting microorganisms 	**Phagocytes** surround any pathogens in the blood - engulf them, digesting and destroying them.
Producing antibodies 	**Lymphocytes** detect foreign (not naturally occurring) cells within your body and produce **antibodies**. The antibodies cause pathogens to stick together and make it easier for phagocytes to engulf them.
Producing antitoxins 	Some pathogens produce **toxins** which make you feel ill. **Lymphocytes** can also produce **antitoxins** to neutralise these toxins.

- **4.4.1 Photosynthesis**
    - Photosynthetic reaction
    - Rate of photosynthesis
    - Uses of glucose from photosynthesis



Cells in plant leaves are full of small parts called **chloroplasts**, which contain a green substance called **chlorophyll**

Energy is transferred from the environment to chloroplasts by **light**

This energy is then used to convert **carbon dioxide** (from air) and **water** (from the soil) into a simple sugar called **glucose**

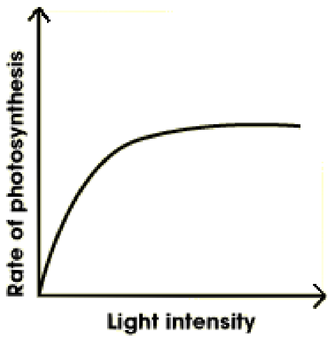
The chemical reaction also produces **oxygen**, as a waste product

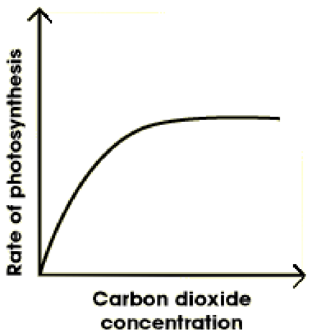
This is an endothermic reaction – it uses energy from the environment

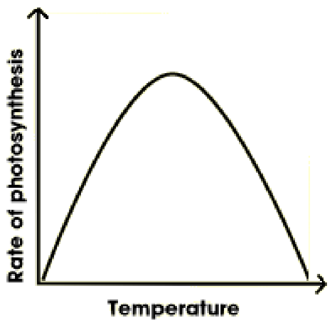
Factors limiting photosynthesis

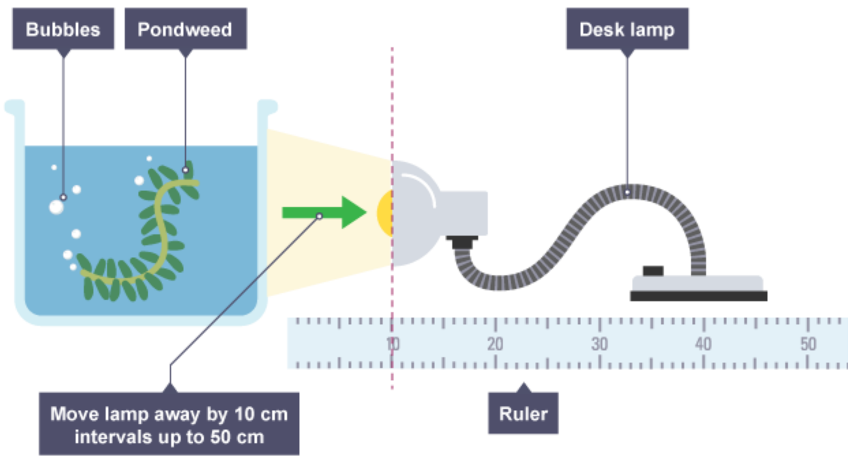
Three factors can limit the speed of photosynthesis –

- light intensity
- carbon dioxide concentration
- temperature.



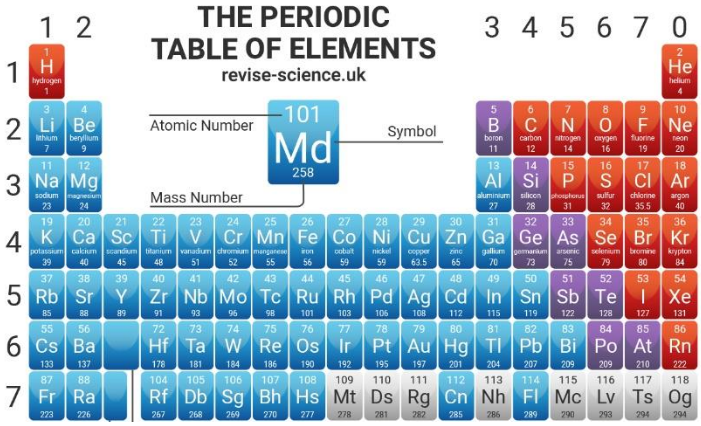


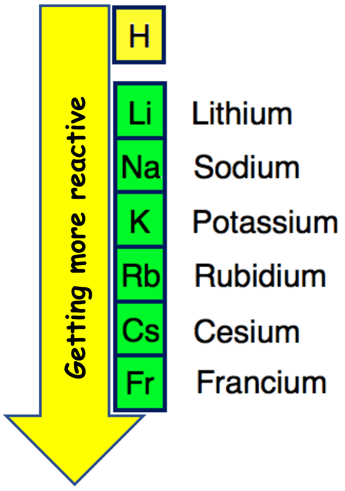




Chemistry – paper 1

- **5.1.2 The periodic table**
  - The periodic table
  - Development of periodic table
  - Metals and non-metals
  - Group 1
  - Group 7
  - Group 0

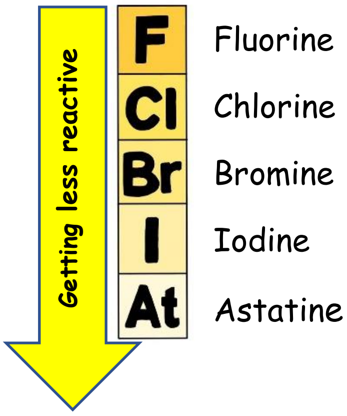




Group 1 – alkali metals. Reactivity increases as you go down the group – due to the outer electron getting further away from the 'pull' of the nucleus.

Similar physical properties:

- are soft metals (they can be cut with a knife)
- have relatively low melting points
- have low densities
- form positively charged ions



Group 7 – halogens. Reactivity decreases as you go down the group – due to the 'pull' of the nucleus being weaker, so less attraction to receive electrons.

Similar physical properties:

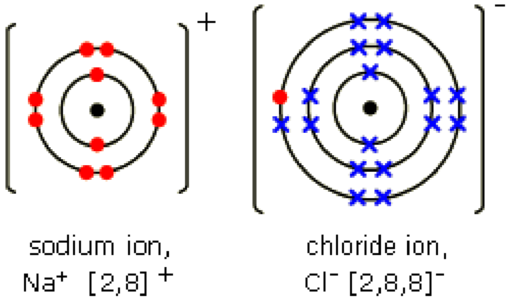
- Non-metals, gas or liquid at room temperature
- have relatively high melting points
- form negatively charged ions

Group 0/8 – noble gases. Unreactive – due to the full outer electron shell.

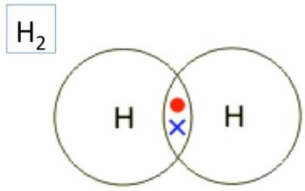
Similar physical properties:

- exist as single non-metals atoms
- gas at room temperature
- low boiling points
- atoms become larger, as you go down the group

- **5.2.2 How bonding and structure are related to the properties of substances**
  - Three states of matter
  - State symbols
  - Properties of ionic compounds
  - Properties of small molecules
  - Polymers
  - Giant covalent structures
  - Properties of metal and alloys
  - Metals as conductors

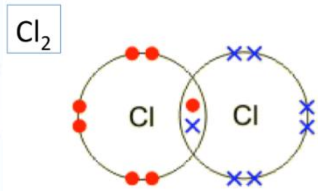


Ionic bonds – form between metals and non-metals. Atoms lose or gain electrons to become ions.



Covalent bonding – form between non-metals only. One or more pairs of electrons are shared.

PROPERTIES	IONIC COMPOUNDS	COVALENT COMPOUNDS
Shape	exist as solid in room temperature	may exist as solids, liquid or gases
Melting & Boiling points	High	Low
Electricity Conductivity	Conduct electricity in aqueous solution or molten state	Do not conduct electricty
Solubility in Water	Soluble	Insoluble
Solubility in Organic Solvent	Insoluble	Soluble

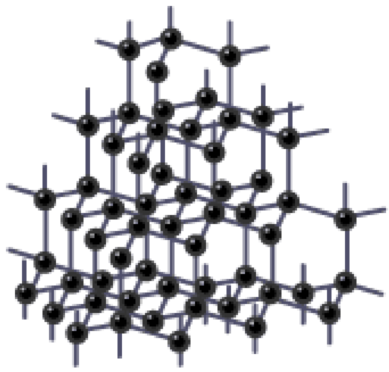


Metallic bonding – form between metal atoms only. Outer electrons are delocalised – free to move – and this sharing of delocalised electrons results in strong metallic bonding.

- **5.2.3 Structure and bonding of carbon**
  - Diamond
  - Graphite
  - Graphene and fullerenes

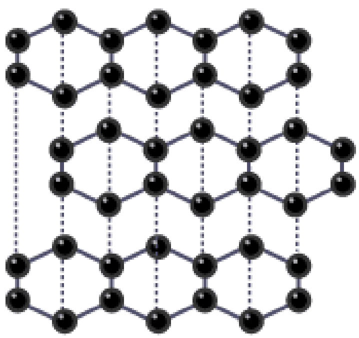
Diamond is a **giant covalent structure** in which:

- each carbon atom is joined to **four** other carbon atoms by **strong covalent bonds**
- the carbon atoms form a **regular tetrahedral** network structure
- there are **no free electrons**

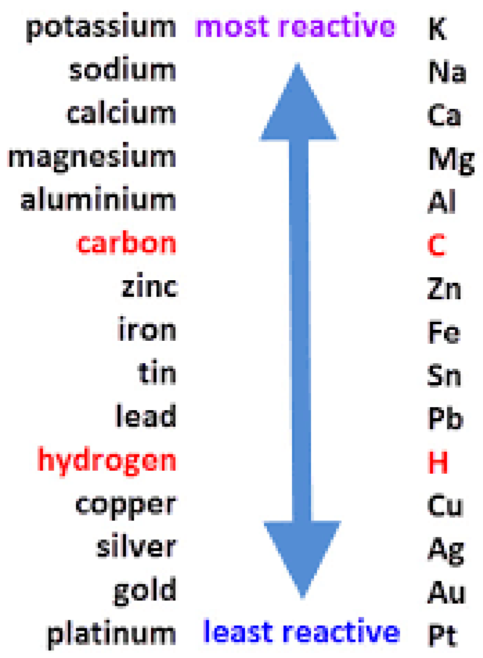


Graphite has a giant covalent structure in which:

- each carbon atom forms **three covalent bonds** with other carbon atoms
- the carbon atoms **form layers** of hexagonal rings
- there are **no covalent bonds** between the layers
- there is **one delocalised (non-bonded) electron** from each atom



- **5.4.1 Reactivity of metals**
  - Metal oxides
  - The reactivity series
  - Extraction of metals and reduction



Extraction of metals:

- The method of extraction of metal depends on how reactive it is
- Unreactive metals, like Gold exist as elements of the Earth's surface
- However, most metals are found as metal oxides or ores

Metals **less reactive** than carbon, e.g. lead and iron can be extracted from their oxides by **heating with carbon**.

Metals that are **more reactive** than carbon, e.g. aluminium are extracted from molten compounds by **electrolysis**.

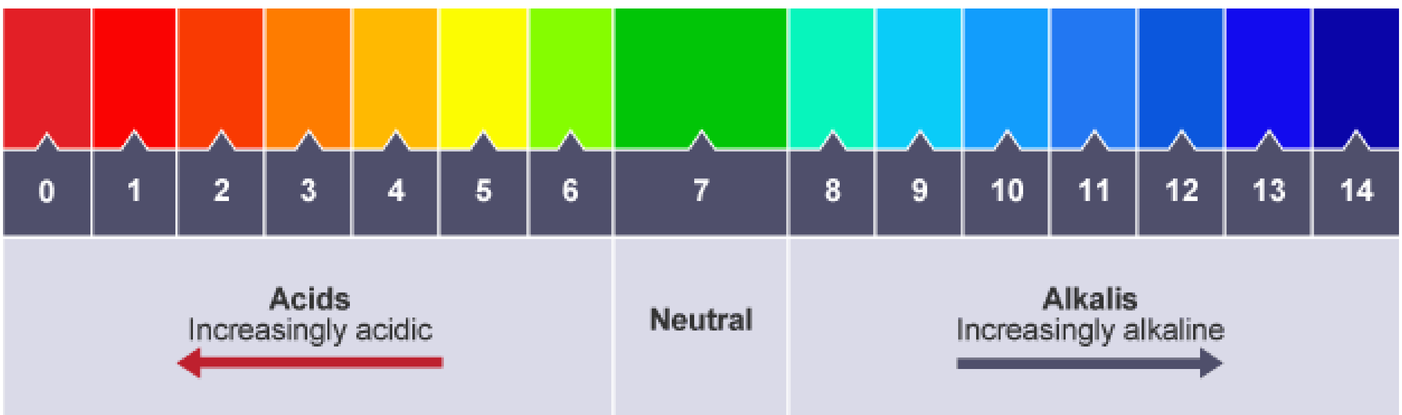
- **5.4.2 Reactions of acids**
  - Reactions of acids with metals
  - Neutralisation of acids and salt production
  - Soluble salts
  - The pH scale and neutralisation

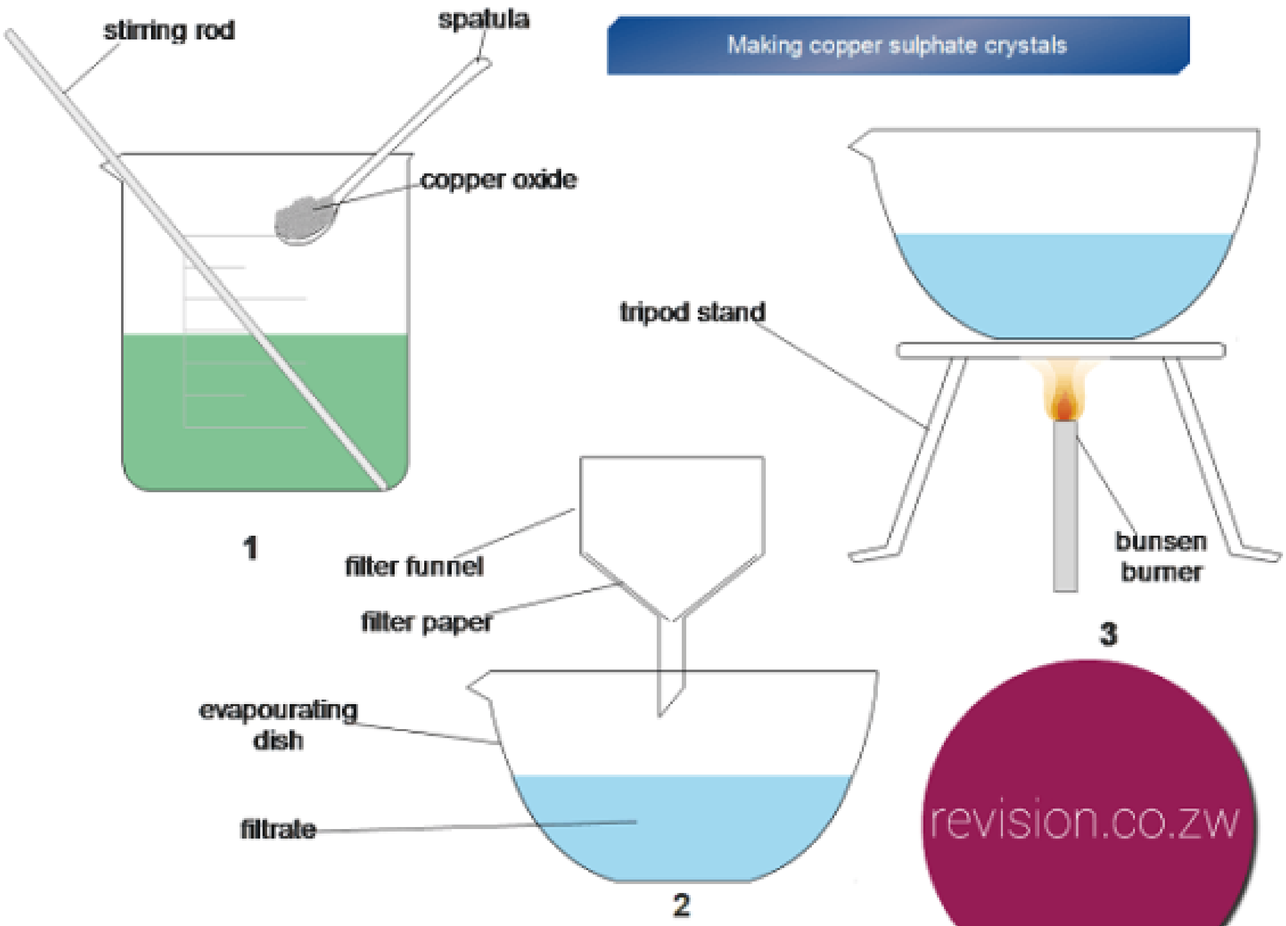
acid + metal → salt + hydrogen

The first part of the salt come from the **metal**.
The second part of the salt comes from the **acid**.

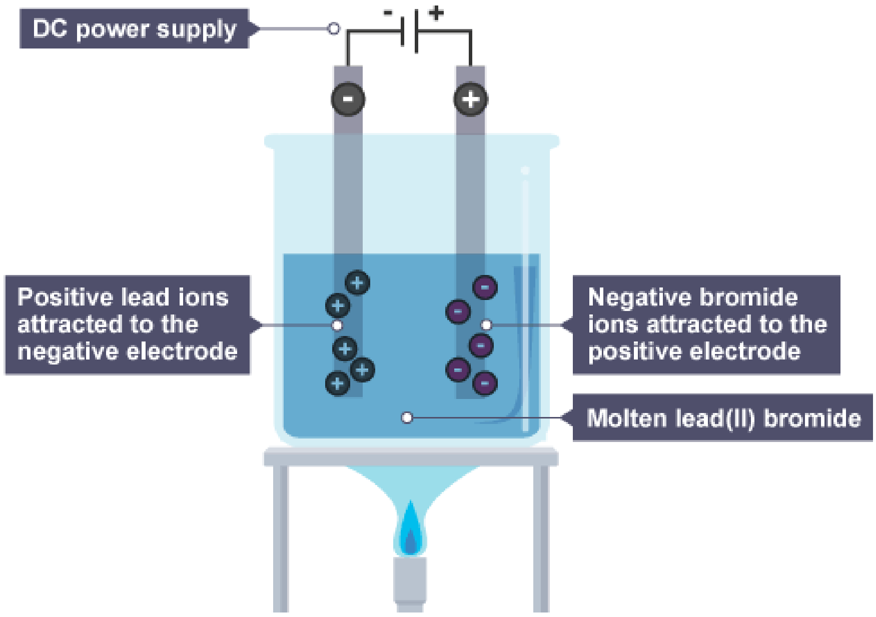
Acid	Salt Formed
hydrochloric acid	- chloride
sulphuric acid	- sulphate
nitric acid	- nitrate

Magnesium + Hydrochloric Acid → Magnesium Chloride + Hydrogen





- **5.4.3 Electrolysis**
  - The process of electrolysis
  - Electrolysis of molten ionic compounds
  - Using electrolysis to extract metals
  - Electrolysis of aqueous solutions



Electrolysis is a process in which electrical energy, breaks down electrolytes. The free moving ions in electrolytes are attracted to the oppositely charged electrodes which connect to the dc supply.

The **negatively charged** electrode in electrolysis is called the **cathode**. **Positively charged ions move towards the cathode.**

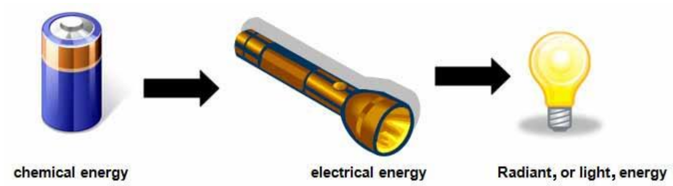
The **positively** charged electrode in electrolysis is called the **anode**. **Negatively charged ions move towards the anode.**

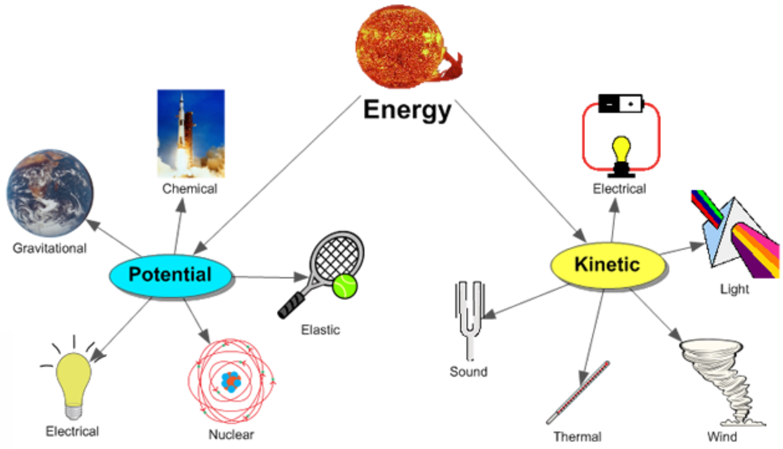
Physics – paper 1

- **6.1.1 Energy changes in a system, and the ways energy is stored**
    - Energy stores and systems
    - Changes in energy
    - Energy changes in systems
    - Power

Energy cannot be created or destroyed!!

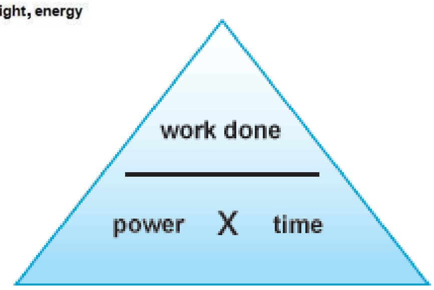
It can be transferred from one store to another. For example:

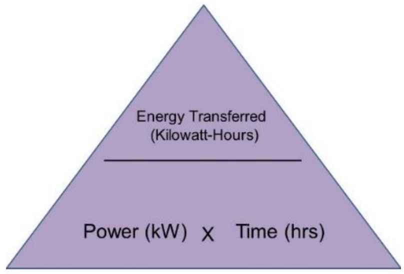




Work done = energy transferred.

Power is how much work is done or energy transferred, it can be calculated using the following equations:





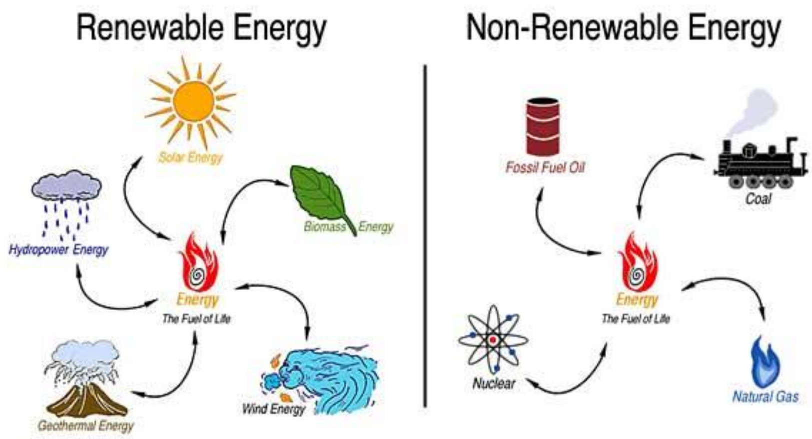
- **6.1.3 National and global energy resources**

Energy is needed in:

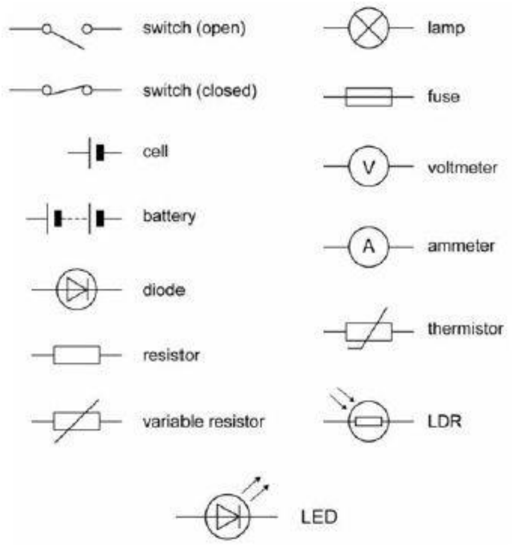
- Homes
- Public services
- Factories and farms
- Transport

Energy is from:

- Non-Renewable resources – finite e.g. fossil fuels
- Renewable resources – are replenished, e.g. wind

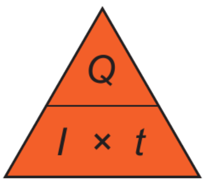


- **6.2.1 Current, potential difference and resistance**
    - Standard circuit diagram symbols
    - Electrical charge and current
    - Current, resistance and potential difference
    - Resistors



Electrical current is the flow of charge – in metals this is carried by delocalised electrons. It can be calculated using this equation:

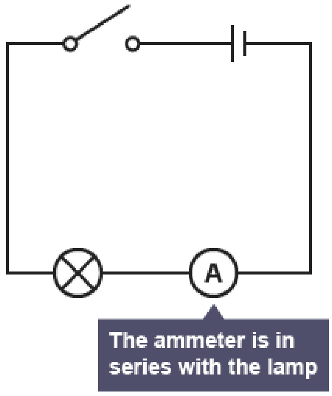
Charge (Q) = current (I) x time (t)

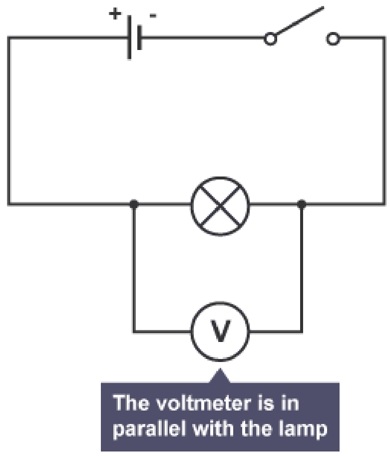


To measure **current (I)** – an **ammeter** is put in to the electrical circuit, unit is **Amps (A).**

To measure **potential difference/voltage (V)** – a **voltmeter** is put parallel to the component, unit is **Volts (V).**

For example:



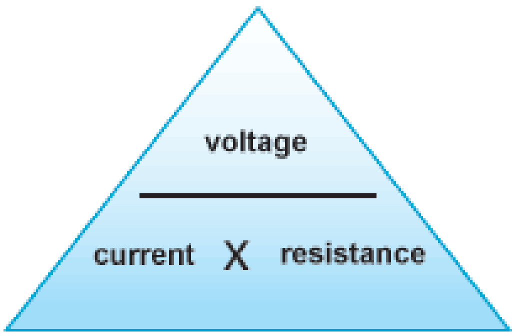


The **current** through a component depends on both the **resistance** of the component and the **potential difference** across the component.

When a charge moves through a potential difference, electrical work is done and energy transferred. The potential difference can be calculated using the equation:

potential difference = current × resistance

V = I × R

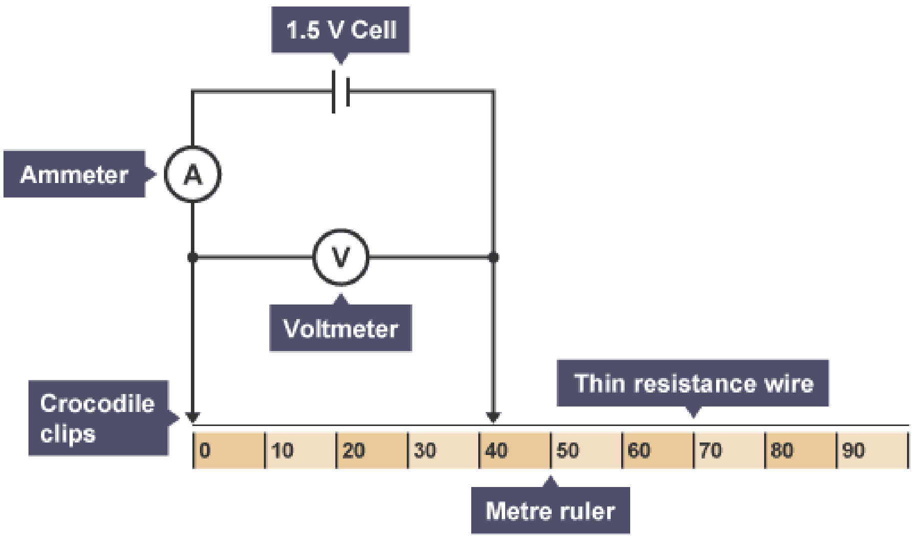


This is when:

- potential difference (*V*) is measured in volts (V)
- current (*I*) is measured in amps (*A*)
- resistance (*R*) is measured in ohms (Ω)

There are different ways to investigate the factors that affect resistance. In this practical activity, it is important to:

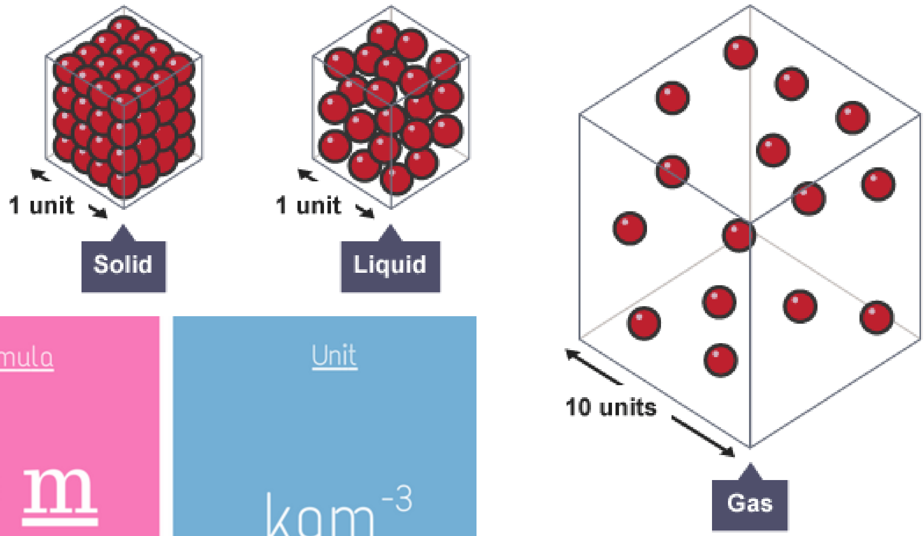
- record the length of the wire accurately
- measure and observe the potential difference and current
- use appropriate apparatus and methods to measure current and potential difference to work out the resistance

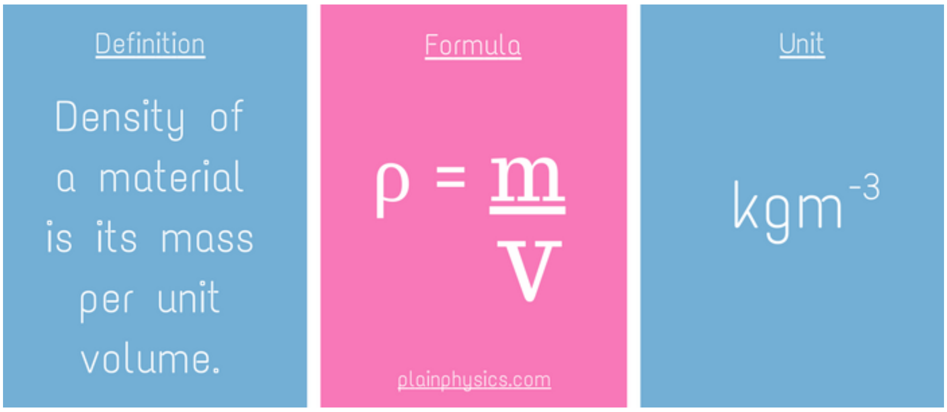


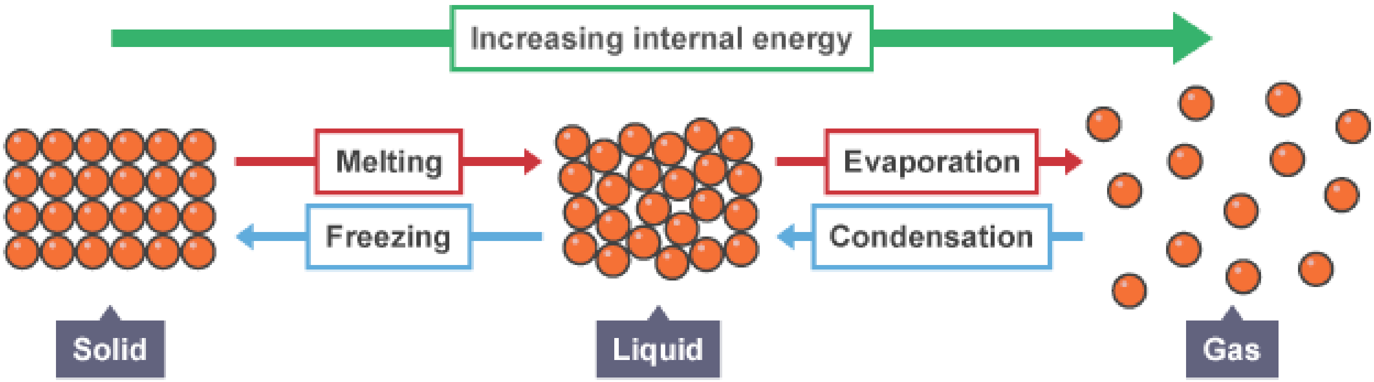
- **6.3.1 Changes of state and the particle model**
    - Density of materials
    - Changes of state

All matter contains particles. The difference between the different states of matter is how the particles are arranged:

- in a solid - particles are tightly packed in a regular structure
- in a liquid - particles are tightly packed but free to move past each other
- in a gas - particles are spread out and move randomly







Internal energy is linked to the temperature of matter but the two are very different things:

- **Internal energy** is a measure of the **total energy of all the particles** in the object or substance. This includes the kinetic energy of the particles and chemical potential energy of the bonds between them.
- **Temperature** is a measure of the **average speed of the particles**. This is based on the kinetic energy of individual particles.

Heating water causes the water molecules to **gain kinetic energy** and speed up. It takes more energy to raise the temperature of a large amount of water because more molecules need to have their speed changed.

The specific heat capacity of water is 4,200 joules per kilogram per degree Celsius (J/kg°/C). This means that it takes 4,200 J to raise the temperature of one kg of water by 1 °C.

Some other examples of specific heat capacities are:

- Brick - 840 J/Kg/°C
- Copper - 385 J/Kg/°C
- Lead - 129 J/Kg/°C

The amount of thermal energy stored or released as a substance changes state can be calculated using the equation:

change in thermal energy = mass × specific heat capacity × temperature change

$$\Delta Et = m \times c \times \Delta\theta$$

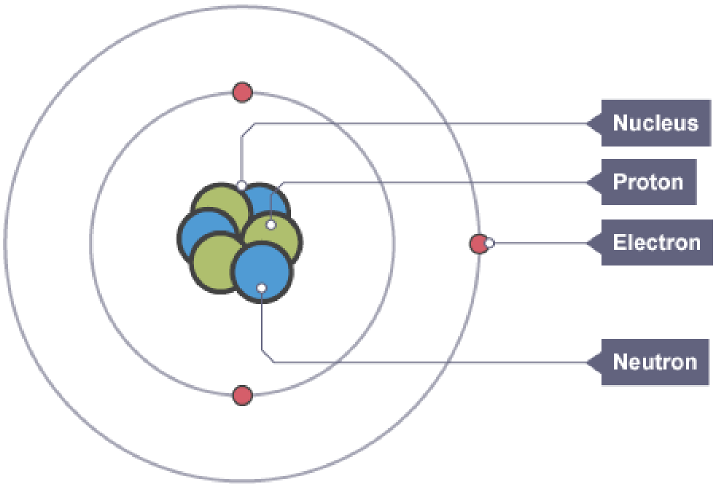
This is when:

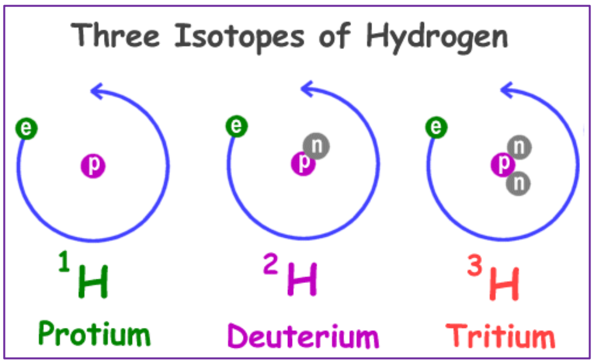
- change in thermal energy (ΔE_t) is measured in joules (J)
- mass (m) is measured in kilograms (kg)
- specific heat capacity (c) is measured in joules per kilogram per degree Celsius (J/kg/°C)
- temperature change ($\Delta\theta$) is measured in degrees Celsius (°C)

- **6.4.2 Atoms and nuclear radiation**
  - Radioactive decay and nuclear radiation
  - Nuclear equations
  - Half-lives and the random nature of radioactive decay
  - Radioactive contamination

Atoms are very small, they have a radius of around **1×10^{-10} metres.**

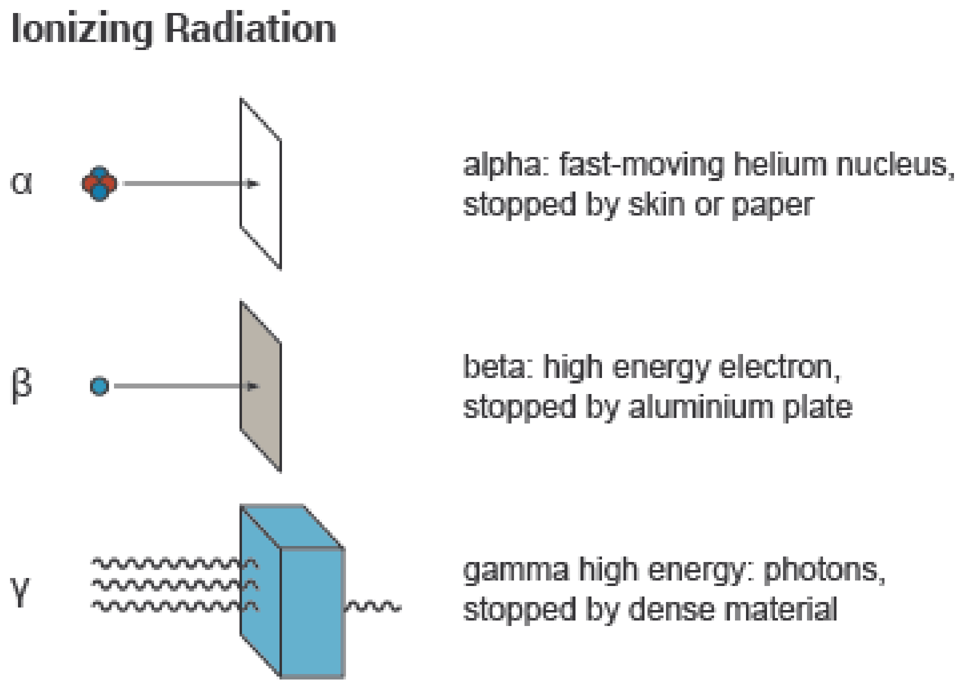
The modern view of the atom is of a nucleus containing **protons and neutrons** with smaller **electrons** orbiting outside the nucleus.





Isotopes are the atoms of an element with **different numbers of neutrons**. They have the **same proton number**, but different mass numbers.

An unstable nucleus ca decay (break down) by emitting an alpha particle, a beta particle, a gamma ray, or in some cases a single neutron.



Radioactive decay is a random process – it is not possible to say which particular nucleus will decay, but given the number of them it is possible to say a certain number will decay in a certain time. This is called the half-life.

Half-life is the time it takes for half of the unstable nuclei in a sample to decay or for the activity of the sample to halve or for the count rate to halve. Count-rate is the number of decays recorded each second by a detector, such as the Geiger-Muller tube.