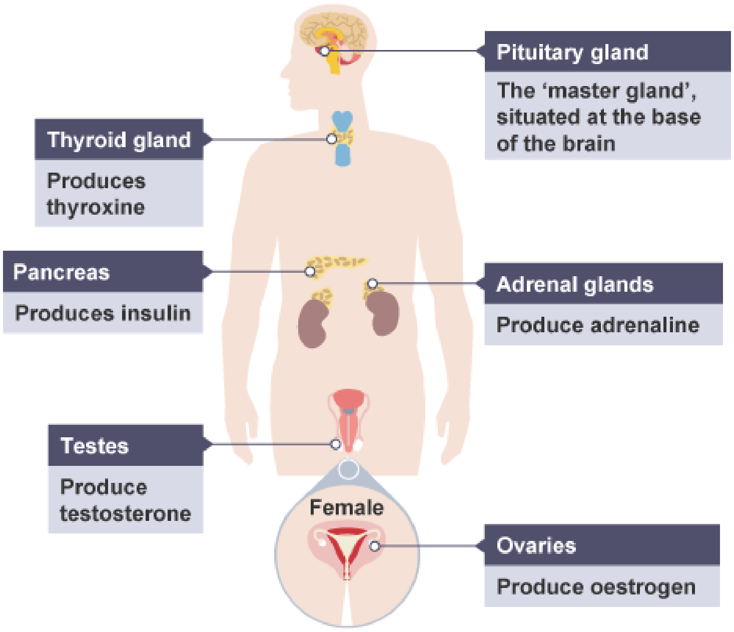
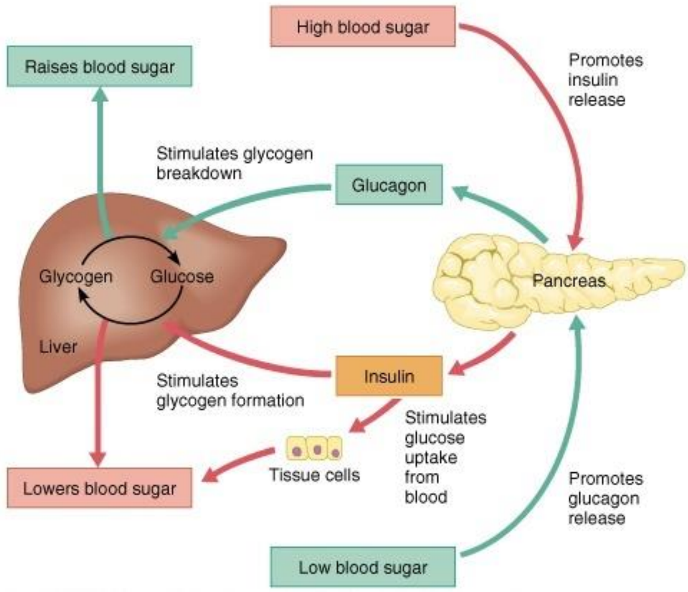
Key points to achieve at least L4:

Paper Biology 2F:

- **4.5.3 Hormonal control in humans**
  - Human endocrine system
  - Control of blood glucose concentration
  - Hormones in human reproduction
  - Contraception



A hormone is a **chemical substance**, produced by a gland and carried in the bloodstream, which **alters the activity** of specific target organs. E.g. the hormone **adrenaline**, which is released by the **adrenal gland**. One of its target organs is the heart, where it increases the heart rate – preparation for 'fight or flight'.



Regulating blood sugar - glucose is needed by cells for respiration.

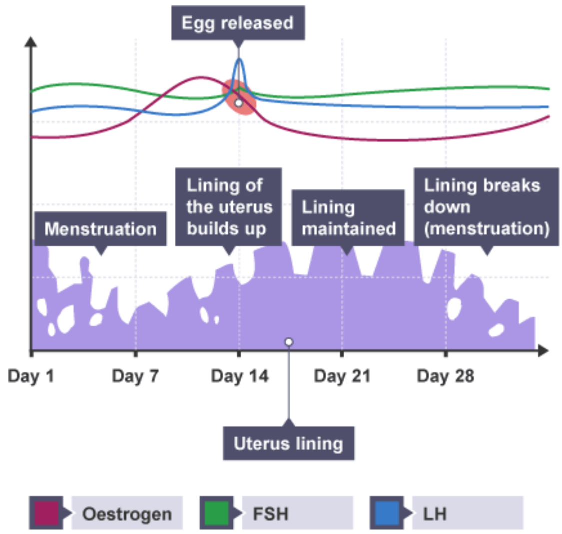
Too high - insulin produced by the **pancreas**, causes glucose to move from the blood to the liver – lowering blood glucose level.

Too low – glucagon is produced, causing glycogen breakdown – raising the blood glucose level.

Changes occur at puberty because of hormones:

- testosterone - produced by the testes - controls the development of male secondary sexual characteristics
- oestrogen - produced by the ovaries - controls the development of female secondary sexual characteristics

Menstrual cycle lasts for approximately 28 days, you can see the changes to hormones during this process on the graph:



- **4.6.1 Reproduction**
  - Sexual and asexual reproduction
  - Meiosis
  - DNA and the genome
  - Genetic inheritance
  - Inherited disorders
  - Sex determination

Only one parent is needed in **asexual reproduction**. There is no fusion of gametes so genetic material does not mix, which means that the offspring produced through this process are genetically identical clones to the parent. Asexual reproduction uses the process of **mitosis**.

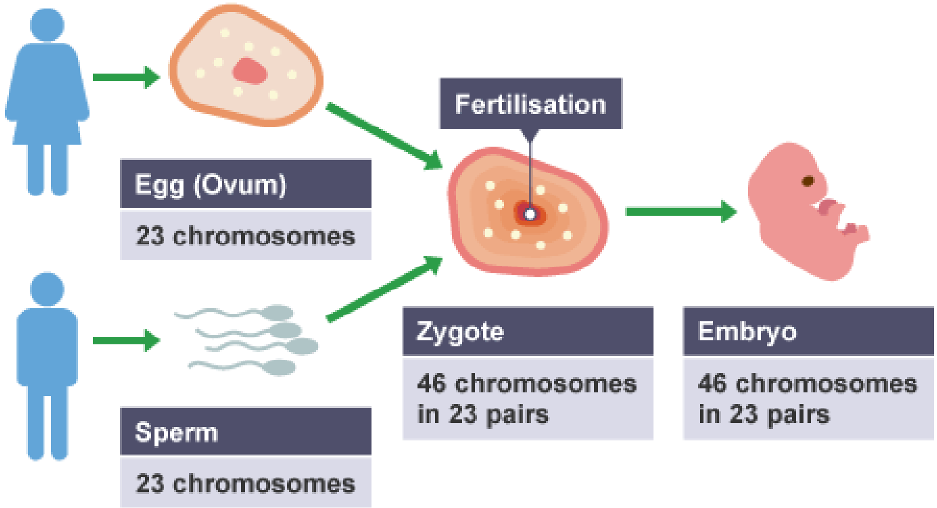
Some examples include:

- bacteria
- production of spores by fungi
- some plants, such as strawberries, use runners
- formation of tubers in potatoes and bulbs in daffodils

Two parents – male and female, are needed in **sexual reproduction**. During this process the nuclei of the male and female **gametes are fused** in order to create a **zygote**. This process is known as **fertilisation.** Sexual reproduction uses the process of **meiosis**, which creates gametes.

Gametes include:

- animals – **egg and sperm**
- flowing plants – **pollen and eggs**



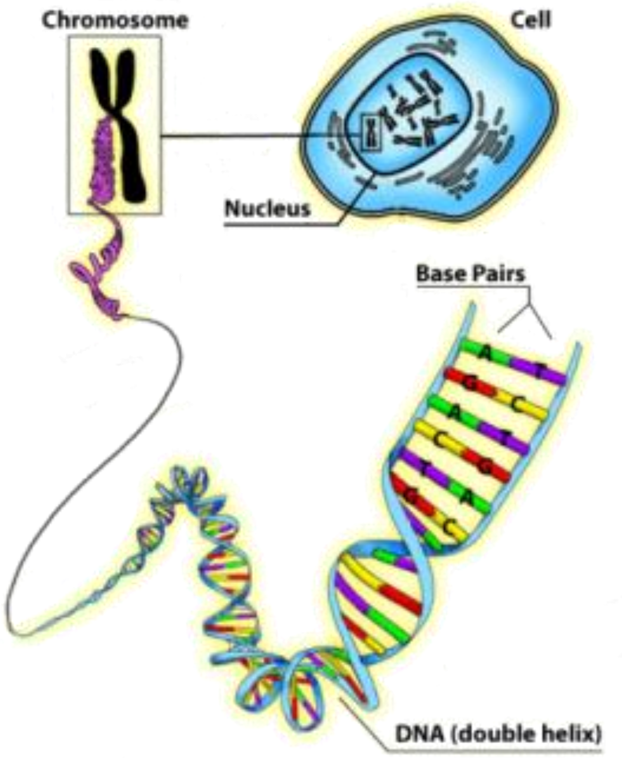
	Asexual reproduction	**Sexual reproduction**
Advantages	- Population can increase rapidly, it's faster - Only one parent needed	- Produces variation in offspring - Disease is less likely to affect all individuals
Disadvantages	- No variation in the population - Disease might affect all individuals	- Time and energy to find a mate - Impossible for an isolated individual

Nucleus – found in every cell

Chromosomes – contained in the nucleus

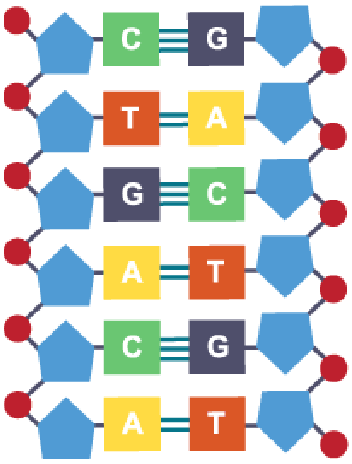
DNA – genetic code, which gives the characteristics

Gene – Small section of DNA in chromosome



Structure of DNA – made from 4 different bases:

- **thymine, T**
- **adenine, A**
- **guanine, G**
- **cytosine, C**



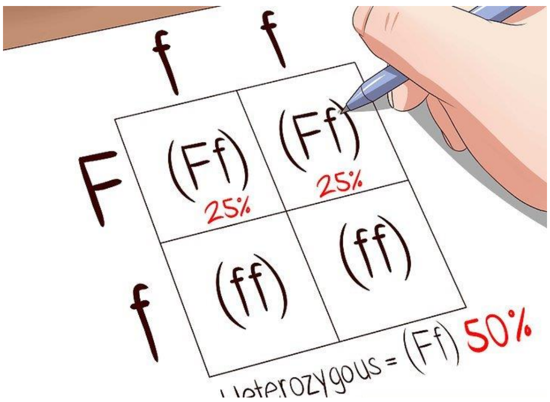
Inherited disorders. Some disorders are inherited, such as:

- red-green colour blindness
- sickle cell anaemia
- cystic fibrosis.

Inherited disorders are caused by **faulty genes**, which are mostly (but not always) **recessive alleles**. **For example**, cystic fibrosis is an inherited disorder that affects the cell membranes, causing the production of thick and sticky mucus.

The chance of a child having an inherited disorder can be shown on a punnet square. This shows the possible offspring combination of parental genetic information:

- **dominant allele**, shown with **capital** letter
- **recessive allele**, shown with **lowercase** letter



You can also show the chance of having a male or female, using the same technique.

Mum – egg XX

Dad – sperm XY

Dad	Mum	X	X
X		XX (girl)	XX (girl)
Y		XY (boy)	XY (boy)

- **4.7.1 Adaptations, interdependence and competition**
    - Communities
    - Abiotic factors
    - Biotic factors
    - Adaptations

These are important key terms:

- An **ecosystem** is the **interaction** between a community of living organisms and their environment.
- A **community** is **two or more populations** of organisms.
- A **population** is all the organisms of the same or **closely-related species** in an area.

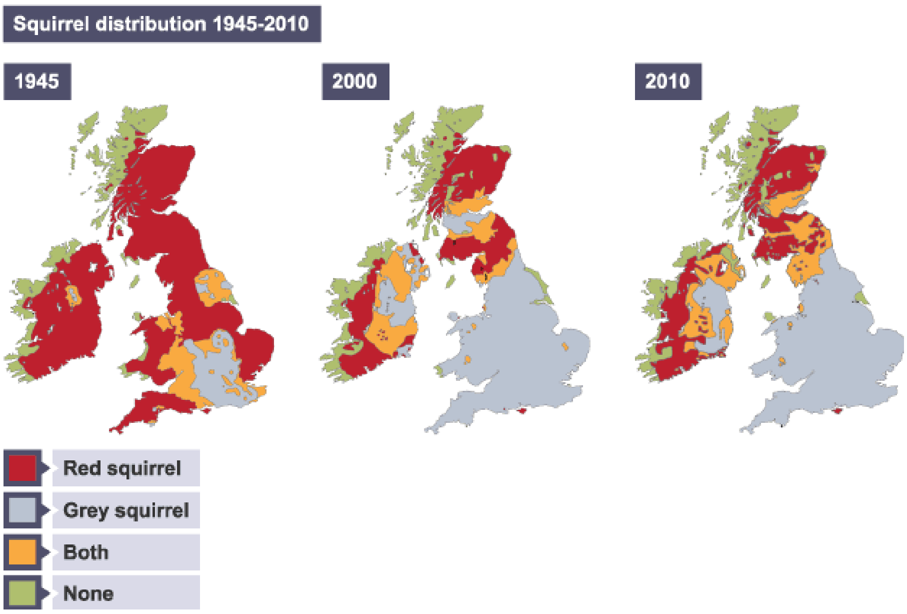
Abiotic factors include:

- Light intensity
- Temperature
- Moisture levels
- Soil pH levels and mineral levels
- Wind intensity and direction
- Carbon dioxide levels (for plants)
- Oxygen levels (animals)

Biotic factors include:

- Availability of food
- New predators
- New pathogens
- New species

For example: Red squirrels (native to Britain) have decreased in numbers, due to the larger Grey squirrel being introduced from USA.



Adaptations to the environment are required in order to make organisms better suited to their ecosystem. Adaptations can be:

- **Structural** – physical features e.g. falcons have sharp claws to catch prey
- **Behavioural** – behaviours which give them an advantage, e.g. lions work together in packs to catch and kill their prey
- **Physiological** – processes which allows them to compete, e.g. snakes producing venom to defend and kill

- **4.7.2 Organisation of an ecosystem**
    - Levels of organisation
    - How materials are cycled

Organisms within an ecosystem are organised into levels:

Producer	Producers are plants and algae, which photosynthesise.
Primary consumer	Primary consumers are herbivores, which eat producers.
Secondary consumer	Secondary consumers are carnivores, which eat primary consumers.
Tertiary consumer	Tertiary consumers are also carnivores. They eat secondary consumers.

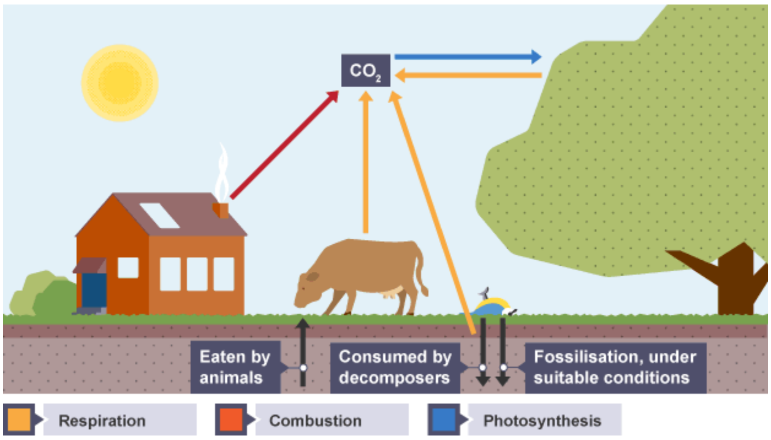
Feeding relationships show what organisms eat or are eaten by others and through this the levels of organisation in an ecosystem. These can be shown in food chains, which add together to make food webs for a habitat.

Food chains/webs show how energy is passed between organisms - always starting with producers (plants), which photosynthesise.

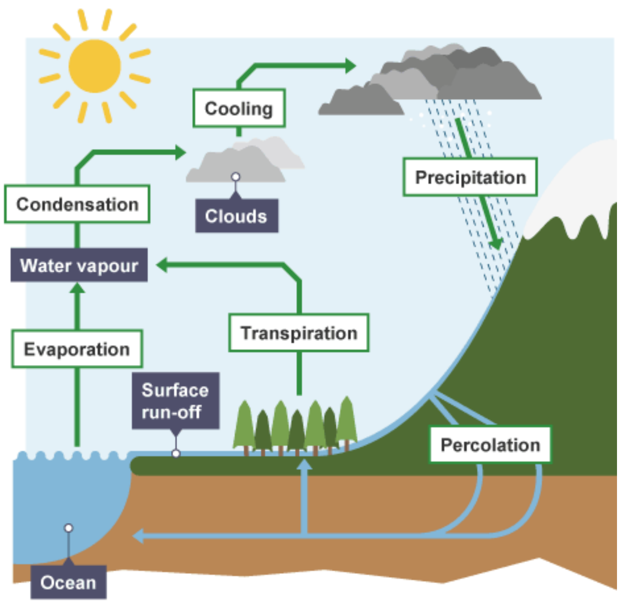
A simple example of a food chain is: **grass → rabbits → foxes**

How materials are cycled:

- **Carbon cycle** – carbon enters atmosphere, from **respiration and combustion**. CO_2 is **absorbed by plants** in photosynthesis. **Animals feed** on the plant. When organisms die, **decomposers** eat them and carbon is returned to the atmosphere.



- **Water cycle – Evaporation:** from puddles, lakes and seas. **Condensation:** cools and forms clouds. **Transport:** clouds are blown many miles. **Precipitation:** rain, hail and snow fall from the sky. **Surface runoff:** fallen rain runs along the surface of the ground. **Percolation:** fallen rain is absorbed into the ground. **Transpiration:** plants allow some water to evaporate from leaves, so more is continually 'pulled' from the soil.



Paper Chemistry 2F:

- **5.6.1 Rate of reaction**
    - Calculating rates of reactions
    - Factors which affect the rates of chemical reactions
    - Collision theory and activation energy
    - Catalysts

The rate of a reaction is a measure of how quickly a reactant is used up, or a product is formed.

Collision theory

For a chemical reaction to happen:

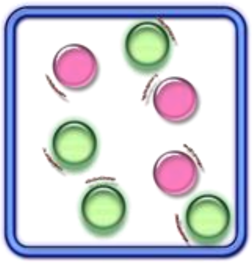
- reactant **particles must collide** with each other
- the particles must **have enough energy** for them to react

A collision that produces a reaction is called a successful collision. The **activation energy** is the **minimum amount of energy** needed for a collision to be successful. It is different for different reactions.

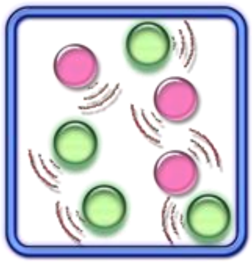
How to increase the rate of a reaction

The rate of a reaction increases if:

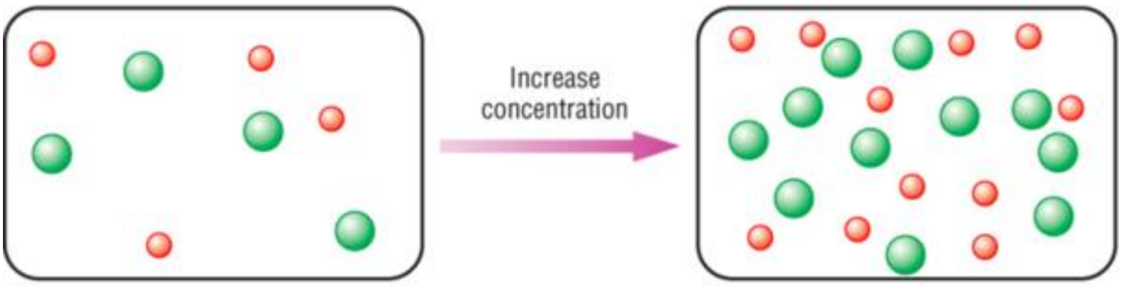
- **Temperature** is increased
- **Concentration** of a dissolved reactant is increased
- **Pressure** of a reacting gas is increased
- **Surface area** - solid reactants are broken into smaller pieces
- **Catalyst** is used

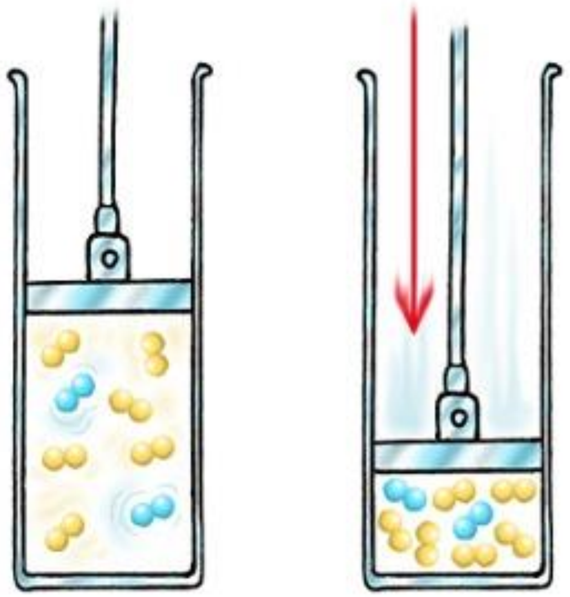


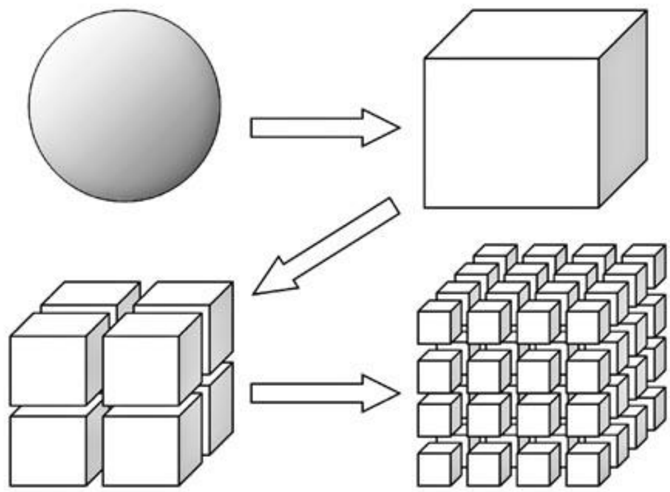
Particles have less energy, less frequent and successful collision

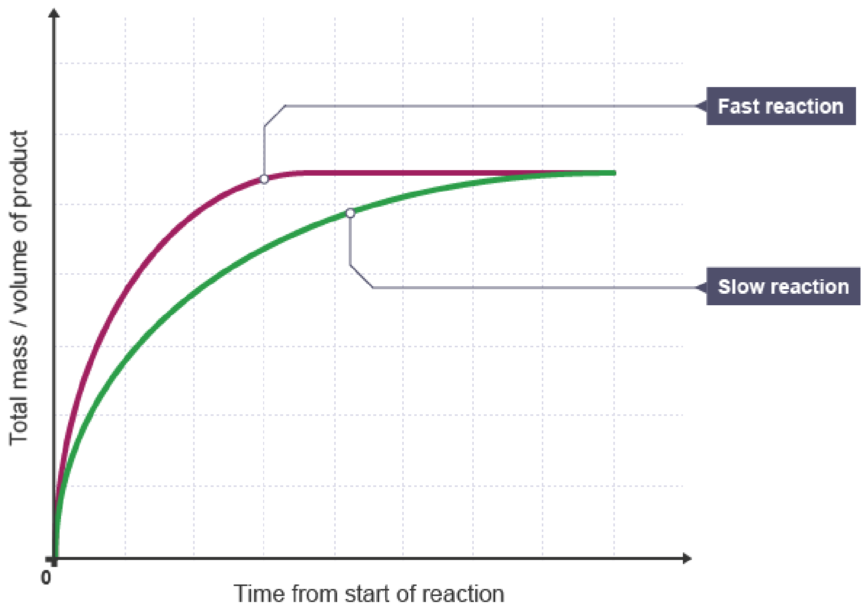


Particles have high energy, more frequent and successful collision









The gradient of the line is equal to the rate of reaction:

- the **steeper** the line, the **greater the rate** of reaction
- fast reactions - seen when the line becomes horizontal - finish sooner than slow reactions

- **5.6.2 Reversible reactions and dynamic equilibrium**
    - Reversible reactions
    - Energy changes and reversible reactions
    - Equilibrium

In some chemical reactions, the products of the reaction can react together to produce the original reactants. These reactions are called reversible reactions. They can be represented in the following way:

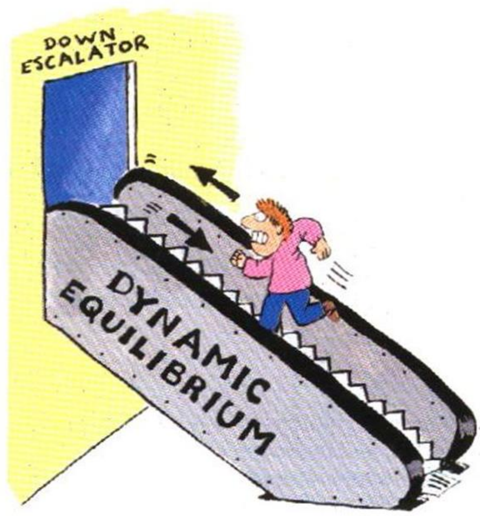
$$A + B \rightleftharpoons C + D$$

If a reaction is **exothermic (temperature increase)** in one direction, it will be **endothermic (temperature decrease)** in the other direction. The **same amount of energy is transferred** in both the forwards and reverse reaction.

Dynamic equilibrium

When a reversible reaction happens in a closed container, it reaches a dynamic equilibrium. At equilibrium:

- the **forward and backward** reactions are still happening
- the forward and backward reactions have the **same rate** of reaction
- the **concentrations** of all the reacting substances **remain constant**

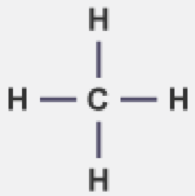
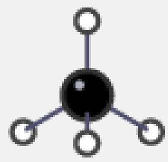
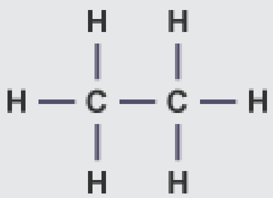
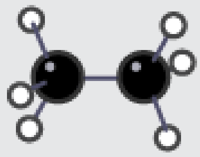
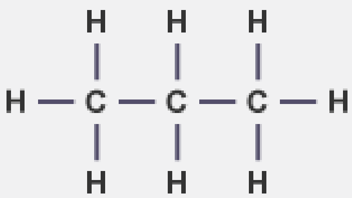
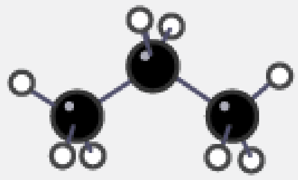
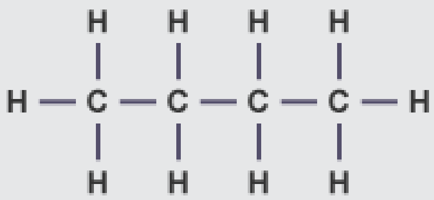
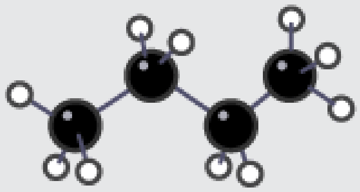


- **5.7.1 Carbon compounds as fuels and feedstock**
    - Crude oil. Hydrocarbons and alkanes
    - Fractional distillation and petrochemicals
    - Properties of hydrocarbons
    - Cracking and alkenes

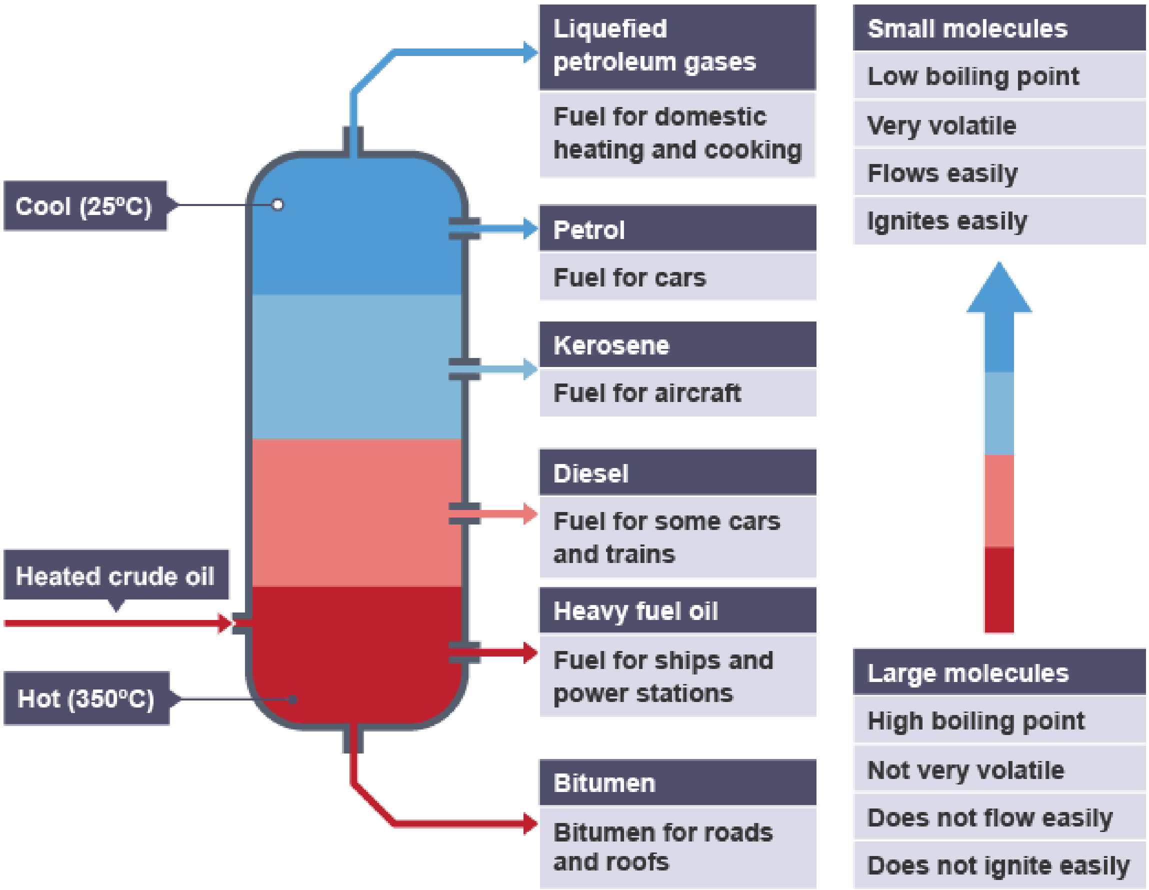
Hydrocarbons - compounds that contain hydrogen and carbon atoms only.

Crude oil - finite resource that is found in the Earth's crust. It is the remains of organisms that lived and died millions of years ago - mainly plankton which was buried in mud.

Alkanes – hydrocarbons, with same general formula: C_nH_{2n+2}, where n is the number of carbon atoms. **Single carbon-carbon covalent** bond, so are **saturated** (no free bonds to react).

Alkane	Molecular formula	Structural formula	Ball-and-stick model
Methane	CH_4		
Ethane	C_2H_6		
Propane	C_3H_8		
Butane	C_4H_{10}		

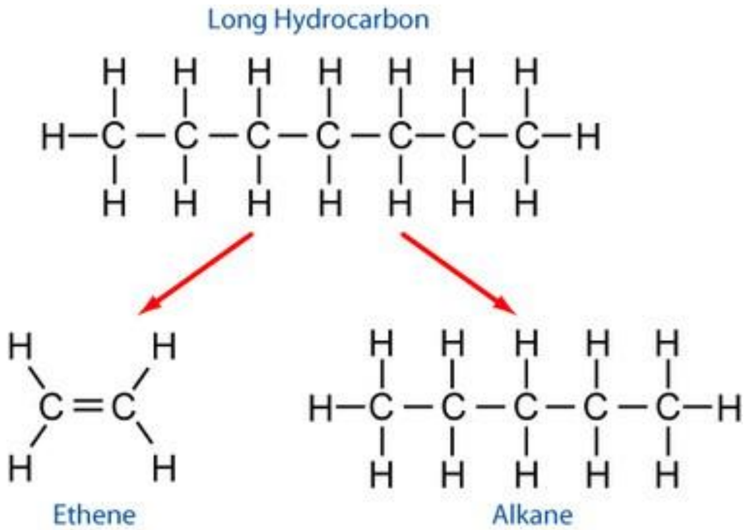
Fractional distillation is used to **separate crude oil** into simpler, more useful mixtures. This method can be used because different hydrocarbons have **different boiling points**.



Cracking is a reaction in which larger saturated hydrocarbon molecules are broken down into smaller, more useful hydrocarbon molecules, some of which are unsaturated:

- the original starting hydrocarbons are alkanes
- the products of cracking include alkanes and alkenes, members of a different homologous series

For example, **hexane** can be cracked to form **butane and ethane**:

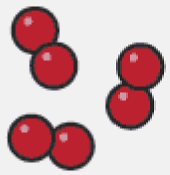
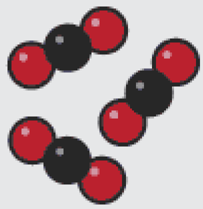
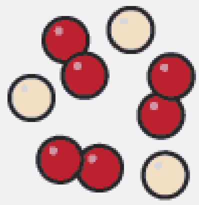
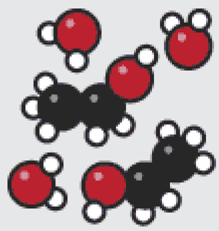
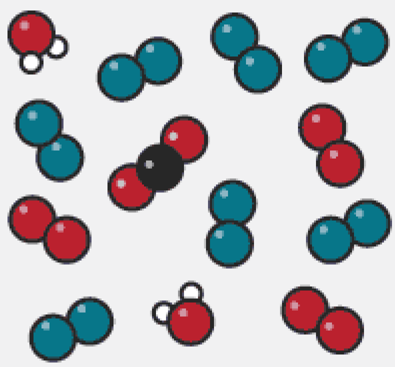


- **5.8.1 Purity, formulations and chromatography**
    - Pure substances
    - Formulations
    - Chromatography

In chemistry:

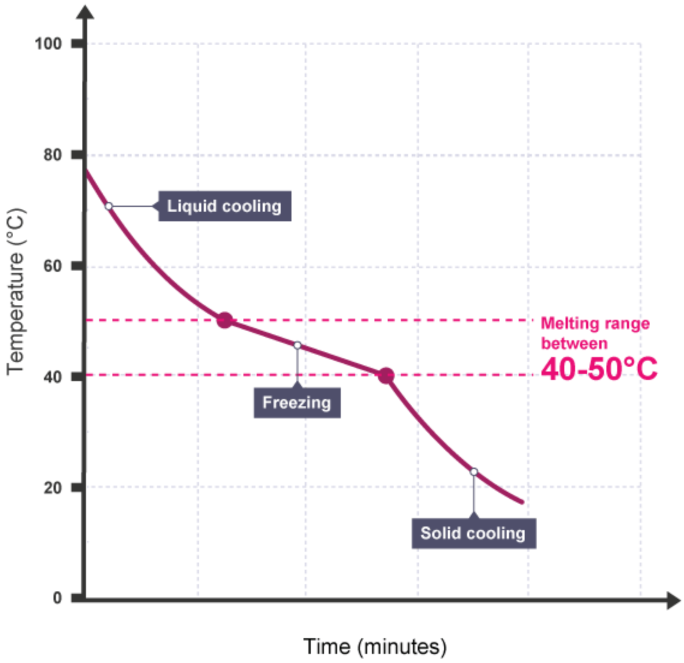
- a pure substance consists only of one element or one compound
- a mixture consists of two or more different substances, not chemically joined together

The table shows some examples:

Description	Example	Diagram
Pure element	Oxygen	
Pure compound	Carbon dioxide	
Mixture of elements	Oxygen and helium	
Mixture of compounds	Alcohol and water	
Mixture of elements and compounds	Air	

Pure substances have a **sharp melting point** but mixtures melt over a **range of temperatures**. This difference is most easily seen when the temperature of a liquid is measured as it cools and freezes.

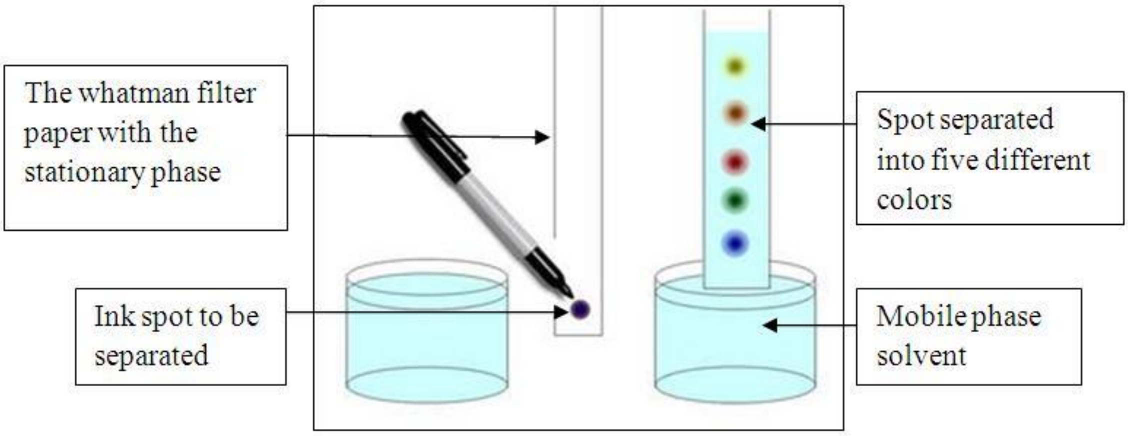
The graph shows slight temperature change as an impure substance:



A formulation is a mixture which has been designed as a useful product – every chemical has been added in a carefully measured amount. Some examples include:

- fuels
- cleaning products
- paints
- medicines

Paper chromatography is used to separate mixtures of soluble substances and to provide information on the possible identity of the substances present in the mixture. These are often coloured substances such as food colourings, inks, dyes or plant pigments.



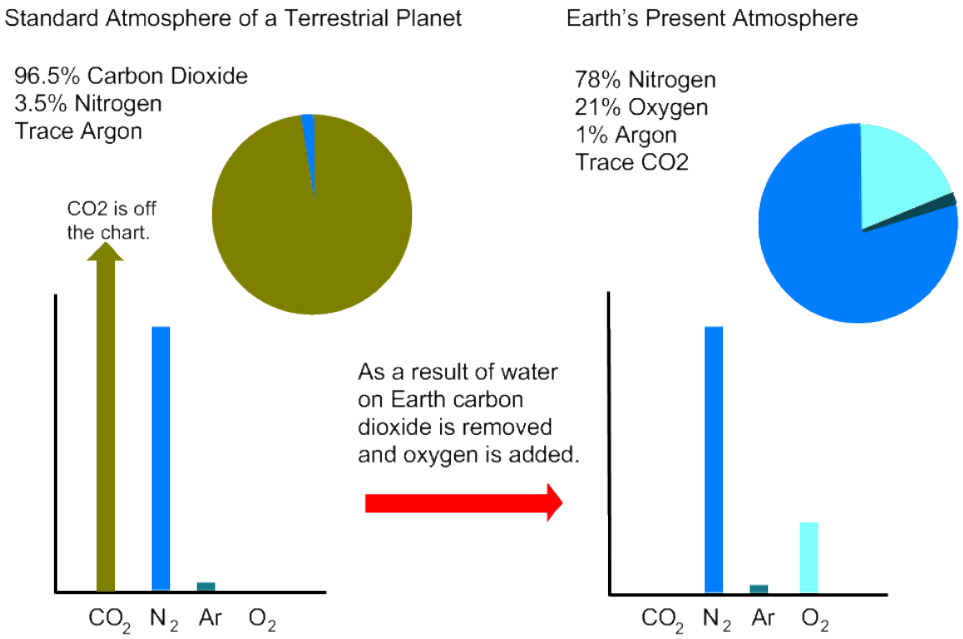
Chromatography relies on two different 'phases':

- **mobile phase** is the solvent that moves through the paper, carrying different substances with it
- **stationary phase** is contained on the paper and does not move through it

R_f values can be used to identify unknown chemicals if they can be compared to a range of reference substances. It can be calculated using this equation:

$$R_f = \frac{distance travelled by substance}{distance travelled by solvent}$$

- **5.9.1 The composition and evolution of the Earth's atmosphere**
  - Proportions of different gases in the atmosphere
  - The Earth's early atmosphere
  - How oxygen increased
  - How carbon dioxide decreased



One theory suggests that the early atmosphere came from **intense volcanic activity**, which released gases that made the early atmosphere very similar to the atmospheres of Mars and Venus today. These atmospheres have:

- a large amount of carbon dioxide
- little or no oxygen
- small amounts of other gases, such as ammonia and methane

Oxygen increased when the Earth cooled - water vapour fell and formed oceans. Plants make their own food by **photosynthesis**, in this process carbon dioxide is reacted with water to produce glucose, with **oxygen as a by-product**:

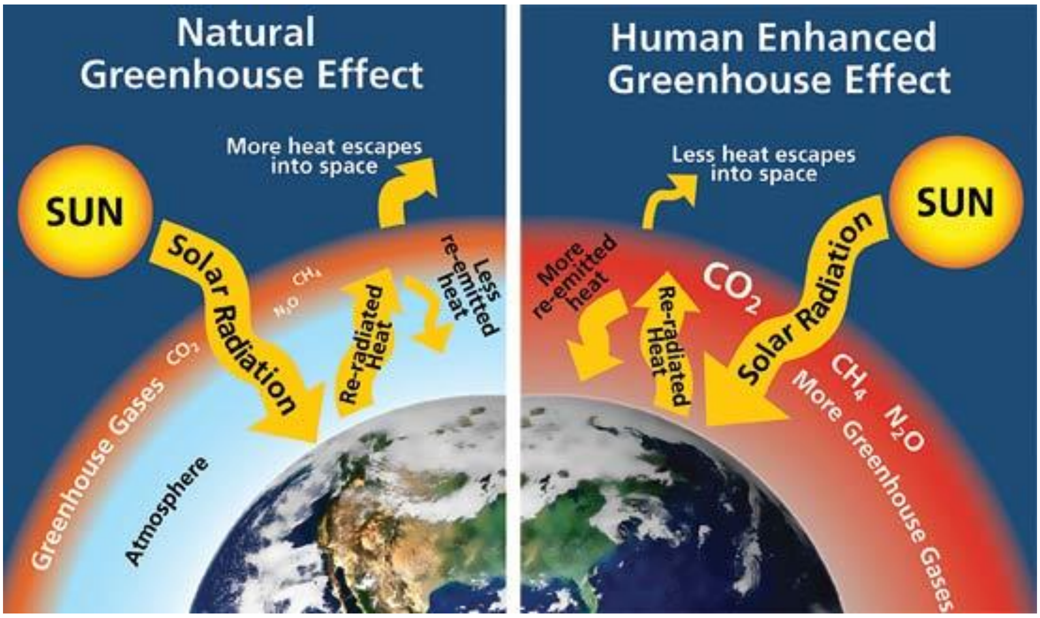
carbon dioxide + water → glucose + oxygen

$$6CO_2(g) + 6H_2O(l) \rightarrow C_6H_{12}O_6(aq) + 6O_2(g)$$

Carbon dioxide decreased through **dissolving in the oceans** formed, carbon dioxide dissolved to form **soluble carbonate compounds**, e.g. limestone.

Carbon dioxide was also absorbed by plants during **photosynthesis**. Many of these organisms, and the simple organisms in the food chains that they supported were turned into **fossil fuels**, e.g. crude oil, coal and natural gas, which all contain carbon.

- **5.9.3 Common atmospheric pollutants and their sources**
    - Atmospheric pollutants from fuels
    - Properties and effects of atmospheric pollutants



Greenhouse gases include:

- Water vapour
- Carbon dioxide
- Methane

Human activities are increasing the amount of come greenhouse gases in the atmosphere. For example:

- farming cattle releases methane
- farming rice in paddy fields releases methane
- burning fossil fuels in vehicles and power stations releases carbon dioxide
- deforestation releases carbon dioxide and reduces the absorption of carbon dioxide through photosynthesis

The **effects** of global warming:

- glaciers and polar ice melting
- sea levels rising
- patterns of rainfall changing, producing floods or droughts
- habitats changing

- **5.10.1 Using the Earth's resources and obtaining potable water**
    - Using Earth's resources and sustainable development
    - Potable water
    - Waste water treatment

Humans use the Earth's natural resources for a number of purposes, including:

- energy and fuels for warmth
- building materials for shelter
- food through farming
- fuels for transport
- materials for clothing

As human population is growing very quickly, some people argue that we are using finite resources at a rate that is too fast and therefore unsustainable.

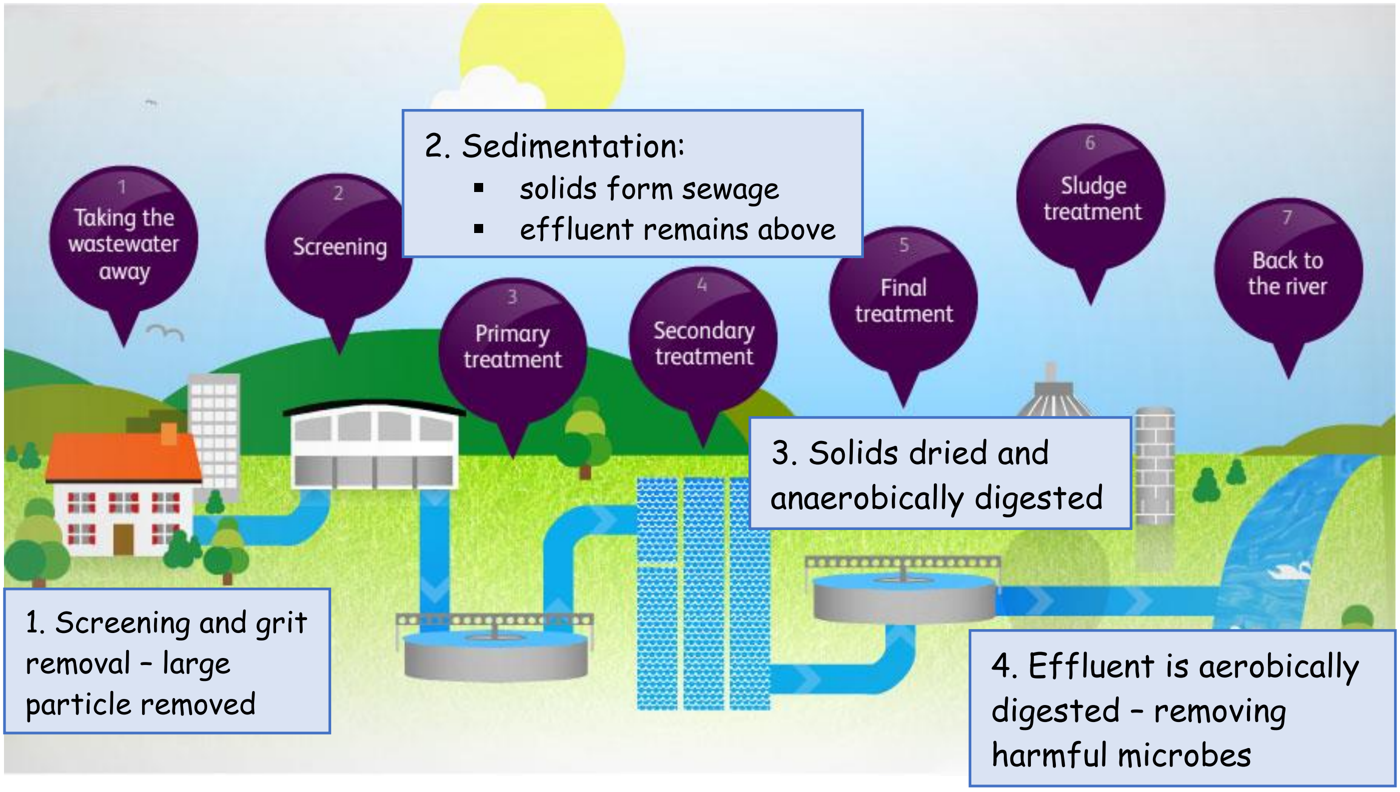
Water is essential for life. Water that is safe for humans to drink is called potable water. Potable water is not pure water because it almost always contains dissolved impurities. For water to be potable, it must have sufficiently low levels of dissolved salts and microbes. This is because:

- dissolved salts can sometimes be harmful for humans
- microbes can cause illnesses

Most potable water in the UK is produced from naturally occurring fresh water by:

1. passing the water through filter beds to remove insoluble particles
2. sterilising the water to kill microbes

How waste water can be made into potable water:



Paper Physics 2F:

- **6.5.1 Forces and their interactions**
  - Scaler and vector quantities
  - Contact and non-contact forces
  - Gravity
  - Resultant forces

Scaler quantity – only have **magnitude** (size). For example: temperature; mass; distance; speed

Vector quantity – have **magnitude and direction** (oh yeah)! For example: force; velocity; acceleration

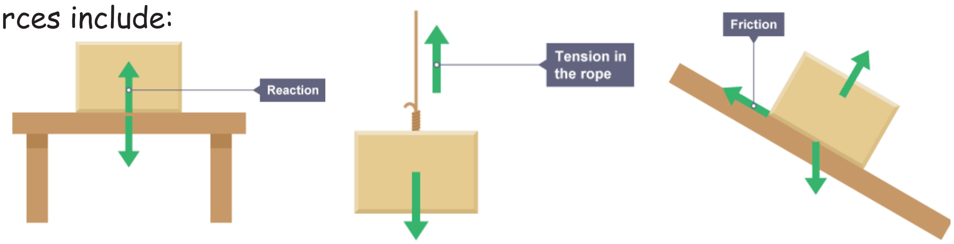
The **resultant force** is a single force that has the same effect as two or more forces acting together. You can easily calculate the resultant force of two forces that act in a straight line. For example:

Forces in the **same direction**:

Forces in **different directions**:

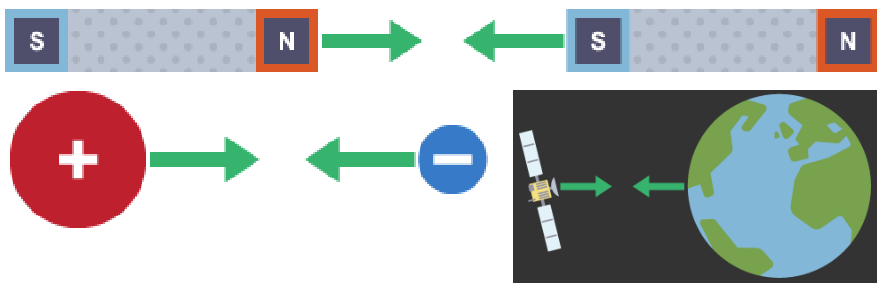
Contact forces are forces that act between two objects that are physically touching each other. Examples of contact forces include:

- Reaction force
- Tension
- Friction
- Air resistance



Non-contact forces are force's that act between two objects that are not physically touching each other. Examples of non-contact forces include:

- Magnetic force
- Electrostatic force
- Gradational force



All objects with mass produce a gravitational field. The more mass an object has, the greater its gravitational field will be. Weight is the force acting on an object due to gravity – it has the unit Newtons (N) and acts towards the centre of a gravitational field.

Weight can be calculated using the equation:

weight = mass x gravitational field strength

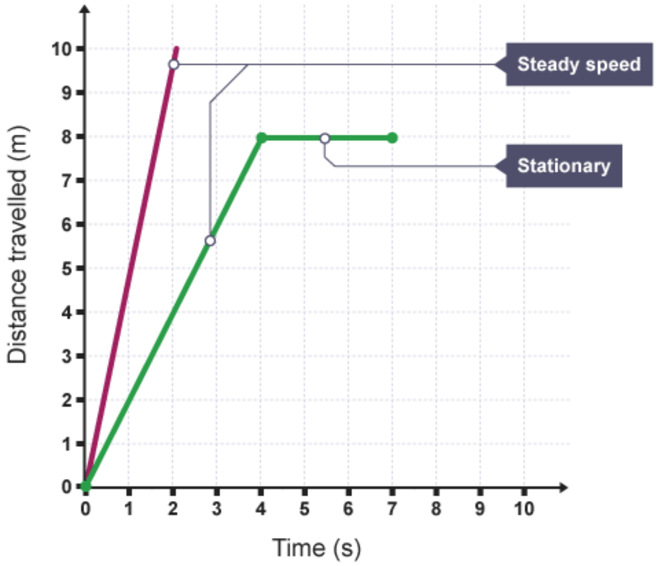
- **6.5.4 Forces and motion**
  - Describing motion along a line
    - Distance and displacement
    - Speed
    - Velocity
    - The distance-time relationship
    - Acceleration

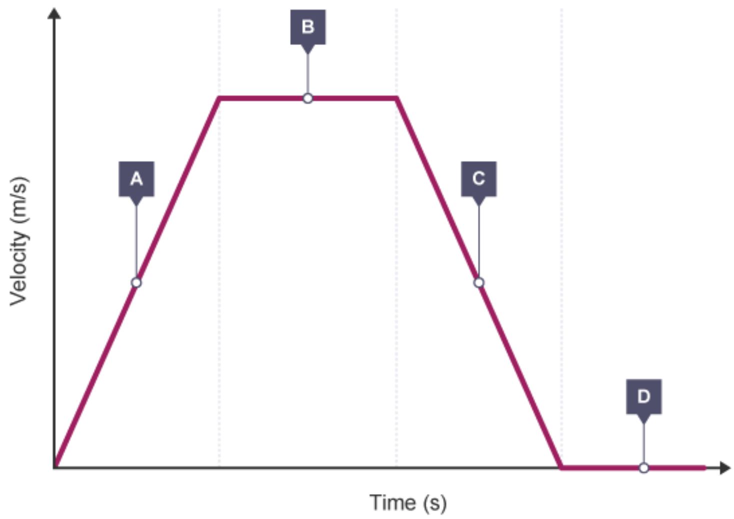
Speed is the rate of change of distance – it is the distance travelled per unit time. Some typical speeds, include:

- Walking – 1.5 m/s
- Running – 3 m/s
- Car – 13-30 m/s
- Aeroplane – 250 m/s

Velocity is the speed of an object in a particular direction, so can be calculated using the same equation: **distance / time.**

In a **distance-time graph**, the gradient of the line is equal to the speed of an object. The steeper the line, the faster the speed.





In a **velocity-time graph**, the gradient of the line is equal to the acceleration of the object:

A. Increasing - acceleration
B. Moving constant – not accelerating
C. Decreasing – deceleration
D. Stationary (at rest)

  - Forces, accelerations and Newton's Laws of motion``
    - Newton’s first law
    - Newtons second law
    - Newtons third law

According to **Newton's First Law of motion**, an object remains in the same state of motion unless a resultant force act on it. If the resultant force acting on an object is zero, it means:

- a stationary object stays stationary
- a moving object continues to move at the same velocity (at the same speed and in the same direction)

Newton's Second Law of motion is the acceleration of an object increases if the resultant force on it increases, and decreases if the mass of the object increases. It can be calculated using the following equation:

Resultant force = mass x acceleration

According to **Newton's Third Law of motion**, whenever two objects interact, they exert equal and opposite forces on each other.

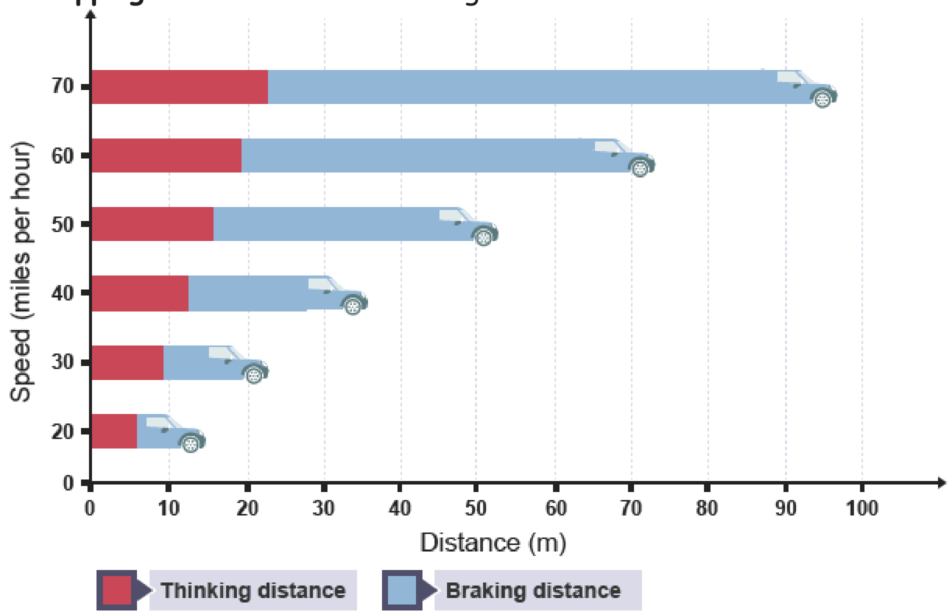
This is often worded as 'every action has an equal and opposite reaction'. However, it is important to remember that the forces act on two different objects at the same time.

- 6.5.4.3 Forces and braking
  - Stopping distances
  - Reaction time
  - Factors affecting braking distance

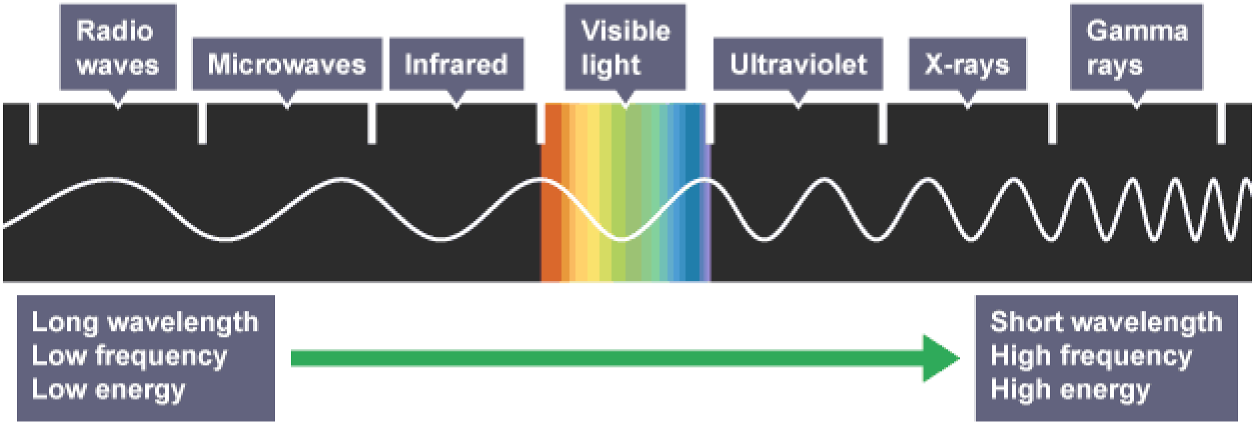
It is important to be able to:

- estimate how the stopping distance for a vehicle varies with different speeds
- interpret graphs relating speed to stopping distance

The diagram shows some **typical stopping distances** for an average car in normal conditions:



- **6.6.2 Electromagnetic waves**
  - Types of EM waves
  - Properties of EM waves
  - Uses and applications of EM waves



All electromagnetic waves:

- **transfer energy as radiation** from the source of the waves to an absorber
- **can travel through a vacuum** such as in space
- **travel at the same speed** through a vacuum or the air

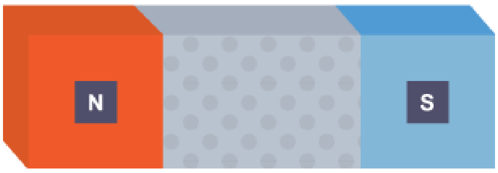
Electromagnetic waves travel at **300 million (m/s)** through a vacuum.

Uses and applications of EM waves include:

Type of wave:	Uses and applications:
Radio	Communication such as television and radio.
Microwaves	Cooking food and for satellite communications.
Infra-red	Electrical heaters, cookers for cooking food, and by infrared cameras which detect people in the dark.
Visible light	Light we can see. It is used in fibre optic communications, where coded pulses of light travel through glass fibres from a source to a receiver.
Ultra-violet	Can cause skin to age prematurely and increase the risk of skin cancer Fluorescent substances are used in energy-efficient lamps - they absorb ultraviolet light produced inside the lamp, and re-emit the energy as visible light.
X-ray	Internal imaging - X-rays are absorbed by dense structures like bones, which is why they are used to help identify broken bones.
Gamma	Used to sterilise medical equipment. Directed treatment for cancer patients.

- **6.7.1 Permanent and induced magnetism, magnetic forces and fields**
  - Poles of a magnet
  - Magnetic fields

A magnet can exert a force on another nearby magnet. Magnets have two poles:



- a north pole
- a south pole

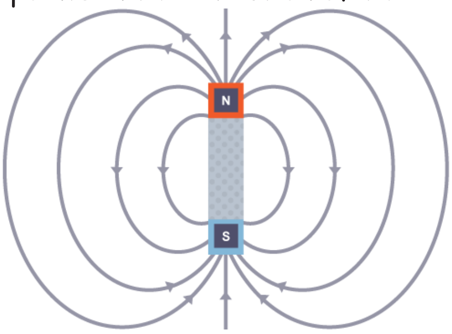
The magnetic force is strongest near the magnet's poles.

Two magnets will either attract or repel each other in the following way:

- like poles (N-N or S-S) repel
- unlike poles (N-S or S-N) attract

Magnetic forces are non-contact forces - this means that magnets affect each other without touching.

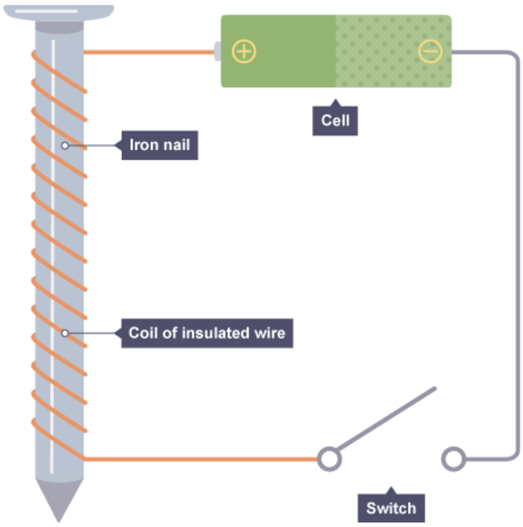
A magnetic field is invisible, but it can be detected using a magnetic compass. A compass contains a small bar magnet on a pivot so that it can rotate. The compass needle points in the direction of the Earth's magnetic field, or the magnetic field of a magnet.



- **6.7.2 The motor effect**
  - Electromagnetism

When a current flows in a wire, it creates a circular magnetic field around the wire. This magnetic field can deflect the needle of a magnetic compass. The strength of the magnetic field is greater:

- closer to the wire
- if the current is increased



A solenoid with an iron core is called an electromagnet. The iron core increases the solenoid’s magnetic field strength. A simple electromagnet is made by coiling wire around an iron nail.

You can increase the strength by:

- Increasing coils around the nail
- Increasing voltage

Electromagnets are used in devices such as electric bells, and door locks that can be controlled remotely.