KNOWLEDGE ORGANISER Year 9: Light and Sound **page 1 of 4**

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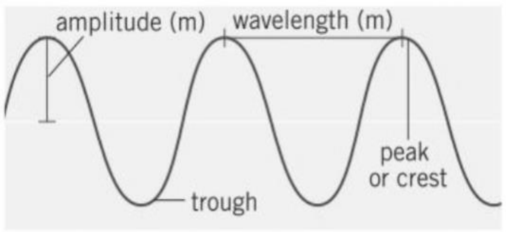
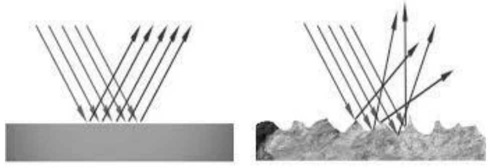
Key Scientific Words

Transverse wave	A wave in which the vibrations are at right angles to the direction of travel of the wave. Light travels as a transverse wave
Peak/crest	The top of a wave.
Trough	The bottom of a wave.
Luminous	An object which gives out light.
Non-luminous	An object which produces no light.
Medium	The material that a light or sound wave is passing through.
Transparent	A material that allows all light to pass through it.
Translucent	A material that allows some light to pass through it. Light is scattered so you can't clearly see what's on the other side.
Opaque	A material that allows no light to pass through it (does not transmit light).
Reflection	The change in direction of a ray or wave after it hits a surface and bounces off.
Retina	Layer at the back of the eye with light detecting cells and where image is formed.
Normal line	Imaginary line as right angels to a surface where a light ray strikes it.
Refraction	The change in direction of a ray or wave when it passes through a boundary as a result of its change in speed.
Amplitude (light wave)	The distance from the middle to the peak (crest) or trough of a wave – units – **metres (m)**

Transverse Wave

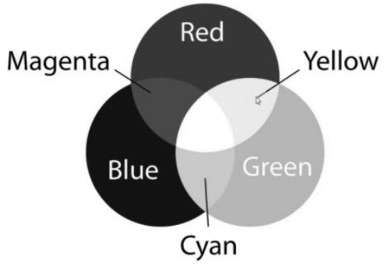


Specular and Diffuse Reflection

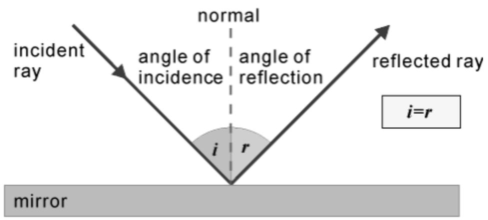

Specular Reflection
Diffuse Reflection

Smooth, shiny surface e.g. reflects all the light at the same angle = a clear image/reflection.
Rough surface it scatters light and gives a diffused reflection (not clear).

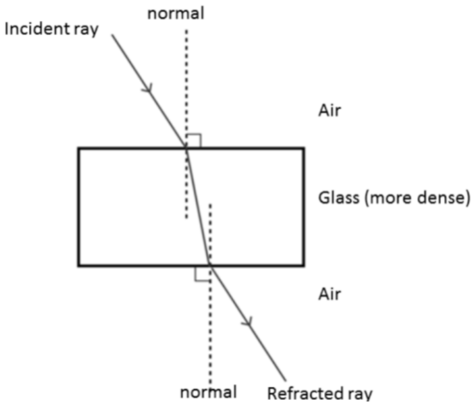
Primary colours of light



Law of Reflection



Refraction



When light hits something transparent it changes speed and direction. Light slows down and changes direction towards the normal. When it travels back out it speeds up again and changes direction away from the normal.

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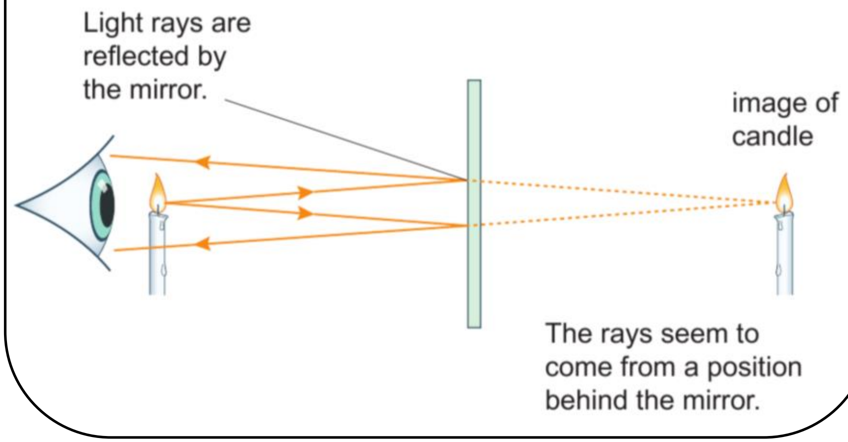
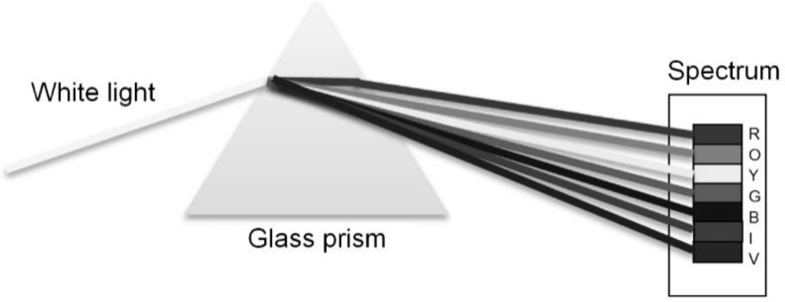
The mage in plane mirror is:

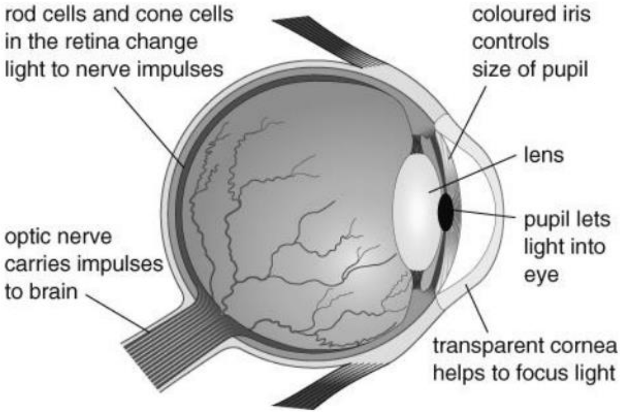
- same size as object
- Same distance behind mirror as object is in front of it
- Has left and right swopped over

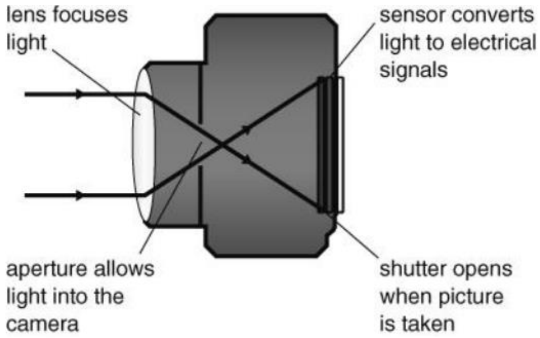


Dispersion:
White light can split into 7 colours (the rainbow). When white light passes through a prism the different frequencies are refracted (change direction) by different amounts, so the colours spread out.



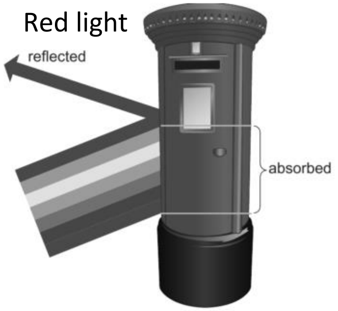
Camera and the eye

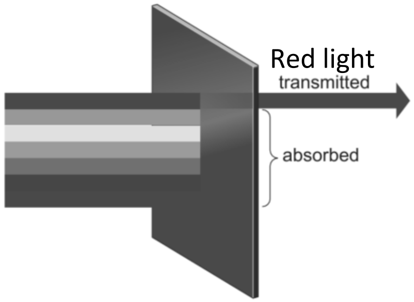




Light through a filter: all the colours except the colour of the filter are absorbed (taken in); colour that is the same as the filter is transmitted (let through)

Making light coloured





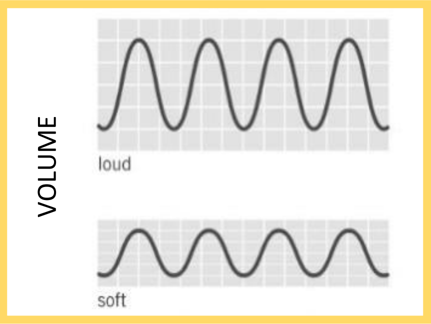
KNOWLEDGE ORGANISER Year 9: Light and Sound **page 3 of 4**

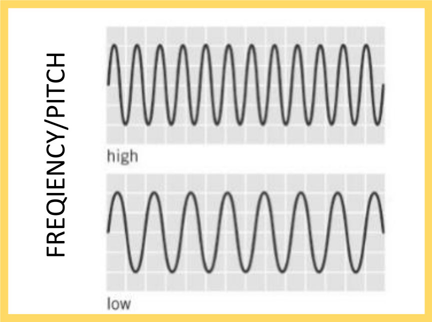
Key Scientific Words

Vibration	A back and forth motion about a point.
Longitudinal wave	Where the direction of vibration is the same as that of the wave motion (or energy transfer). Sound travels as a longitudinal wave
Amplitude (sound wave)	The distance from the middle to the maximum vibration of the wave– units – **metres (m)**
Wavelength	The distance between two identical points on a wave – units = **metres (m)**
Frequency	The number of complete waves produced in one second – units = **Hertz (Hz)**
Volume	How loud or quiet a sound is – units = **decibels (dB)**
Pitch	How low or high a sound sounds. A low pitch sound has a low frequency. A high pitch sound has a high frequency.
Vacuum	A space in which there is no particles of matter.
Compression	The part of a longitudinal wave where the air particles are close together.
Rarefaction	The part of a longitudinal wave where the air particles are spread out.
Echo	The reflection of a sound wave by an object.
Ultrasound	Sound at a frequency greater than 20000 Hz, above the range of human hearing.

- Sound needs a medium, a solid, liquid or gas to travel through.
- Sound does not travel through a vacuum because there are no particles to vibrate and pass on the energy.
- Sound travels faster in a more dense medium. This means sound travels fastest in solids, then liquids, and slowest in gases.
- The speed of sound in air is 330 m/s, a million times slower than light. This means you see lightening and then hear thunder.

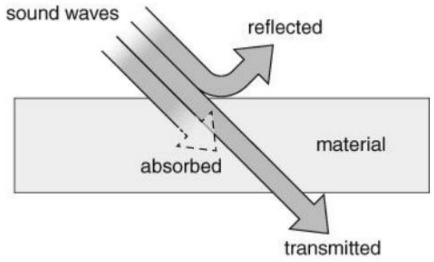
- The greater the amplitude of the wave, the louder the sound.
- The greater the frequency (the shorter the wavelength), the higher the pitch.
- Humans can only hear sounds of certain frequencies (the audible range). This is 20-20000 Hz. Different species have different audible ranges.





Sound waves can be:

Absorbed – sound becomes muffled
Reflected – echo
Transmitted – sound can be heard



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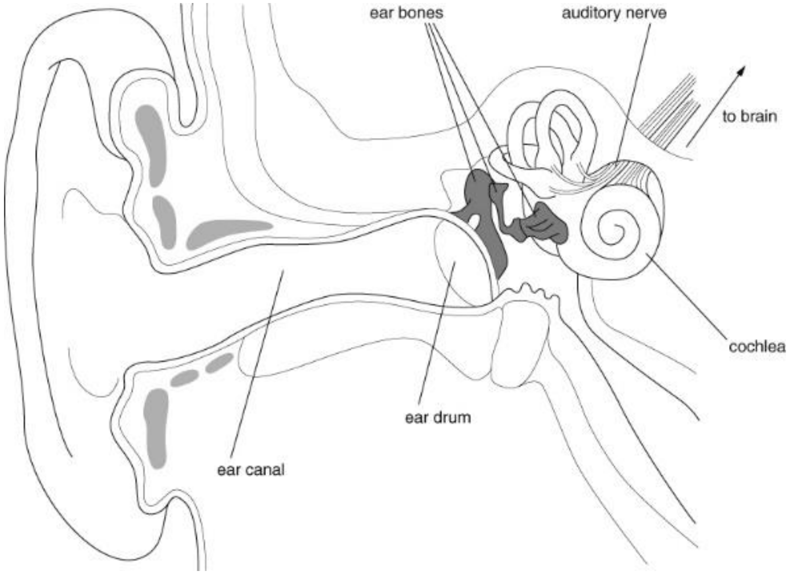
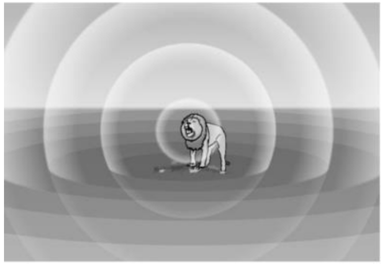
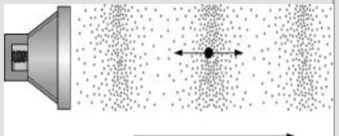
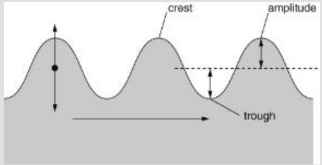


Sound waves make the **eardrum vibrate**. The vibrations are passed on by three small **ear bones**, which also **amplify** the vibrations (make them bigger). The vibrations pass on to the **liquid** inside the **cochlea**, where tiny **hairs** detect them and send **impulses** along the auditory **nerve** to the **brain**.



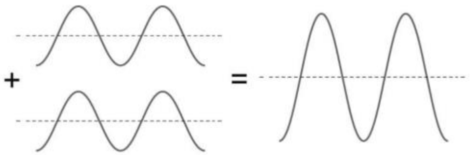
Sound waves spread out in all directions from a source. As you get **further** away the **energy** caried by the sound wave **spreads out** further so there is less energy for your ear to detect.

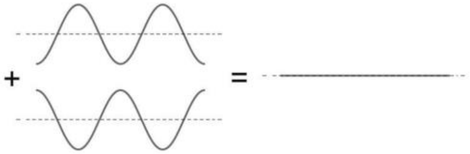
Comparing waves

	Longitudinal	**Transverse**
Diagram		
Movement	Particles move in the same direction as the wave. NEEDS PARTICLES	Particles move at right angles (up and down) compared to the wave. DOESN'T NEED PARTICLES.

All waves:

- transfer energy without transferring matter
- can be reflected, transmitted and absorbed
- can affect other waves by **superposition**, when their effects can add up or cancel out.





Confidence level?

Not sure								**Very happy**	
1	2	3	4	5	6	7	8	9	10

KNOWLEDGE ORGANISER Year 9: Genetics and Evolution page 1 of 2

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Key Scientific Words

Competition	Competing with other organisms for the same resources.
Adaptation	A characteristic that helps an organism to do a certain job or survive in its environment.
Species	A group of organisms that can breed and produce fertile offspring.
Variation	Differences in particular characteristics within a species.
Inherited variation	Variation between organisms passed on to offspring by parents in reproduction e.g. eye colour
Environmental variation	Variation between organism caused by the surroundings e.g. diet, lifestyle
Continuous variation	A characteristic that can take any value within a range of values e.g. height, foot length.
Discontinuous variation	A characteristic that can only take a limited number of possible values e.g. blood group, shoe sizes
DNA	Chemical containing all the genetic information needed to make an organism. Short for **D**eoxyribose **N**ucleic **A**cid.
Gene	Section of DNA that contains the instructions for a particular characteristic e.g. eye colour.
Chromosomes	A long strand of coiled DNA that contains many genes. Found in the nuclei of cells.
Evolution	A change in one or more characteristic of a population over a long period of time.
Natural selection	Process by which an organisms is more likely to survive and reproduce than other members of the species because it has a certain inherited characteristics which are more suited to its environment .

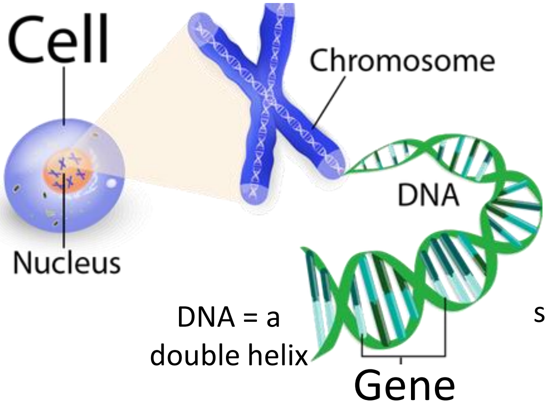
All zebra have stripes but there is between each animal. Offspring inherit characteristics from each parents because two **gametes** (one male and one female) fuse during fertilisation to produce a **zygote** that contains **genetic information** from each parent.

Both genes and the environment can cause **variation**, but only genetic variation can be passed on to the next generation.

environmental

inherited & discontinuous

Inherited, environmental & continuous



Human body cells have 46 chromosomes (23 pairs), except for gametes (sex cells) which have 23 in total

Genetic info stored in parts of DNA molecule called genes

Model of the structure DNA first made by Watson and Crick based on X-ray photo's from Franklin and Wilkins

KNOWLEDGE ORGANISER Year 9: Genetics and Evolution **page 2 of 2**

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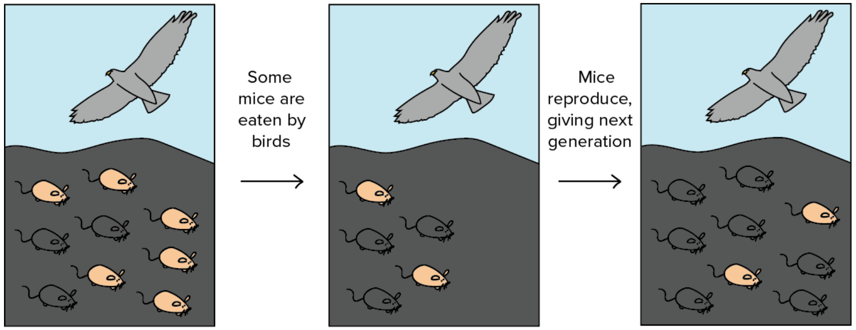
Evolution due to Natural Selection

1. There are natural variations in characteristics within a population due to differences in genes (caused by gene mutations).
2. When there is a change in the environment there may be competition for resources or the need to survive attack from predator.
3. Individuals with characteristics best adapted will survive, others will die out. This is **natural selection** (survival of the fittest).
4. Survivors reproduce, passing on the genes for their favourable characteristics to their offspring.
5. Over many generations this process repeats leading to a variation in characteristics (**evolution**).



A population of mice has moved into a new area where the rocks are very dark. Due to natural genetic variation, some mice are black, while others are tan.

Tan mice are more visible to predatory birds than black mice. Thus, tan mice are eaten at higher frequency than black mice. Only the surviving mice reach reproductive age and leave offspring.

Because black mice had a higher chance of leaving offspring than tan mice, the next generation contains a higher fraction of black mice than the previous generation.

Endangerment and extinction

Changes in an ecosystem can cause species to become endangered or extinct. This is usually due to:

- changes in physical environmental factors
- competition from other organisms
- disease
- human activities (e.g. hunting, clearing habitats, using poisons).

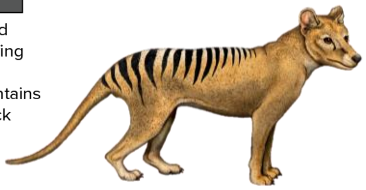
We can try to stop this happening and preserve biodiversity (the number of species) by:

- protecting areas and setting up nature reserves
- setting up breeding programmes in zoos
- banning the hunting of some animals or the collecting of wild plants
- setting up gene banks (to store parts of organisms, such as seeds and gametes).

We should preserve biodiversity because:

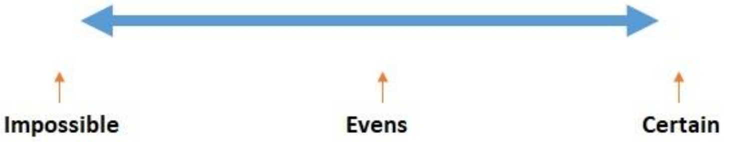
- organisms depend on one another (they are interdependent)
- we won't be able to make use of organisms if they become extinct
- more biodiverse areas recover better from natural disasters.

Tasmanian tiger: now extinct due to human activities



Probability scale

Number				
0	0.25	0.5	0.75	1
Fraction				
0	$\frac{1}{4}$	$\frac{1}{2}$	$\frac{3}{4}$	1
Percentage				
0%	25%	50%	75%	100%



Confidence level?

Not sure **Very happy**

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KNOWLEDGE ORGANISER Year 9: Making Materials Page 1 of 2

Key Scientific Words

Ceramic	Hard, durable, non-metallic materials, which are generally unaffected by heat.
Insulator	A material that does not allow something to pass through it (e.g. heat, electricity).
Lattice structure	An arrangement of many atoms or other particles, which are bonded together in a fixed regular (grid-like) pattern.
Elastic	Substance that will return to its original shape and size after it has been stretched or squashed.
Monomer	A small molecule that can join with other molecules like itself to form a polymer.
Natural polymer	A substance found in nature that is made up of very long molecules containing repeating groups of atoms.
Plastic	A description of a substance that can be moulded into different shapes.
Aggregate	Gravel, small stones or pieces of crushed rocks used in building.
Composite material	A material made by combining two or more other materials. The separate materials do not react together.
Biomagnification	Microorganisms absorb toxic compounds which do not break down; these are passed up the food chain and concentrate in animals higher up the food chain.
Peer review	An evaluation of the quality of a scientific paper carried out by other scientists who work in the same area of science.

Ceramics

e.g.
Porcelain
China
Pottery
Glass

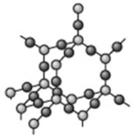
Properties

- High m.p
- Strong
- Durable
- Non conductors of heat and electricity
- Unreactive
- Brittle

Uses

- Porcelain → cable supports of electricity pylons as does not conduct electricity
- China → tableware as strong and heat insulator

Structure



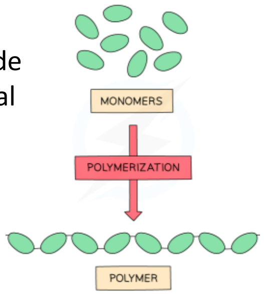
- Billions of atoms joined together
- Strong bonds and rigid structure
- Open lattice structure, grid-like pattern
- Large crystals if molten ceramics are allowed to cool slowly

→ High melting points as lots of energy need to break strong bonds

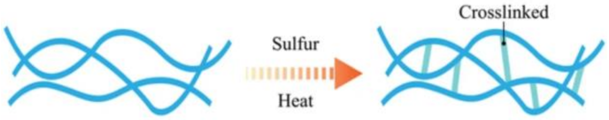
→ Brittle as rigid grid-like structure

Polymers

- Most synthetic made from crude oil; some natural
- Formed by joining monomers together into long chains of repeating units



Cross links between chains makes polymer harder and less easy to melt e.g. vulcanisation uses sulfur to form cross-links in rubber

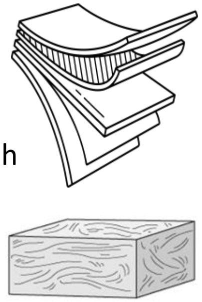


- Poly(ethene) strong flexible and durable (→ plastic bags, buckets)
- Poly(vinyl chloride) [PVC] strong flexible and an electrical insulator (→ covering for electric cables)

KNOWLEDGE ORGANISER **Year 9:** Making Materials **Page 2 of 2**

Composites

- Combinations of two or more different materials
- Useful because they combine properties of both
- Many contain fibres embedded in a polymer matrix or resin



Composite examples

- Plywood, chipboard and MDF → wood + polymer resin → hard, durable, impact resistant → furniture, doors, flooring
- Safety glass → glass + clear polymer → strong and transparent → car windshields
- Concrete → aggregate + cement + sand → strong and durable → buildings
- Racing car bodies, bullet proof vest → polymer resin and Kevlar polymer fibres → extremely strong, light, flexible, easily moulded
- Glass reinforced plastic → glass fibre + polymer → strong but flexible → boat hulls

Problems with <u>making</u> and <u>using</u> materials

Making:

1. Burning fossil fuels provides the energy needed to make materials but is also linked to:
   - acid rain from production of sulfur dioxide
   - increase in carbon dioxide levels and the greenhouse effect
   - soot dirtying buildings and damaging health.
2. Toxic substances, released during manufacture in waste, get into food chains.
   - large animals eat lots of smaller animals
   - toxin levels increase up the food chain (biomagnification) and can reach harmful levels in humans.

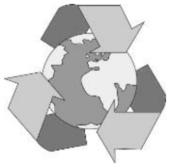
Using:

3. Non-biodegradable polymer waste causes pollution problems and dangers to animals for years.

Solutions

- Remove sulfur from fuels
- Reduce use of fossil fuels and use more renewable energy sources
- control hazardous waste from factories
- use biodegradable polymers, which break down in the soil, so they disappear more quickly

Recycling



- reduces our use of landfill sites
- reduces the need to burn fossil fuels
- reduces pollution from manufacturing process
- saves our resources of raw materials, e.g. metal ores for metals and wood for paper.

Metals – by separating and melting.
Glass – by separating colours and melting.
Polymers – by using recycle labels.
Paper – by removing ink and adding water to make a pulp.
Concrete – by crushing and grading.

Exothermic reactions transfer energy into the surroundings and so increase the temperature around them, e.g. combustion reactions.

Endothermic reactions transfer energy from the surroundings and so decrease the temperature around them, e.g. decomposition reactions

Confidence level?

Not sure								Very happy	
1	2	3	4	5	6	7	8	9	10

KNOWLEDGE ORGANISER Year 9: Forces, Motion and Space **Page 1 of 2**

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Key Scientific Vocabulary

Balanced forces	When two forces on an object are the same strength, but in opposite directions
Unbalanced forces	When two forces acting in opposite directions on an object are not the same strength. Unbalanced forces change the motion of objects.
Resultant forces	The difference between forces in two opposite directions
Gradient	A way of describing the steepness of a line on a graph in numbers
Pivot or fulcrum	A point about which something turns.
Moment	Turning effect of a force. It is calculated by multiplying the force by the perpendicular distance of the force from the pivot.
Ramp	A sloping surface. A ramp is a force multiplier: it needs less force to pull something up a ramp than it does to lift it directly.
Pulley	A simple machine consisting of a wheel that can turn on an axis with a rope running around it. Using more than one pulley with a rope allows a force to be multiplied.
Elliptical	Oval-shaped
Gravity	The force of attraction between any two objects. The Earth is very big and so has strong gravity that pulls everything down towards it.
Satellite	Anything that orbits a planet or a moon. Can be natural e.g. the moon or artificial e.g. ISS
Magnetic field	The space around a magnet where it can affect magnetic materials or other magnets.

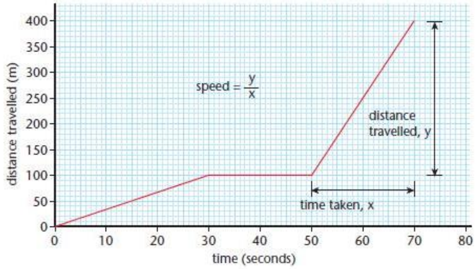
Speed

This is a measure of how much distance you cover in time.
It can be measured in km/h, m/s or mph but SI Units are **m/s.**

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

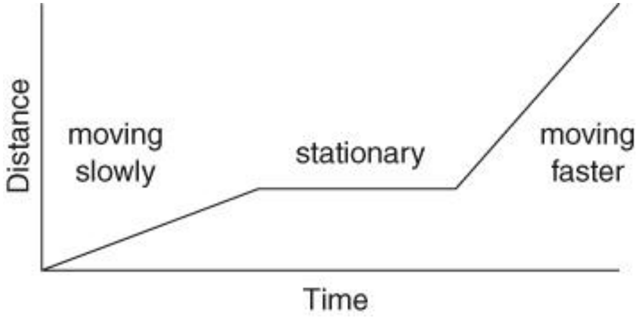
Worked out from the gradient on a distance time graph.

$$\textbf{Gradient} = \frac{\text{vertical change}}{\text{horizontal change}}$$



Distance time graphs

- Show the distance moved from the start point.
- If the line is flat, it is stationary and not moving.
- The steeper the line on the graph, the faster the object or person is moving.



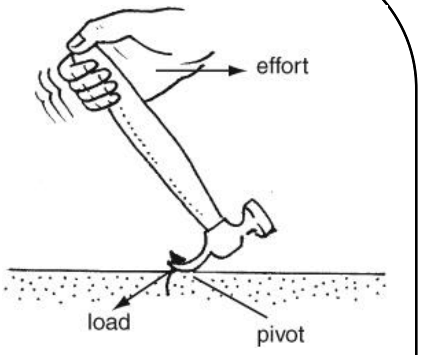
Relative speeds

A car travelling at 50 km/h overtakes one travelling at 30 km/h. The **relative speed** of the faster car compared to the slower car is 20 km/h.

KNOWLEDGE ORGANISER Year 9: Forces, Motion and Space **Page 2 of 3**

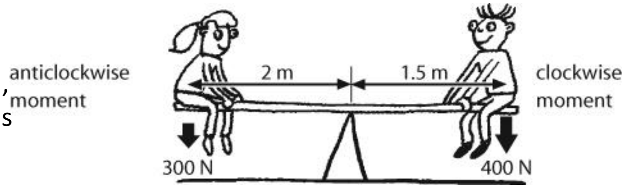
Levers & Moments

- Forces can be used to turn objects around **pivots**
- **Levers** can be **force multipliers**, when they increase the force that is put in (the **effort**).
- They can be **distance multipliers** if they make the **load** move further than the effort.
- A turning force is called a **moment**.
- Moments are measured in **newton metres** (**N m**).

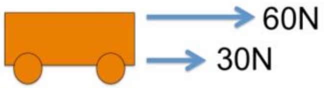


moment (in N m) = force (in N) × perpendicular distance from the pivot (m).

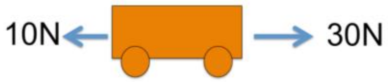
When an object is balanced, the anticlockwise moment is equal to the clockwise moment.



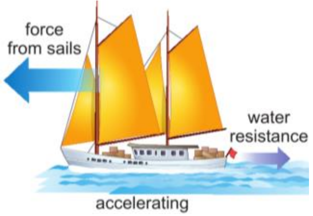
Resultant Forces



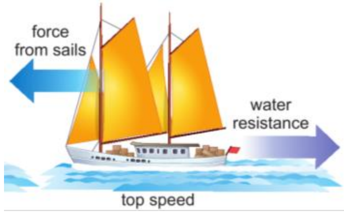
= 90N to the right



= 20N to the right



Water resistance less than force from sails so boat accelerates



Water resistance = force from sails so boat is at its top speed

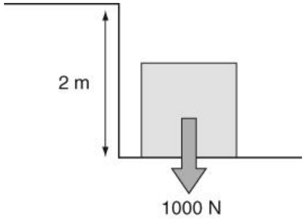
Simple machines

If a machine makes it possible to lift or move a load using a smaller force, the force has to move through a greater distance. The total amount of energy needed is the same.

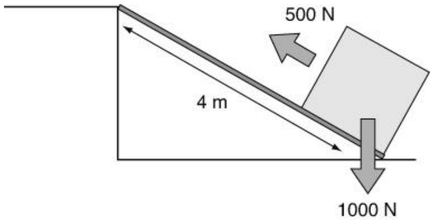
Work is done when a **force** moves through a **distance**.

Work is measured in joules (J).

work = force × distance moved in the direction of the force

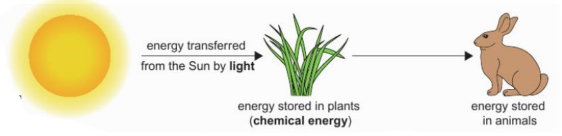


The work done to lift the box 2 m is:
work = **1000 N** × **2 m**
= **2000 J**



The ramp makes it possible to move the box using a force of only **500 N**, but the box has to be moved **4 m**.
work = 500 N × 4 m
= 2000 J.

Energy



Gravitational potential energy

Elastic potential energy

Thermal energy

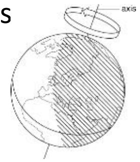
Kinetic energy

Nuclear energy

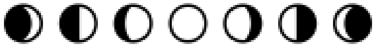
KNOWLEDGE ORGANISER Year 9: Forces, Motion and Space **Page 3 of 3**

THE DEAN TRUST
Ashton on Mersey School

The Earth and Moon



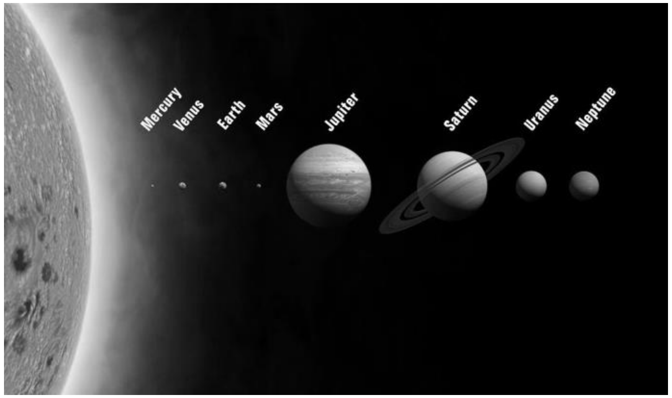
- **Day** → Earth spins on its axis once every 24 hours
- **Daytime and Night time** → side of the Earth facing the Sun has daylight, and it is night on the side facing away from the Sun.
- **Year** → The Earth orbits around the Sun. It takes one year to go around once.
- **Phases of the Moon** → The different shapes. Phases happen because we cannot always see all of the part that is lit by the Sun.



Ptolemy (90-168) worked out a solar system model with the *Earth* at the *centre*—this is called the **geocentric model**.

Copernicus (1473-1543) suggested that the Earth and other planets moved in circles (orbits) *around* the *Sun*. This is the **heliocentric model** (our modern-day solar system model).

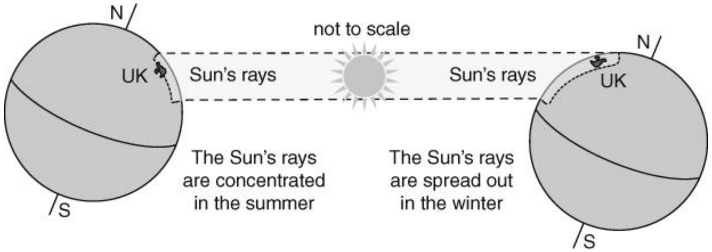
Galileo used one of the first telescopes to provide *evidence* for Copernicus' model.



Planets are Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune.

Seasons

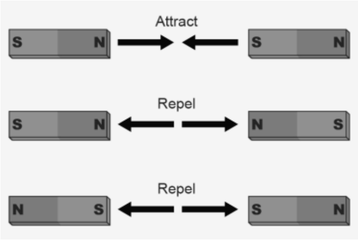
- The Earth's axis is tilted.
- When the **northern hemisphere** is tilted towards the Sun it is summer in the UK. Days are longer than nights, and the Sun is higher in the sky. The Sun's rays are more concentrated, so it feels hotter



Magnets

Magnets attract **magnetic materials**

- North pole and south pole attract each other.
- Two north poles or two south poles repel each other



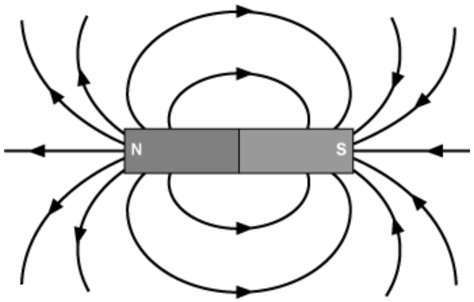
Gravity is the force of attraction between two masses. The force of gravity is stronger if:

- the objects have large masses
- the objects are close together.
- Sun's gravity keeps all the planets in our Solar System moving in elliptical orbits around it.
- Earth's gravity keeps the Moon in orbit around Earth

weight (N) = mass (kg) × **gravitational field strength** (N/kg)

Magnetic fields

shape of the magnetic field of a bar magnet: draw lines with arrows N → S



Confidence level?

Not sure **Very happy**

1	2	3	4	5	6	7	8	9	10

KNOWLEDGE ORGANISER Year 9: Reactivity Page 1 of 2

Key Scientific Words

Rust	A weak, brown, crumbly solid formed when iron corrodes. A mixture of oxides and hydroxides of iron.
Sacrificial protection	Using a more reactive metal to protect iron from rusting.
Oxidising agent	A substance that provides oxygen to oxidise another substance.
Endothermic	A reaction that that absorbs energy form the surroundings making the temperature of the surroundings fall.
Exothermic	A reaction that transfers energy into the surroundings making the temperature of the surrounding rise.
Displacement reaction	A reaction where a more reactive element takes the place of a less reactive element in a compound.
Native state	When a metal is found in the Earth as an element.
Electrolysis	Breaking down a substance using electricity.

Physical changes	Chemical reactions
Do not make new substances.	Always make one or more new substances.
Are often easy to reverse.	Are usually difficult to reverse.
The substances may change state or just be mixed together.	The new substances have different properties from the original substances.
Examples include: melting, boiling, condensing, freezing.	Examples include: combustion, neutralisation, thermal decomposition.

Reactivity Series
Lists the metals in order of their reactivity with oxygen, water, and dilute acid

Metal	Reaction with oxygen in air	Reaction with cold water	Reaction with dilute acid
potassium	🔥	🔥	💥
sodium	🔥	✓✓✓	💥
lithium	🔥	✓✓	✓✓✓
calcium	🔥	✓✓	✓✓✓
magnesium	🔥	✓	✓✓
aluminium	✓✓✓	●●●	✓✓
zinc	✓✓	●●●	✓✓
iron	✓✓	●●●	✓
tin	✓	●●●	✓
lead	✓	●●●	✓
copper	✓	✗	✗
mercury	●●●	✗	✗
silver	●●●	✗	✗
gold	✗	✗	✗
platinum	✗	✗	✗

Increasing reactivity ↑

Key

💥 explosive	🔥 can catch fire	✓✓✓ reacts very quickly
✓✓ reacts quickly	✓ reacts	●●● slow or partial reaction
✗ no reaction		

GENERAL Word Equations

Metal + Oxygen → Metal Oxide

Metal + Water → Metal hydroxide + Hydrogen

Metal + Acid → (Metal) Salt + Hydrogen

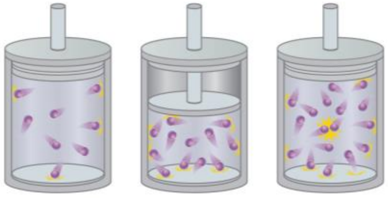
The name of the salt formed depends on the name of the acid:

- hydrochloric acid → **chloride**
- sulfuric acid → **sulfate**
- nitric acid → **nitrate**

Iron and steel need air and water to rust.
Salt makes them rust even more quickly.
Steel is an alloy of iron + carbon.
Rusting can be prevented by:

- **physical barrier** to stop the air and water being in contact with the iron
- **sacrificial protection**, in which a more reactive metal e.g **zinc** Zn or **magnesium** Mg is attached to the iron. The **Zn** or **Mg** then corrodes **instead** of the **iron**.

Gas pressure is caused by the force of the particles hitting the walls of the container.



Low pressure High pressure High pressure

Change that increases pressure	Reason
increase the temperature	the particles move faster and so hit the walls of the container with more force and more often
increase the number of particles in the container	the particles are closer together and hit the walls of the container more often
decrease the volume of the container	the particles are closer together and hit the walls of the container more often

KNOWLEDGE ORGANISER **Year 9:** Reactivity **Page 2 of 2**

Energy changes

Exothermic reactions **transfer energy** from the **reactants** to the **surroundings**
e.g. combustion of hydrocarbons; neutralisation reactions

The temperature of the surroundings increases.

EXOTHERMIC = **EX**IT

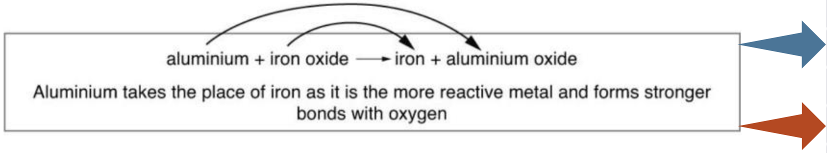
Endothermic reactions use **energy transferred** from the **surroundings** to the **reactants.**
e.g. photosynthesis

The temperature of the surroundings decreases.

ENDOTHERMIC = **EN**TER

Displacement reactions

In a displacement reaction a more reactive metal takes the place of a less reactive metal in a compound. We can use the reactivity series to predict whether chemical reactions will take place.



aluminium + iron oxide → iron + aluminium oxide

Aluminium takes the place of iron as it is the more reactive metal and forms stronger bonds with oxygen

silver + copper chloride → **no reaction**
Because silver is **LESS** reactive than copper

tin + lead sulfate → tin sulfate + lead
Because tin is **MORE** reactive than lead

copper + potassium nitrate → **no reaction**
Because copper is **LESS** reactive than potassium

Confidence level?

Not sure								Very happy	
1	2	3	4	5	6	7	8	9	10

Extracting metals

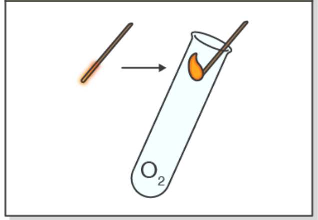
- Most metals occur as compounds in ores in the Earth's crust. Only a few, such as silver and gold, occur as the metallic element.
- The metals high in the reactivity series are difficult to chemically extract from their ores and their isolation has happened relatively recently.
- The metals lower in the reactivity series are easier to extract from their ores and they have been available to use as the pure elements for much longer.
- Metals from zinc downwards in the reactivity series can be extracted from their ores by heating with **carbon**.
- Metals above zinc in the reactivity series need **electrolysis** to extract them from their ores.
- Oxidation is the gain of oxygen. Reduction is the loss of oxygen.

Percentage Loss or Gain

$$\frac{\text{actual change}}{\text{original amount}} \times 100$$

Test for Oxygen

relights a glowing splint



What is the % loss in mass when 8.4g of magnesium carbonate is heated if the mass of magnesium oxide left is 4.0g? Give your answer to 1 decimal place

Initial mass – final mass =
8.4 - 4.0 = 4.4g

$$\frac{\text{actual change}}{\text{original amount}} \times 100$$

$$\frac{4.4}{8.4} \text{ x } 100 = 52.38\%$$

= 52.4% to 1 d.p

KNOWLEDGE ORGANISER Year 9: Plant Growth Page 1 of 3

THE DEAN TRUST
Ashton on Mersey School

Key Scientific Words

Photosynthesis	Process that plants use to make their own food
Limiting factor	Variable that prevents the rate (speed) or a process from becoming any faster.
Phloem vessels	Tubes made of phloem cells that transports dissolved sugars around the plant.
Xylem vessels	Tubes made of xylem cells that carries water and dissolved mineral salts in plants. Found in stems and roots.
Stomata	Tiny holes in leaf through which gases cab diffuse into and out of the leaf. Singular = stoma.
Guard cells	Cells that open and close the stomata.
Epidermis cells	Cells that from tissues covering the surface of an organ e.g. in leaf produce a waxy layer (**cuticle**).
Palisade cells	Tall cell found in leaves that contain many chloroplasts.
Lipids	Fats and oils.
Decomposers	Organism that feeds on dead organisms or animal wastes causing them to decay.
Pesticides	Chemical substances that kill pests.
Germination	When seeds start to grow
Variety	A group of plants that have different characteristics from other plants of same species.
Cross-breeding	When sexual reproduction occurs between different varieties or breeds.
Selective breeding	When humans choose an organism that has a certain characteristic and breed more, making the chosen characteristic more obvious.
Bias	A shift away from a correct meaning or value.

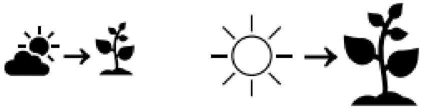
Photosynthesis is a series of **chemical reactions.** Energy and **chlorophyll** (found inside **chloroplasts** in cells in the leaves) are needed for it to happen. The energy is transferred by light (usually from the Sun) and becomes stored in glucose ("food" for the plant).

carbon dioxide + water → glucose + oxygen

products → reactants

Photosynthesis can occur at different rates. The **limiting factors** are:

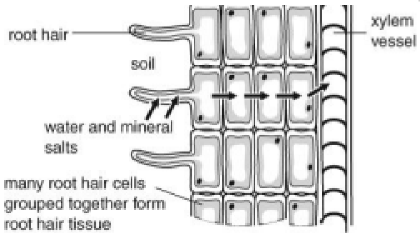
- light
- CO_2
- Temperature



Aerobic respiration also happens in all cells of the plant and releases the energy stored in the glucose:

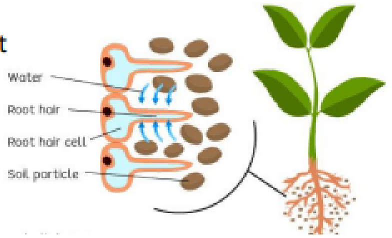
glucose + oxygen → carbon dioxide + water

Water (and dissolved mineral salts needed for healthy plant growth) are absorbed by root hair cells and pass to xylem vessels (hollow tubes) and travel from the root to the leaves



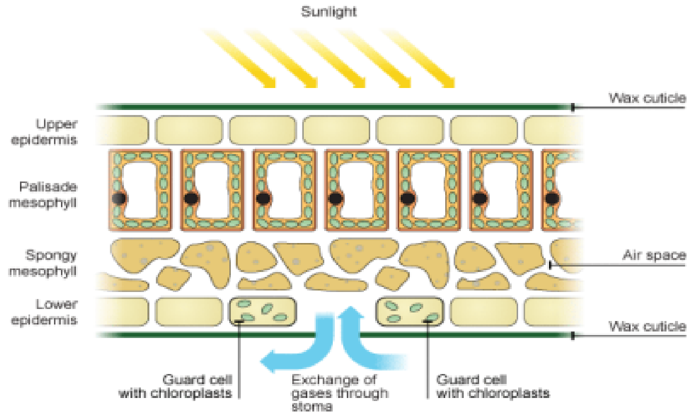
Root adaptations

1. Branched and spread out to help get water from soil
2. Spread out to help anchor the plant
3. Have root hair cells with a large surface area so can quickly absorb water from the soil



KNOWLEDGE ORGANISER Year 9: Plant Growth Page 2 of 3

Feature of plant leaves	Adaptation for photosynthesis
Large surface area	Maximise light absorption; also often arranged so leaves do not overlap arranged so leaves do
Thin	Gives short distance so CO_2 can quickly diffuse into leaf cells
Thin waxy cuticle	This protects the leaves and reduces water loss without blocking out light
Transparent epidermis	Allows light to reach the palisade cells
Stoma	Allow exchange of CO_2 and O_2
Guard cells	Allow stoma to open and close to control the loss of H_2O.
Palisade cells	Packed full of chloroplasts; long and thin so light passes through as many chloroplasts as possible; can move near to surface in dim light to maximise photosynthesis and away in bright light to avoid damage.
Xylem tissue	Delivers steady supply of water from the roots to the leaf.
Phloem tissue	Transports glucose away from the leaf.



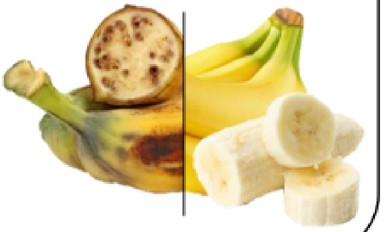
Plant products

- *Lipids*: found in cuticle to make it waterproof; found in plant seeds and used for energy stores.
- *Carbohydrates*: glucose molecules made during photosynthesis link making polymer called starch (a carbohydrate); this then broken down to glucose again and carried to otter parts of plant to be used in respiration; can also be converted to storage organs eg potatoes or plant walls (cellulose)
- *Proteins*: polymers e.g. enzymes made from mineral salts and glucose; needed for photosynthesis and respiration; also stored in seeds to help them grow.

Selective breeding

1. Farmers choose or 'select' a plant with certain preferred characteristics.
2. This organism is then used to breed from.
3. The offspring that have the best selected characteristics are then bred from again.
4. This is process is repeated and repeated.
5. Over many generations a new improved **variety** is produced.

Selective breeding of wild bananas to reduce seed size



Cross-breeding is when two different varieties are bred together to try to produce offspring with characteristics from both **varieties**

Modern farming

What is done	Why it is done	Problems this causes
land is cleared of hedges and trees	to create more land for crops and make it easier for machinery to move around	Destroys habitats. Lack of roots can cause soil erosion. Plants remove CO_2 → global warming
pesticides herbicides, insecticides used	to kill pests that compete with or harm crops	Can kill useful organisms as well as pests. Damages food webs.
fertilisers are used	they contain mineral salts that help plants to grow and increase the yield	Can wash into streams and rivers and cause pollution so that the organisms in the water die.
varieties	varieties of plants are chosen that produce the highest yield	The planting of huge areas of a single variety reduces **biodiversity**.

Confidence level?

Not sure **Very happy**

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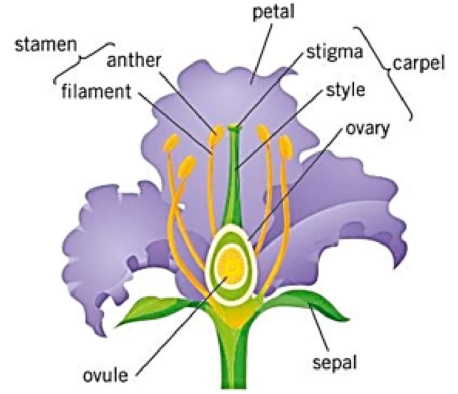
Plant growth Page3 of 3

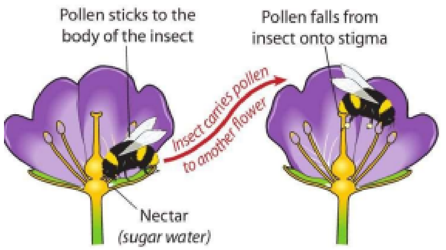
PARTS OF A FLOWER

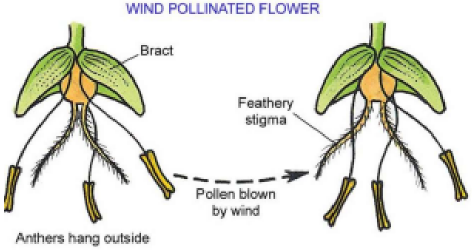


POLLINATION

- Can occur between two different plants (cross-pollination) or between male and female parts of the same plant (self-pollination).
- Pollen can be transferred by wind, insects, or other animals.

Insect pollination





How are new plants made? Plants reproduce sexually to produce seeds. These seeds form after pollen grains and ovules join. After fertilisation, the fruit and seed are formed.

The tube grows out of the pollen grain and down through the style.

The pollen nucleus moves down the tube.

The pollen nucleus joins with the ovule nucleus. Fertilisation takes place and a seed will form.

	Insect pollinated	Wind pollinated
Petals	Large brightly coloured	Small dull in colour
Smell	Sweet	No scent
Nectar	Yes (attract insects)	No
Pollen quantity	Very little	Large quantity
Pollen type	Sticky or spiky	Light, dry, smooth (
Anther position	Firm and inside	Loose and outside
Stigma position	Inside flower	Outside flower
Stigma type	sticky	Sticky but also feathery

SEEDS have three important structures:

1. Seed coat → tough outer layer
2. Embryo → young root and shoot
3. Food store → store of food (starch) the young plant uses until it can photosynthesise.

To germinate a seeds needs:

1. Water → seed swells and embryo can grow.
2. Oxygen → respiration (energy)
3. Warmth → speeds up reactions

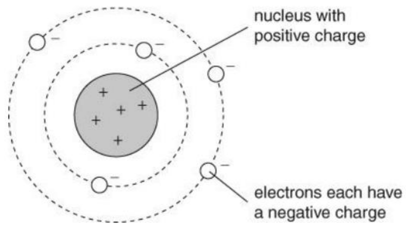
Method	Detail of seed dispersal	Examples
Wind	Seeds have lightweight parts, wings or parachutes.	Dandelion, sycamore
Animals (inside)	Brightly coloured and tasty fruits contain seeds with indigestible coats, so that the seeds pass through the animal's digestive system undamaged. They reach the ground in animal droppings and may be able to germinate.	Tomato, plum, raspberry, grape
Animals (outside)	Fruits have hooks that attach them to the fur of passing animals. The seeds drop and reach the ground where they may be able to germinate.	Goose grass, burdock
Water	Seeds with a small mass can float on water and may germinate if they reach land. Wood fruits are waterproof and are carried away by the sea.	Willow trees, coconut tree
Explosive	Have a pod that bursts open when ripe, throwing the seeds away from the plant in all directions.	Pea pod

KEYWORD	DEFINITION
Anther	The male part of the flower that produces pollen.
Carpel	The female part of the flower, made up on the stigma where the pollen lands, style and ovary.
Fertilisation	Joining of a nucleus from a male and female sex cell.
Filament	The part of a flower that holds up the anther.
Fruit	Structure that the ovary becomes after fertilisation, which contains seeds.
Germination	The period of time when a seed starts to grow.
Ovary	The part of a flower that contains ovules.
Ovules	Female sex cells in plants found in the ovary.
Petals	A brightly coloured part of a flower that attracts insects.
Pollen	Contains the plant male sex cells found on the stamens.
Pollination	Transfer of pollen from the male part of the flower to the female part of the flower on the same or another plant.
Seed	Structure that contains the embryo of a new plant.
Seed dispersal	The movement of seeds away from the parent plant.
Sepal	The special leaves found under the flower, which protect unopen buds.
Stamen	The male reproductive parts of the flower.
Stigma	The female part of a flower that is sticky to catch grains of pollen.
Style	The female part of a flower that holds up the stigma.

KNOWLEDGE ORGANISER **Year 9:** Force Fields and Electromagnets **Page 1 of 2**

Key Scientific Words

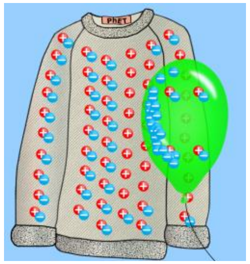
Force field	The volume around something where a non-contact force can effect things e.g. **electric**, **magnetic** and **gravitational** fields.
Static electricity	A *positive* or *negative charge* on an insulating material. Caused when rubbing transfers **electrons** from one material to another.
Nucleus	The central part of an atom. Has an overall positive charge.
Electron	Tiny particle with a negative charge that is found in in an atom, moving around the central **nucleus.**
Current	The flow of electricity around a circuit. Measured using an **ammeter** which is connected in **series** in the circuit. Units for measuring current are **Amperes** (**A**) abbreviated to **Amps**.
Voltage	A way of saying how much energy is transferred by electricity. Also called potential difference. Measured using a **voltmeter** connected in **parallel** in the circuit. Units for measuring voltage are **Volts** (**V**).
Resistance	A way of saying how difficult it is for electricity to flow through something. Unit for measuring resistance is **Ohm** (**Ω**)
Resistors	A component that makes it difficult for electricity to flow. Used to reduce the size of current in a circuit.
Relay	A switch that is turned on and off without a person touching it. Makes use of electromagnets.
Motor effect	The force produced when a wire carrying a current is placed in a magnetic field.

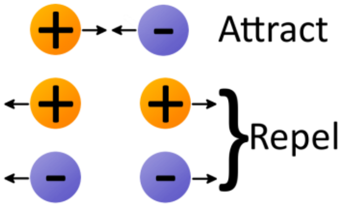


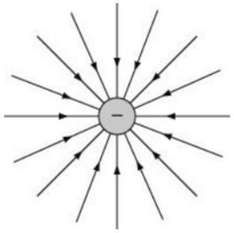
- An atom consists of a central nucleus with small particles called electrons moving around it.
- An atom normally has no overall charge because it has the **same number** of **positive** and **negative** charges.

Static electricity

When you rub two materials together, electrons may be transferred from one material to the other. If the objects are **insulating** materials, the object that **gains electrons** has a **negative charge** of **static electricity**. The object that loses electrons has a positive charge.

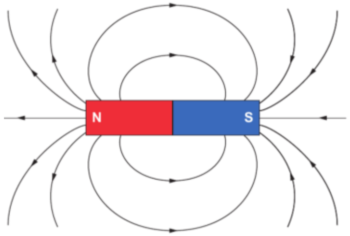






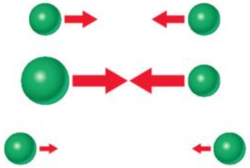
The space around a charged object where it will attract or repel other charged objects is its electric field. The arrows on the diagram show the direction a positive charge would move.

Magnetic field lines show space around a magnet where it can attract magnetic materials



North-seeking pole

South-seeking pole



All objects attract each other.

If one or both of the objects has more mass, the force is bigger.

If the objects are further apart, the force is smaller.

Weight (N) = **mass** (kg) x **gravitational field strength** (N/kg)

KNOWLEDGE ORGANISER **Year 9:** Force Fields and Electromagnets **Page 2 of 2**

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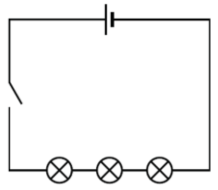
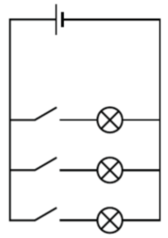
Series circuits	**Parallel circuits**
	
The current is the same everywhere in the circuit.	The current through the cell splits up when it comes to a junction.
All the bulbs go off when the switch is opened.	Each bulb can be controlled individually.
If you add more bulbs in series, the current in the circuit is reduced and the bulbs are dimmer.	If you add more bulbs in parallel, the bulbs all stay at the original brightness. The current through each bulb stays the same.

Current electricity

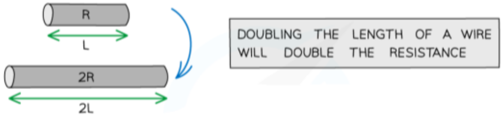
- In a <u>series</u> circuit the resistance of the circuit is higher with more bulbs, so current is less as you add bulbs.
- In a <u>parallel</u> circuit it is easier for the current to flow with more branches because there are more ways for the charges to go.

Resistance

- High resistance = hard for electricity to flow → small current
- Low resistance = easy for electricity to flow → large current

Resistance of wire depends on wire

- material
- length
- thickness

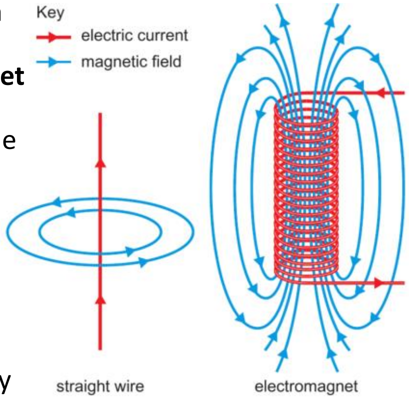


DOUBLING THE LENGTH OF A WIRE WILL DOUBLE THE RESISTANCE

DOUBLING THE CROSS-SECTIONAL AREA OF A WIRE WILL HALF THE RESISTANCE

A bar magnet is a **permanent magnet**, because it is always magnetic. A wire with electricity flowing through it has a **magnetic field** around it. An **electromagnet** is a coil of wire with an electric current flowing through it. It is only magnetic while the current is flowing. The shape of the magnetic field of an electromagnet is similar to the magnetic field of a bar magnet. You make one **stronger** by

- increasing the number of **coils** of wire
- increasing the size of the **current** (by increasing the voltage)
- using an **iron** core.

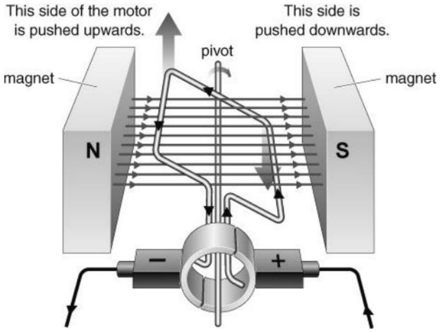


If a wire carrying a current crosses a magnetic field, the wire will experience a force. This is the **motor effect**.

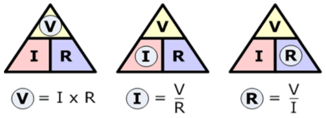
An electric motor consists of a coil of wire in a magnetic field. When there is a current in the coil, there is a force on each side of the coil that makes it turn.

The speed of the motor (or the force it provides) can be increased by:

- increasing the <u>size of the current</u>
- increasing the <u>strength of the magnetic field</u>
- increasing the <u>number of turns</u> of wire on the coil.



Voltage (V) = Current (I) x Resistance (R)



$V = I \times R$ $\quad I = \frac{V}{R}$ $\quad R = \frac{V}{I}$

Confidence level?									
Not sure								Very happy	
1	2	3	4	5	6	7	8	9	10

Knowledge Organiser: CB1 Key Concepts in Biology (1 of 2)

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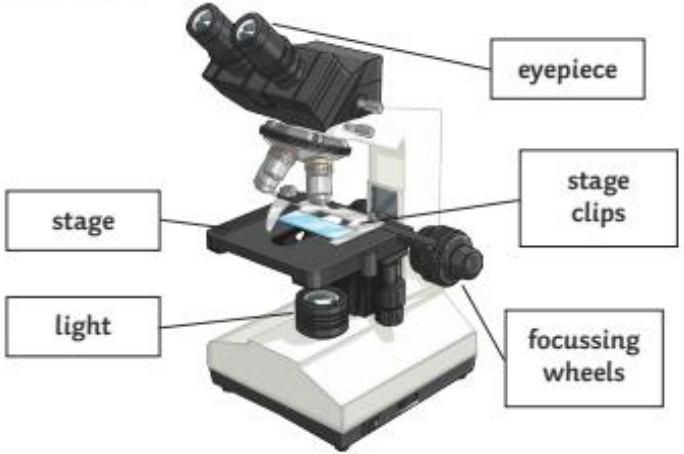
Key Learning

- Using a microscope
- Preparing slide (CP)
- Calculating magnification
- Labelling cells
- Role of cell parts
- Comparing prokaryotic and eukaryotic cells
- Movement of substances into and out of cells
- Investigating osmosis (CP)
- Role of enzymes in digestion
- Function of enzyme active site on specificity
- Effect of temp and pH on enzyme activity
- Investigating effect of pH on enzyme activity (CP)

Microscopy Required Practical

- Includes preparing a slide, using a light microscope, drawing any observations – use a pencil and label important observations.

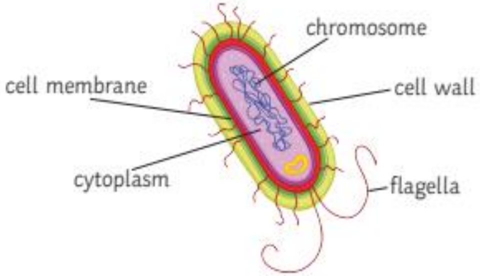


Prefix	Effect on unit	Example
milli-	÷ 1000	millimetres (mm)
micro-	÷ 1 000 000	micrometres (μm)
nano-	÷ 1 000 000 000	nanometres (nm)
pico-	÷ 1 000 000 000 000	picometres (pm)

× 1000 ÷ 1000
× 1000 ÷ 1000
× 1000 ÷ 1000

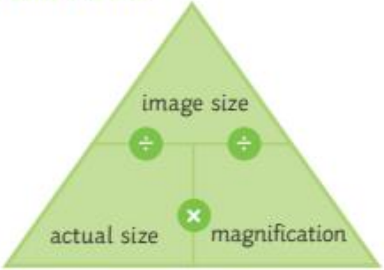
Bacterial Cells

Bacterial cells do not have a true nucleus, they just have a single strand of DNA that floats in the cytoplasm. They contain a plasmid.



Equations and Maths

Equation



Maths Skills

Conversions:

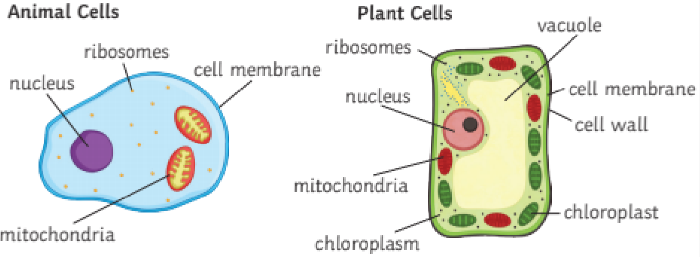
Micrometres to millimetres: divide by 1000.

Standard Form:

$0.003 = 3 \times 10^{-3}$

$5.6 \times 10^{-5} = 0.0056$

Prokaryotic and Eukaryotic Cells



Plant and animal cells have similarities and differences:

	Animal	Plant
nucleus	✓	✓
cytoplasm	✓	✓
chloroplast	X	✓
cell membrane	✓	✓
permanent vacuole	X	✓
mitochondria	✓	✓
ribosomes	✓	✓
cell wall	X	✓

Key Terms and definitions

Microscopes
Magnification
Specimen
Prefix
Prokaryote
Eukaryote
Enzymes
Denatured
Biological catalyst
Optimum
Diffusion
Osmosis
Active Transport

Context

Microbiology in covid-19 tests

Knowledge Organiser: CB1 Key Concepts in Biology (2 of 2)

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Specialised Cells

When a cell changes to become a specialised cell, it is called differentiation.

Specialised Cell	Function	Adaptation
sperm	To get the male DNA to the female DNA.	Streamlined head, long tail, lots of mitochondria to provide energy.
nerve	To send electrical impulses around the body.	Long to cover more distance. Has branched connections to connect in a network.
muscle	To contract quickly.	Long and contain lots of mitochondria for energy.
root hair	To absorb water from the soil.	A large surface area to absorb more water.
phloem	Transports substances around the plant.	Pores to allow cell sap to flow. Cells are long and joined end-to-end.
xylem	Transports water through the plant.	Hollow in the centre. Tubes are joined end-to-end.

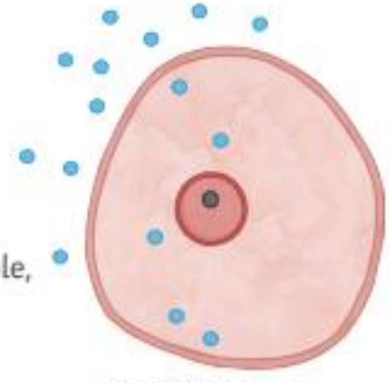
Key Processes

Diffusion is the spreading out of particles from an area of higher concentration to an area of lower concentration.

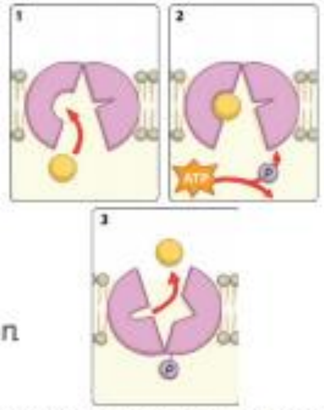
Cell membranes are semi-permeable, only small molecules can get through.

Osmosis is the movement of water molecules across a partially permeable membrane from a region of higher concentration to a region of lower concentration.

Active transport is the movement of substances against the concentration gradient. This process requires energy from respiration.



Cell Diffusion

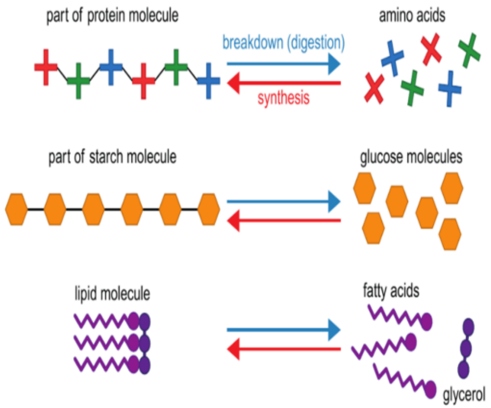


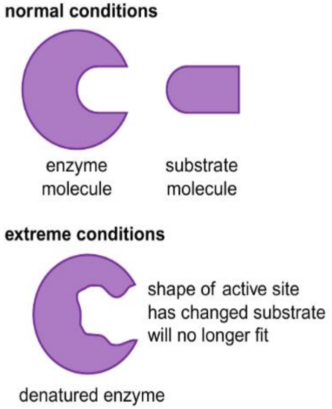
Active Transport in Cells

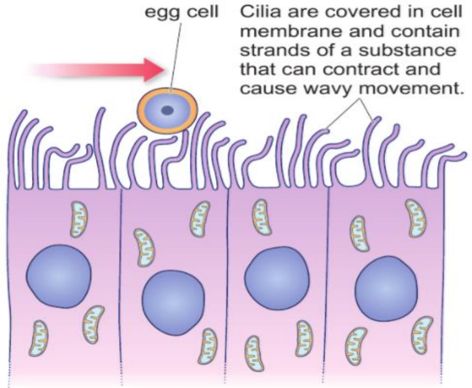
Osmosis and Potato Practical

- Independent variable – concentration.
- Dependent variable – change in mass.
- Control variable – volume of solution, temperature, time, surface area of the potato.

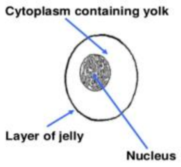
The potato in the sugar solution will lose water and so will have less mass at the end; the potato in the pure water solution will gain water.



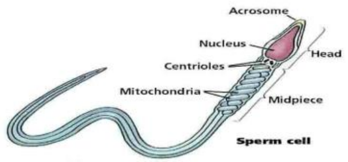




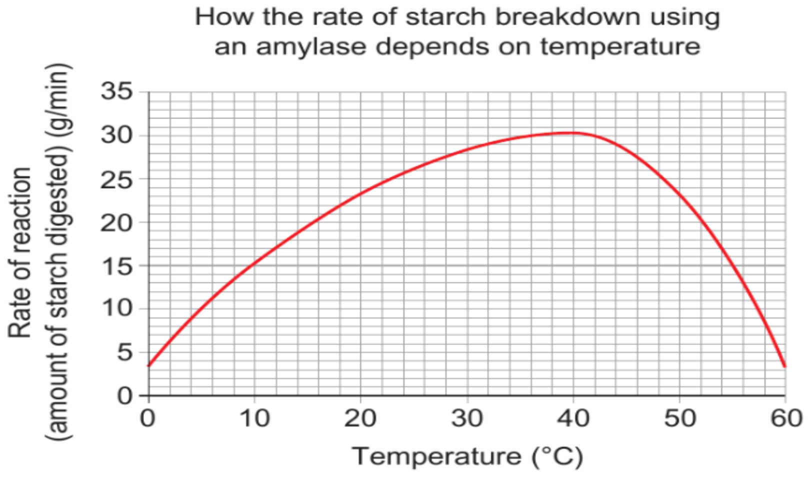
Cilia are covered in cell membrane and contain strands of a substance that can contract and cause wavy movement.



- Designed to be Fertilised.
- Found in the Ovaries.
- An egg cell is large and bulky.
- Contains yolk which provides a large food store for the new cell being formed.



Enzyme name	Where found	Reaction catalysed
amylase	saliva and small intestine	breaking down starch to small sugars, such as maltose
catalase	most cells, but especially liver cells	breaking down hydrogen peroxide made in many cell reactions to water and oxygen
starch synthase	plant	synthesis of starch from glucose
DNA polymerase	nucleus	synthesis of DNA from its monomers



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

Knowledge Organiser: CC3 Atomic Structure & CC4 The Periodic Table (1 of 2)

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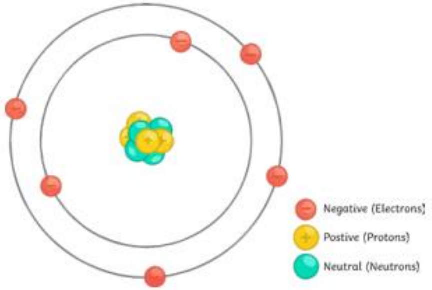
Atomic theory

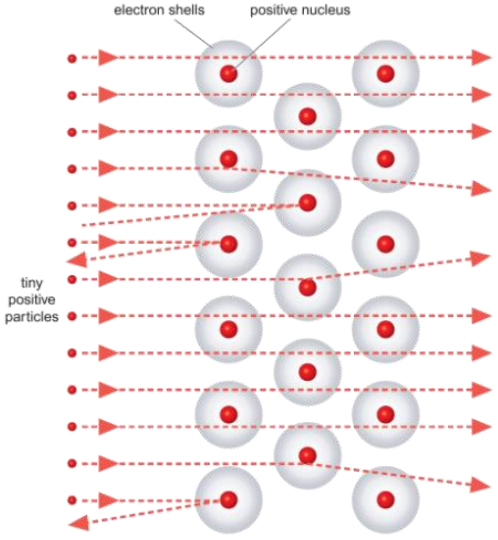
- all matter is made up of tiny particles called **atoms**
- atoms are tiny, hard spheres that cannot be broken down into smaller parts
- atoms cannot be created or destroyed
- the atoms in an **element** are all identical (but each element has its own type of atom).

Electronic Structure

Electrons are found in shells. A maximum of two in the most inner shell, then eight in the 2nd and 3rd shell. The inner shell is filled first, then the 2nd then the 3rd shell.



In 1909, Ernest Rutherford (1871–1937) was working with others to investigate the structure of atoms. In one experiment, tiny positive particles were fired at a thin gold foil. To everyone's surprise most of the particles passed straight through the gold foil, with a few being deflected and a very small number bouncing back. Rutherford explained this by suggesting that atoms are mostly empty space, with a small positive central nucleus that contains most of the mass.



A Rutherford's scattering experiments suggested a nuclear atomic model.

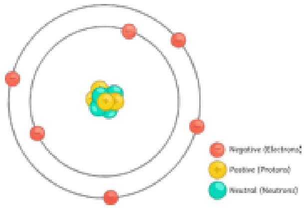
History of the atom

Scientist	Time	Discovery
John Dalton	start of 19th century	Atoms were first described as solid spheres.
JJ Thomson	1897	Plum pudding model – the atom is a ball of charge with electrons scattered.
Ernest Rutherford	1909	Alpha scattering experiment – mass concentrated at the centre; the nucleus is charged. Most of the mass is in the nucleus. Most atoms are empty space.
Niels Bohr	around 1911	Electrons are in shells orbiting the nucleus.
James Chadwick	around 1940	Discovered that there are neutrons in the nucleus.

Atoms

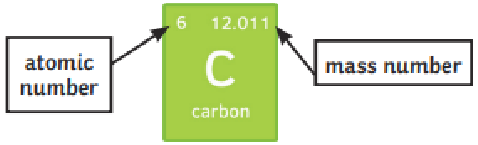
Contained in the nucleus are the **protons** and **neutrons**. Moving around the nucleus are the **electron** shells. They are negatively charged.

Particle	Relative Mass	Charge
proton	1	+1
neutron	1	0
electron	Very small	-1

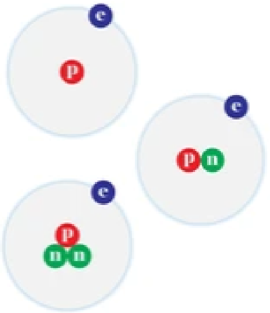


Overall, atoms have no charge; they have the same number of protons as electrons. An ion is a charged particle - it does not have an equal number of protons to electrons.

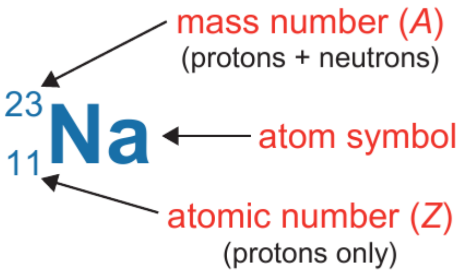
Atomic Number and Mass Number



An isotope is an element with the same number of protons but a different number of neutrons.
They have the same atomic number but different mass number.



Isotope	Protons	Electrons	Neutrons
$^{1}_{1}\mathrm{H}$	1	1	1 - 1 = 0
$^{2}_{1}\mathrm{H}$	1	1	2 - 1 = 1
$^{3}_{1}\mathrm{H}$	1	1	3 - 1 = 2



The mass of an electron is described as 'negligible' – it is so small that it can be ignored. This explains why the nucleus of any atom contains nearly all its mass. For this reason the total number of protons and neutrons in an atom is called its **mass number**.

Knowledge Organiser: CC3 Atomic Structure & CC4 The Periodic Table (2 of 2)

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In the early 1800s, elements were arranged by atomic mass. The periodic table was not complete because some of the elements had not been found. Some elements were put in the wrong group.

Dimitri Mendeleev (1869) left gaps in the periodic table. He put them in order of **atomic mass**. The gaps show that he believed there was some undiscovered elements. He was right! Once found, they fitted in the pattern.

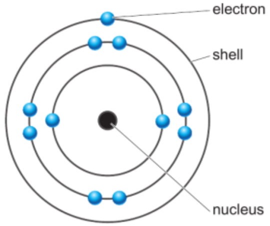
The Modern Periodic Table

Elements are in order of **atomic mass/proton number**. It shows where the metals and non-metals are. **Metals** are on the **left** and **non-metals** on the **right**. The **columns** show the **groups**. The **group number** shows the number of **electrons** in the **outer shell**. The rows are **periods** – each period shows another full shell of electrons.

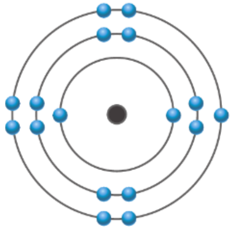
The periodic table can be used to predict the reactivity of elements.

Electronic configuration

In an atom, electrons occupy **electron shells** arranged around the nucleus. The shells can be modelled in diagrams as circles, with the electrons drawn as dots or crosses on each circle. The way in which an atom's electrons are arranged is called its **electronic configuration**.



The electronic configuration for sodium is 2.8.1

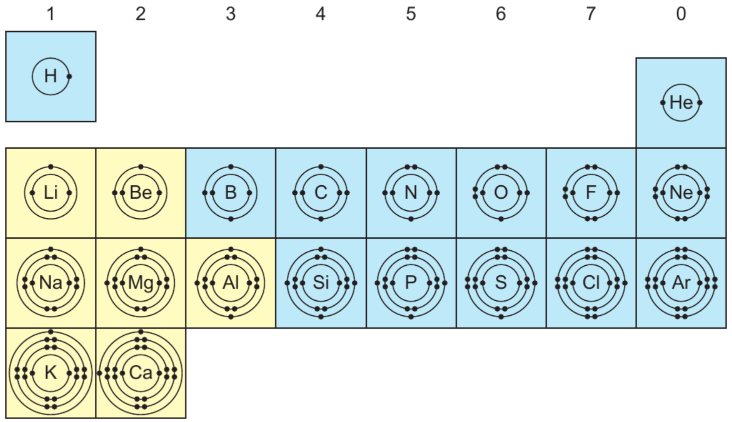


The electronic configuration for chlorine is 2.8.8

Connections with the periodic table

Diagram D shows the electronic configurations for the first 20 elements in the periodic table. The electronic configuration of an element is related to its position:

- the number of occupied shells is equal to the period number
- the number of electrons in the outer shell is equal to the group number (except for group 0 elements, which all have full outer shells).



D These are the electronic configurations of the first 20 elements.

Unit glossary

atom	Atoms are small particles from which all substances are made. They are the smallest neutral part of an element that can take part in chemical reactions.
atomic number	The number of protons in the nucleus of an atom (symbol Z). Also known as the proton number.
chemical property	How a substance reacts with other substances.
electronic configuration	The arrangement of electrons in shells around the nucleus of an atom.
element	A simple substance made up of only one type of atom.
group	A vertical column of elements in the periodic table. Elements in the same group generally have similar properties.
relative charge	The electric charge of a subatomic particle compared to the charge on a proton.
relative mass	The mass of a subatomic particle compared to the mass of a proton.
subatomic particles	The smaller particles that make up atoms – protons, neutrons and electrons.
mass number	The total number of protons and neutrons in the nucleus of an atom (symbol A). Also known as the nucleon number.
isotopes	Atoms of an element with the same number of protons (atomic number) but different mass numbers due to different numbers of neutrons.
nuclear fission	The reaction in which the nucleus of a large atom, such as uranium, splits into two smaller nuclei.
relative atomic mass (RAM)	The mean mass of an atom relative to the mass of an atom of carbon-12, which is assigned a mass of 12. The RAM of an element is the mean relative mass of the isotopes in the element.
periodic table	An ordered list of all known elements.
physical property	A description of how a material behaves and responds to forces and energy. Hardness is a physical property.
prediction	What you think will happen in an experiment and why you think this.
relative atomic mass, Ar	The mean mass of an atom relative to the mass of one-twelfth of an atom of carbon-12, which is assigned a mass of 12. The Ar of an element is the mean relative mass of the isotopes in the element.

Knowledge Organiser: CP1 Motion (1 of 2)

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A **scalar** quantity has **magnitude** only. Examples include temperature or mass.

A **vector** quantity has both **magnitude** and **direction**. Examples include velocity.

Speed is the scalar magnitude of **velocity**.

A vector quantity can be shown using an **arrow**. The size of the arrow is relative to the magnitude of the quantity and the direction shows the associated direction.

A change in velocity is called acceleration. Acceleration is a vector quantity – it has a size (magnitude) and a direction. If a moving object changes its velocity or direction, then it is accelerating.

Acceleration is calculated using the following equation:

$$\text{acceleration (m/s}^2\text{)} = \frac{\text{change in velocity (m/s)}}{\text{time taken (s)}}$$

This can also be written as:

$$a = \frac{v - u}{t}$$

where a is the acceleration

v is the final velocity

u is the initial velocity

t is the time taken for the change in velocity.

Acceleration does not always mean getting faster. An acceleration can also cause an object to get slower. This is sometimes called a **deceleration**, and the acceleration will have a negative value.

Acceleration can be related to initial velocity, final velocity and distance travelled by this equation:

$$\underset{(\text{m/s})^2}{(\text{final velocity})^2} - \underset{(\text{m/s})^2}{(\text{initial velocity})^2} = 2 \times \underset{(\text{m/s}^2)}{\text{acceleration}} \times \underset{(\text{m})}{\text{distance}}$$

This can also be written as $v^2 - u^2 = 2 \times a \times x$, where x represents distance.

Examples of scalar and vector quantities

Scalar	Vector
Distance, speed, mass, energy, density, power, length, area, volume, time, temperature, work	Displacement, velocity, weight, acceleration, force, pressure, momentum, gravity

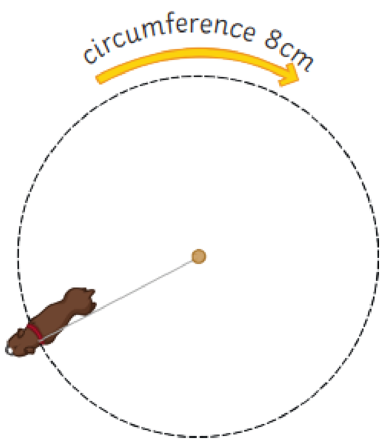
Distance is a **scalar** quantity. It measures how far something has moved and does not have any associated direction.

Displacement is a **vector** quantity. It measures how far something has moved and is measured in relation to the direction of a straight line between the starting and end points.

E.g. A dog is tethered to a post. It runs 360˚ around the post three times. Each 360˚ lap is 8m

distance = 8 × 3 = 24m

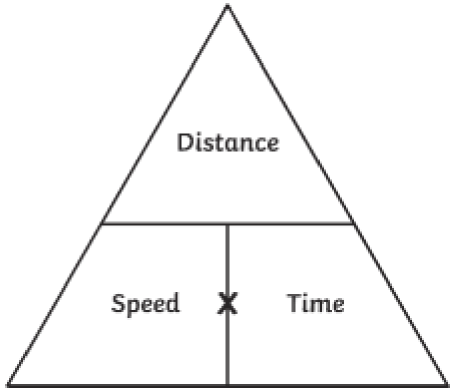
displacement = 0m (The dog is in the same position as when it started.)



Acceleration due to gravity

An object in free fall moves downwards due to the force of gravity acting on it. The acceleration due to gravity is constant close to the Earth's surface. If no other forces (such as air resistance) act on the object, the acceleration towards the Earth is therefore a constant 9.8 m/s². This value is known as the acceleration due to gravity. It is represented by the symbol *g* and is often rounded to 10 m/s² in calculations.

speed = distance ÷ time



Worked example:

John runs 5km. It takes him 25 minutes. Find his average speed in metres per second.

Step 1: convert the units

km → m (×1000) = 5000m

min → s (×60) = 1500s

Step 2: calculate s = d ÷ t

s = 5000 ÷ 1500

s = 3.33m/s

Worked example 2:

Zi Xin has driven along the motorway. Her average speed is 65mph. She has travelled 15 miles. How long has her journey taken? Give your answer in minutes.

Step 1: calculate t = d ÷ s

t = 15 ÷ 65

t = 0.23 (hours)

Step 2: convert units

hr → min (×60) = 13.8 minutes

Knowledge Organiser: CP1 Motion (2 of 2)

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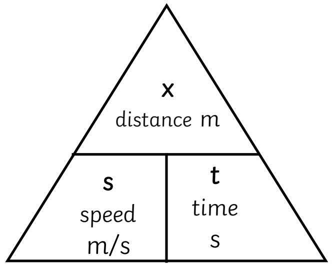
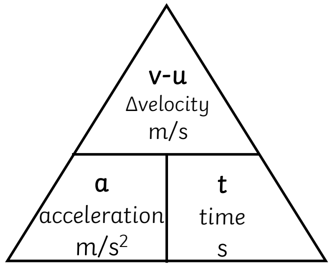
Glossary

Word	Meaning
acceleration	A measure of how quickly the velocity of something is changing.
displacement	The distance travelled in a particular direction. Displacement is a vector quantity.
distance	How far something has travelled. Distance is a scalar quantity, and has no direction.
force	At the simplest level a force is a push, pull or twist. Forces acting on an object can cause it to accelerate. Force is a vector quantity.
magnitude	The size of something
mass	A measure of the amount of material that there is in an object.
scalar quantity	A quantity that has a magnitude (size) but not a direction e.g. mass, distance, energy and speed.
speed	The distance an object travels in a given time
vector quantity	A quantity that has both a size and a direction e.g. force, velocity, displacement, momentum and acceleration.
velocity	The speed of an object in a particular direction. Velocity is a vector quantity.
weight	The force acting on an object due to gravity.
average speed	The speed worked out from the total distance travelled divided by the total time taken for a journey. speed = distance travelled /time
distance/time graph	A graph of the distance travelled against time for a moving object. The gradient of a line on a distance/time graph gives the speed.
instantaneous speed	The speed at one particular moment in a journey.
gradient	A way of describing the steepness of a line on a graph in numbers.
deceleration	When an object is slowing down.
velocity/time graph	A graph of velocity against time for a moving object. The gradient of a line on the graph gives the acceleration and the area under the graph gives the distance travelled.

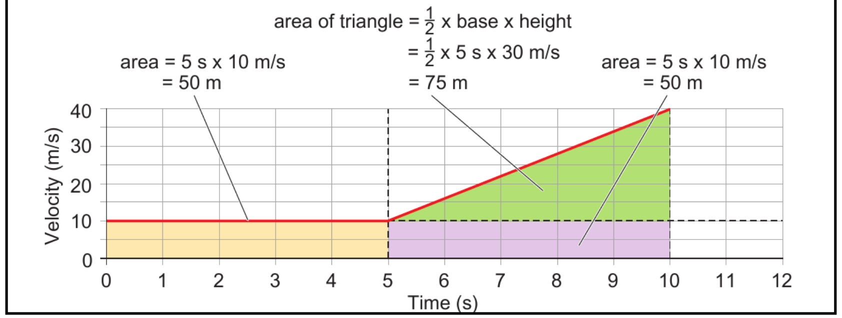
Equation triangles

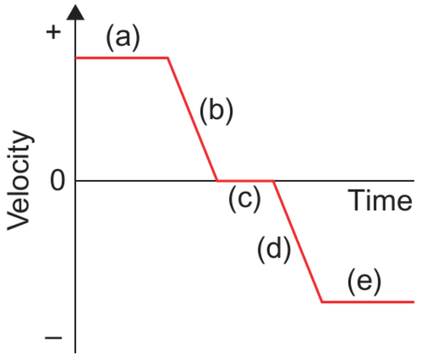




Calculating distance travelled from a graph

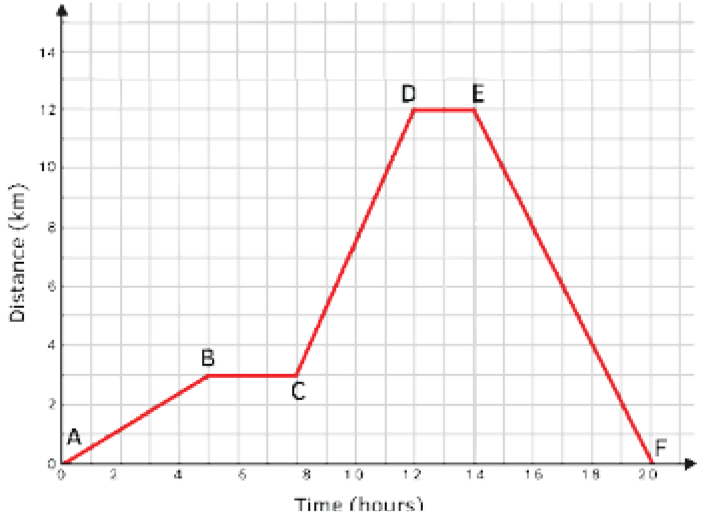
The area under a velocity/time graph is the distance the object has travelled





B The graph shows a lift moving up at a constant speed (a), slowing to a stop (b) and waiting at a floor (c) then accelerating downwards (d) and then travelling downwards at a constant speed (e).

When an object travels in a **straight line**, we can show the distance which has been covered in a **distance-time graph**.



You should be able to understand what the features of the two types of graph can tell you about the motion of an object.

Graph Feature	Distance-Time Graph	Velocity-Time Graph
x-axis	time	time
y-axis	distance	velocity
gradient	speed	acceleration (or deceleration)
plateau	stationary (stopped)	constant speed
uphill straight line	steady speed moving away from start point	acceleration
downhill straight line	steady speed returning to the start point	deceleration
uphill curve	acceleration	increasing acceleration
downhill curve	deceleration	increasing deceleration
area below graph		distance travelled