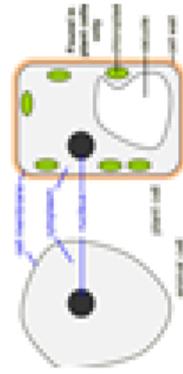


WCSA



Science



Home Learning Booklet

Year 9 Learning cycle 1

Science

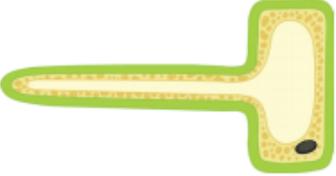
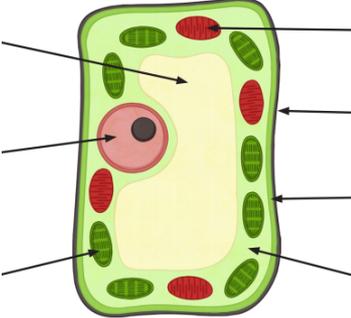
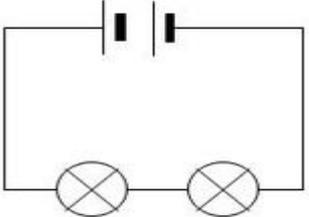
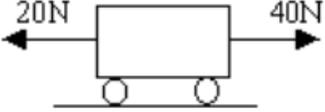
Name: _____

Tutor Group: 9

Science Teacher(s): _____

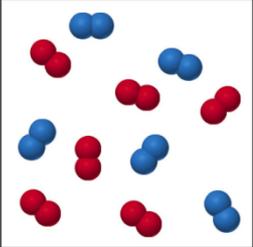
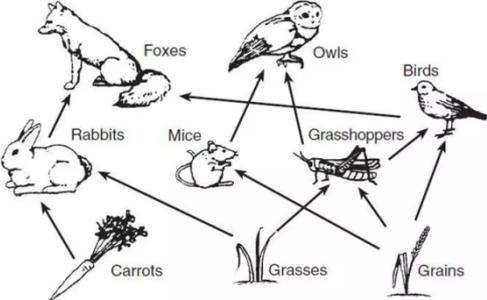
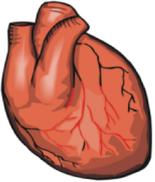
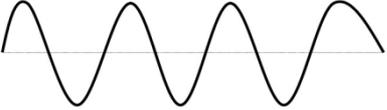
Learning cycle 1 - Week 1

Teacher sign/stamp

<p>What is this?</p> 	<p>Draw the particle diagram for</p> <p>a) Solid</p>  <p>b) Liquid</p> 	<p>Write down an equation used to calculate speed using distance and time</p>	<p>Which piece of scientific equipment is used to measure force?</p>
<p>Write down as many parts of an animal cell (Around 6 parts overall)</p>	<p>Give an example of a unicellular organism.</p>	<p>Label the cell</p> 	<p>What is the difference between a producer and a consumer?</p>
	<p>Name five types of energy e.g. Sound energy</p>	<p>What is the difference between an element and a compound</p>	<p>What type of circuit is this...Series or parallel?</p> 
<p>Name the term used to describe the change in state from gas to liquid.</p>	<p>What is the overall force?</p> 		
<p>What are these compounds?</p> <p>a) H₂O</p> <p>b) CO₂</p>			

Learning cycle 1 - Week 2

Teacher sign/stamp

<p>What is the name given to the chemical formed in photosynthesis?</p>	<p>Complete the following reactions:</p> <p>a) Acid + Alkali → Metal Salt + _____</p> <p>b) Acid + Metal → M____l Salt + H_____</p>	<p>Name the three states of matter</p>	<p>Element, compound or mixture?</p> 
<p>M____ is the measurement of how heavy something is. It is measured in g____s or K____g____s</p>	<p>What is this the symbol for?</p> 	<p>Which part of an animal cell controls it's function?</p>	<p>What is the definition of density?</p>
<p>Complete the term: R_sp_r_ti__</p>	<p>Write three food chains from this food web</p> 	<p>Where are chromosomes found?</p>	<p>Calculate the speed of a car that travels 40m in 10 seconds</p>
<p>Organ, tissue or cell?</p> 	<p>What do they do?</p> <p>What do they contain?</p>	<p>True or false: Atoms and molecules are particles.</p>	<p>Label the peak and trough of the wave below</p> 
<p>Why do sperm cells have tails?</p> 	<p>Label the peak and trough of the wave below</p> <p>Can you also label a wavelength?</p>		

Learning cycle 1 - Week 3

Teacher sign/stamp

Write an equation that links potential difference, current and resistance

What are the units for these?

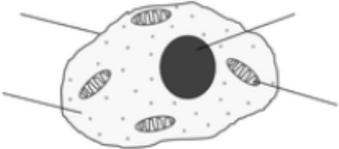


What is the order of the visible light spectrum?

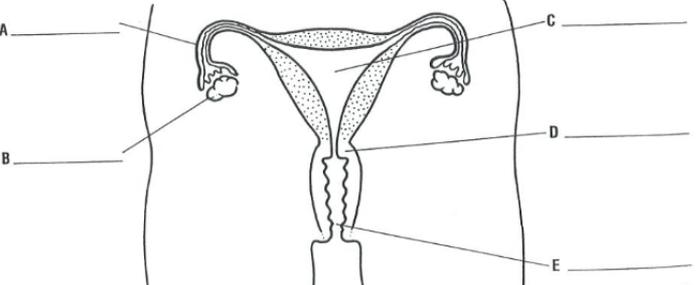
True or false: The vacuole of a cell is full of watery sap that stores minerals.

What is the pH of an acid?(number and colour)

Label the animal cell below
(No keywords given)



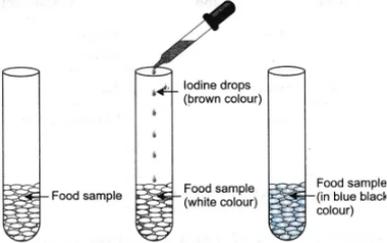
Label the diagram of the female reproductive system.
Keywords: Uterus, ovary, cervix, vagina and fallopian tubes



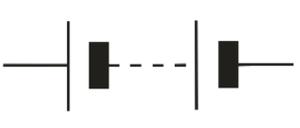
What are the three types of fossil fuel?

True or false?
The elastic limit is when an extended spring will not return to its original length.

Iodine turns blue/black in the presence of which type of molecule found in food?



What symbol is this?



Complete: ___ are part of a balanced diet primarily used for growth and repair.

Name the term used to describe the change in state from gas to liquid.

Add arrows to the diagram to show weight and air resistance

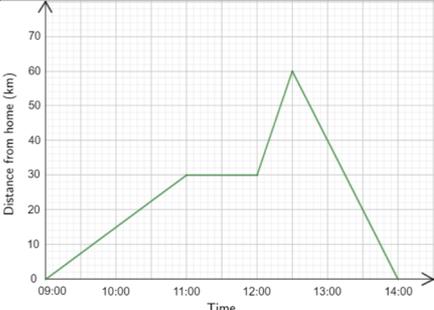


Sketch the magnetic field of a bar magnet



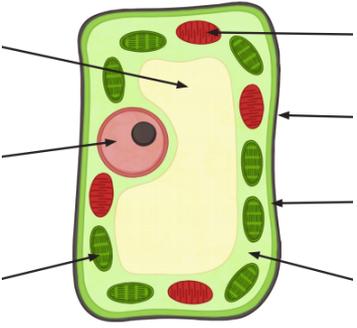
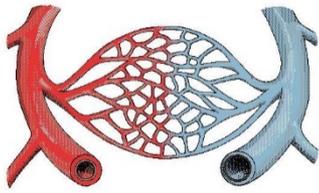
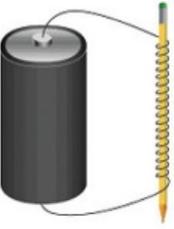
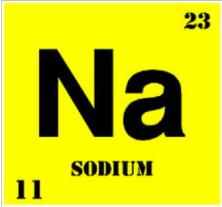
Learning cycle 1 - Week 4

Teacher sign/stamp

<p>Where do plants get their:</p> <ul style="list-style-type: none"> a) Water b) Carbon dioxide c) Nutrients/Minerals 	<p>What is this organ and what does it do?</p> 	<p>Complete the word equation for photosynthesis:</p> <p>_____ + Carbon dioxide → _____ + Oxygen</p> <p>What is needed for photosynthesis to take place?</p> <p>Where does photosynthesis take place in a palisade cell?</p>	
<p>What is the role of the placenta?</p> 	<p>In electricity, resistance is caused by... (pick one)</p> <ul style="list-style-type: none"> a) Collision of atoms with metal ions b) Collisions of electrons with metal ions c) Collisions of positive charge with metallic atoms 	<p>Calculate the distance travelled by a car travelling 60mph for 2.5 hours</p>	<p>Give three changes that can occur during puberty</p> 
<p>What does friction do when acting against the motion of an object?</p>			
<p>What happened between 11:00 and 12:00?</p> 	<p>What is the boiling point of water?</p>	<p>These are examples of...</p> 	<p>What is chemical energy?</p> <p>Where do humans receive their chemical energy?</p>
	<p>What is the melting point of ice?</p>		

Learning cycle 1 - Week 5

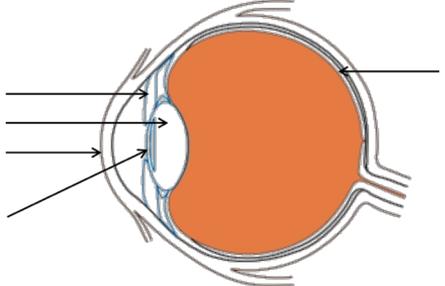
Teacher sign/stamp

<p>What is a physical reaction?</p>	<p>What is the chemical formula for glucose?</p>	<p>What is this?</p> 	<p>Label the palisade cell</p> 	
<p>Name three risk factors for foetus development</p>	<p>What is this component called?</p> 	<p>Name the three types of blood vessel</p> 	<p>State what the states changes are for:</p> <ol style="list-style-type: none"> Freezing Melting Boiling 	<p>Where does respiration take place in our body?</p>
<p>What type of mineral does milk provide us?</p>	<p>What is the equation that links density, mass and volume?</p>	<p>Name two ways you can increase the strength of an electromagnet</p> 	<p>What do you call a fertilised egg cell?</p> 	<p>Why did Mendeleev leave gaps in his periodic table?</p>
<p>How many protons, electrons and neutrons are there in this atom?</p>  <p>Protons = _____ Electrons = _____ Neutrons = _____</p>	<p>What is the chemical symbol for Hydrochloric acid?</p>			

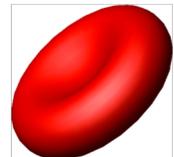
Learning cycle 1 - Week 6

Teacher sign/stamp

Label the diagram of the eye using the following **keywords**:
Iris, pupil, retina, optic nerve, lens, cornea



How is a red blood cell adapted to its role?



Name 3 types of contraception

How does a condom work?

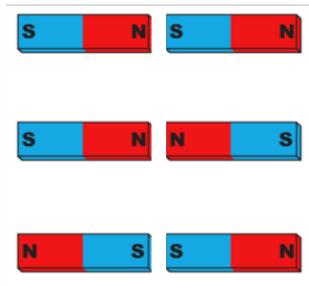
Write down an equation that links voltage, current and resistance

Describe what is meant by acceleration?

How do you calculate acceleration?

What factors can affect your thinking distance?

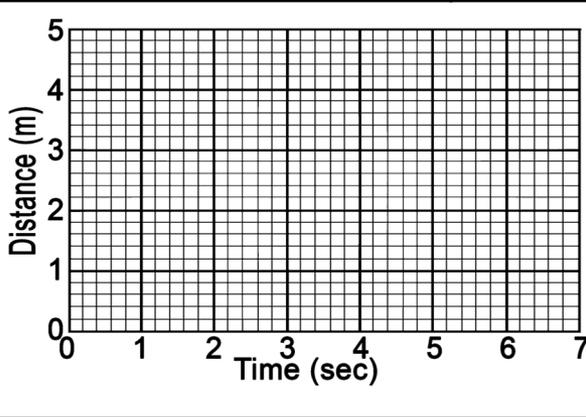
Attract or repel?



What is the word?
 M _ _ r _ _ _ op _

What are the names of these chemicals

- 1) MgO
- 2) CaO
- 3) NaCO₃
- 4) HNO₃



Complete the distance-time graph using for the scenario below:

- ✓ A car travels 2m in 1 second
- ✓ Stops at a traffic light for 2 seconds
- ✓ Travels another 3m in 3 seconds
- ✓ Comes back to where it started in 1.5 seconds

What speed did the car travel at when it was returning home?

Learning cycle 1 - Week 7

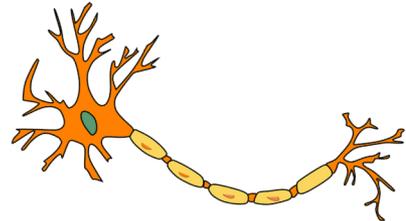
Teacher sign/stamp

What is the difference between inherited and environmental variation?

How is a leaf adapted to maximise the amount of sunlight it can absorb

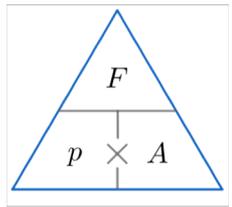


What is this?



What element do fuels react with during combustion?

Calculate the pressure (in N/m^2) if a force of 6N is spread over 2 metres.

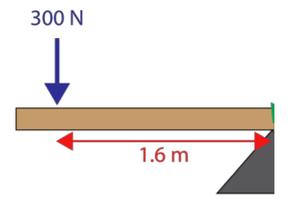
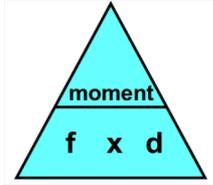


What are the hazards of using this piece of equipment?

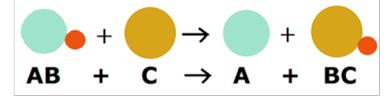


How do you control these hazards?

Calculate the moment of the see-saw below



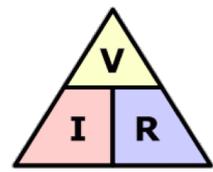
A displacement reaction is when a more reactive metal replaces a less reactive metal from a compound



Complete the displacement reactions below:

- a) Iron Chloride + Sodium \rightarrow _____ + _____
- b) Lead oxide + Magnesium \rightarrow _____ + _____
- c) Copper Iodide + Zinc \rightarrow _____ + _____

Calculate the resistance of a 8V lightbulb that passes 2 amps through it

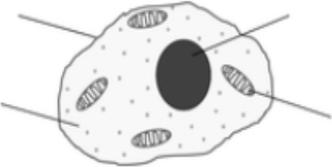


List the health risks associated with too much fat in the diet.

Learning cycle 1 - Week 8

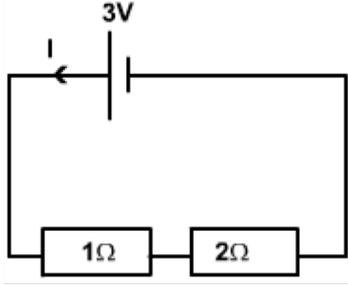
Teacher sign/stamp

Label the animal cell



a) Calculate the total resistance in the circuit

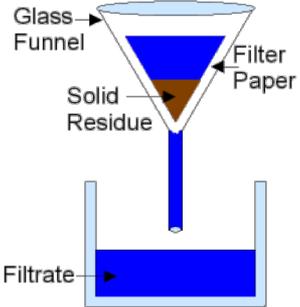
b) Calculate the current flowing from the total resistance and voltage



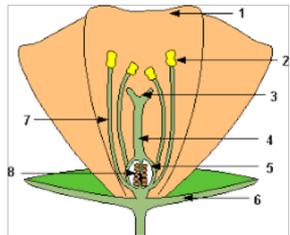

Where is the DNA stored in all living organisms?

What is an independent variable?

Describe what is happening in this diagram



Label the plant reproductive system



What barriers does a sperm cell need to overcome before fertilising an egg?

Calculate the weight of the object below. Take $g = 10 \text{ N/kg}$



What does the term soluble mean?

What does the term solute mean?

1. P _ t _ l
2. A _ t h _ _
3. St _ gm _
4. C _ _ p _ _
5. Ov _ ry
6. S _ pal
7. St _ m _ n



How is the sperm adapted to overcome these barriers?

Learning cycle 1 - Week 9

Teacher sign/stamp

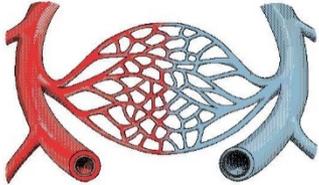
Draw the particle diagram for a gas in the box below



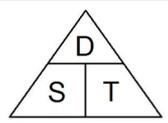
Draw the circuit symbol for a voltmeter

Write an equation that links voltage, resistance and current

Name the **three** types of vessels



Calculate the distance travelled by a train that travels at 30m/s for 1 hour.

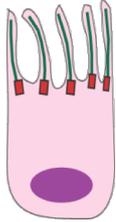


How is a polar bear adapted to its environment?



Describe how one feature helps it to survive?

What type of cell is this?



What is its specialism?

What is the green organelle that is found in plants called?

What is the pigment found in this organelle called?

Complete the chemical equation for **aerobic respiration**

Glucose + _____ → water + _____ + energy

What are the male and female sex chromosomes

Male:

Female:

What is meant by genetic variation?

Complete the chemical equation for **photosynthesis**

Carbon dioxide + _____ → _____ + Oxygen + energy

What % chance is there for a couple to have either a boy or a girl?

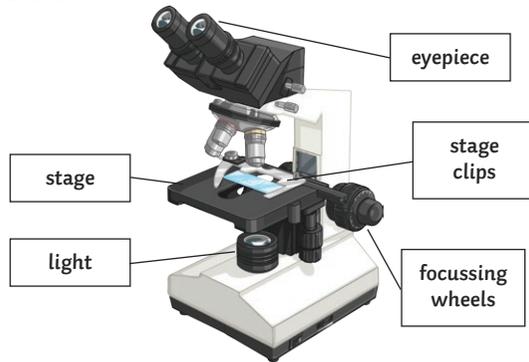
Give 5 examples of inherited characteristics

Cell Biology Knowledge Organiser – Foundation and Higher

Required Practical

Microscopy Required Practical

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



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.



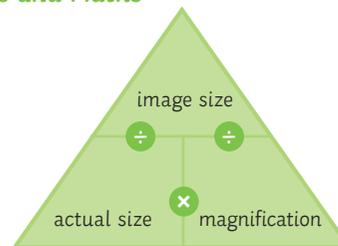
Specialised Cells

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.

Equations and Maths

Equation



Maths Skills

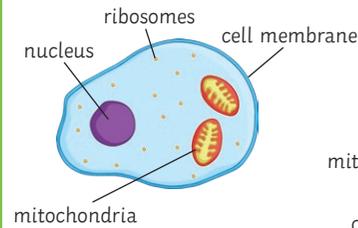
Conversions:
Micrometres to millimetres: divide by 1000.

Standard Form:
 $0.003 = 3 \times 10^{-3}$

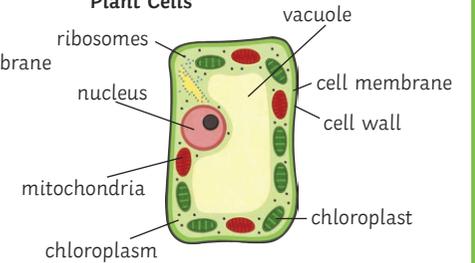
$5.6 \times 10^{-5} = 0.0056$

Prokaryotic and Eukaryotic Cells

Animal Cells



Plant Cells

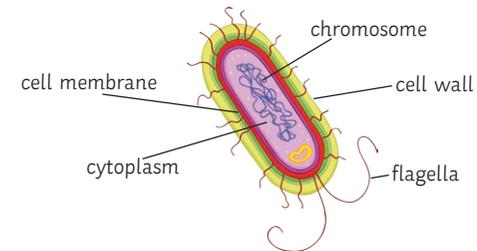


Plant and animal cells have similarities and differences:

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

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.



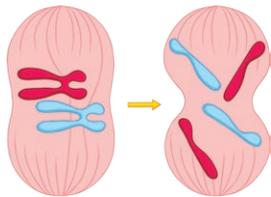
Chromosomes and Mitosis

In the nucleus of a human cell there are 23 pairs of **chromosomes**. Chromosomes contain a double helix of **DNA**. Chromosomes have a large number of genes.



The **cell cycle** makes new cells.

Mitosis: DNA has to be **copied/replicated** before the cell carries out mitosis.



Key Vocabulary

- active transport
- alveoli
- chromosome
- diffusion
- eukaryotic
- gas exchange
- mitosis
- multicellular
- osmosis
- prokaryotic
- undifferentiated
- replicated
- specialised
- villi

Stem Cells

Embryonic stem cells are **undifferentiated** cells, they have the potential to turn into any kind of cell.



Adult stem cells are found in the bone marrow, they can only turn into some types of cells e.g. blood cells.

Uses of stem cells:

- Replacing faulty blood cells;
- making insulin producing cells;
- making nerve cells.

Some people are against stem cell research.

For Stem Cell Research	Against Stem Cell Research
Curing patients with stem cells - more important than the rights of embryos.	Embryos are human life.
They are just using unwanted embryos from fertility clinics, which would normally be destroyed.	Scientists should find other sources of stem cells.

Stem Cells in Plants

In plants, stem cells are found in the **meristem**. These stem cells are able to produce clones of the plant. They can be used to grow crops with specific features for a farmer, e.g. **disease resistant**.

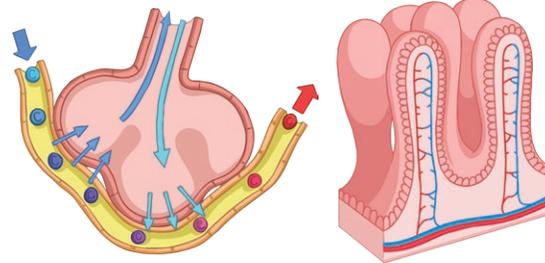
Exchange – Humans

Multicellular organisms have a large surface area to volume ratio so that all the substances can be exchanged.

Gas exchange: Lungs

The alveoli are where gas exchange takes place.

They have a large surface area, moist lining, thin walls and a good blood supply.

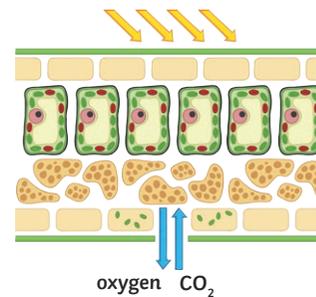


Villi: Small Intestine

Millions of villi line the small intestine increasing the surface area to absorb more digested food.

They are a single layer of cells with a good blood supply.

Exchange in Plants

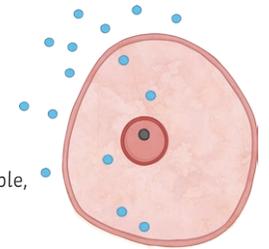


The surface of the leaf is flattened to increase the surface area for more gas exchange by diffusion.

Oxygen and water vapour diffuse out of the stomata. Guard cells open and close the stomata, controlling water loss.

Key Processes

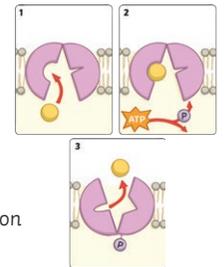
Diffusion is the spreading out of particles from an area of higher concentration to an area of lower concentration.



Cell Diffusion

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.

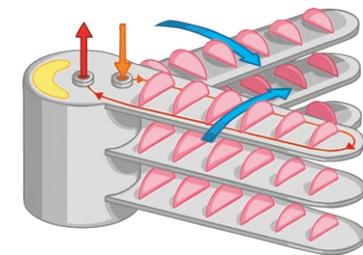


Active Transport in Cells

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

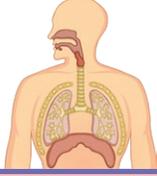
Exchange in Fish

Fish have a large surface area for gas exchange. These are called **gills**. Water enters the fish through the mouth and goes out through the gills. The oxygen is transported from the water to the blood by **diffusion**. Carbon dioxide diffuses from the blood to the water. Each gill has **gill filaments** which give the gills a large surface area. **Lamellae** cover each gill filament to further increase the surface area for more gas exchange. They have a **thin surface layer** and **capillaries** for good blood supply which helps with diffusion.



AQA GCSE Biology (Combined Science) Unit 2: Organisation

Principles of Organisation

				
cell	tissue	organ	organ system	organism
Cells are the basic building blocks of all living things.	A group of cells with a similar structure and function is called a tissue.	An organ is a combination of tissues carrying out a specific function.	Organs work together within an organ system.	Organ systems work together to form whole living organisms.

Food Tests (Required Practical)

What are you testing for?	Which indicator do you use?	What does a positive result look like?
sugar	Benedict's reagent	Once heated, the solution will change from blue-green to yellow-red.
starch	iodine	Blue-black colour indicates starch is present.
protein	biuret	The solution will change from blue to pink-purple.
lipid	sudan III	The lipids will separate and the top layer will turn bright red.

Effect of pH on the Rate of Reaction of Amylase (Required Practical)

Iodine is used to test for the presence of **starch**.

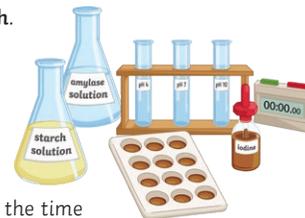
If starch is present, the colour will change to blue-black.

The **independent variable** in the investigation is the pH of the buffer solution.

The **dependent variable** in the investigation is the time taken for the reaction to complete (how long it takes for all the starch to be digested by the amylase).

Method:

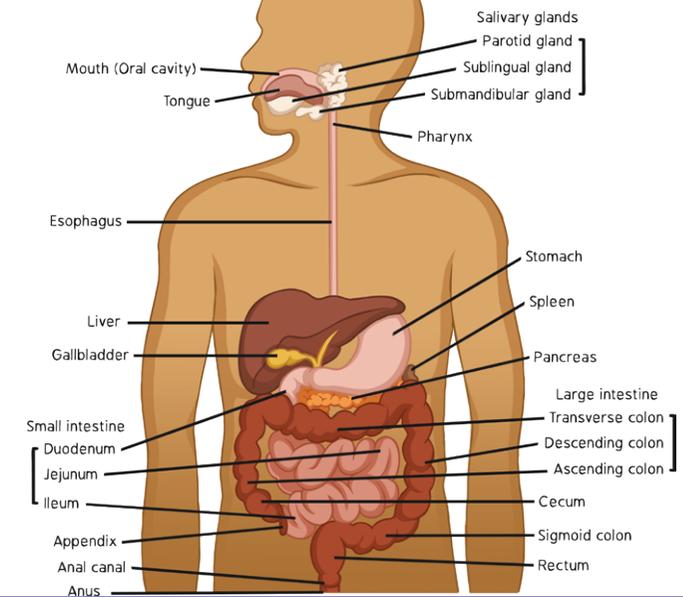
- Use the marker pen to label a test tube with the first value of pH buffer solution (pH 4) and stand it in the test tube rack.
- Into each well of the spotting tiles, place a drop of iodine.
- Using a measuring cylinder, measure 2cm³ of amylase and pour into the test tube.
- Using a syringe, measure 1cm³ of the buffer solution and pour into the test tube.
- Leave this to stand for five minutes and then use the thermometer to measure the temperature. Make a note of the temperature.



- Add 2cm³ of starch solution into the test tube, using a different measuring cylinder to measure, and begin a timer (leave the timer to run continuously).
- After 10 seconds, use a pipette to extract some of the amylase/starch solution, and place one drop into the first well of the spotting tile. Squirt the remaining solution back into the test tube.
- Continue to place one drop into the next well of the spotting tile, every 10 seconds, until the iodine remains orange.
- Record the time taken for the starch to be completely digested by the amylase by counting the wells that were tested positive for starch (indicated by the blue/black colour change of the iodine). Each well represents 10 seconds of time.
- Repeat steps 1 to 8 for pH values 7 and 10.

The Digestive System

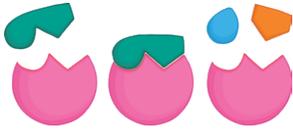
The purpose of the digestive system is to break down large molecules into smaller, soluble molecules, which are then absorbed into the bloodstream. The rate of these reactions is increased by enzymes.



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Enzymes

An enzyme is a biological **catalyst**; enzymes speed up chemical reactions without being changed or used up.



This happens because the enzyme lowers the **activation energy** required for the reaction to occur. Enzymes are made up of chains of amino acids folded into a globular shape.

Enzymes have an **active site** which the **substrate** (reactants) fits into. Enzymes are very specific and will only catalyse one specific reaction. If the reactants are not the complimentary shape, the enzyme will not work for that reaction.

Enzymes also work optimally at specific conditions of pH and temperature. In extremes of pH or temperature, the enzyme will **denature**. This means that the bonds holding together the 3D shape of the active site will break and the active shape will deform. The substrate will not be able to fit into the active site anymore and the enzyme cannot function.

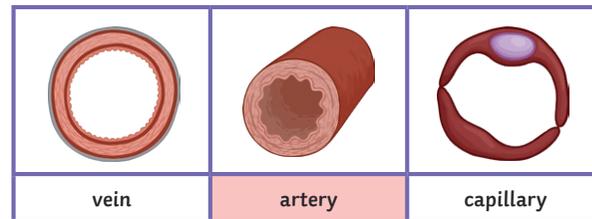
Enzyme	Reactant	Product
amylase	starch	sugars (glucose)
protease	protein	amino acids
lipase	lipid	glycerol and fatty acids

The products of digestion are used to build new carbohydrates and proteins and some of the glucose is used for respiration.

Bile is produced in the **liver** and stored in the gall bladder. It is an **alkaline** substance which **neutralises** the hydrochloric acid in the stomach. It also works to **emulsify** fats into small droplets. The fat droplets have a higher **surface area** and so the rate of their digestion by lipase is increased.

The Heart and Blood Vessels

The **heart** is a large muscular organ which **pumps blood** carrying oxygen or waste products around the body. The **lungs** are the site of **gas exchange** where oxygen from the air is exchanged for waste carbon dioxide in the blood. Oxygen is used in the **respiration** reaction to release energy for the cells and carbon dioxide is made as a waste product during the reaction.



The three types of blood vessels, shown above, are each adapted to carry out their specific function.

Capillaries are narrow vessels which form networks to closely supply cells and organs between the veins and arteries. The walls of the capillaries are only **one cell thick**, which provides a short **diffusion pathway** to increase the rate at which substances are transferred.

The table below compares the structure and function of arteries and veins:

	Artery	Vein
direction of blood flow	away from the heart	towards the heart
oxygenated or deoxygenated blood?	oxygenated (except the pulmonary artery)	deoxygenated (except the pulmonary vein)
pressure	high	low (negative)
wall structure	thick, elastic, muscular, connective tissue for strength	thin, less muscular, less connective tissue
lumen (channel inside the vessel)	narrow	wide (with valves)

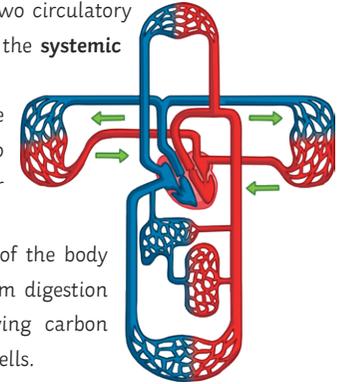
The Heart as a Double Pump

The heart works as a **double pump** for two circulatory systems; the **pulmonary** circulation and the **systemic** circulation.

The pulmonary circulation serves the lungs and bring deoxygenated blood to exchange waste carbon dioxide gas for oxygen at the **alveoli**.

The systemic circulation serves the rest of the body and transports oxygen and nutrients from digestion to the cells of the body, whilst carrying carbon dioxide and other waste away from the cells.

The systemic circulation flows through the whole body. This means the blood is flowing at a much higher pressure than in the pulmonary circuit.



The Heart as Pacemaker

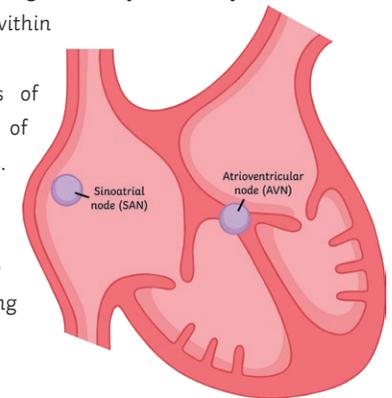
The rate of the heart beating is very carefully, and automatically, controlled within the heart itself.

Located in the muscular walls of the heart are small groups of cells which act as pacemakers.

They produce electrical impulses which stimulate the surrounding muscle to contract, squeezing the chambers of the heart and pumping the blood.

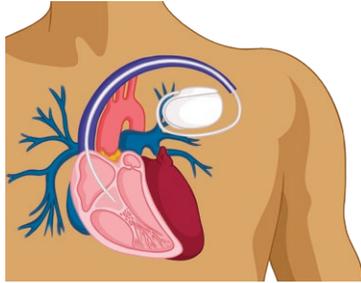
The **sino-atrial node (SAN)** is located near the right atrium and it stimulates the atria to contract.

The **atrio-ventricular node (AVN)** is located in between the ventricles and stimulates them to contract.



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Artificial pacemakers can be surgically implanted into a person if their heart nodes are not functioning correctly.



Coronary Heart Disease

Coronary heart disease is a condition resulting from **blockages** in the **coronary arteries**. These are the main arteries which supply blood to the heart itself and they can become blocked by build-up of **fatty deposits**.

In the UK and around the world, coronary heart disease is a major cause of many **deaths**.

The main symptoms can include **chest pain, heart attack** or **heart failure**. Yet, not all people suffer the same symptoms, if any at all.

Lifestyle factors can increase the risk of a person developing coronary heart disease.

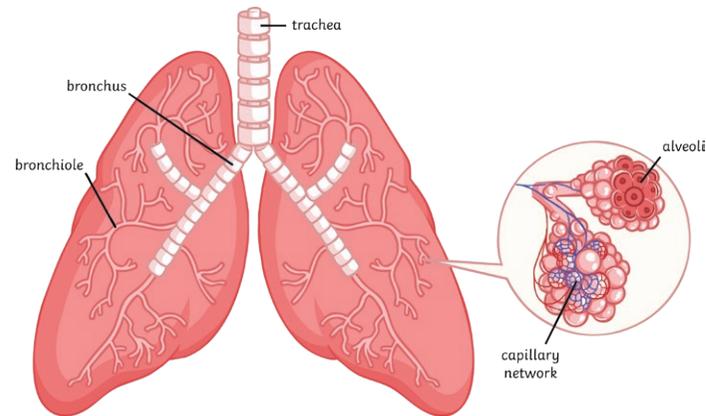
Diet – a high-fat diet (containing lots of saturated fat) can lead to higher cholesterol levels and this cholesterol forms the fatty deposits which damage and block the arteries.

Smoking – chemicals in cigarette smoke, including nicotine and carbon monoxide, increase the risk of heart disease. Carbon monoxide reduces the amount of oxygen which can be transported by the red blood cells and nicotine causes an increased heart rate. The lack of oxygen to the heart and increased pressure can lead to heart attacks.

Stress – prolonged exposure to stress or stressful situations (such as high pressure jobs) can lead to high blood pressure and an increased risk of heart disease.

Drugs – illegal drugs (e.g. ecstasy and cannabis) can lead to increased heart rate and blood pressure, increasing the risk of heart disease.

Alcohol – regularly exceeding unit guidelines for alcohol can lead to increased blood pressure and risk of heart disease.



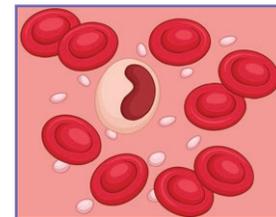
Blood

Blood is composed of red blood cells (erythrocytes), white blood cells and platelets, all suspended within a plasma (a tissue).

The **plasma** transports the different blood cells around the body as well as carbon dioxide, nutrients, urea and hormones. It also distributes the heat throughout the body.

Red blood cells transport oxygen attached to the haem group in their structure. It has a biconcave shape to increase surface area and does not contain a nucleus so it can bind with more oxygen molecules.

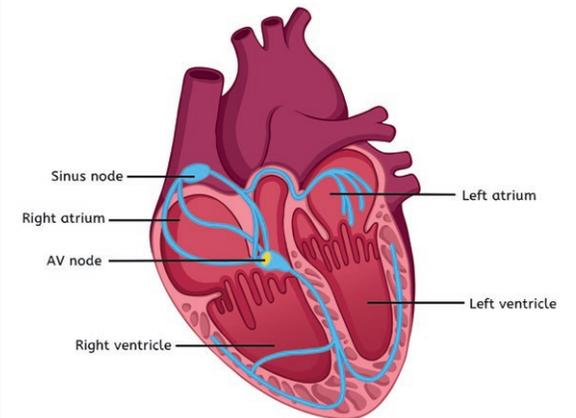
White blood cells form part of the immune system and ingest pathogens and produce antibodies. **Platelets** are important blood clotting factors.



at the lungs

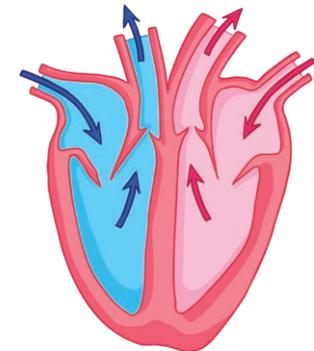
haemoglobin + oxygen \rightleftharpoons oxyhaemoglobin

at the cells



The **right atrium** receives deoxygenated blood via the **vena cava**. It is then pumped down through the valves into the right ventricle. From here, it is forced up through the **pulmonary artery** towards the **lungs** where it exchanges carbon dioxide for oxygen. The oxygenated blood then enters the **left atrium** via the **pulmonary vein** and down into the left ventricle. The muscular wall of the **left ventricle** is much thicker so it can pump the blood more forcefully out of the heart and around the entire body, via the **aorta**.

The blood only flows in **one direction**. This is because there are **valves** in the heart which close under pressure and prevent the backward flow of blood.



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Rate Calculations for Blood Flow

The number of beats the heart performs each minute is called the **pulse** (or heart rate).

It is easily measured by counting the number of beats in a given time, e.g. 15s, and finding the total beats **per minute**.

Typically, a lower resting pulse rate indicates a greater level of physical **fitness**. During exercise, and for some time after, the pulse rate increases while the heart is working to provide more **oxygen** to the muscles.

Cardiac output is a measure of the volume of blood pumped by the heart each **minute**. **Stroke volume** is a measure of the volume of blood pumped from the heart each **contraction** (heart beat).

Cardiac output (cm³/min) = heart rate (bpm) × stroke volume (cm³/beat)

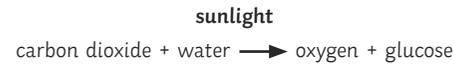
Cancer

Cancer is the result of **uncontrolled** cell growth and division. The uncontrolled growth of cells is called a **tumour**.

Benign Tumour	Malignant Tumour
<ul style="list-style-type: none"> Usually grows slowly. Usually grows within a membrane and can be easily removed. Does not normally grow back. Does not spread around the body. Can cause damage to organs and be life-threatening. 	<ul style="list-style-type: none"> cancerous Usually grows rapidly. Can spread around the body, via the bloodstream. Cells can break away and cause secondary tumours to grow in other areas of the body (metastasis).

Plant Tissues, Organs and Systems

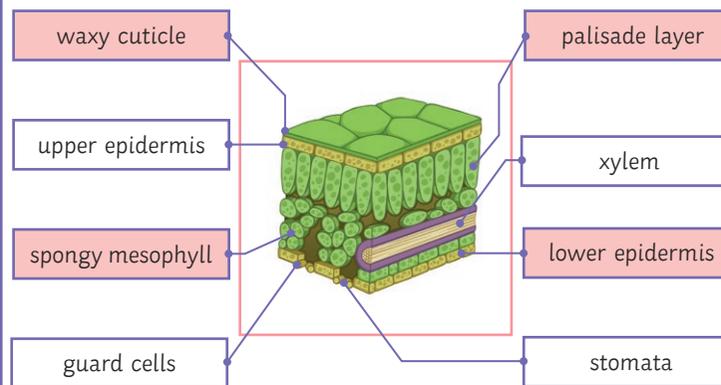
Leaves are plant organs and their main function is to absorb sunlight energy for use in **photosynthesis**. Within the cells are small organelles called **chloroplasts** which contain a green pigment called **chlorophyll**. This is the part of the plant which absorbs the sunlight and where photosynthesis occurs.



Leaves are adapted to carry out their function. Leaves are typically flat and thin with a large **surface area**. This means they have a maximum area to absorb the sunlight and carbon dioxide. The **thin** shape reduces the distance for **diffusion** of water and gases.

Leaves contain vessels called xylem and phloem. The **xylem** transport water and dissolved minerals toward the leaves. The **phloem** transport glucose and other products from photosynthesis around the plant.

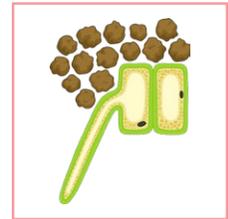
The large **air spaces** between the cells of the spongy mesophyll layer allow for the diffusion of gases. **Carbon dioxide** enters the leaves and **oxygen** exits the leaves.



The **guard cells** are specially adapted cells located on the underside of the leaf. They are positioned in pairs, surrounding the **stomata** (a small opening in the epidermis layer). The guard cells change shape to open and close the stomata, controlling the rate of **gas exchange** in the leaf.

Root Hair Cells

Plants absorb water by **osmosis** through the root hair cells of the roots. Dissolved in the water are important minerals for the plant's growth and development, which are absorbed by **active transport**.

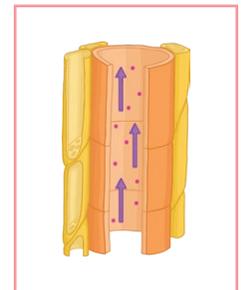


The **root hair cells** are adapted to their function with the following features:

- Finger-like projection in the membrane increases the **surface area** available for water and minerals to be absorbed across.
- The narrow shape of the projection can squeeze into small spaces between soil particles, bringing it closer and reducing the distance of the **diffusion pathway**.
- The cell has many **mitochondria**, which release energy required for the active transport of some substances.

Xylem and Phloem

Xylem vessels transport **water** through the plant, from roots to leaves. They are made up of **dead**, lignified cells, which are joined end to end with no walls between them, forming a long central tube down the middle. The movement of the water, and dissolved minerals, along the xylem is in a **transpiration stream**.

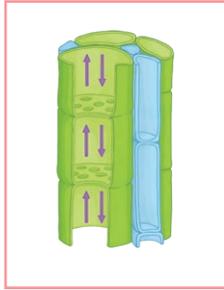


Xylem vessels also provide **support** and **strength** to the plant structure. They are found in the middle of roots so they aren't crushed within the soil. They are found in the middle of the stem to provide strength and prevent bending. In the leaves, they are found in **vascular bundles** alongside the phloem and can be seen as the veins which network across the leaf.



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Phloem vessels transport **food** such as dissolved sugars and glucose from photosynthesis. The food is transported around the plant to where growth is occurring (root and shoot tips), as well as to the organs which store the food. The transport occurs in **all directions** throughout the plant. The cells making up the phloem tube are **living**, with small holes in the walls where the cells are joined.



Disease Interactions

Having one type of illness can often make a person more susceptible to another type of illness:

- immune disorders → increased risk of infectious disease
- viral infection of cells → increased risk of cancer
- immune reactions → can trigger allergies
- very poor physical health → increased risk of depression or other mental illness

Health and Disease

Health is the state of being free from **illness** or **disease**. It refers to **physical** and **mental** wellbeing.

Disease and lifestyle factors, such as diet, stress, smoking, alcohol consumption and the use of illegal drugs, can all impact the health of a person.

Some conditions are associated with certain lifestyle choices:

- Liver conditions are associated with poor **diet** and prolonged excessive **alcohol** consumption.
- Lung cancer is associated with **smoking**.
- Memory loss, poor physical health and hygiene are associated with the use of illegal or recreational **drugs**.
- Obesity and diabetes are associated with poor diet.
- Anxiety and depression are associated with **stress** and prolonged excessive alcohol consumption.

Transpiration and Translocation

Transpiration is the loss of water, by **evaporation** and **diffusion**, from the leaves of the plant. Water is a cohesive molecule and as it evaporates, there is less water in the leaf, so water from further back moves up to take its place. This, in turn, draws more water with it. This is the **transpiration stream**.

Transpiration occurs naturally as there is a tendency for water to diffuse from the leaves (where the concentration is relatively high) to the air around the plants (where the concentration is relatively low), via the **stomata**.

Environmental factors can change the rate at which transpiration occurs:

- Increased **light intensity** will increase the rate of transpiration because light stimulates the stomata to open. The leaf will also be warmed by the sunlight.
- Increased **temperature** will cause the water to evaporate more quickly and so increase the rate of transpiration.
- Increased **humidity** (moisture in the air) will reduce the rate of transpiration. Whereas if the air becomes drier, the rate increases. A greater concentration gradient will increase the rate of diffusion.
- If the **wind speed** increases, then the rate of transpiration also increases. This is because as the water surrounding the leaves is moved away more quickly, the concentration gradient is increased.
- If the **water content** in the soil is decreased, then the rate of absorption in the roots decreases. This causes the stomata to become flaccid and close, reducing transpiration. If the loss of turgor affects the whole plant, then it will wilt.

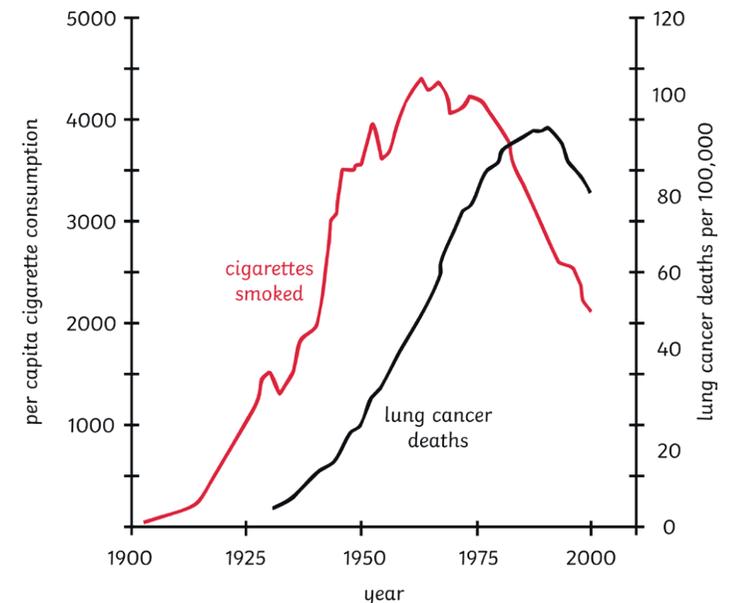
There can often be correlations between some factors and types of illness or specific diseases.

For example, in the graph shown to the right, there is a positive correlation between the number of cigarettes smoked and the number of lung cancer deaths.

However, there are other factors which can contribute to the development of lung cancer e.g. working with asbestos, genetic predisposition.

This means that although the evidence in the graph gives a strong indication that smoking is a cause of lung cancer, it cannot be stated that '**smoking will cause lung cancer**'. Not every person who smokes will develop lung cancer and not every person who develops lung cancer will be a smoker.

Therefore, it can be stated that **smoking increases the risk of lung cancer**.



Heart Disease (Treatments)

There are a range of medical treatments for heart disease.

Treatment	Description	Advantages	Disadvantages
statins	Drugs used to lower cholesterol levels in the blood, by reducing the amount produced in the liver.	<ul style="list-style-type: none"> • Can be used to prevent heart disease developing. • Improved quality of life. 	<ul style="list-style-type: none"> • Long-term treatment. • Possible negative side-effects.
stents	Mechanical device which is used to stretch narrow or blocked arteries, restoring blood flow.	<ul style="list-style-type: none"> • Used for patients where drugs are less effective. • Offers long-term benefits. • Made from metal alloys so will not be rejected by the patients body. • Improved quality of life. 	<ul style="list-style-type: none"> • Requires surgery under general anaesthetic, which carries risk of infection.
heart transplant	The entire organ is replaced with one from an organ donor (a person who has died and previously expressed a wish for their organs to be used in this way).	<ul style="list-style-type: none"> • Can treat complete heart failure in a person. • extended life • Improved quality of life. • Artificial plastic hearts can be used temporarily until a donor is found. 	<ul style="list-style-type: none"> • Requires major surgery under general anaesthetic, which carries risks. • Lack of donors available. • Risk of infection or transplant rejection. • Long recovery times.

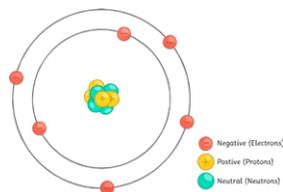


Atomic Structure and the Periodic Table – Foundation and Higher

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



Elements

Elements are made of atoms with the same atomic number. Atoms can be represented as symbols.

N = nitrogen F = fluorine Zn = zinc Ca = calcium

Isotopes – 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
$\begin{matrix} 1 \\ \text{H} \\ 1 \end{matrix}$	1	1	1 - 1 = 0
$\begin{matrix} 2 \\ \text{H} \\ 1 \end{matrix}$	1	1	2 - 1 = 1
$\begin{matrix} 3 \\ \text{H} \\ 1 \end{matrix}$	1	1	3 - 1 = 2

Compounds – a compound is when two or more elements are chemically joined. Examples of compounds are carbon dioxide and magnesium oxide. Some examples of formulas are CO₂, NaCl, HCl, H₂O, Na₂SO₄. They are held together by chemical bonds and are difficult to separate.

Equations and Maths

To calculate the relative atomic mass, use the following equation:

relative atomic mass (A_r) =

$$\frac{\text{sum of (isotope abundance} \times \text{isotope mass number)}}{\text{sum of abundances of all isotopes}}$$

Balancing Symbol Equations

There must be the same number of atoms on both sides of the equation:



$$\text{C} = 1$$

$$\text{O} = 4$$

$$\text{H} = 4$$

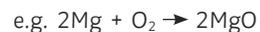
Chemical Equations

A chemical reaction can be shown by using a **word equation**.

e.g. magnesium + oxygen → magnesium oxide

On the left-hand side are the reactants, and the right-hand side are the products.

They can also be shown by a **symbol equation**.



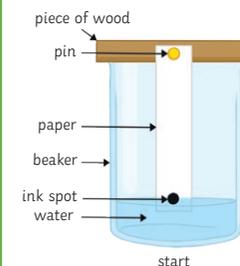
Equations need to be **balanced**, so the same number of atoms are on each side. To do this, numbers are put in front of the compounds.



Mixtures, Chromatography and Separation

Mixtures – in a mixture there are no chemical bonds, so the elements are easy to separate. Examples of mixtures are air and salt water.

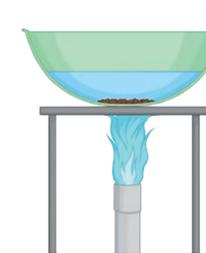
Chromatography – to separate out mixtures.



Filtration – to separate solids from liquids.



Evaporation – to separate a soluble salt from a solution; a quick way of separating out the salt.



Crystallisation - to separate a soluble salt from a solution; a slower method of separating out salt.



Separating out salt from rock salt:

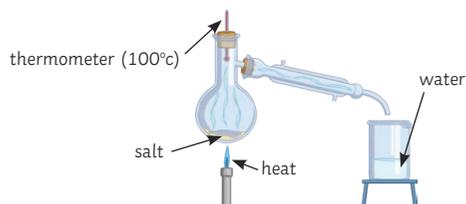
1. Grind the mixture of rock salt.
2. Add water and stir.
3. Filter the mixture, leaving the sand in the filter paper
4. Evaporate the water from the salt, leaving the crystals.

Atomic Structure and the Periodic Table – Foundation and Higher

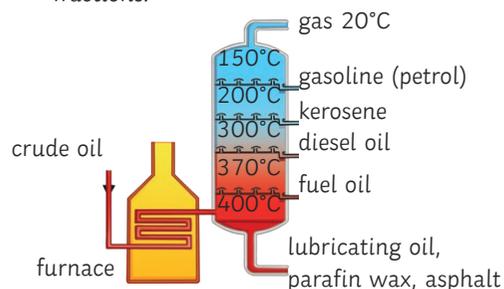
Distillation

To separate out mixtures of liquids.

1. **Simple distillation** – separating a liquid from a solution.



2. **Fractional distillation** – separating out a mixture of liquids. Fractional distillation can be used to separate out crude oil into fractions.



Metals and Non-metals

They are found at the **left** part of the periodic table. Non-metals are at the **right** of the table.

Metals

Are strong, malleable, good conductors of electricity and heat. They bond metallicity.

Non-Metals

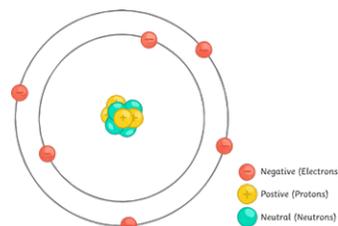
Are dull, brittle, and not always solids at room temperature.

History of the Atom

Scientist	Time	Discovery
John Dalton	start of 19 th 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.

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.



Group 7 Elements and Noble Gases

Halogens

The halogens are **non-metals**: fluorine, chlorine, bromine, iodine. As you go down the group they become less reactive. It is harder to gain an extra electron because its outer shell is further away from the nucleus. The melting and boiling points also become higher.

Noble Gases

The **noble gases** (group 0 elements) include: **helium, neon** and **argon**. They are un-reactive as they have full outer shells, which makes them very stable. They are all colourless gases at room temperature.

The boiling points all increase as they go down the group – they have greater intermolecular forces because of the increase in the number of electrons.

Development of the Periodic Table

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.

Alkali Metals

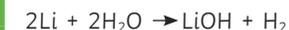
The alkali metals (**group 1** elements) are soft, very reactive metals. They all have **one electron** in their **outer shell**, making them **very reactive**. They are **low density**. As you go down the group, they become more reactive. They get bigger and it is easier to lose an electron that is further away from the nucleus.

They form ionic compounds with non-metals.

They react with water and produce hydrogen.

E.g.

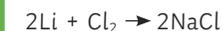
lithium + water → lithium hydroxide + hydrogen



They react with chlorine and produce salt.

E.g.

lithium + chlorine → lithium chloride



They react with oxygen to form metal oxides.

AQA Physics (Combined Science) Unit 6.1: Energy

Required Practical

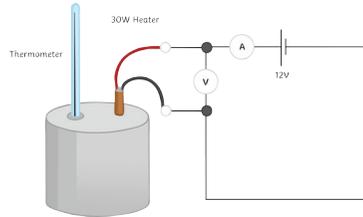
Investigating Specific Heat Capacity

independent variable – material

dependent variable – specific heat capacity

control variables – insulating layer, initial temperature, time taken

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



Method:

- Using the balance, measure and record the mass of the copper block in kg.
- Wrap the insulation around the block.
- Put the heater into the large hole in the block and the block onto the heatproof mat.
- Connect the power pack and ammeter in series and the voltmeter across the power pack.
- Using the pipette, put a drop of water into the small hole.
- Put the thermometer into the small hole and measure the temperature.
- Switch the power pack to 12V and turn it on.
- Read and record the voltmeter and ammeter readings – during the experiment, they shouldn't change.
- Turn on the stop clock and record the temperature every minute for 10 minutes.
- Record the results in the table.
- Calculate work done and plot a line graph of work done against temperature.

Equations

$$E = \frac{1}{2}mv^2$$

$$E_p = mgh$$

$$E_e = \frac{1}{2}ke^2$$

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

$$P = \frac{E}{t}$$

$$P = \frac{W}{t}$$

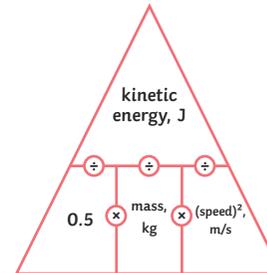
Kinetic and Potential Energy Stores

Movement Energy

kinetic energy = $\frac{1}{2} \times \text{mass} \times \text{speed}^2$

$$E_k = \frac{1}{2}mv^2$$

(J) (kg)(m/s)

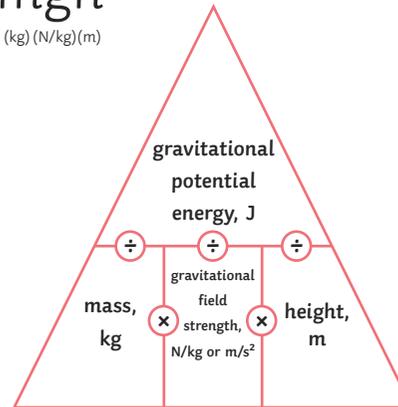


When something is off the ground, it has gravitational potential energy

gravitational potential energy = mass \times gravitational field strength \times height

$$E_p = mgh$$

(J) (kg) (N/kg)(m)



When an object falls, it loses gravitational potential energy and gains kinetic energy.

Stretching an object will give it elastic potential energy.

elastic potential energy = $\frac{1}{2} \times \text{spring constant} \times \text{extension}^2$

$$E_e = \frac{1}{2}ke^2$$

(J) (N)(m)

Transferring Energy by Heating

Heating a material transfers the energy to its thermal energy store - the temperature increases.

E.g. a kettle: energy is transferred to the thermal energy store of the kettle. Energy is then transferred by heating to the water's thermal energy store. The temperature of the water will then increase.

Some materials need more energy to increase their temperature than others.

change in thermal energy = mass \times specific heat capacity \times temperature change

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

(J) (kg) (J/kg°C) (°C)

Specific heat capacity is the amount of energy needed to raise the temperature of 1kg of a material by 1°C.

Energy Stores and Systems

Energy Stores	
kinetic	Moving objects have kinetic energy.
thermal	All objects have thermal energy.
chemical	Anything that can release energy during a chemical reaction.
elastic potential	Things that are stretched.
gravitational potential	Anything that is raised.
electrostatic	Charges that attract or repel.
magnetic	Magnets that attract or repel.
nuclear	The nucleus of an atom releases energy.

Energy can be transferred in the following ways:

mechanically – when work is done;

electrically – when moving charge does work;

heating – when energy is transferred from a hotter object to a colder object.

Conservation of Energy

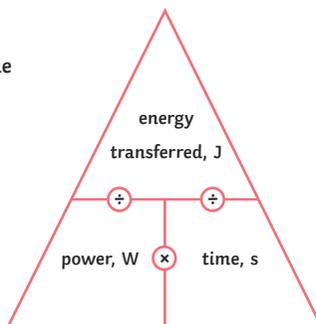
Energy can never be created or destroyed, just transferred from one form to another. Some energy is transferred usefully and some energy gets transferred into the environment. This is mostly wasted energy.

Power

Power is the rate of transfer of energy – the amount of work done in a given time.

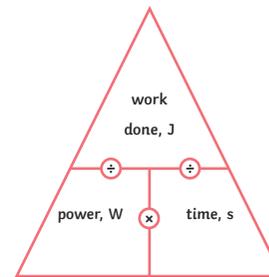
power = energy transferred ÷ time

P (W) = E (J) ÷ t (s)



power = work done ÷ time

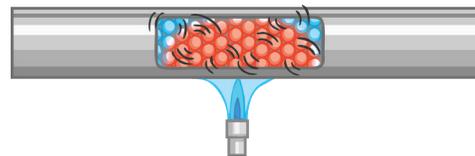
P (W) = W (J) ÷ t (s)



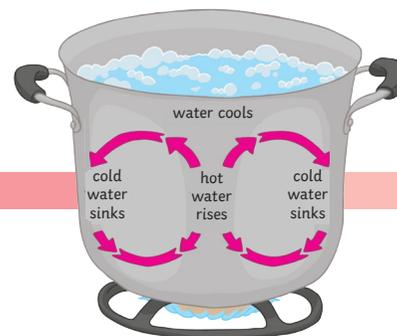
Energy Transfer

Lubrication reduces the amount of friction. When an object moves, there are frictional forces acting. Some energy is lost into the environment. Lubricants, such as oil, can be used to reduce the friction between the surfaces.

Conduction – when a solid is heated, the particles vibrate and collide more, and the energy is transferred.

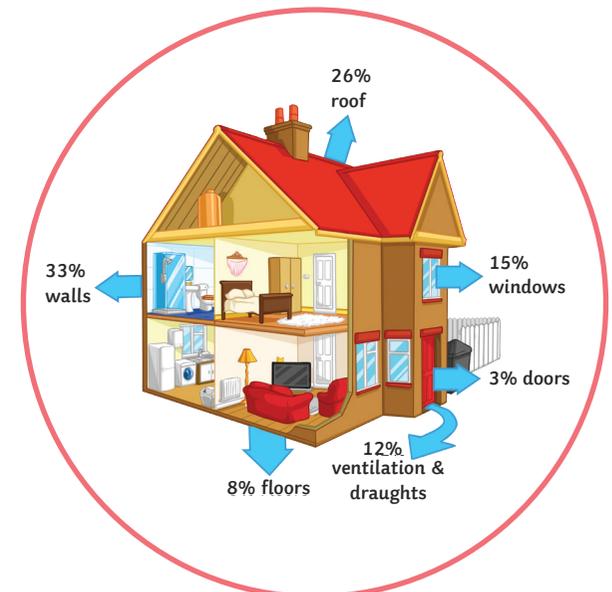


Convection – when a liquid or a gas is heated, the particles move faster. This means the liquid or gas becomes less dense. The denser region will rise above the cooler region. This is a convection current.



Insulation – reduces the amount of heat lost. In your home, you can prevent heat loss in a number of ways:

- thick walls;
- thermal insulation, such as:
- loft insulation (reducing convection);
- cavity walls (reduces conduction and convection);
- double glazing (reduces conduction).

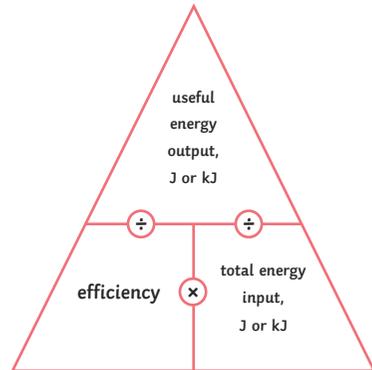


Efficiency

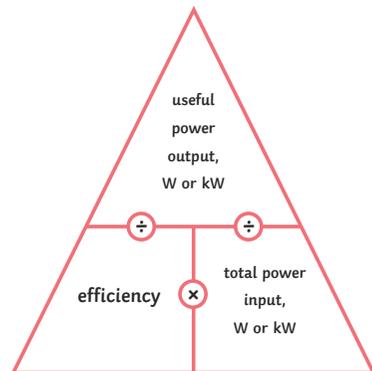
When energy is transferred, some energy is wasted. The less energy that is wasted during the transfer, the more efficient the transfer.

There are two equations to calculate efficiency:

$$\text{efficiency} = \frac{\text{useful output energy transfer}}{\text{total input energy transfer}}$$



$$\text{efficiency} = \frac{\text{useful power output}}{\text{total power input}}$$



Some energy is always wasted. Nothing is 100% efficient.

Efficiency

Non-renewable – coal, oil, gas - they will all run out, they damage the environment, but provide most of the energy.

Renewable – they will never run out, can be unreliable and do not provide as much energy.

Energy Resource	Advantages	Disadvantages
solar – using sunlight	Renewable, no pollution, in sunny countries it is very reliable.	Lots of energy needed to build, only works during the day, cannot increase power if needed.
geothermal – using the energy of hot rocks	Renewable and reliable as the rocks are always hot. Power stations have a small impact on environment.	May release some greenhouse gases and only found in specific places.
wind – using turbines	Renewable, no pollution, no lasting damage to the environment, minimal running cost.	Not as reliable, do not work when there is no wind, cannot increase supply if needed.
hydroelectric – uses a dam	Renewable, no pollution, can increase supply if needed.	A big impact on the environment. Animals and plants may lose their habitats.
wave power – wave powered turbines	Renewable, no pollution.	Disturbs the seabed and habitats of animals. Unreliable.
tidal barrages – big dams across rivers	Renewable, very reliable, no pollution.	Changes the habitats of wildlife, fish can be killed in the turbines.
biofuels	Renewable, reliable, carbon neutral.	High costs, growing biofuels may cause a problem with regards to space, clearance of natural forests.
non-renewable – fossil fuels	Reliable, enough to meet current demand, can produce more energy when there is more demand.	Running out, release CO ₂ , leading to global warming, and also release SO ₂ which causes acid rain.

Trends in energy resources – most of our electricity is generated by burning fossil fuels and nuclear. The UK is trying to increase the amount of renewable energy resources. The governments are aware that non-renewable energy resources are running out; targets of renewable resources have been set. Electric and hybrid cars are also now on the market.

However, changing the fuels we use and building renewable power plants cost money. Many people are against the building of the plants near them and do not want to pay the extra in their energy bills. Hybrid and electric cars are also quite expensive.

