AQA GCSE (Combined Science) Unit 4: Bioenergetics Higher

Photosynthesis

The Effect of Light Intensity on the Rate of Photosynthesis (RPI)

Photosynthesis is a chemical reaction which takes place in plants. It converts carbon dioxide and water into glucose and oxygen. It uses light energy to power the chemical reaction, which is absorbed by the green pigment **chlorophyll**. This means that photosynthesis is an example of an **endothermic** reaction. The whole reaction takes place inside the **chloroplasts** which are small organelles found in plant cells.

the carbon dioxide via diffusion Plants acquire through the **stomata** of their leaves. The water is absorbed from the soil through the roots and transported to the cells carrying out photosynthesis, via the **xylem**.



The glucose made in photosynthesis is used for respiration, stored as starch, fat or oils, used to produce cellulose or used to produce amino acids for protein synthesis.

The Rate of Photosynthesis and Limiting Factors

A **limiting factor** is something which stops the photosynthesis reaction from occurring at a faster rate. Temperature, light intensity and carbon dioxide level are all limiting factors.

Increasing the temperature of the surroundings will increase the rate of reaction, but only up to around 45°C. At around this temperature, the enzymes which catalyse the reaction become denatured.

Increasing the light intensity will increase the rate of reaction because there is more energy to carry out more reactions. Increasing the carbon dioxide concentration will also increase the rate of reaction because there are more reactants available.

The amount of light a plant receives affects the rate of photosynthesis. If a plant receives lots of light, lots of photosynthesis will occur. If there is very little or no light, photosynthesis will stop.



Method

- 1. Measure 20cm³ of sodium hydrogen carbonate solution and pour into a boiling tube.
- 2. Collect a 10cm piece of pondweed and gently attach a paper clip to one end.
- 3. Clamp the boiling tube, ensuring you will be able to shine light onto the pondweed.
- 4. Place a metre rule next to the clamp stand.
- 5. Place the lamp 10cm away from the pondweed.
- 6. Wait two minutes, until the pondweed has started to produce bubbles.
- 7. Using the stopwatch, count the number of bubbles produced in a minute.
- 8. Repeat stages 5 to 7, moving the lamp 10cm further away from the pondweed each time until you have five different distances.
- 9. Now repeat the experiment twice more to ensure you have three readings for each distance.

The independent variable was the light intensity.

The **dependent** variable was the amount of bubbles produced. Counting the bubbles is a common method, but you could use a gas syringe instead to more accurately measure the volume of oxygen produced.

The control variables were same amount of time and same amount of pondweed. A bench lamp is used to control the light intensity and the water in the test tube containing the pondweed is monitored with a thermometer to monitor and control the temperature.

Interaction of Limiting Factors (HT only)

The limiting factor for the reaction will depend on the environmental conditions.

For example:

At night, light intensity is the limiting factor.

In winter, temperature is the limiting factor.

In other conditions, carbon dioxide is usually the limiting factor.



From the graph, you can see that increasing one of the factors will also increase the rate of reaction, but only for so long before it plateaus. This is because another factor will have then become the limiting factor. E.g. you could increase the supply of carbon dioxide, but if there is not enough chlorophyll to absorb the sunlight, then the sunlight will become the limiting factor instead.

Greenhouse Economics (HT only)

To grow plants in the most suitable conditions, a greenhouse can be used.

A greenhouse traps the sun's radiation as heat inside the greenhouse, so that temperature is not a limiting factor for the rate of photosynthesis.

Artificial lighting can be installed in the greenhouse to provide constant light energy and prevent light intensity being a limiting factor.

A paraffin heater can be used in the greenhouse to not only maintain a suitable temperature, but the by-product of the combustion off the paraffin is carbon dioxide.

Enclosing the crops in a greenhouse and regulating all the conditions in this way can be expensive; however, it is often outweighed because the harvest of the crop is much healthier, faster-grown crops. Furthermore, the enclosed conditions mean that disease and pests can be easily controlled and prevented.





AQA GCSE (Combined Science) Unit 4: Bioenergetics Higher

Inverse Square Law and Light Intensity

The **inverse square law** is used to describe the light intensity at different distances from the source.

The inverse square law states that: the intensity of light is inversely proportional to the square distance from the source.



Light intensity is calculated by the following equation:

```
light intensity \propto 1
distance<sup>2</sup>
```

- The symbol, \propto , means 'is proportional to'.
- Distance is measured in metres, m.

In other words, if an object is moved twice as far away from the light source, the light intensity received is reduced to just one quarter.

Worked example:

If the light source is 10cm from a plant, calculate the light intensity reaching the plant.

- 1 ÷ (distance²)
- $1 \div (0.10 \times 0.10)$
- 1 ÷ 0.01
- = 100 arbitrary units

If the light source is moved 25cm from the plant, calculate the light intensity reaching the plant.

- 1 ÷ (distance²)
- 1 ÷ (0.25 × 0.25)
- 1 ÷ 0.0625
- = 16 arbitrary units



Respiration is the chemical reaction which occurs inside the **mitochondria** of all living cells to release energy for living functions and processes, e.g. movement, warmth and building larger molecules for growth and repair. The reaction is **exothermic**, meaning that energy is released to the surroundings. Respiration can be either **aerobic** (using oxygen) or **anaerobic** (without using oxygen).

carbon glucose oxygen dioxide water energy C6H12O6 + 6O2 ➡ 6CO2 + 6H2O + ATP

In anaerobic respiration, the glucose is not completely oxidised. This means that there is less energy released than in aerobic respiration.

	lactic	
glucose	acid	energy
C6H12O6	2C3H6O3	+ ATP

In plants and yeast, anaerobic respiration makes some different products. The reaction is also called fermentation and is used in bread-making and beer-brewing.



Effect of Exercise

When a person exercises, their body (specifically their **muscles**) need much more energy. To release more energy, the amount of respiration reactions occurring has to increase.

The **heart** pumps faster and the **breathing** rate and breath volume all increase to supply more **oxygen** to the muscles via the bloodstream.

If the muscles are not receiving enough oxygen to keep up the demand needed by the respiration reactions, then **anaerobic** respiration begins to occur. This incomplete oxidation of the glucose produces **lactic acid**, which can build up in the muscles and results in an **oxygen debt**.

After long periods of exercise, the muscles can become fatigued and stop contracting. You might experience a pain commonly called a **stitch**.

This means	Metabolism	Oxygen Debt (HT only)
	Metabolism is the combination of all the reactions in a cell or in the body.	During vigorous exercise, the body can begin to carry out anaerobic respiration and produces lactic acid .
nt products. making and	 Energy released during respiration is used during metabolic processes to synthesise new molecules: Glucose is converted to starch, glycogen and cellulose. 	Lactic acid is transported via the bloodstream to the liver . The liver converts the lactic acid back into glucose . However, oxygen is needed to carry out this reaction.
ay b	 Glycerol and three fatty acids are joined to form a lipid molecule. Glucose and nitrate ions are joined to form amino acids. Amino acids are joined to form proteins. 	The oxygen debt is the amount of the oxygen required by the body to convert the built-up lactic acid back into glucose and remove it from the respiring cells.
	 Excess proteins are broken down and released as urea during excretion. Respiration itself is also a process 	
	which is included in metabolism.	





AQA GCSE Chemistry (Combined Science) Unit 4: Chemical Changes Knowledge Organiser

AWA GOSE Onemistry (Combined Science)	Onte 4. Onemical Ona	inges Kilowieug	e orge	
The Reactivity Series	Reactions of Acids			Reactions with Carbonates
Here's a mnemonic to help you learn the order:	The general formula for the reaction between an acid and a metal is:		The general formula for the reaction between an acid and a carbonate is:	
purple (potassium)	acid + metal 🔶 salt + hydrogen			acid + carbonate \longrightarrow salt + water + carbon dioxide
slime (sodium)	For example: hydrochloric acid + sodi	um → sodium chloride +	hydrogen	hydrochloric acid + calcium carbonate \longrightarrow calcium chloride + water
can (calcium)	2HCl + 2Na → 2NaCl + H ₂			+ carbon dioxide
make (magnesium)	When an acid reacts with an alkali, a	a neutralisation reaction t	akes place	pH Scale Neutral
a (aluminium)	and a salt and water are produced.			Acid Alkali
careless (carbon) carbon	The general formula for this kind of	reaction is as follows:		Strong Weak Weak Strong
zebra (zinc)	acid + alkali 🔶 salt + water			1 2 3 4 5 6 7 8 9 10 11 12 13 14
insane (iron)	hydrochloric acid + sodium hydroxid	e 🔶 sodium chloride +	water	
try (tin)	HCl + NaOH → NaCl + H ₂ O			In aqueous solutions, acids produce H^* ions and alkalis produce OH^- ions.
learning (lead) hydrogen lead	Naming Salts			Neutral solutions are pH7 and are neither acids or alkalis.
how (hydrogen) copper	The first part comes from the	Acid Used Salt P	roduced	For example, in neutralisation reactions, hydrogen ions from an acid
camels (copper) silver	metal in the metal carbonate,	hydrochloric chl	oride	react with hydroxide ions from an alkali to produce water:
surprise (silver) gold	oxide or hydroxide. The second	nitric nit	rate	H⁺ + OH⁻ → H₂O
gorillas (gold) platinum	acid that was used to make it	sulfuric su	lfate	Making Soluble Salts
The reactivity series is a league table for metals. The more reactive metals	For example, sodium chloride			1. Make a saturated 2. Filter the solution
are near the top of the table with the least reactive near the bottom.	Paday Reactions (Higher Tier Only)		solution by stirring to remove the	
In chemical reactions, a more reactive metal will displace a less	When metals react with acids they	undergo a redox reaction	A reday	copper oxide into
reactive metal.	reaction occurs when both oxidation	on and reduction take pla	ace at the	the sulfuric acid oxide solid.
Reactions of Metals with Water	same time.			until no more
Metals, when reacted with water, produce a metal hydroxide and	For example:			will dissolve.
lithium + water> lithium hydrovida + hydrogon	2H⁺ + Ca → Ca²⁺ + H₂			3. Half fill a beaker 4. Add some of the
	The ionic equation can be further sp	lit into two half equations		with water and set solution to the
$2Ll + 2H_2 O \longrightarrow 2Ll OH + H_2$	Ca → Ca ²⁺ + 2e ⁻			this over a Bunsen evaporating basin
The more reactive a metal is, the faster the reaction.	Oxidation is loss of electrons.			burner to heat the Action and heat until
Reactions of Metals with Dilute Acia	2H⁺ + 2┍⁻ →► H₂			water. Place an crystals begin
Sediene i hedereklerie seiden in sediene ekleriden hederen.	Reduction is gaining of electrons			evaporating dish on to form.
Sodium + nyarochioric acia \rightarrow sodium chioride + nyarogen	Reduction is guilting of electrons.			top of the beaker.
$2Na + 2HCl \rightarrow 2NaCl + H_2$	The general formula for the reaction h	petween an acid and a met	al oxide is:	5. Once cooled, pour 6. Remove the
Metals that are below hydrogen in the reactivity series do not react with	acid + metal oxide → salt + water			the remaining crystals with a
unute actus.	sulfuric acid + copper oxide — cop	per sulfate + water		liquid into a spatula and pat
	H₂SO₄ + CuO → CuSO₄ + H₂O			crystallising dish dry between
				and leave to cool paper towels.
				for 24 hours.





twinkl

AQA GCSE Chemistry (Combined Science) Unit 4: Chemical Changes Knowledge Organiser

Strong and Weak Acids (Higher Tier Only) Th

A strong acid completely dissociates in a solution. For example: $HCl \rightarrow H^+ + Cl^-$

Hydrochloric acid is able to completely dissociate in solution to form hydrogen and chloride ions.

Examples of strong acids include nitric acid (HNO_3) and sulfuric acid (H_2SO_4).

Weak acids in comparison only partially dissociate.

For example acetic acid **partially dissociates** to form a hydrogen and acetate ion.

 $\mathsf{CH}_3\mathsf{COOH} \Longrightarrow \mathsf{CH}_3\mathsf{COO}^- + \,\mathsf{H}^{\scriptscriptstyle +}$

The **double arrow** symbol indicates that the reaction is **reversible**. Both the forward and reverse reaction occur at the same time and the reaction never goes to completion.

The Process of Electrolysis

Electrolysis is the **splitting up** of an ionic substance using **electricity**.

On setting up an electrical circuit for electrolysis, two **electrodes** are required to be placed in the electrolyte. The electrodes are **conducting rods**. One of the rods is connected to the **positive** terminal and the other to the **negative** terminal.

The **electrodes** are **inert** (this means they do not react in the reaction) and are often made from **graphite** or platinum.

During the process of electrolysis, **opposites attract**. The positively charged ions will be attracted toward the negative electrode. The negatively charged ions will be attracted towards the positive electrode.

When ions reach the electrodes, the charges are lost and they become elements.

The **positive** electrode is called the **anode**.

The **negative** electrode is called the **cathode**.

Electrolysis of Aqueous Solutions



Gases may be given off or metals deposited at the electrodes. This is dependent on the reactivity of the elements involved.

If the metal is **more reactive** than **hydrogen** in the reactivity series, then **hydrogen** will be **produced** at the **negative cathode**. At the **positive anode**, negatively charged ions **lose** electrons. This is called **oxidation** and you say that the ions have been oxidised.

Using Electrolysis to Extract Metals

Metals are extracted by electrolysis if the metal in question reacts with carbon or if it is too reactive to be extracted by reduction with carbon. During the extraction process, large quantities of energy are used to melt the compounds.

Aluminium is manufactured by the process of electrolysis. Aluminium oxide has a high melting point and melting it would use large amounts of energy. This would increase the cost of the process, therefore molten **cryolite** is added to aluminium oxide to lower the melting point and thus reduce the cost.

Electrolysis of Molten Ionic Compounds – Lead Bromide

Lead bromide is an ionic substance. Ionic substances, when solid, are **not** able to conduct electricity. When molten or in solution, the ions are free to move and are able to carry a charge.

The **positive** lead ions are attracted toward the **negative cathode** at the same time as the **negative bromide** ions are attracted toward the **positive anode**.



Oxidation is the loss of electrons and reduction is the gaining of electrons. **OIL RIG** (Higher Tier Only).

We represent what is happening at the electrodes by using **half equations** (Higher Tier Only).

The lead ions are attracted towards the negative electrode. When the **lead ions** (Pb^{2+}) reach the cathode, each ion **gains two electrons** and becomes a neutral atom. We say that the lead ions have been **reduced**.

Pb²+ + 2e⁻ → Pb

The bromide ions are attracted towards the positive electrode. When the **bromide ions** (Br-) reach the anode, each ion **loses one electron** to become a neutral atom. Two bromine atoms are then able to bond together to form the covalent molecule Br_2 .

2Br⁻ → Br₂ + 2e⁻





Principle	es of Organi	sation				6.
						7. 8.
	cell	tissue	organ	organ system	organism	
Cells are building l living thin	e the basic blocks of all gs.	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.	9.
Food Tes	Food Tests (Required Practical) Effect of pH on the Rate of Reaction of Amylase (Required Practical)					10.
What are you testing for?	Which indicator do you use?	What does a positive result look like?	Iodine is used to test for th If starch is present, the colo blue-black. The independent variable i is the pH of the buffer solu:	ne presence of starch . our will change to in the investigation tion.	mujere provide the second	The polub
sugar	Benedict's reagent	Once heated, the solution will change from blue-green to yellow-red.	 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 			
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.	test tube. 5. Leave this to stand fi measure the tempera	or five minutes and then use ature. Make a note of the ter	e the thermometer to nperature.	

- 6. 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.
- 3. Continue to place one drop into the next well of the spotting tile, every 10 seconds, until the iodine remains orange.
- P. 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.
- 10. Repeat steps 1 to 8 for pH values 7 and 10.

ne 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.







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.

glucose + oxygen — carbon dioxide + water + [energy]



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.

Sinoatrial node (SAN)

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.





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 ⇒ 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 directio**n. This is because there are valves in the heart which close under pressure and prevent the backward flow of blood.







visit twinkl.com



AQA GCSE Biology (Combined Science) Unit 2: Organisation				
Rate Calculations for Blood Flow		Plant Tissues, Organs and Systems	Root Hair Cells	
The number of beats the heart perform pulse (or heart rate). It is easily measured by counting the r e.g. 15s, and finding the total beats pe Typically, a lower resting pulse rate ince physical fitness . During exercise, and f rate increases while the heart is worki the muscles. Cardiac output is a measure of the vol- heart each minute . Stroke volume is a blood pumped from the heart each cor Cardiac output (cm ³ /min) = heart rate (Cancer Cancer is the result of uncontrol	as each minute is called the number of beats in a given time, er minute. dicates a greater level of for some time after, the pulse ing to provide more oxygen to lume of blood pumped by the measure of the volume of htraction (heart beat). bpm) × stroke volume (cm ³ /beat) led cell growth and division.	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. sunlight carbon dioxide + water → oxygen + glucose 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	 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. 	
The uncontrolled growth of cells is called a tumour .		for the diffusion of gases. Carbon dioxide enters the leaves and oxygen exits the leaves.	Xylem and Phloem	
 Benign Tumour 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. 	 Malignant Tumour 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). 	waxy cuticle upper epidermis spongy mesophyll guard cells 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.	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.	
Science		Page 4 of 6	visit twinkl.com	



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.



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.

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

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**.

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.







visit twinkl.com

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.	 Can be used to prevent heart disease developing. Improved quality of life. 	Long-term treatment.Possible negative side-effects.
stents	Mechanical device which is used to stretch narrow or blocked arteries, restoring blood flow.	 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. 	 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).	 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. 	 Requires major surgery under general anaesthetic, which carries risks. Lack of donors available. Risk of infection or transplant rejection. Long recovery times.





AQA Combined Science: Physics Topic 2 Electricity – Foundation and Higher

Required Practical

Investigating Resistance in a Wire

Independent variable: length of the wire.

Dependent variable: resistance.

Control variables: type of metal, diameter of the wire.

Conclusion: As the length of the wire increases, the resistance of the wire also increases.

Investigating Series and Parallel Circuits with Resistors

Independent variable: circuit type (series, parallel).

Dependent variable: resistance.

Control variables: number of resistors, type of power source.

Conclusion: Adding resistors in series increases the total resistance of the circuit. In a parallel circuit, the more resistors you add, the smaller the resistance.

Investigating I-V Relationships in Circuits (Using a filament bulb, ohmic conductor, diode.)

Independent variable: potential difference/volts (V).

Dependent variable: current (A).

Control variable: number of components (e.g. 1 filament bulb, 1 resistor), type of power source.

Set up the circuits as shown below and measure the current and the potential difference.



Draw graphs of the results once collected.

Lyualions and mains				
Equations				
Charge:	Q = It			
Potential difference:	V = IR			
Energy transferred:	E = Pt			
Energy transferred:	E = QV			
Power:	P = VI			
Power:	$P = I^2 R$			

Equations and Mathe

Maths

1kW = 1000W 0.5kW = 500W

Charge

Electric current is the flow of electric charge. It only flows when the circuit is complete.

The **charge** is the current flowing past a point in a given time. Charge is measured in **coulombs (C)**.

Calculating Charge

charge flow (C) = current (A) × time (s) Q = It

potential difference = current × resistance V (V) = I (A) × R (Ω)

Resistance

voltage (V) = current (A) × resistance (Ω) V = IR

Graphs of I-V Characteristics for Components in a Circuit

1. **Ohmic conductor**: the current is directly proportional to the potential difference - it is a straight line (at a constant temperature).





- 2. **Filament lamp**: as the current increases, so does the temperature. This makes it harder for the current to flow. The graph becomes less steep.
- 3. **Diode**: current only flows in one direction. The resistance is very high in the other direction which means no current can flow.

Current and Circuit Symbols

Current: the flow of electrical charge.

Potential difference (voltage): the push of electrical charge. **Resistance**: slows down the flow of electricity.





AQA Combined Science: Physics Topic 2 Electricity – Foundation and Higher

Circuit Devices

LDR – Light Dependent Resistor

An LDR is dependent on light intensity. In bright light the resistance falls and at night the resistance is higher.

Uses of LDRs: outdoor night lights, burglar detectors.



Thermistor



A thermistor is a temperature dependent resistor. If it is hot, then the resistance is less. If it becomes cold, then the resistance increases.

Uses of thermistors: temperature detectors.





Once one of the components is broken then all the components will stop working.

Potential difference – the total p.d. of the supply is shared between all the components. $V_{total} = V_1 + V_2$

Current – wherever the ammeter is placed in a series circuit the reading is the same. $I_1 = I_2 = I_3$

Resistance – In a series circuit, the resistance will add up to make the total resistance.

 $R_{total} = R_1 + R_2$

Parallel Circuits



Potential Difference – this is the same for all components. $V_1 = V_2$

- v₂

Current – the total current is the total of all the currents through all the components. $I_{total} = I_1 + I_2 + I_3$

Resistance – adding resistance reduces the total resistance.

Electricity in the Home

 $\rm AC$ – alternating current. Constantly changing direction - UK mains supply is 230V and has a frequency of 50 hertz (Hz).

 $\ensuremath{\text{DC}}$ – direct current. Supplied by batteries and only flows in one direction.

Cables – most have three wires: live, neutral and earth. They are covered in plastic insulation for safety.

Live wire – provides the potential difference from the mains.

Neutral wire – completes the circuit.

Earth wire – protection. Stops the appliance from becoming live. Carries a current if there is a fault. Touching the live wire can cause the current to flow through your body. This causes an electric shock.

Energy Transferred – this depends on how long the appliance is on for and its power.

energy transferred (J) = power (W) × time (s) E = Pt

Energy is transferred around a circuit when the charge moves.

energy transferred (J) = charge flow (C) × potential difference (V) E = QV

power (W) = potential difference (V) × current (A) P = VI

power (W) = current² (A) × resistance (Ω) P = I²R

The National Grid

The National Grid is a system of cables and transformers. They transfer electrical power from the power station to where it is needed. Power stations are able to change the amount of electricity that is produced to meet the demands. For example, more energy may be needed in the evenings when people come home from work or school. Electricity is transferred at a low current, but a high voltage so less energy is being lost as it travels through the cables.

Step-up transformers – increase the voltage as the electricity flows through the cables.

Step-down transformers – decrease the potential difference to make it safe.





earth wire neutral wire fuse outer insulation cable grip