AQA GCSE

Year 11 H

Biology

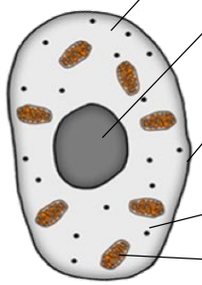
Knowledge Organiser

AQA Cell Structure

Eukaryotes complex organisms

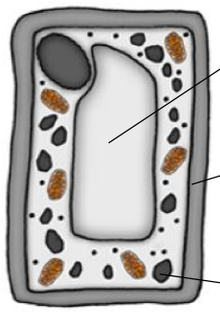
animal cell

plant cell



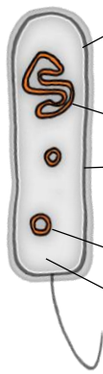
cytoplasm	*site of chemical reactions in the cell*	gel like substance containing enzymes to catalyse the reactions
nucleus	*contains **genetic material***	controls the activities of the cell and codes fro proteins
cell membrane	*semi permeable*	controls the movement of substances in and out of the cell
ribosome	*site of protein synthesis*	mRNA is translated to an amino acid chain
mitochondrion	*site of respiration*	where energy is released for the cell to function

contains all the parts of animal cells plus extras



permanent vacuole	*contains cell sap*	keeps cell turgid, contains sugars and salts in solution
cell wall	*made of cellulose*	supports and strengthens the cell
chloroplast	*site of photosynthesis*	contains chlorophyll, absorbs light energy

Prokaryotes simpler organisms



cell membrane	*site of chemical reactions in the cell*	gel like substance containing enzymes to catalyse the reactions
bacterial DNA	*not in nucleus floats in the cytoplasm*	controls the function of the cell
cell wall	***NOT** made of cellulose*	supports and strengthens the cell
plasmid	*small rings of DNA*	contain additional genes
cytoplasm	*semi permeable*	controls the movement of substances in and out of the cell

Bacterial cells are much smaller than plant and animal cells

Specialised cells

specialised animal cells

nerve	*carry electrical signals*	long branched connections and insulating sheath
sperm	*fertilise an egg*	streamlined with a long tail acrosome containing enzymes large number of mitochondria
muscle	*contract to allow movement*	contains a large number of mitochondria long

specialised plant cells

root hair	*absorb water and minerals from soil*	hair like projections to increase the surface area
xylem	*carry water and minerals*	TRANSPIRATION - dead cells cell walls toughened by lignin flows in one direction
phloem	*carry glucose*	TRANSLOCATION - living cells cells have end plates with holes flows in both directions

Cell differentiation

how a cell changes and becomes **specialised**
Undifferentiated call are called **STEM** cells

animal cell differentiation

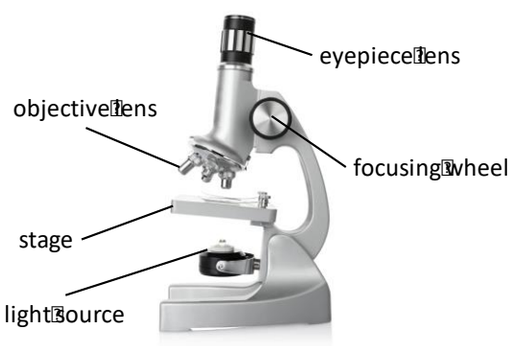
early stages of development
only for repair and replacement

plant cell differentiation

all stages of life cycle the stem cells are grouped together in meristems

Microscopy

$$\text{magnification (M)} = \frac{\text{size of image}}{\text{real size of the object}}$$



Feature	Light (optical) microscope	Electron microscope
Radiation used	Light rays	Electron beams
Max magnification	~ 1500 times	~ 2 000 000 times
Resolution	200nm	0.2nm
Size of microscope	Small and portable	Very large and not portable
Cost	~£100 for a school one	Several £100,000 to £1 million plus

PREFIXES

Prefix	Multiple	Standard form
centi (cm)	1 cm = 0.01 m	x 10^{-2}
milli (mm)	1 mm = 0.001 m	x 10^{-3}
micro (µm)	1 µm = 0.000 001 m	x 10^{-6}
nano (nm)	1nm = 0.000 000 001 m	x 10^{-9}

AQA Cell Biology 2

largest

cell	The smallest structural and functional unit of an organism.
nucleus	A structure that contains genetic material and controls the activities of the cell.
chromosome	A thread like structure of coiled DNA found in the nucleus of eukaryotic cells.
DNA	A polymer made up of two strands forming a double helix.
gene	A section of DNA that codes for a specific protein or characteristic.

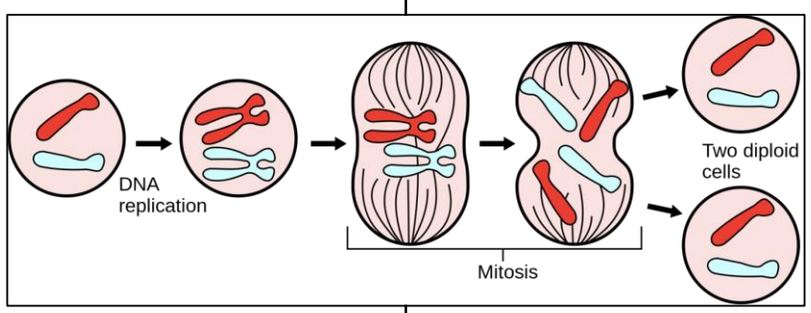
smallest

Cell division

MITOSIS AND THE CELL CYCLE

Cells divide in a series of stages. The genetic material is doubled and then divided into two identical cells.

Stage 1	***Growth***	Increase the number of sub-cellular structures e.g. ribosomes and mitochondria.
Stage 2	***DNA Synthesis***	DNA replicates to form two copies of each chromosome.
Stage 3	***Mitosis***	One set of chromosomes is pulled to each end of the cell and the nucleus divides. Then the cytoplasm and cell membranes divide to form two cells that are identical to the parent cell.



Mitosis occurs during growth, repair, replacement of cells. Asexual reproduction occurs by mitosis in both plants & simple animals.

STEM CELLS

Undifferentiated cell of an organism

Divides to form more cells of the same type, and can differentiate to form many other cell types.

Human Embryonic stem cells	***Can be cloned and made to differentiate into most cell types***	Therapeutic cloning uses same genes so the body does not reject the tissue. Can be a risk of infection
Adult bone marrow stem cells	***Can form many types of human cells e.g. blood cells***	Tissue is matched to avoid rejection, risk of infection. Only a few types of cells can be formed.
Meristems (plants)	***Can differentiate into any plant cell type throughout the life of the pant.***	Used to produce clones quickly and economically, e.g. rare species, crop plants with pest /disease resisitance

Treatment with stem cells may be able to help conditions such as diabetes and paralysis. Some people object to the use of stem cells on ethical or religious grounds

Transport in cells

ADAPTATIONS FOR DIFFUSSION

Small intestines	***Villi – increase surface area, Good blood supply – to maintain concentration gradient, Thin membranes – short diffusion distance.***
Lungs	***Alveoli– increase surface area, Good blood supply – to maintain concentration gradient, Thin membranes – short diffusion distance.***
Gills in fish	***Gill filaments and lamella – increase surface area, Good blood supply – to maintain concentration gradient, Thin membranes – short diffusion distance.***
Roots	***Root hair cells - increase surface area.***
Leaves	***Large surface area, thin leaves for short diffusion path, stomata on the lower surface to let O_2 and CO_2 in and out.***

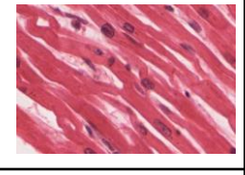
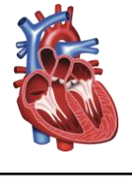
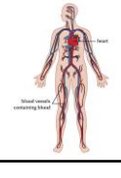
The greater the difference in concentrations the faster the rate of diffusion.

Diffusion ***No*** energy required	***Movement of particles in a solution or gas from a higher to a lower concentration***	E.g. O_2 and CO_2 in gas exchange, urea in kidneys. Factors that affect the rate are concentration, temperature and surface area.
Osmosis ***No*** energy required	***Movement of water from a dilute solution to a more concentrated solution***	E.g. Plants absorb water from the soil by osmosis through their root hair cells. Plants use water for several vital processes including photosynthesis and transporting minerals.
Active transport ***ENERGY*** required	***Movement of particles from a dilute solution to a more concentrated solution***	E.g. movement of mineral ions into roots of plants and the movement of glucose into the small intestines.

AQA GCSE ORGANISATION Part 1

Principles of organisation

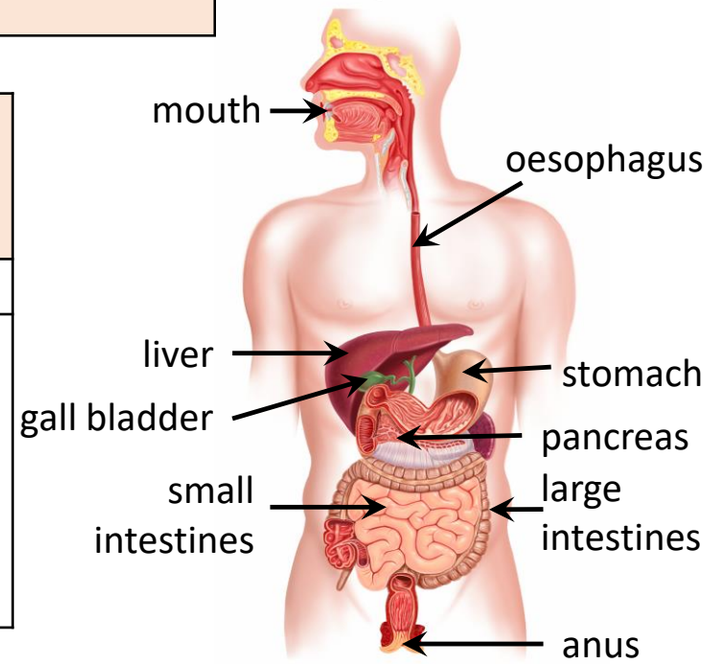
Cells, tissues, organs and systems

Cells		*e.g. muscle cells*	The basic building blocks of all living organisms.
Tissues		*e.g. muscle tissue*	A group of cells with a similar structure and function.
Organs		*e.g. the heart*	Aggregations (working together) of tissues performing a specific function.
Organ systems		*e.g. the circulatory system*	Organs working together to form organ systems, which work together to form an organism.

The products of digestion are used to build new carbohydrates, lipids and proteins. Some glucose is used for respiration.

Enzymes in digestion

An organ system in which organs work together to digest and absorb food.



Sugars (glucose)	*Benedicts' test*	Orange to brick red precipitate.
Starch	*Iodine test*	Turns black.
Biuret	*Biuret reagent*	Mauve or purple solution.

Food tests

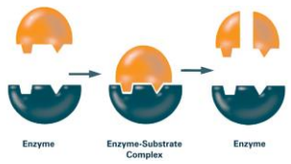
Non-communicable diseases

More energy consumed in food and drink than used
obesity
Linked to increased rates of cardiovascular disease and development of diabetes type 2.

The human digestive system

Enzymes catalyse (increase the rate of) specific reactions in living organisms

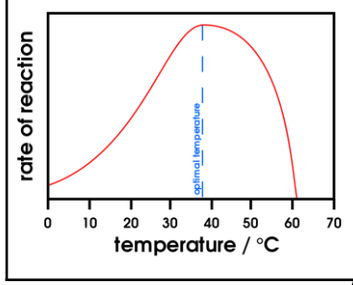
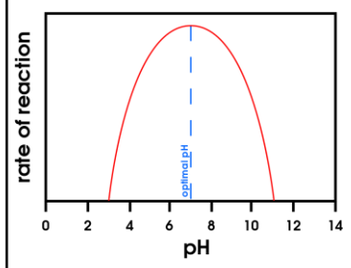
The 'lock and key theory' is a simplified model to explain enzyme action



Enzymes catalyse specific reactions in living organisms due to the shape of their active site

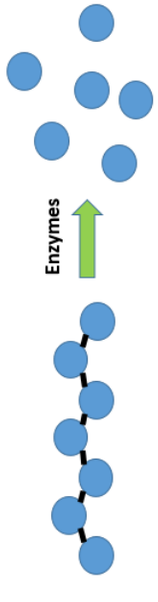
Digestive enzymes speed up the conversion of large insoluble molecules (food) into small soluble molecules that can be absorbed into the bloodstream

The activity of enzymes is affected by changes in temperature and pH

Enzymes activity has an optimum temperature	*Enzyme activity has an optimum pH*
	

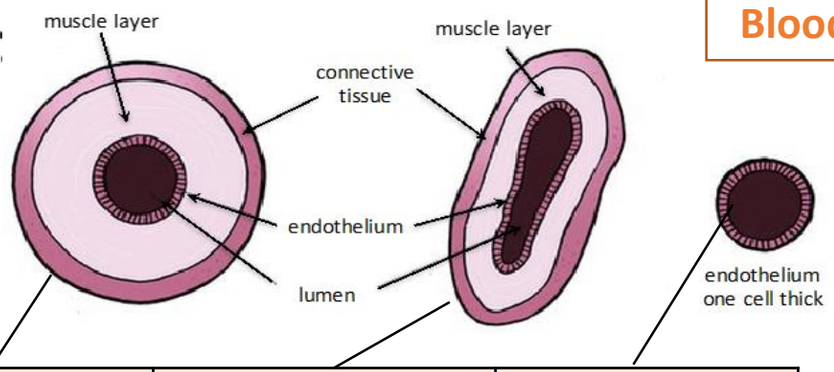
Large changes in temperature or pH can stop the enzyme from working (denature)

Temperature too high	*pH too high or too low*
Enzyme changes shape (denatures) the substrate no longer fits the active site.	

Carbohydrases (e.g. amylase)		*Made in salivary glands, pancreas, small intestine*	Break down carbohydrates to simple sugar (e.g. amylase breaks down starch to glucose).
Proteases		*Made in stomach, pancreas*	Break down protein to amino acids.
Lipases		*Made in pancreas (works in small intestine)*	Break down lipids (fats) to glycerol and fatty acids).
Bile (not an enzyme)		*Made in liver, stored in gall bladder.*	Emulsifies lipids to increase surface area to increase the rate of lipid break down by lipase. Changes pH to neutral for lipase to work

AQA GCSE ORGANISATION part 2

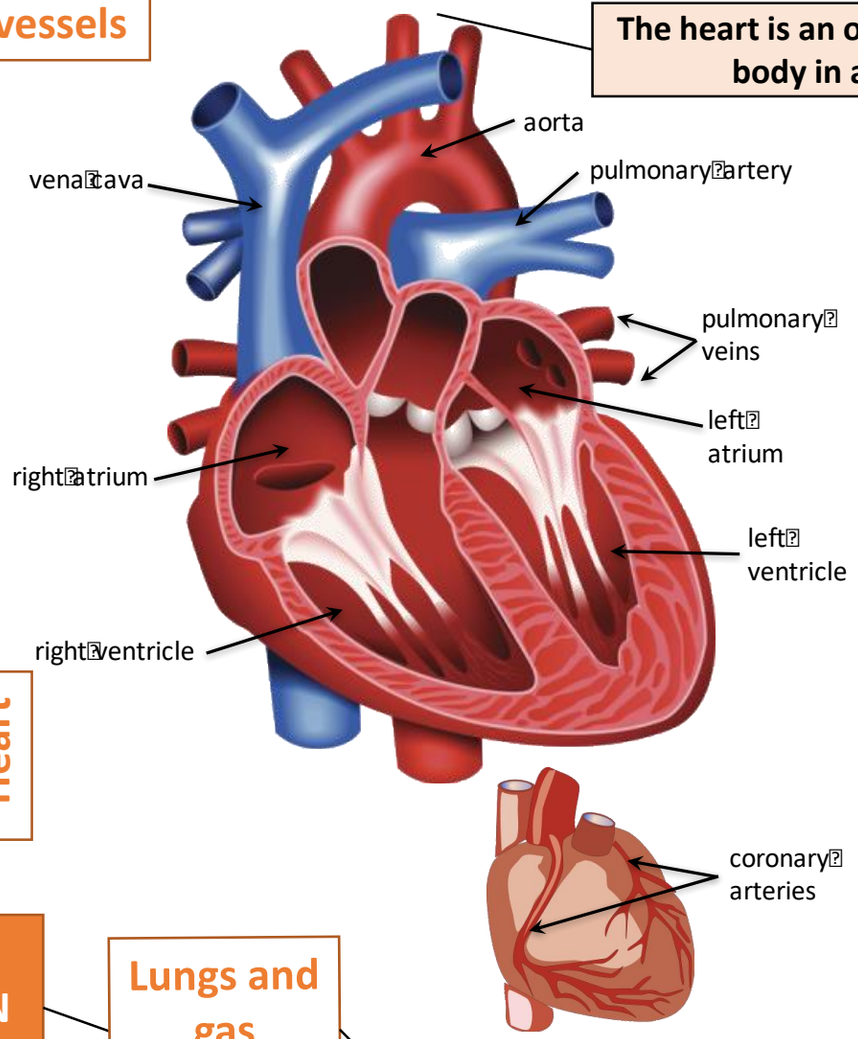
Blood vessels



Artery	Vein	Capillary
Carry blood away from the heart	*Carry blood to the heart*	*Connects arteries and veins*
Thick muscular walls, small lumen, carry blood under high pressure, carry oxygenated blood (except for the pulmonary artery).	Thin walls, large lumen, carry blood under low pressure, have valves to stop flow in the wrong direction, carry deoxygenated blood (except for the pulmonary vein).	One cell thick to allow diffusion, Carry blood under very low pressure.

Heart

The heart is an organ that pumps blood around the body in a double circulatory system



Different structure in the heart have different functions		
	Right ventricle	Pumps blood to the lungs where gas exchange takes place.
	Left ventricle	Pumps blood around the rest of the body.
	Pacemaker (in the right atrium)	Controls the natural resting heart rate. Artificial electrical pacemakers can be fitted to correct irregularities.
	Coronary arteries	Carry oxygenated blood to the cardiac muscle.
	Heart valves	Prevent blood in the heart from flowing in the wrong direction.

Blood

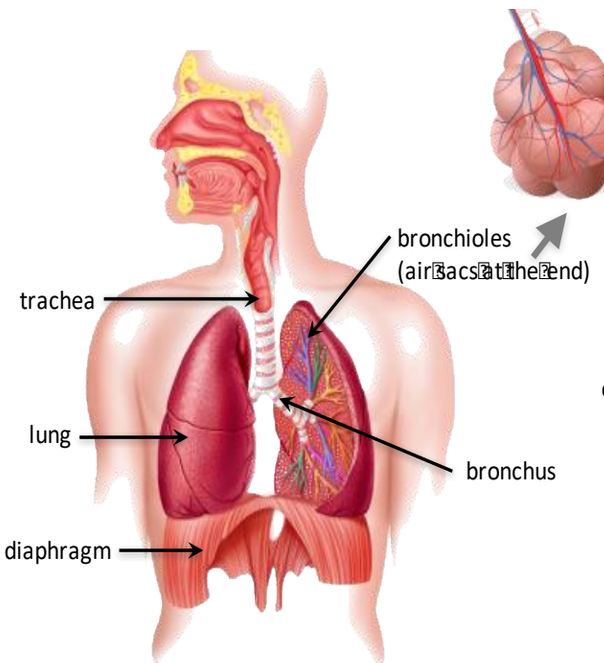
Blood is a tissue consisting of plasma, in which blood cells, white blood cells and platelets are suspended

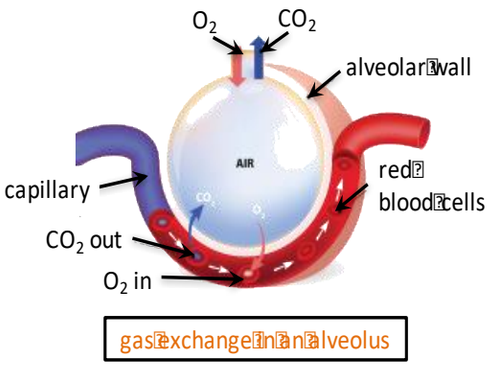
Plasma (55%)	*Pale yellow fluid*	Transports CO_2, hormones and waste.
Red blood cells (45%)	*Carries oxygen*	Large surface area, no nucleus, full of haemoglobin.
White blood cells (<1%)	*Part of the immune system*	Some produce antibodies, others surround and engulf pathogens.
Platelets (<1%)	*Fragments of cells*	Clump together to form blood clots.

Lungs and gas exchange

The heart pumps low oxygen/high carbon dioxide blood to the lungs

Trachea	*Carries air to/from the lungs*	Rings of cartilage protect the airway.
Bronchioles	*Carries air to/from the air sacs (alveoli)*	Splits into multiple pathways to reach all the air sacs.
Alveoli	*Site of gas exchange in the lungs*	Maximises surface area for efficient gas exchange.
Capillaries	*Allows gas exchange between into/out of blood*	Oxygen diffuses into the blood and carbon dioxide diffuses out.





gas exchange in an alveolus

Heart failure can be treated with a transplant or artificial heart

AQA GCSE ORGANISATION part 3

Disease	Cause	Effect	Treatment
Coronary heart disease (CHD)	*A build up for fatty substances in the coronary arteries (atherosclerosis)*	Oxygen-ated blood cannot get to the cardiac muscle.	Stents: inserted into the blocked artery to open it up. Statins: lower harmful cholesterol.
Faulty heart valves	*Valves don't open or close properly*	Blood can leak or flow in the wrong direction	Biological valve transplant or a mechanical valve can be inserted

Cancer

Non-communicable diseases

The result of changes in DNA that lead to uncontrolled growth and division

Benign tumour	Contained in one area of the body (usually by a membrane) – not cancer.
Malignant tumour	Invade tissues and spread to different parts of the body to form secondary tumours.

Some cancers have genetic risk factors.

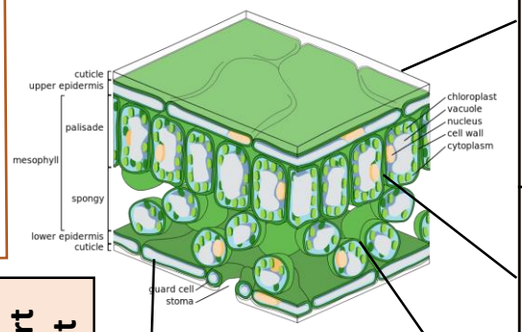
Carcinogens and ionising radiation increase the risk of cancer by changing/ damaging DNA

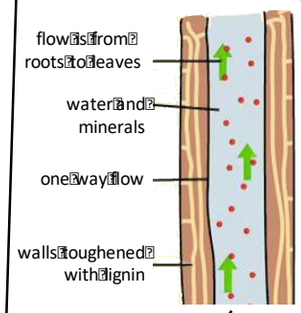
Risk factors for heart/lung disease and certain types of cancer include drinking alcohol, diet, obesity and smoking

These risks factors can also affect the brain, liver and the health of unborn babies

Plant organ systems

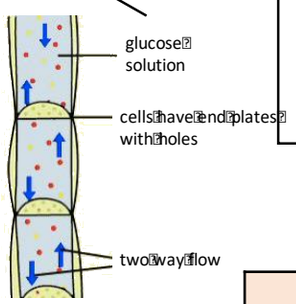
The roots, stem and leaves form a plant organ system for transport of substances around the plant

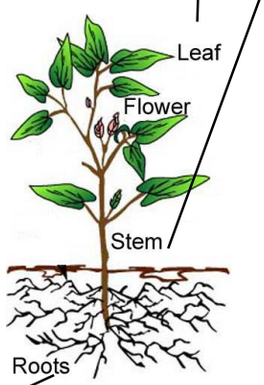


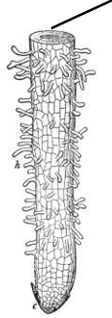


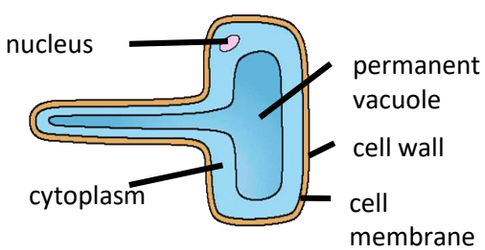
xylem

phloem







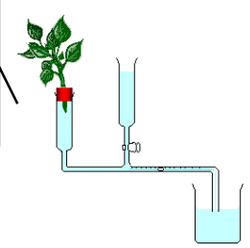


Plant tissues

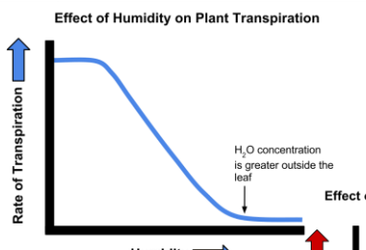
Epidermal tissues	*Waxy cuticle (top layer of the leaf)*	Reduces water loss from the leaf
	Guard cells and stomata	Guard cells open and close the stomata to control water loss and allow for gas exchange (oxygen and carbon dioxide).
Palisade mesophyll	*Palisade cells*	Cells near the top surface of the leaf that are packed with chloroplasts that contain chlorophyll. Both adaptations maximize photosynthesis.
Spongy mesophyll	*Air spaces in the leaf between cells*	Increased surface area for gas exchange so that carbon dioxide can diffuse into photosynthesising cells.
xylem	*Hollow tubes strengthened by lignin adapted for the transportation of water in the transpiration stream*	Allows transport of water and mineral ions from the roots to the stem and the leaves.
phloem	*Cell sap moves from one phloem cell to the next through pores in the end walls*	Transports dissolved sugars from the leaves to the rest of the plant for immediate use or storage (translocation).
Meristem tissue	*New cells (roots and shoot tips) are made here including root hair cells*	Root hair cells have an increased surface area for the uptake of water by osmosis, and mineral ions by active transport.

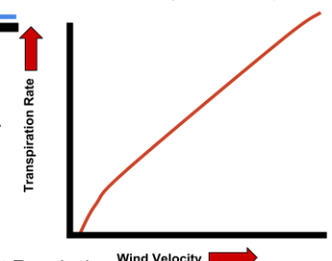
Transpiration

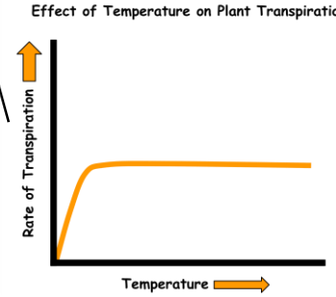
A potometer is used to measure the amount of water lost over time (rate of transpiration)



Transpiration	*The rate at which water is lost from the leaves of a plant. The transpiration stream is the column of water moving through the roots, stem and leaves*	Temperature, humidity, air movement and light intensity affect the rate of transpiration.







The shape of the graph for light intensity is the same for temperature (energy)

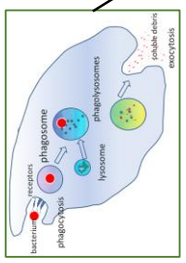
AQA GCSE INFECTION AND RESPONSE part 1

Human defence systems

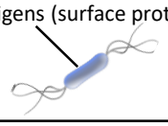
White blood cells are part of the immune system

Immune system

Phagocytes	***Phagocytosis*** — Phagocytes engulf the pathogens and digest them.
Lymphocytes	***Antibody production*** — Specific antibodies destroy the pathogen. This takes time so an infection can occur. If a person is infected again by the same pathogen, the lymphocytes make antibodies much faster.
	Antitoxin production — Antitoxin is a type of antibody produced to counteract the toxins produced by bacteria.



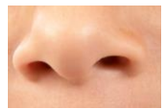
Antigens (surface protein)



Pathogens are identified by white blood cells by the different proteins on their surfaces **ANTIGENS.**

Non-specific defence systems

The human body has several non specific ways of defending itself from pathogens getting in

	***Nose***	Nasal hairs, sticky mucus and cilia prevent pathogens entering through the nostrils.
	***Trachea and bronchus (respiratory system)***	Lined with mucus to trap dust and pathogens. Cilia move the mucus upwards to be swallowed.
	***Stomach acid***	Stomach acid (pH1) kills most ingested pathogens.
	***Skin***	Hard to penetrate waterproof barrier. Glands secrete oil which kill microbes

Plants have several ways of defending themselves from pathogens and animals

Physical	***Mechanical***
Thick waxy layers, cell walls stop pathogen entry	Thorns, curling up leaves to prevent being eaten
Chemical	
Antibacterial and toxins made by plant	

Detection and identification of plant diseases (bio only)

Detection	**Identification**
Stunted growth	Reference using gardening manual or website, laboratory test for pathogens, testing kit using monoclonal antibodies.
Spots on leaves	
Area of decay	
growths	
Malformed stem/leaves	
Discolouration	
Presence of pests	

Nitrate ions needed for protein synthesis – lack of nitrate = stunted growth.

Magnesium ions needed to make chlorophyll – not enough leads to chlorosis – leaves turn yellow.

Pathogens may infect plants or animals and can be spread by direct contact, water or air

Pathogen	***Disease***	**Symptoms**	**Method of transmission**	**Control of spread**
Virus	***Measles***	Fever, red skin rash.	Droplet infection from sneezes and coughs.	Vaccination as a child.
Virus	***HIV***	Initially flu like systems, serious damage to immune system.	Sexual contact and exchange of body fluids.	Anti-retroviral drugs and use of condoms.
Virus	***Tobacco mosaic virus***	Mosaic pattern on leaves.	Enters via wounds in epidermis caused by pests.	Remove infected leaves and control pests that damage the leaves.
Bacteria	***Salmonella***	Fever, cramp, vomiting, diarrhoea.	Food prepared in unhygienic conditions or not cooked properly.	Improve food hygiene, wash hands, vaccinate poultry, cook food thoroughly.
Bacteria	***Gonorrhoea***	Green discharge from penis or vagina.	Direct sexual contact or exchange of body fluids.	Use condoms. Treatment using antibiotics.
Protists	***Malaria***	Recurrent fever.	By an animal vector (mosquitoes).	Prevent breeding of mosquitoes. Use of nets to prevent bites.
Fungus	***Rose black spot***	Purple black spots on leaves.	Spores carried via wind or water.	Remove infected leaves. Spray with fungicide.

Communicable diseases

Pathogens

Pathogens are microorganisms that cause infectious disease

Bacteria may produce toxins that damage tissues and make us fell ill

Viruses	**Bacteria (prokaryotes)**	**Protists (eukaryotes)**	**Fungi (eukaryotes)**
e.g. cold, influenza, measles, HIV, tobacco mosaic virus	***e.g. tuberculosis (TB), Salmonella, Gonorrhoea***	***e.g. dysentery, sleeping sickness, malaria***	***e.g. athlete's foot, thrush, rose black spot***
DNA or RNA surrounded by a protein coat	No membrane bound organelles (no chloroplasts, mitochondria or nucleus). Cell wall. Single celled organisms	Membrane bound organelles. Usually single celled.	Membrane bound organelles, cell wall made of chitin. Single celled or multi-cellular

Viruses live and reproduce inside cells causing damage

AQA INFECTION AND RESPONSE

Antibiotics and painkillers

Antibiotics have greatly reduced deaths from infectious bacterial disease

antibiotics	***e.g. penicillin***	Kill infective bacteria inside the body. Specific bacterial infections require specific antibiotics.
Painkillers and other medicines	***e.g. aspirin, paracetamol, ibuprofen***	Drugs that are used to treat the symptoms of a disease. They do not kill pathogens

Antibiotics cannot be use to treat viral pathogens

It is difficult to develop drugs to kill viruses without harming body tissues because viruses live and reproduce inside cells

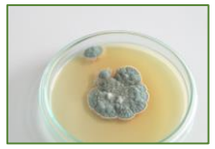
Bacteria can mutate

Sometimes this makes them resistant to antibiotic drugs.

Discovery and drug development

Most new drugs are synthesised by chemists in the pharmaceutical industry.

Traditionally drugs were extracted from plants and microorganisms

Digitalis	***Aspirin***	***Penicillin***
Extracted from foxglove plants and used as a heart drug	A painkiller and anti-inflammatory that was first found in willow bark	Discovered by Alexander Fleming from the *Penicillium* mould and used as an antibiotic
		

Drugs have to be tested and trialled before to check they are safe and effective

New drugs are extensively tested for:	
Efficacy	Make sure the drug works
Toxicity	Check that the drug is not poisonous
Dose	The most suitable amount to take

Preclinical trials - using cells, tissues and live animals - must be carried out before the drug can be tested on humans.

Clinical trials use healthy volunteers and patients

Stage 1	***Stage 2***	***Stage 3***	***Stage 4***
Healthy volunteers try small dose of the drug to check it is safe record any side effects	A small number of patients try the drug at a low dose to see if it works	A larger number of patients; different doses are trialled to find the optimum dose	A double blind trial will occur. The patients are divided into groups. Some will be given the drug and some a placebo.

Double blind trial: patients and scientists do not know who receives the new drug or placebo until the end of the trial. This avoids bias.

A placebo can look identical to the new drug but contain no active ingredients

Vaccination

Used to immunise a large proportion of the population to prevent the spread of a pathogen

Vaccination			
	Small amount of dead or inactive form of the pathogen	***1st infection by pathogen***	White blood cells detect pathogens in the vaccine. Antibodies are released into the blood.
		Re-infection by the same pathogen	White blood cells detect pathogens. Antibodies are made much faster and in larger amounts.

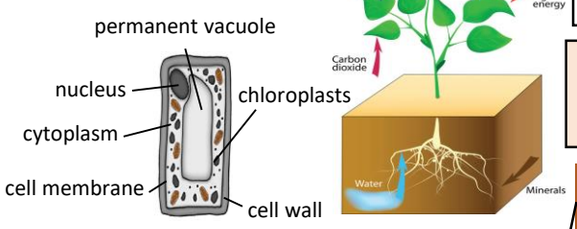
A person is unlikely to suffer the symptoms of the harmful disease and it's spread in a population is prevented

Created more side effects than expected (fatal in some cases) and are not as widely used as everybody hoped when first developed.

Monoclonal antibodies can be used in a variety of ways

Diagnosis	***Detecting pathogens***	***Detecting molecules***	***Treatment***
e.g. pregnancy test – measure the level of hormones	Can detect very small quantities of chemicals in the blood	Fluorescent dye can be attached so it can be seen inside cells or tissues	Bound to radioactive substance, toxic drug or chemical Cancer cells are targeted to normal body cells are unharmed

AQA GCSE BIOENERGETICS part 1



Respiration, stored as insoluble starch, fats or oils for storage, cellulose for cell walls, combine with nitrates from the soil to form amino acids for protein synthesis

Plants use the glucose produced in photosynthesis in a variety of ways

Photosynthetic reaction

The plant manufactures glucose from carbon dioxide and water using energy transferred from the environment to the chloroplasts by light

Photosynthesis	***Plants make use of light energy from the environment (ENDOTHERMIC) to make food (glucose)***	Carbon dioxide + Water $\xrightarrow{\text{light}}$ Oxygen + Glucose
		$CO_2 + H_2O \xrightarrow{\text{light}} O_2 + C_6H_{12}O_6$

Control conditions in greenhouses to reduce limiting factors can improve crop yields

Heating	Used to provide optimum temperatures for maximum plant growth.
Artificial lighting	Enhances the natural sunlight especially overnight and on cloudy days.
Extra carbon dioxide	Gas can be pumped into the air inside the greenhouse.

Growers must balance the economics of additional costs of controlling the conditions to maximise photosynthesis with making a profit.

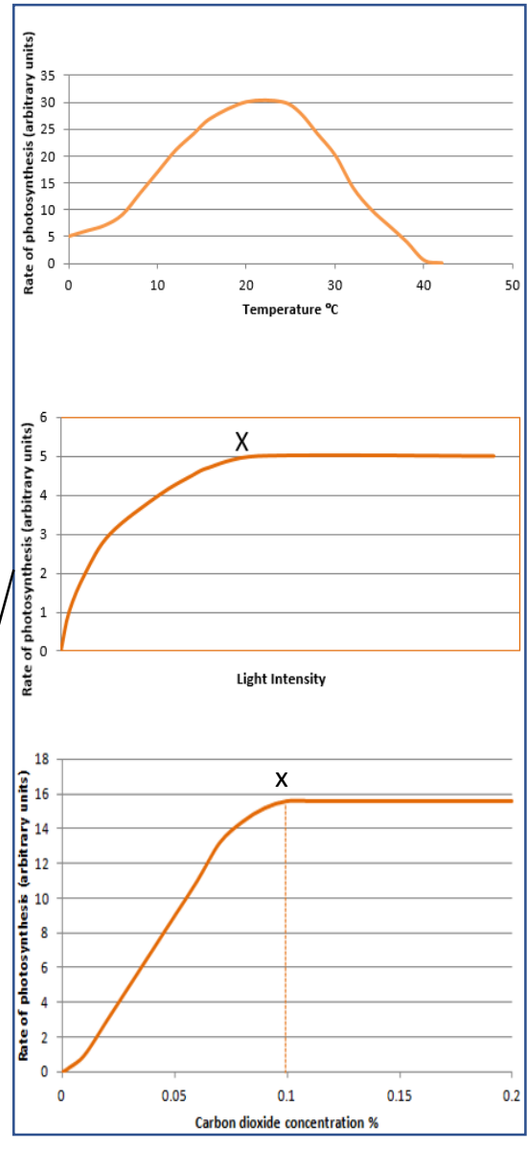
Rate of photosynthesis HT Only

Rate of photosynthesis

The rate of photosynthesis is affected by temperature, light intensity, carbon dioxide concentration, and the amount of chlorophyll

Factors affecting the rate of photosynthesis

Factor	How the rate is affected	Limiting factors (why the rate stops going up)
Temperature	***As the temperature of the environment the plant is in increases rate of photosynthesis increases (up to a point) as there is more energy for the chemical reaction.***	Photosynthesis is an enzyme controlled reaction. If the temperature increases too much, then the enzymes become denatured and the rate of reaction will decrease and stop
Light intensity	***Light intensity increases as the distance between the plant and the light sources increases. As light intensity increases so does the rate of photosynthesis (up to a point) as more energy is available for the chemical reaction.***	At point X another factor is limiting the rate of photosynthesis. This could be carbon dioxide concentration, temperature or the amount of chlorophyll
Carbon dioxide concentration	***Carbon dioxide is needed for plants to make glucose. The rate of photosynthesis will increase when a plant is given higher concentrations of carbon dioxide (up to a point).***	At point X another factor is limiting the rate of photosynthesis. This could be light intensity, temperature or the amount of chlorophyll
Amount of chlorophyll	***Chlorophyll is a photosynthetic pigment that absorbs light and allows the reaction between water and carbon dioxide to occur (photosynthesis)***	Another factor could limit the rate of photosynthesis. This could be light intensity, temperature or the carbon dioxide concentration



Light intensity obeys the inverse square law. This means that if you double the distance between the plant and the light source you quarter the light intensity

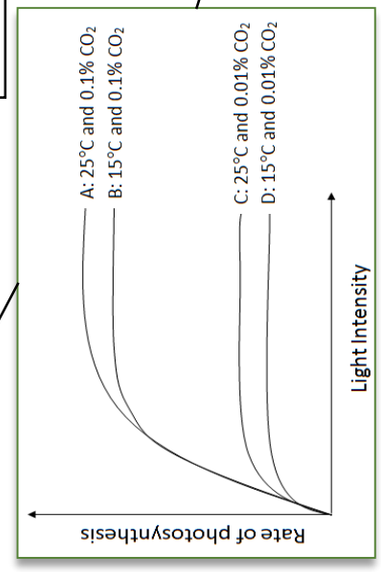
Graph lines C and D: If temperature is increased by 10°C then a slight increase in rate of photosynthesis occurs.

Graph lines A and D: If carbon dioxide concentration and temperature are increased the rate of photosynthesis increases significantly up to a point.

Graph line A: Rate could be limited by temperature and/or amount of chlorophyll. Plant tissue can be damaged when carbon dioxide concentrations exceed 0.1%

Explain graphs of two or three factors and decide which is the limiting factor

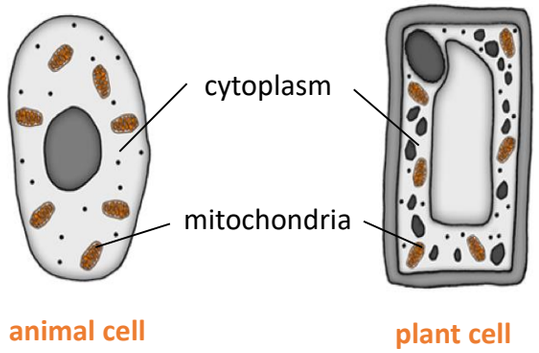
Graph Lines A and B: If carbon dioxide concentration is increased from 0.01% to 0.1% then a large increase in rate occurs up to a point.



AQA GCSE BIOENERGETICS part 2

Respiration

Cellular respiration is an exothermic reaction which is continuously occurring in all living cells



animal cell

plant cell

Electron micrograph of a mitochondrion

Anaerobic respiration	Aerobic respiration
Respiration when oxygen is in short supply. Occurs during intensive exercise	*Respiration with oxygen. Occurs inside the mitochondria continuously*
During hard exercise, muscle cells are respiring so fast that blood cannot transport enough oxygen to meet their needs. Glucose is partially oxidised to produce lactic acid which builds up in muscle tissue causing them to become painful and fatigued.	Glucose is oxidised by oxygen to transfer the energy the organism needs to perform it's functions.
glucose ⟶ lactic acid	$C_6H_{12}O_6 + O_2 \longrightarrow CO_2 + H_2O$ glucose + oxygen ⟶ carbon dioxide + water
Anaerobic respiration releases a much smaller amount of energy than aerobic respiration.	*Aerobic respiration releases a large amount of energy from each glucose molecule*
The incomplete oxidation of glucose causes a build up of lactic acid and creates an oxygen debt	

Anaerobic respiration in plant and yeast cells

The end products are ethanol and carbon dioxide. Anaerobic respiration in yeast cells is called fermentation

glucose ⟶ ethanol + carbon dioxide

This process is economically important in the manufacture of alcoholic drinks and bread.

Response to exercise

Response to exercise HT only

During exercise the human body reacts to increased demand for energy		
	Heart rate increases	Top pump oxygenated blood faster to the muscle tissues and cells.
	Breathing rate and breath volume increase	This increases the amount of oxygen entering the blood stream.

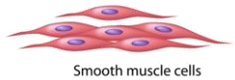
The extra amount of oxygen required to remove all lactic acids from cells is called the oxygen debt

Lactic acid builds up in the muscles cells during exercise → Blood flows through the muscle cells and transports the lactic acid to the liver → The liver oxidises the lactic acid and converts it back to glucose

Metabolism

Metabolism is the sum of all the reactions in a cell or the body

Metabolism		
	The energy transferred by respiration in cells is used by the organism for the continual enzyme controlled processes of metabolism.	Conversion of glucose to starch, glycogen and cellulose.
		The formation of lipid molecules from a molecule of glycerol and three molecules of fatty acid.
		The use of glucose and nitrate ions to form amino acids which in turn are used to synthesise proteins.
		Respiration
		Breakdown of excess proteins to form urea for excretion.

An organism will receive all the energy it needs for living processes as a result of the energy transferred from respiration			
	For movement	 Smooth muscle cells	To enable muscles to contract in animals.
	For keeping warm		To keep a steady body temperature in a cold environment.
	For chemical reactions		To build larger molecules from smaller one.

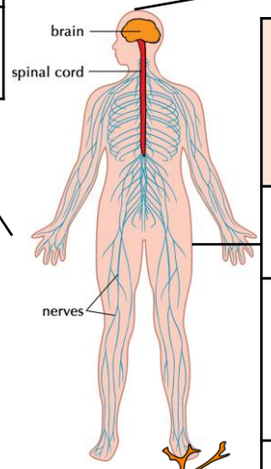
During long periods of vigorous activity muscles become fatigued and stop contracting efficiently

AQA GCSE HOMEOSTASIS AND RESPONSE part 1

The human nervous system

Human control systems include		
	Cells called receptors	Detect stimuli (changes in environment).
	Coordination centres	e.g. brain, spinal cord and pancreas that receive information from receptors.
	Effectors	Muscles or glands, which bring about responses to restore optimum levels.

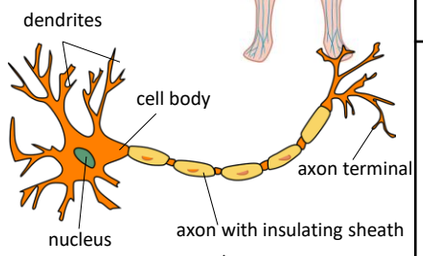
Enables humans to react to their surroundings and to co-ordinate their behaviour



Information from receptors passes along cells (neurones) as electrical impulses to the central nervous system (CNS)

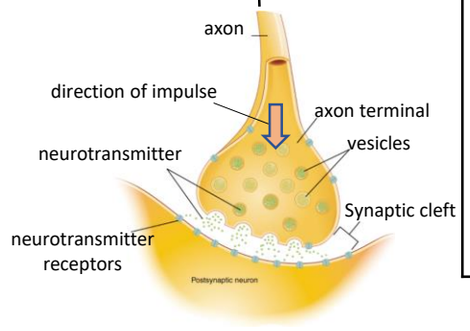
The CNS is the brain and the spinal cord.

Coordinates the response of effectors; muscles contracting or glands secreting hormones



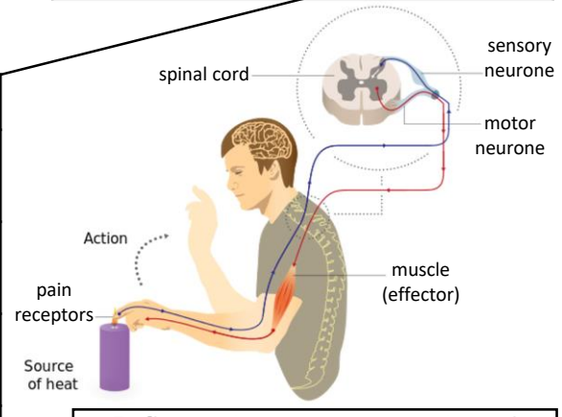
Typical motor neurone

Synapse (gap where two neurones meet).



Stimulus	Lights switch on
⇩	⇩
Receptor	Cells in retina
⇩	⇩
Coordinator	CNS
⇩	⇩
Effector	Muscles connected to iris
⇩	⇩
Response	Pupils get smaller

Reflex arc		
	Receptor	Detect stimuli.
	Sensory neurone	Long axon carries impulse from receptor to spinal cord.
	Synapse	Gap where neurones meet. Chemical message using neurotransmitter.
	Relay neurone	Allows impulses to travel between sensory and motor neurones in the spinal cord.
	Motor neurone	Long axon carries impulse from receptor to effector.
	Effector	Muscle or gland that carries out response.



Reflex actions are automatic and rapid; they do not involve the conscious part of the brain and can protect humans from harm.

AQA GCSE HOMEOSTASIS AND RESPONSE PART 2

Response to internal and external change

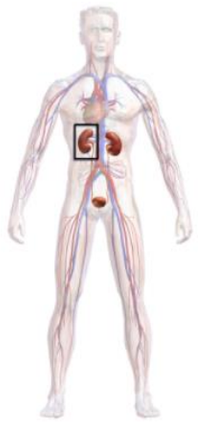
Homeostasis

The regulation of internal conditions of a cell or organism to maintain optimum conditions for function.

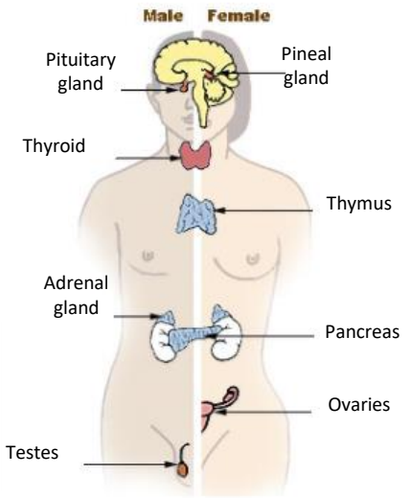
Homeostasis maintains optimal conditions for enzyme action and all cell functions.

Controls in the human body	
	Blood glucose concentration
	Body temperature
	Water levels

These automatic control systems may involve nervous responses or chemical responses.



Human endocrine system



Endocrine system		
	Composed of glands which secrete chemicals called hormones directly into the bloodstream.	The blood carries the hormone to a target organ where is produces an effect. Compared to the nervous system effects are slower but act for longer.

Pituitary gland		
	'Master gland'; secretes several hormones into the blood	Stimulates other glands to produce hormones to bring about effects.

Control of blood glucose concentration

Blood glucose concentration	
Monitored and controlled by the pancreas	
Too high	**(HT only)** Too low
Pancreas produces the hormone insulin, glucose moves from the blood into the cells. In liver and muscle cells excess glucose is converted to glycogen for storage.	Pancreas produces the hormone glucagon that causes glycogen to be converted into glucose and released into the blood.

(HT) Rising glucose levels inhibit the release of glucagon in a negative feedback system. Insulin is released to reduce glucose levels and which cause the pancreas to release glucagon

Negative feedback (HT only)		
	Adrenaline	Produced in adrenal glands, increases breathing/heart rate, blood flow to muscles, conversion glycogen to glucose. Prepares body for 'fight or flight'.
	Thyroxine	Produced in the thyroid gland, stimulates the basal metabolic rate. Important in growth and development.

Increasing thyroxine levels prevent the release of thyroid stimulating hormone which stops the release of thyroxine.

Diabetes	
Type 1	***Type 2***
Pancreas fails to produce sufficient insulin leading to uncontrolled blood glucose levels. Normally treated by insulin injection.	Obesity is a risk factor. Body cells no longer respond to insulin. Common treatments include changing by diet and increasing exercise.

AQA GCSE HOMEOSTASIS AND RESPONSE PART 3

Hormones are used in modern reproductive technologies to treat infertility

FSH and LH are used as 'fertility drugs' to help someone become pregnant in the normal way

In Vitro Fertilisation (IVF) treatment.

Involves giving a mother FSH and LH to stimulate the maturation of several eggs

The eggs are collected from the mother and fertilised by sperm from the father in a laboratory.

The fertilised eggs develop into embryos.

At the stage when they are tiny balls of cells, one or two embryos are inserted into the mother's uterus (womb).

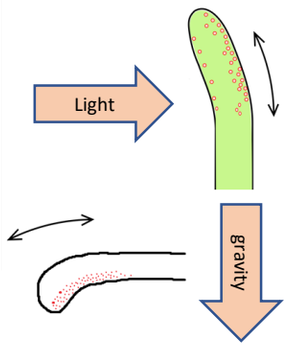
Potential disadvantages of IVF	Emotional and physical stress.
	Success rates are not high.
	Multiple births risk to mother and babies.

The use of hormone to treat infertility (HT only)

Plant hormones

Plants produce hormones to coordinate and control growth

Plant responses using hormones (auxins)	***Light (phototropism)***	Light breaks down auxins and they become unequally distributed in the shoot. The side with the highest concentration of auxins has the highest growth rate and the shoot grows toward the light.
	Gravity (geotropism or gravitropism)	Gravity causes an unequal distribution of auxins. In roots the side with the lowest concentration has the highest growth rate and the root grows in the direction of gravity.
		In new shoots from a seedling the unequal distribution of auxins causes the shoot to grow away from gravity.



(HT only) Gibberellins are important in initiating seed germination.

(HT only) Ethene controls cell division and ripening of fruits.

Use of plant hormones (HT only)

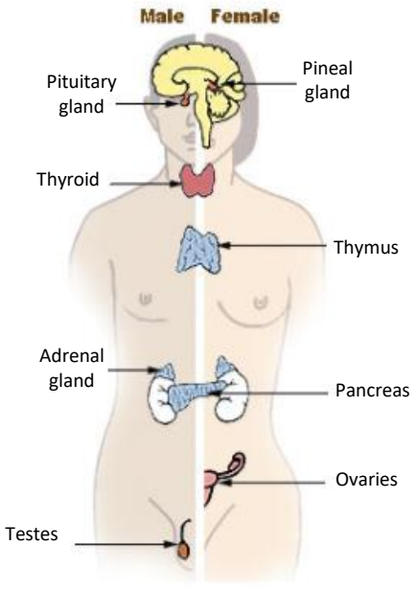
Plant growth hormones are used in agriculture and horticulture	***Auxins***	Weed killers, rooting powders, promoting growth in tissue culture.
	Ethene	Control ripening of fruit during storage and transport.
	Gibberellins	End seed dormancy, promote flowering, increase fruit size.

Contraception

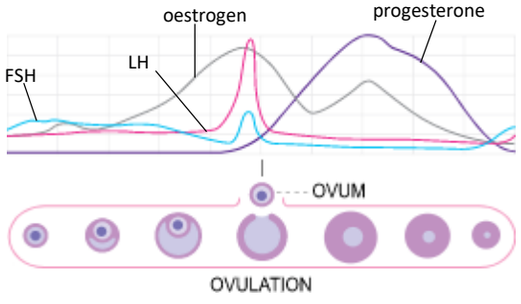
Fertility can be controlled by hormonal and non hormonal methods	***Oral contraceptives***	Contain hormones to inhibit FSH production so that no eggs mature.
	Injection, implant, skin patch	For slow release of progesterone to inhibit the maturation and release of eggs for months or years.
	Barrier methods	Condoms or diaphragms which prevent sperm reaching the egg.
	Intrauterine devices	Prevent implantation of an embryo or release a hormone.
	Spermicidal agents	Kill or disable sperm.
	Abstaining	Avoiding intercourse when an egg may be in the oviduct.
	Surgery	Male or female sterilisation.

Hormones in human reproduction

During puberty reproductive hormones cause secondary sexual characteristics to develop	
Oestrogen (main female reproductive hormone)	***Testosterone (main male reproductive hormone)***
Produced in the ovaries. At puberty eggs being to mature releasing one every 28 days – **ovulation**.	Produced in the testes stimulation sperm production.



(HT only) a graph of hormone levels over time



Menstrual cycle	***Follicle stimulating hormone (FSH)***	Causes maturation of an egg in the ovary.	**(HT)** FSH stimulates ovaries to produce oestrogen.
	Luteinising hormone (LH)	Stimulates release of an egg.	**(HT)** Oestrogen stops FSH production and stimulates LH production in pituitary gland.
	Oestrogen and progesterone	Maintain uterus lining.	

AQA GCSE INHERITANCE, VARIATION AND EVOLUTION Part 1

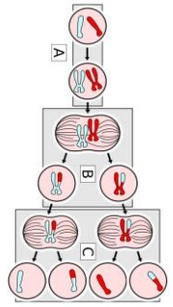
Meiosis

Meiosis halves the number of chromosomes

Gametes are made in reproductive organs (in animals ovaries and testes)

Cells divide by meiosis to form gametes

- Copies of the genetic information are made.
- The cell divides twice to form four gametes each with single set of chromosomes.
- All gametes are genetically different from each other.



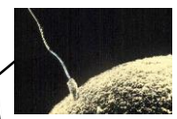
Gametes join at fertilisation to restore the number of chromosomes

The new cell divides by mitosis. The number of cells increase. As the embryo develops cells differentiate.

Meiosis leads to non-identical cells being formed while mitosis leads to identical cells being formed

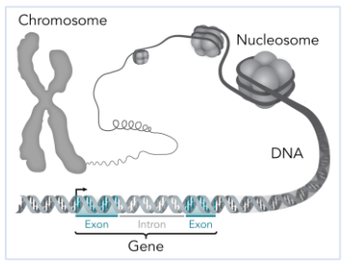
Sexual and asexual reproduction

Sexual reproduction involves the fusion of male and female gametes.	***Sperm and egg in animals.***	Produced by meiosis. There is mixing of genetic information which leads to a variety in the offspring.
	Pollen and egg cells in flowering plants.	
Asexual reproduction involves only one parent and no fusion of gametes.	***e.g. cloning of females only in an aphid population.***	Only mitosis is involved. There is no mixing of genetic information. This leads to genetically identical clones.



DNA and the genome

Genetic material in the nucleus is composed of a chemical called DNA.



DNA structure

Polymer made up of two strands forming a double helix.

Contained in structures called chromosomes. A gene is a small section of DNA on a chromosome. Each gene codes for a sequence of amino acids to make a specific protein.

The genome is the entire genetic material of an organism.

The whole human genome has now been studied.	***It is of great importance for future medical developments***	Searching for genes linked to different types of disease.
		Understanding and treatment of inherited disorders.
		Tracing migration patterns from the past.

Mutations occur continuously (HT only)

When the protein chain is complete it folds to form a unique shape. This allows proteins to do their job as enzymes, hormones or new structures such as collagen.

Some change the shape and affect the function of proteins e.g. and enzyme active site will change or a structural protein loses its strength

Most do not alter the protein so that its appearance or function is not changed.

Protein synthesis (HT only)

(HT) Making new proteins (protein synthesis)

Composed of chains of amino acids. A sequence of 3 bases codes for a particular amino acid.

DNA in the nucleus unravels.

⇩

Enzymes make a copy of the DNA strand called mRNA.

⇩

mRNA moves from the nucleus to ribosome in the cytoplasm.

⇩

Ribosomes translate each 3 bases into amino acids according to mRNA template

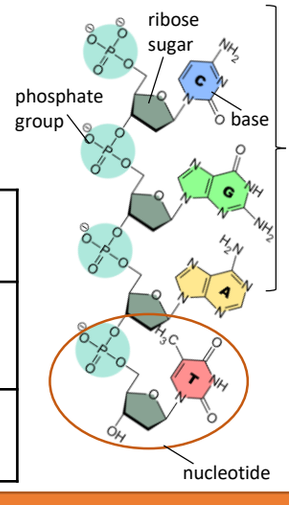
⇩

Ribosomes link amino acids brought by carrier proteins.

⇩

A long chain of amino acids form. Their specific order forms a specific protein.

In DNA the complementary strands C, A, T, G always link in the same way. C always linked to G on the opposite strand and A to T.



A sequence of 3 bases is the code for a particular amino acid. The order of bases controls the order in which each amino acid is assemble to produce a specific protein.

AQA GCSE INHERITANCE, VARIATION AND EVOLUTION PART 2

Variation

Variation: difference in the characteristics of individuals in a population may be due to

Genetic causes (inheritance)	There is usually extensive genetic variation within the population of a species e.g. hair colour, skin colour, height that can also be affected by environment e.g. nutrition, sunlight.
Environmental causes (condition they have developed in)	
A combination of genes and environment	

Very rarely a mutation will lead to a new phenotype which if is suited to environmental change can lead to rapid change in the species.

Mutations occur continuously

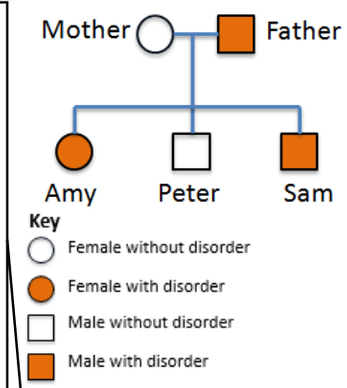
All genetic variation arises in mutation, most have no effect on phenotype, some influence but very few determine phenotype.

The genome and its interaction with the environment influence the development of phenotypes

Define terms linked to genetics

Gamete	Sex cells produced in meiosis.
Chromosome	A long chain of DNA found in the nucleus.
Gene	Small section of DNA that codes for a particular protein.
Allele	Alternate forms of the same gene.
Dominant	A type of allele – always expressed if only one copy present and when paired with a recessive allele.
Recessive	A type of allele – only expressed when paired with another recessive allele.
Homozygous	Pair of the same alleles, dominant or recessive.
Heterozygous	Two different alleles are present 1 dominant and 1 recessive.
Genotype	Alleles that are present for a particular feature e.g. Bb or bb
Phenotype	Physical expression of an allele combination e.g. black fur, blonde hair, blue eyes.

Using a family tree: If the father was homozygous dominant then all of the offspring would have the disorder. He must be heterozygous



Inherited disorders

Embryo screening: small piece of developing placenta removed to check for presence of faulty genes

Gene therapy: replacing the faulty allele in somatic cells with a normal allele

Embryo screening and gene therapy may alleviate suffering

Embryo screening /gene therapy issues		
	Economic	Costly and not 100% reliable.
	Social	Not available to everyone (due to cost).
	Ethical	Should only 'healthy' embryos be implanted following screening.

Some disorders are inherited. They are caused by the inheritance of certain alleles

Polydactyly	***Cystic fibrosis***
Caused by inheriting a dominant allele.	Caused by inheriting a recessive allele (both parents have to at least carry it).
Causes a person/animal to have extra toes or fingers.	A disorder of the cell membrane. Patients cannot control the viscosity of their mucus.

Ordinary human body cells contain 23 pairs of chromosomes

One pair of chromosomes carry the genes that determine sex

Female	***Male***
XX	XY

Gametes	X	Y
X	XX	XY
X	XX	XY

The probability of a male of female child is 50%. The ratio is 1:1

Sex determination

Genetic inheritance

Some characteristics are controlled by a single gene e.g. fur colour, colour blindness.

The alleles present, or genotype operate at a molecular level to develop characteristics that can be expressed as a phenotype.

Most characteristics are as a result of multiple genes interacting.

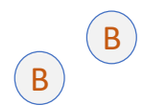
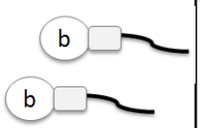
The concept of probability in predicting results of a single gene cross.

Dominant and recessive allele combinations

Dominant	***Recessive***
Represented by a capital letter e.g. B.	Represented by a lower case letter e.g. b.

3 possible combinations:
Homozygous dominant BB
Heterozygous dominant Bb
Homozygous recessive bb

Using a punnet square (using mouse fur colour as an example)

Parent phenotype	Black fur 	White fur 
Parent genotype	BB	bb
What gametes are present	In each egg 	In each sperm 

Gametes	b	b
B	Bb	Bb
B	Bb	Bb

The probability of black fur offspring phenotype is 100%. All offspring genotypes are heterozygous (Bb).

Crossing two heterozygous mice (Bb)

Gametes	B	b
B	BB	Bb
b	Bb	bb

The probability of black fur is 75% and white fur 25%. The ratio of black to white mice is 3:1

AQA GCSE INHERITANCE VARIATION AND EVOLUTION PART 3

Evolution

A change in the inherited characteristics of a population over time through the process of natural selection.

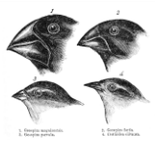
Over time this results in the formation of new species.

The theory of evolution by natural selection.

Species of all living things have evolved from simple life forms that first developed 3 billion years ago.

Through natural selection of variants (genotypes) that give rise to phenotypes best suited to their environment or environmental change e.g. stronger, faster. This allows for variants to pass on their genotype to the next generation.

If two populations of one species become so different in phenotype that they can no longer interbreed to produce fertile offspring they have formed two new species.

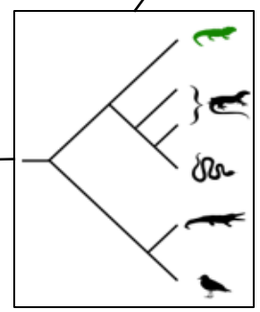


Darwin's finches

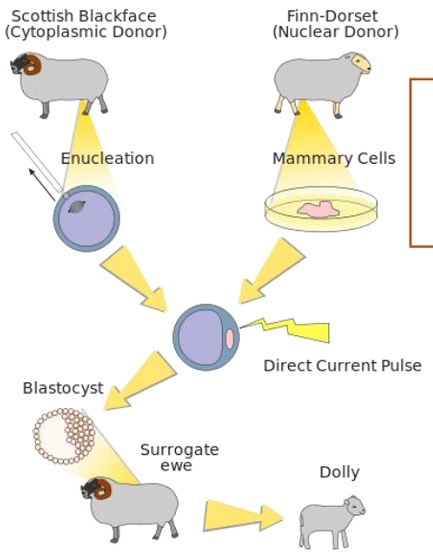
Classification of living organisms

Evolutionary trees are a method used by scientists to show how organisms are related

Use current classification data for living organisms and fossil data for extinct organisms



Cloning (Biology only)



Adult cell cloning

1. Nucleus is removed from an unfertilised egg.
2. Nucleus from body cell is inserted into egg cell.
3. An electric shock stimulates the egg to divide into an embryo
4. Embryo cells are genetically identical to adult cells.
5. When embryo has developed into ball of cells it is inserted into host womb.

Cloning techniques in plants/animals

Tissue culture	Small groups of cells to grow new plants. Important for preservation of rare plants and commercially in nurseries.
Cuttings	Part of a plant is cut off and grown into full plant.
Embryo transplants	Splitting apart cells from animals embryo before they become specialised. New clone embryos are inserted into womb of adult female.

Concern: some people have ethical objections to adult cell cloning e.g. welfare of the animals.

Selective breeding

The process by which humans breed plants/animals for particular genetic characteristics

Humans have been doing this for thousands of years since they first bred food from crops and domesticated animals.

Selective breeding

Choosing parents with the desired characteristics from a mixed population

Chosen parents are bred together.

↓

From the offspring those with desired characteristics are bred together.

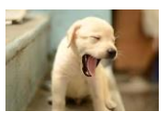
↓

Repeat over several generations until all the offspring show the desired characteristics.

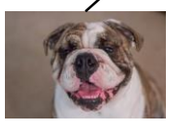
Concern: effect of GMO on human health not fully explored

Choosing characteristics

Desired characteristics are chosen for usefulness or appearance

Disease resistance in food crops.	
Animals which produce more meat or milk.	
Domestic dogs with a gentle nature.	
Large or unusual flowers.	

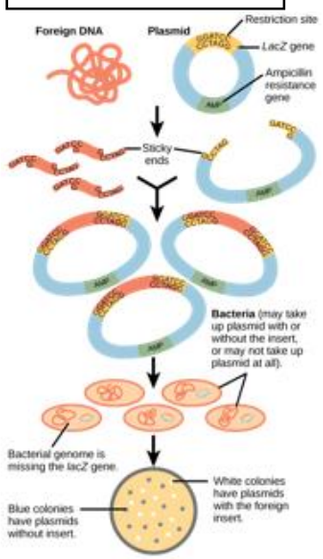
Concern: effect of GMO on wild populations of flowers and insects.



Selective breeding can lead to 'inbreeding' where some breeds are particularly prone to disease or inherited defects e.g. British Bulldogs have breathing difficulties.

Genetic engineering

Modern medical is exploring the possibility of GM to over come inherited disorders e.g. cystic fibrosis



Genetic engineering process (HT only)

1. Enzymes are used to isolate the required gene.
2. Gene is inserted into a vector – bacterial plasmid or virus.
3. Vector inserts genes into the required cells.
4. Genes are transferred to plants/animals/microbes at an early stage of development so they develop the required characteristics.

Genes from the chromosomes of humans or other organisms can be 'cut out' and transferred to the cells of other organisms.

Genetically modified crops (GMO)

Crops that have genes from other organisms

- To become more resistant to insect attack or herbicides.
- To increase the yield of the crop.

AQA GCSE INHERITANCE VARIATION AND EVOLUTION PART 4

Classification of living organisms

The full human classification

Carl Linnaeus classified living things	
Kingdom	Animalia
Phylum	Chordata
Class	Mammalia
Order	Primates
Family	Hominidae
Genus	*Homo*
Species	*sapiens*

Organisms are named by the binomial system of genus and species. Humans are *Homo sapiens*

Due to improvements in microscopes, and the understanding of biochemical processes, new models of classification were proposed.

Carl Woese

3 domain based on chemical analysis.

Archaea (primitive bacteria), true bacteria, eukaryota.

Evidence for evolution

Fossils and antibiotic resistance in bacteria provide evidence for evolution.

Antibiotic resistant bacteria		
	Mutations produce antibiotic resistant strains which can spread	Resistant strains are not killed.
		Strain survives and reproduces.
		People have no immunity to strain and treatment is ineffective.

Evolution is widely accepted. Evidence is now available as it has been shown that characteristics are passed on to offspring in genes.

Extinction

When no members of a species survive

Due to extreme geological events, disease, climate change, habitat destruction, hunting by humans.

Fossils tell scientists how much or how little different organisms have changed over time.

Fossils

'remains' of ancient organisms which are found in rocks

Parts of organism that have not decayed as necessary conditions are absent.

Parts of the organism replaced by minerals as they decay.

Preserved traces of organisms such as footprints, burrows and rootlet traces.

Early forms of life were soft bodied and few traces are left behind and have been destroyed by geological activity, cannot be certain about how life began.

AQA GCSE ECOLOGY PART 1

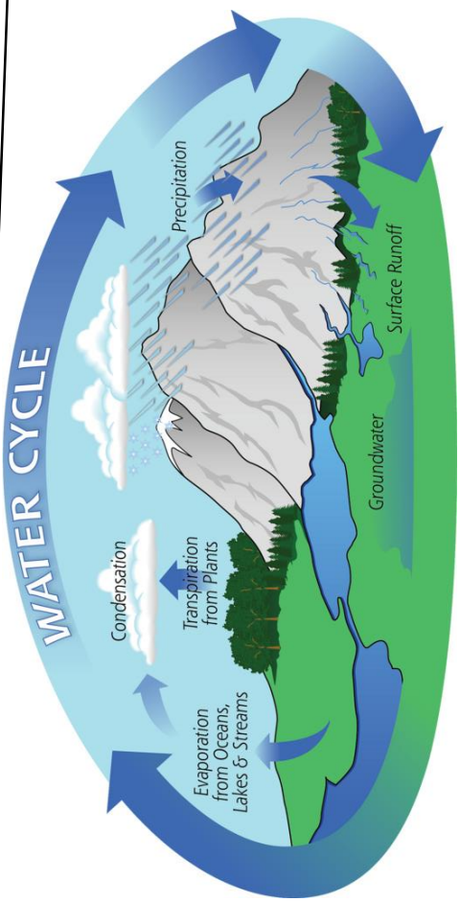
Ecosystem		
	Environment	The conditions surrounding an organism; abiotic and biotic.
	Habitat	Place where organisms live e.g. woodland, lake.
	Population	Individuals of a species living in a habitat.
	Community	Populations of different species living in a habitat.

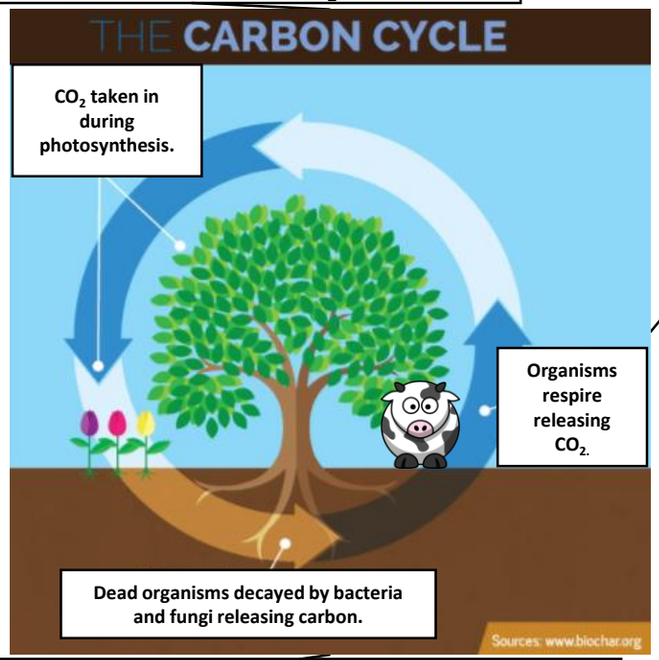
Organisms require a supply of materials from their surroundings and from the other living organisms.

Farmers optimise conditions for making compost for use as a natural fertiliser.

Bacteria respire when breaking down dead organisms releasing CO_2.

Anaerobic decay in biogas generators produces methane gas, used as a fuel.





Materials are recycled to provide the building blocks for future organisms

Decomposition and material cycling

Surviving and reproducing		
	Competition	Plants in a community or habitat compete with each other for light, space, water and mineral ions.
		Animals compete with each other for food, mates and territory.
	Interdependence	Species depend on each other for food, shelter, pollination, seed dispersal etc. Removing a species can affect the whole community

EXAMPLE: climate change is leading to more dissolved CO_2 in oceans lowering the pH of the water affecting organisms living there.

EXAMPLE: Introduction of grey squirrels to UK increased competition for food for red squirrels. The greys also carry a pathogen that kills reds.

Interdependence and competition

Abiotic	Biotic
Non-living factors that affect a community	***Living factors that affect a community***
Living intensity.	Availability of food.
Temperature.	
Moisture levels.	New predators arriving.
Soil pH, mineral content.	
Wind intensity and direction.	New pathogens.
Carbon dioxide levels for a plant.	
Oxygen levels for aquatic organisms.	One species outcompeting so numbers are no longer sufficient to breed

Adaptations

Organisms adaptations enable them to survive in conditions where they normally live.

Adaptations may be structural, behavioural or functional.

Adaptations		
Plants	***Animals***	***Extremophiles***
Cactus in dry, hot desert	Polar bear in extreme cold artic	Deep sea vent bacteria
		
No leaves to reduce water loss, wide deep roots for absorbing water.	Hollow hairs to trap layer of heat. Thick layer of fat for insulation.	Populations form in thick layers to protect outer layers from extreme heat of vent.

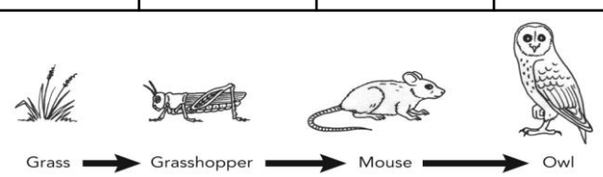
Levels of organisation

Abiotic and biotic factors.

Food chains

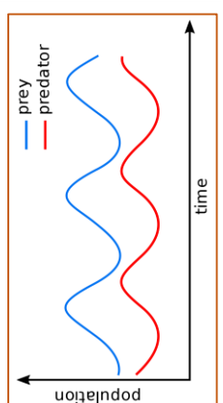
Feeding relationships in a community

Producer	Primary consumer	Secondary consumer	Tertiary consumer



All food chains begin with a producer e.g. grass that is usually a green plant or photosynthetic algae.

Consumers that kill and eat other animals are predators and those eaten are prey.



In a stable community the numbers of predators and prey rise and fall in cycles.

Photosynthetic organisms are the producers of biomass for life on Earth

Factors affecting rate of decay

Temperature, water, oxygen

Increase the rate of decay. In enzyme controlled reactions raising the temperature too high will denature the enzymes.

Breakdown of dead organisms releases mineral ions can into the soil.

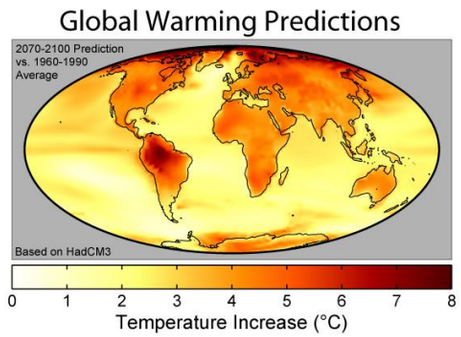
AQA GCSE ECOLOGY PART 2

Global warming

Levels of CO_2 and methane in the atmosphere are increasing.

Decreased land availability from sea level rise, temperature rise damages delicate habitats, extreme weather events harm populations of plants and animals.

There is a global consensus about global warming and climate change based on systematic reviews of thousands of peer reviewed publications.



Maintaining biodiversity

Human activity can have a positive impact on biodiversity

Scientists and concerned citizens

Put in place programmes to reduce the negative impacts of humans on ecosystems and biodiversity

- Breeding programmes for endangered species.
- Protection and regeneration of rare habitats.
- Reintroduction of field margins and hedgerows in agricultural areas where farmers grow only one type of crop.
- Reduction of deforestation and CO_2 emissions by some governments.
- Recycling resources rather than dumping waste in landfill.

Some of the programmes potentially conflict with human needs for land use, food production and high living standards.

AQA GCSE ECOLOGY PART 3

Biodiversity and the effect of human interaction on the ecosystem

Biodiversity

Biodiversity is the variety of all different species of organisms on Earth, or within an ecosystem

Maintain a great biodiversity	***Ensures the stability of ecosystems***	By reducing the dependence on one species on another for food, shelter, maintenance of the physical environment.
	Future of human species	Many human activities are reduction biodiversity and only recently measures have been taken to stop it.

Experimental methods are used to determine the distribution and abundance of a species.

Sampling techniques	***Quadrats***	Organisms are counted within a randomly placed square
	Transects	Organisms are counted along a belt (transect) of the ecosystem.

Processing data	
Median	Middle value in a sample.
Mode	Most occurring value in a sample.
Mean	The sum of all the value in a sample divided by the sample number.

Human activity can have a negative impact on biodiversity

Pollution kills plants and animals which can reduce biodiversity.

Waste management	***Rapid growth in human population and higher standard of living***	More resources used and more waste produced.
		Pollution in water; sewage, fertiliser or toxic chemicals.
		Pollution in air; smoke or acidic gases.
		Pollution on land; landfill and toxic chemicals.

Waste, land use and deforestation

Land use
Humans reduce the amount of land and habitats available for other plants, animals and microorganisms.
Building and quarrying.
Farming for animals and food crops.
Dumping waste.
Destruction of peat bogs to produce cheap compost for gardeners/farmers to increase food production.

The decay or burning of peat release CO_2 into the atmosphere.

This conflicts with conserving peat bogs and peatlands as habitats for biodiversity and reduce CO_2 emissions.

Large scale deforestation
Provide land for cattle and rice fields, grow crops for biofuels.

Deforestation reduces biodiversity and removes a sink for increasing the amount CO_2 in the atmosphere.