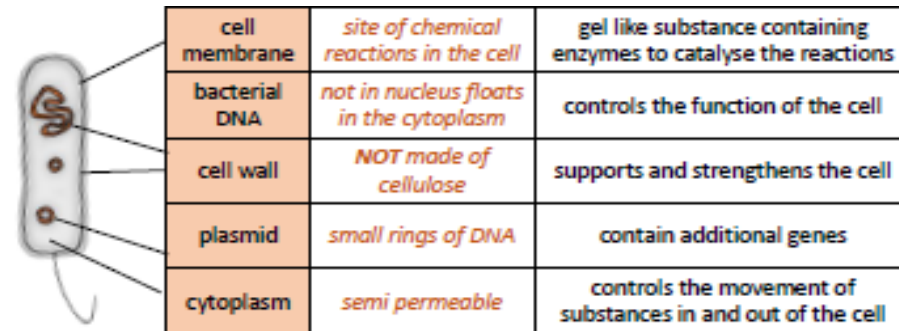
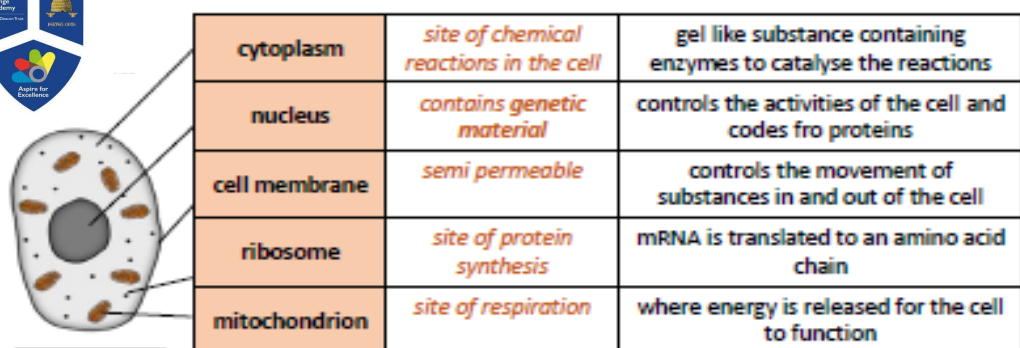




Bacterial cells are much smaller than plant and animal cells

animal cell

plant cell

Eukaryotes complex organisms

AQA Cell Structure

Prokaryotes simpler organisms

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

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

Cell differentiation

Microscopy

animal cell differentiation

plant cell differentiation

early stages of development
only for repair and replacement

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

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

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	TRANSLLOCATION - living cells cells have end plates with holes flows in both directions



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	$\times 10^{-2}$
milli (mm)	1 mm = 0.001 m	$\times 10^{-3}$
micro (μm)	1 μm = 0.000 001 m	$\times 10^{-6}$
nano (nm)	1 nm = 0.000 000 001 m	$\times 10^{-9}$



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.

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.

ADAPTATIONS FOR DIFFUSION

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

AQA Cell Biology

Cell division

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.

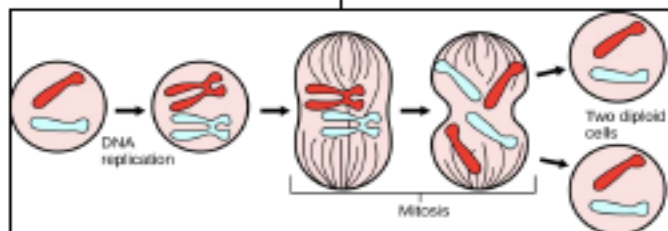
Transport in cells

Diffusion <u>No</u> 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 <u>No</u> 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 <u>ENERGY</u> 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.

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

MITOSIS AND THE CELL CYCLE

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.

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 plant.	Used to produce clones quickly and economically, e.g. rare species, crop plants with pest /disease resistance

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



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

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

B2

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



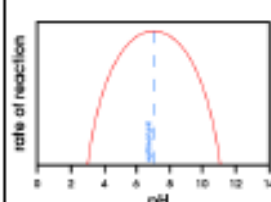
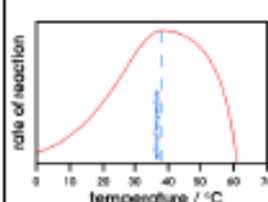
Enzymes catalyse specific reactions in living organisms due to the shape of their active site

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



Enzymes in digestion

The human digestive system

AQA GCSE ORGANISATION Part 1

Principles of organisation

Non-communicable diseases

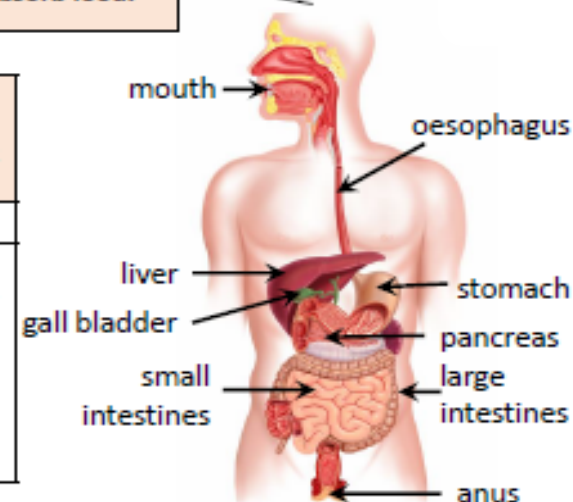
More energy consumed in food and drink than used

obesity

Linked to increased rates of cardiovascular disease and development of diabetes type 2.

Food tests

Sugars (glucose)	<i>Benedict's test</i>	Orange to brick red precipitate.
Starch	<i>Iodine test</i>	Turns black.
Biuret	<i>Biuret reagent</i>	Mauve or purple solution.



Carbohydrases (e.g. amylase)

Proteases

Lipases

Bile (not an enzyme)



Made in salivary glands, pancreas, small intestine

Break down carbohydrates to simple sugar (e.g. amylase breaks down starch to glucose).

Made in stomach, pancreas

Break down protein to amino acids.

Made in pancreas (works in small intestine)

Break down lipids (fats) to glycerol and fatty acids.

Made in liver, stored in gall bladder.

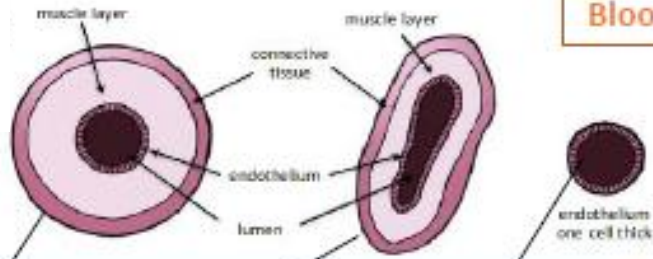
Emulsifies lipids to increase surface area to increase the rate of lipid break down by lipase. Changes pH to neutral for lipase to work

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

Cells, tissues, organs and systems

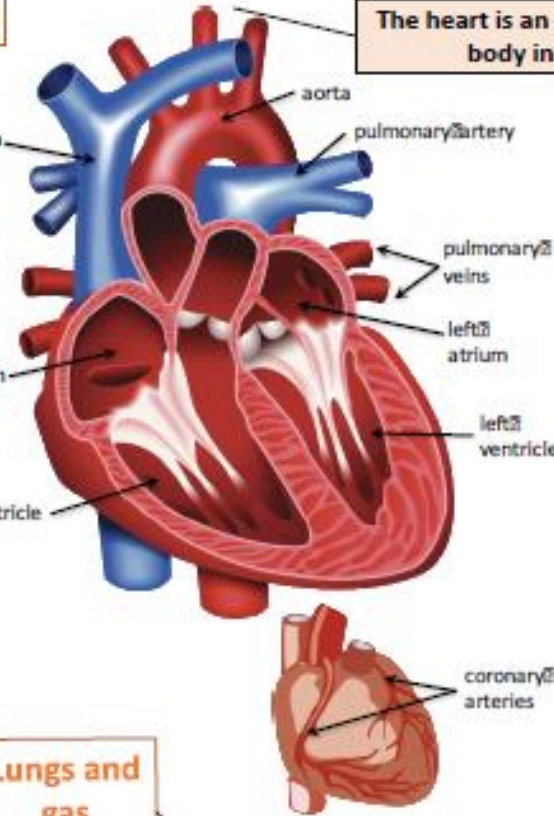
Cells		<i>e.g. muscle cells</i>	The basic building blocks of all living organisms.
Tissues		<i>e.g. muscle tissue</i>	A group of cells with a similar structure and function.
Organs		<i>e.g. the heart</i>	Aggregations (working together) of tissues performing a specific function.
Organ systems		<i>e.g.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

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

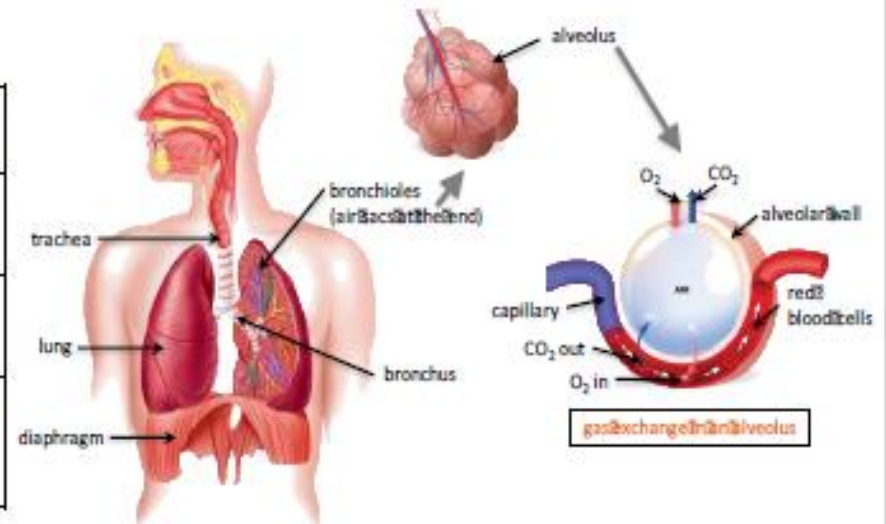
AQA GCSE ORGANISATION part 2

Lungs and gas exchange

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

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.

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

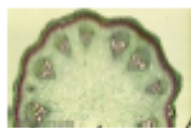
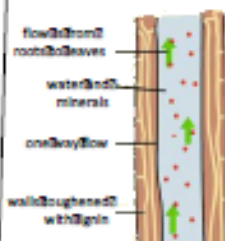
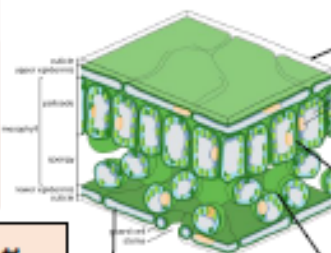
AQA GCSE ORGANISATION part 3

Plant tissues

Cause	Effect	Treatment
Coronary heart disease (CHD)	A build up for fatty substances in the coronary arteries (atherosclerosis)	Oxygenated 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

Plant organ systems

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



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.

Cancer

Non-communicable diseases

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

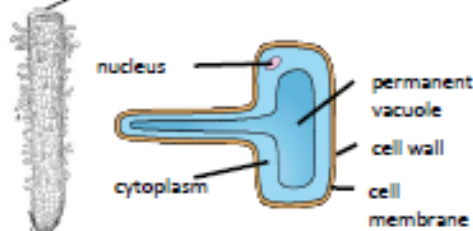
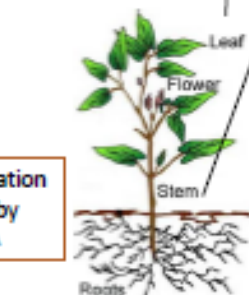
Benign tumour	Contained in one area of the body (usually by a membrane) – not cancer.
Malignant tumour	Invade tissues and spread to different parts of the body to form secondary tumours.

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

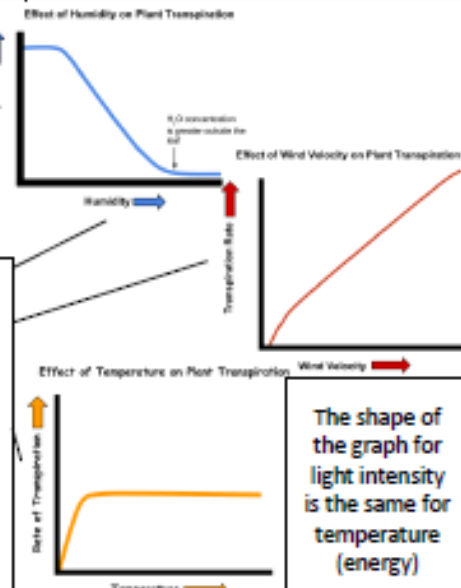


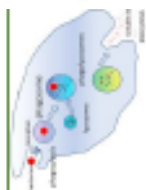
A potometer is used to measure the amount of water lost over time (rate of transpiration)

Transpiration

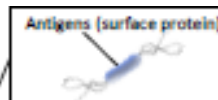
The rate at which water is lost from the leaves of a plant. The transpiration stream is the column of water moving through the roots, stem and leaves

Temperature, humidity, air movement and light intensity affect the rate of transpiration.





Phagocytes	<i>Phagocytosis</i>	Phagocytes engulf the pathogens and digest them.
Lymphocytes	<i>Antibody production</i>	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.
	<i>Antitoxin production</i>	Antitoxin is a type of antibody produced to counteract the toxins produced by bacteria.



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

White blood cells are part of the immune system

Immune system

Non-specific defence systems

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

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

AQA GCSE INFECTION AND RESPONSE part 1

Plants have several ways of defending themselves from pathogens and animals

Human defence systems

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

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

Detection and identification of plant diseases (bio only)

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

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.

Bacteria may produce toxins that damage tissues and make us feel 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

Pathogens are microorganisms that cause infectious disease

Pathogens

Communicable diseases

Viruses live and reproduce inside cells causing damage

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



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 <i>Penicillium</i> mould and used as an antibiotic
		

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

Antibiotics and painkillers

Bacteria can mutate

Sometimes this makes them resistant to antibiotic drugs.

Antibiotics have greatly reduced deaths from infectious bacterial disease

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

Antibiotics cannot be used to treat viral pathogens

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

Discovery and drug development

AQA INFECTION AND RESPONSE

Vaccination

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

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

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.

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.

Monoclonal antibodies (Biology only HT)

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

Monoclonal antibodies	Identical copies of one type of antibody produced in laboratory	1. A mouse is injected with pathogen
		2. Lymphocytes produce antibodies
		3. Lymphocytes are removed from the mouse and fused with rapidly dividing mouse tumour cells
		4. The new cells are called hybridomas
		5. The hybridomas divide rapidly and release lots of antibodies which are then collected

Vaccination	Small amount of dead or inactive form of the pathogen	1 st 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.

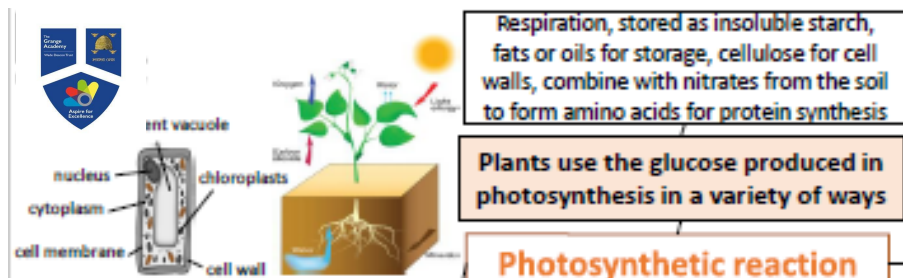
A person is unlikely to suffer the symptoms of the harmful disease and it's spread in a population is prevented

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

Specific to one binding site on the antigen. Can target specific chemicals or cells in the body



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
		$\text{CO}_2 + \text{H}_2\text{O} \xrightarrow{\text{light}} \text{O}_2 + \text{C}_6\text{H}_{12}\text{O}_6$

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

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

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.

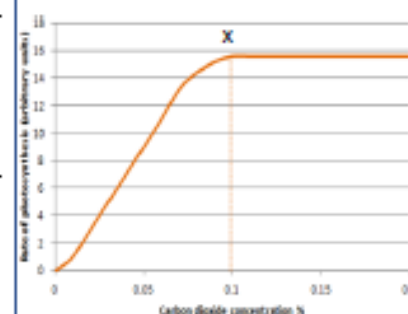
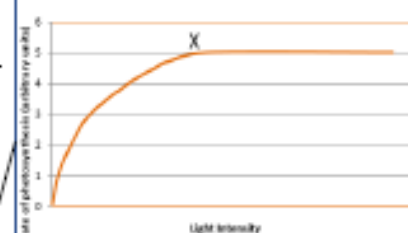
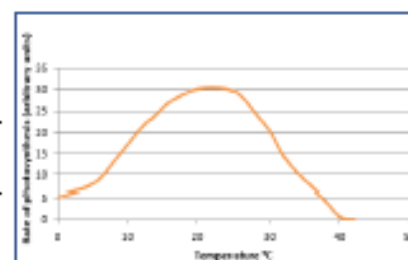
Growers must balance the economics of additional costs of controlling the conditions to maximise photosynthesis with making a profit.



AQA GCSE BIOENERGETICS part 1

Rate of photosynthesis

Rate of photosynthesis HT Only



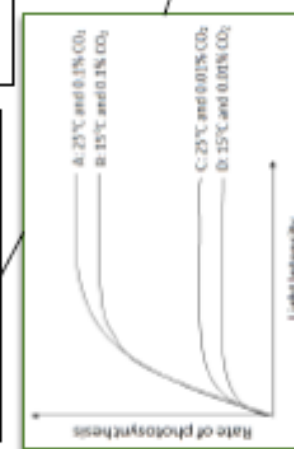
Graph lines C and D: If temperature is increased by 10°C then a slight increase in rate of photosynthesis occurs.

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

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

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.

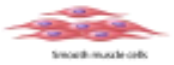
Graph line A: Rate could be limited by temperature and/or amount of chlorophyll. Plant tissue can be damaged when carbon dioxide concentrations exceed 0.1%.



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



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

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

Response to exercise

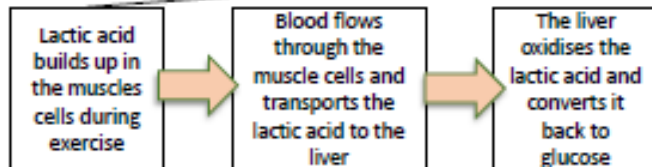
During exercise the human body reacts to increased demand for energy	<i>Heart rate increases</i>	Top pump oxygenated blood faster to the muscle tissues and cells.
	<i>Breathing rate and breath volume increase</i>	This increases the amount of oxygen entering the blood stream.

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

Metabolism

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.

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



Response to exercise HT only

Respiration

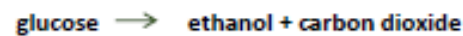
AQA GCSE BIOENERGETICS part 2



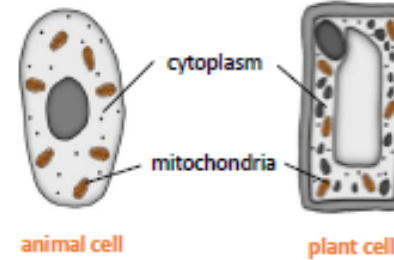
Cellular respiration is an exothermic reaction which is continuously occurring in all living cells

Anaerobic respiration in plant and yeast cells

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



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



Electron micrograph of a mitochondrion

Anaerobic respiration

Respiration when oxygen is in short supply. Occurs during intensive exercise

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.



Anaerobic respiration releases a much smaller amount of energy than aerobic respiration.

The incomplete oxidation of glucose causes a build up of lactic acid and creates an oxygen debt

Aerobic respiration

Respiration with oxygen. Occurs inside the mitochondria continuously

Glucose is oxidised by oxygen to transfer the energy the organism needs to perform its functions.



carbon dioxide + water

Aerobic respiration releases a large amount of energy from each glucose molecule

The iris can dilate the pupil (aperture) to let in more light in dim conditions

Retina	Light sensitive cell layer.
Optic nerve	Carries impulse to brain.
Sclera	Protects the eye.
Cornea	Transparent layer that covers the pupil and iris.
Iris	Pigmented layer, controls size of pupil.
Ciliary muscles	Controls thickness of lens.
Suspensory ligaments	Connects lens to ciliary muscles.

Sense organ containing receptors sensitive to light intensity and colour

The Eye (Bio only)

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.

AQA GCSE HOMEOSTASIS AND RESPONSE part 1

The human nervous system

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

The Brain (Bio only)

The brain controls complex behaviour. It is made of billions of interconnected neurones.

The brain has different regions that carry out different functions.	Cerebral cortex	Largest part of the human brain. Higher thinking skills e.g. speech, decision making.
	Cerebellum	Balance and voluntary muscle function e.g. walking, lifting.
	Medulla	Involuntary (automatic) body functions e.g. breathing, heart rate.

Neuroscientists have been able to map regions of the brain by studying patients with brain damage, electrical stimulation and MRI.

(HT) The complexity and delicacy of the brain makes investigating and treating brain disorders very difficult

Treating brain damage and disease e.g. Lobotomy - cutting part of the cerebral cortex

Benefit: thought to alleviate the symptoms of some mental illnesses.
Risks: bleeding in the brain, seizures, loss of brain function.
Procedure was abandoned in the 1950s due to risk.

Typical motor neurone

Synapse (gap where two neurones meet).

Accommodation is the process of changing the shape of the lens to focus

Near object	Far object
Ciliary muscles contract, suspensory ligaments loosed, lens get thicker, light is more refracted.	Ciliary muscles relax, suspensory ligaments pulled tight, lens pulled thin, light is only slightly refracted.

Hyperopia (long sightedness)	Myopia (short sightedness)
Treated using a convex lens so the light is focused on the retina.	Treated using a concave lens so light is focused on the retina.

New technologies now include hard/soft contact lens, laser surgery to change the shape of the cornea and a replacement lens in the eye.

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.



Response to internal and external change

Controls in the human body	Blood glucose concentration	These automatic control systems may involve nervous responses or chemical responses.
	Body temperature	
	Water levels	

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.

Homeostasis

Water and nitrogen balance (Biology only)

If body cells lose or gain too much water by osmosis they do no function efficiently.	Uncontrolled water/ion/urea loss	Water exhaled in lungs, water, ions and urea in sweat.
	Controlled water/ion/urea loss	Via the kidneys in urine.

Kidney failure is treated by organ transplant or dialysis.

Kidney function	Maintain water balance of the body.	Produce urine by filtration of the blood and selective reabsorption of glucose, ions and water.
		A dialysis machine removes urea from the blood by diffusion while maintaining ion and glucose levels.

(HT only) ADH	Acts on kidney tubules to control water levels.	Released by pituitary gland when blood is too concentrated. Water is reabsorbed back into the blood from the kidney tubules (NEGATIVE FEEDBACK).
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Thermoregulatory centre (hypothalamus)

Control of body temperature (Biology only)

AQA GCSE HOMEOSTASIS AND RESPONSE PART 2

Control of blood glucose concentration

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.

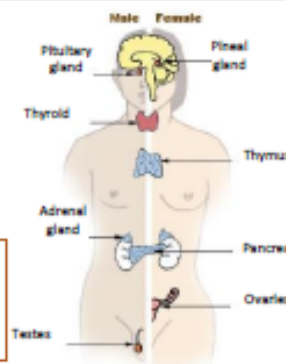
Monitoring body temperature	Thermoregulatory centre	Contains receptors sensitive to the temperature of the blood.
	Skin	Contains temperature receptors, sends nervous impulses to the thermoregulatory centre.

Body temperature	Too high	Blood vessels dilate (vasodilation), sweat produced from sweat glands.
	Too low	Blood vessels constrict (vasoconstriction), sweating stops, muscles contract (shivering).

(HT) Thermal energy is lost from blood near the surface of the skin, sweat evaporates transferring thermal energy.

(HT) Thermal energy loss at the surface of the skin is reduced, respiring muscles cells transfer chemical to thermal energy.

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 it produces an effect. Compared to the nervous system effects are slower but act for longer.

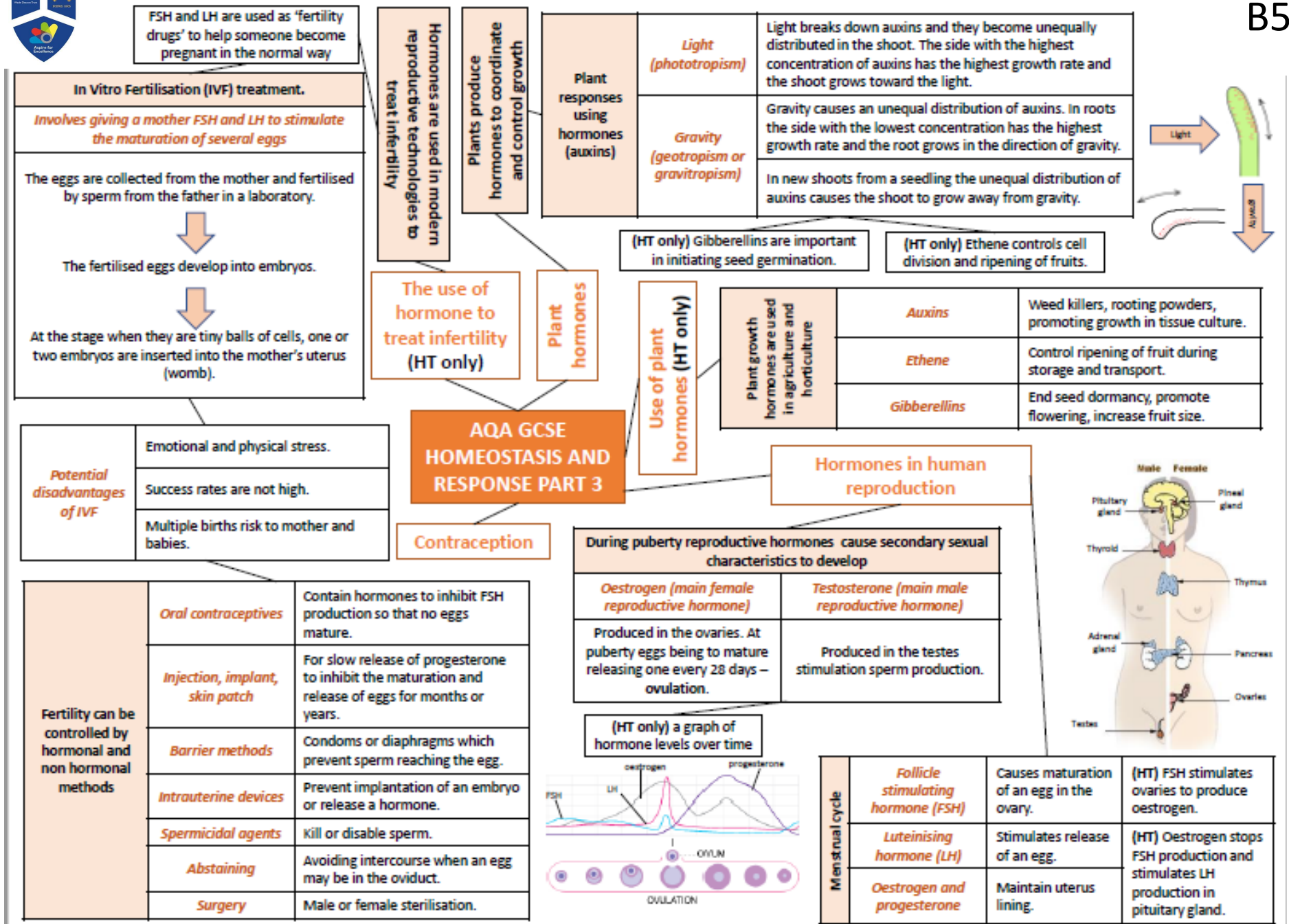
Pituitary gland	'Master gland'; secretes several hormones into the blood	Stimulates other glands to produce hormones to bring about effects.
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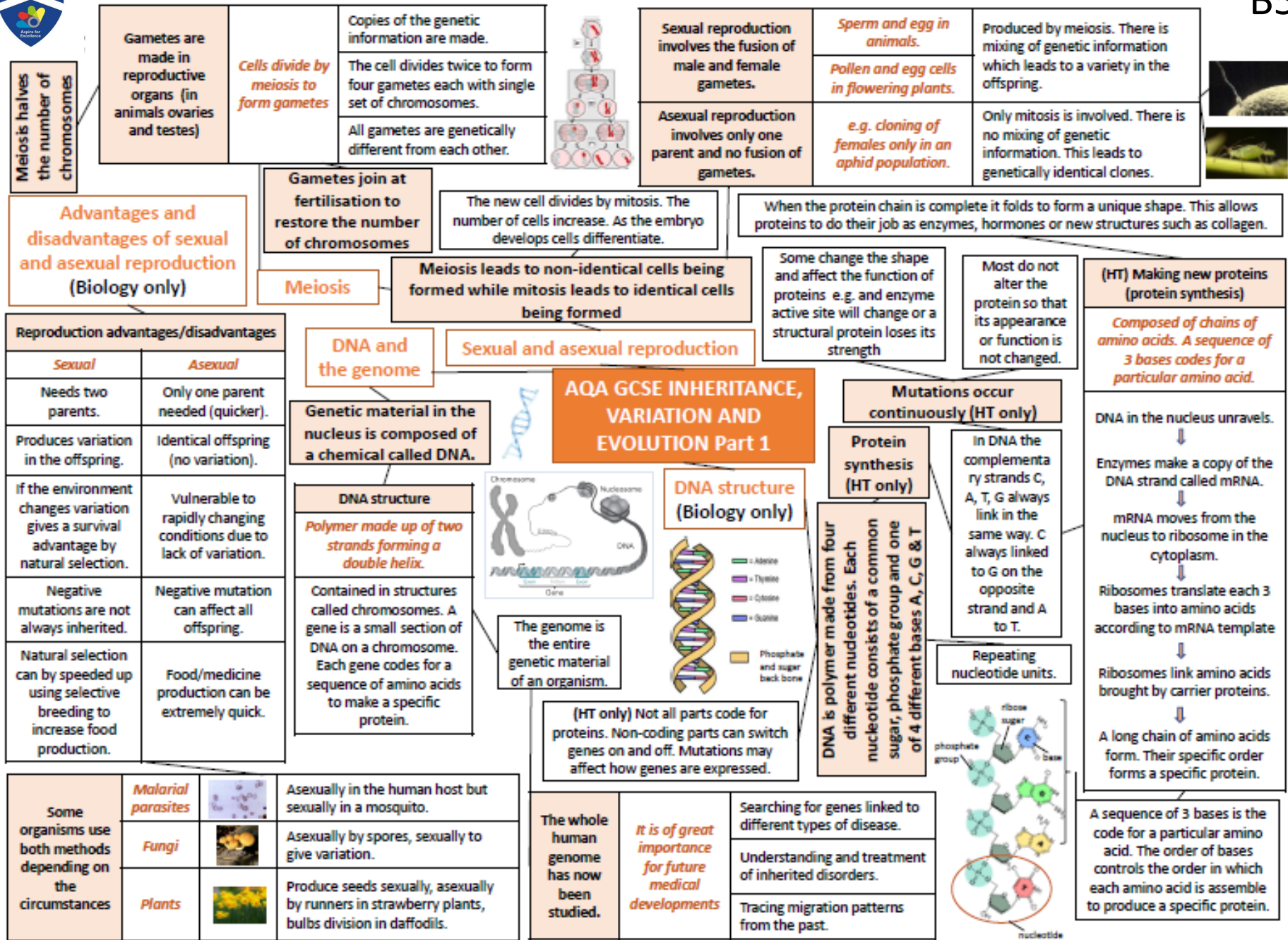
Blood glucose concentration	
Monitored and controlled by the pancreas	
Too high	(HT only) Too low
Pancreas produces the hormone insulin, glucose moves from the blood into the cells. In liver and muscle cells excess glucose is converted to glycogen for storage.	Pancreas produces the hormone glucagon that causes glycogen to be converted into glucose and released into the blood.

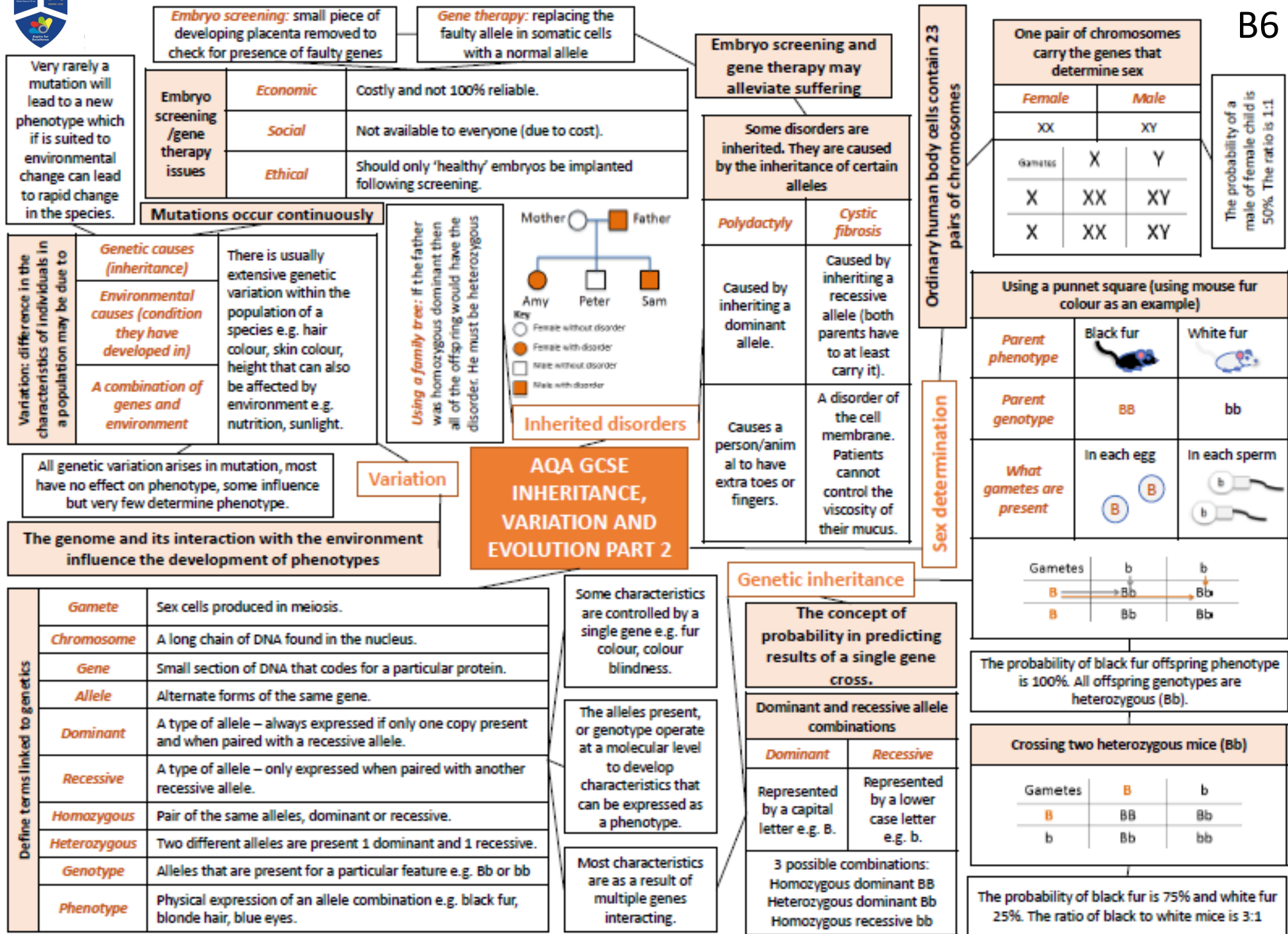
Diabetes	
Type 1	Type 2
Pancreas fails to produce sufficient insulin leading to uncontrolled blood glucose levels. Normally treated by insulin injection.	Obesity is a risk factor. Body cells no longer respond to insulin. Common treatments include changing by diet and increasing exercise.

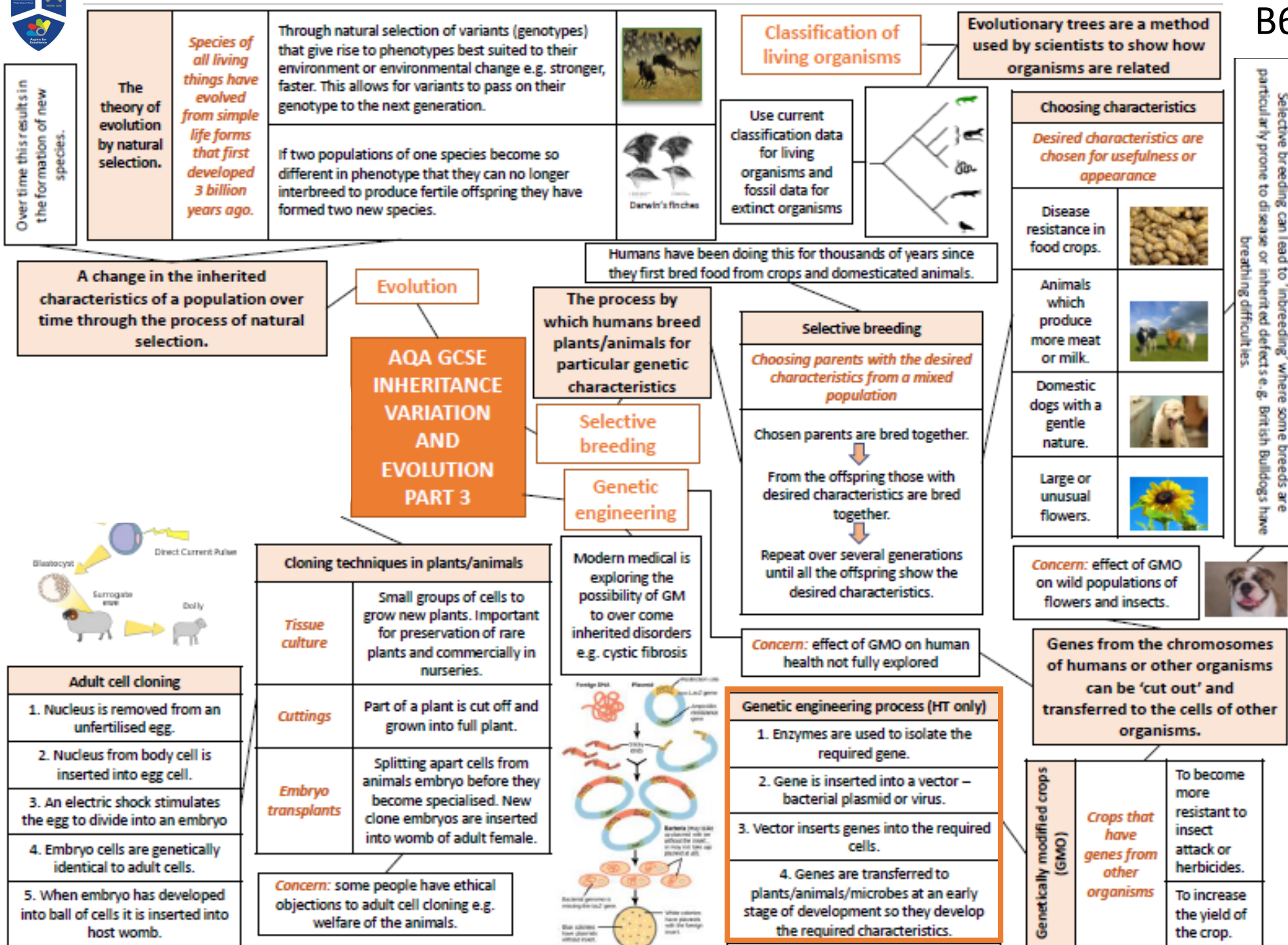
(HT only) digestion of proteins results in excess amino acids. In the liver they are de-aminated to form toxic ammonia which is converted to urea

(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











Charles Darwin

Theory of evolution by natural selection.

- Individual organisms within a particular species show a wide range of variation for a characteristic.
- Individual most suited to the environment are more likely to breed successfully.
- Characteristics enable individuals to survive are then passed on to the next generation.

Evidence from around the world, experimentation, geology, fossils, discussion with other scientists (Alfred Wallace) lead to:

Charles Darwin 'On the Origin of the Species' (1859)

Published the theory of evolution by natural selection

Slowly accepted; challenged creation theory (God), insufficient evidence at time, mechanism of inheritance not yet known.

Other theories e.g. Lamarckism are based on the idea that changes occur in an organism during its lifetime which can be inherited. We now know that in the vast majority of cases this cannot occur.

The full human classification

Classification of living organisms

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

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

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

Carl Woese

3 domain based on chemical analysis.

Archaea (primitive bacteria), true bacteria, eukaryota.

AQA GCSE INHERITANCE VARIATION AND EVOLUTION PART 4

Evidence for evolution

The understanding of genetics (biology only)

Gregor Mendel

In the mid 19th century carried out breeding experiments on plants

Inheritance of each characteristic is determined by units that are passed on to descendants unchanged.

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, can't be certain about how life began.

Led to gene theory being developed but not until long after Mendel died.

Further understanding of genetics

Improving technology allowed new observations.

Late 19th century: behaviour of chromosomes in cell division.

Early 20th century: chromosomes and Mendel's 'units' behave in similar ways. 'units' now called genes must be located on chromosomes.

Mid 20th century: structure of DNA determined. Mechanism of gene function worked out.



Alfred Wallace

Independently proposed the theory of evolution by natural selection

Published joint writings with Darwin in 1858.

Worked worldwide gathering evidence.

Best known for work on warning colouration in animals and his theory of speciation.



Speciation

Due to isolation of a population of a species e.g. species are split across far apart islands.

Environmental conditions differ for populations e.g. types of food available, habitat.

Individuals in each population most suited to their environments are more likely to breed successfully.

Over long periods of time each population will have greater differences in their genotype.

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.

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.

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.

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



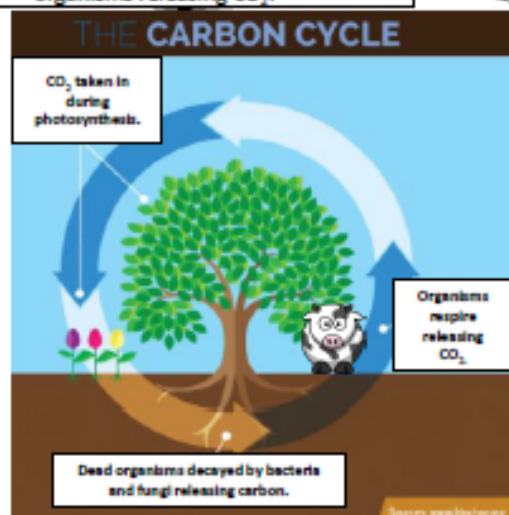
Farmers optimise conditions for making compost for use as a natural fertiliser.

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

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.

Bacteria respire when breaking down dead organisms releasing CO_2 .



Materials are recycled to provide the building blocks for future organisms

Photosynthetic organisms are the producers of biomass for life on Earth

Food chains			
Feeding relationships in a community			
Producer	Primary consumer	Secondary consumer	Tertiary consumer
Grass	Grasshopper	Mouse	Owl
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.	

Decomposition and material cycling

Interdependence and competition

AQA GCSE ECOLOGY PART 1

Adaptations

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

Adaptations may be structural, behavioural or functional.

Levels of organisation

Abiotic and biotic factors.

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.

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.	New pathogens.
Wind intensity and direction.	
Carbon dioxide levels for a plant.	One species outcompeting so numbers are no longer sufficient to breed
Oxygen levels for aquatic organisms.	

Adaptations		
Plants	Animals	Extremophiles
Cactus in dry, hot desert	Polar bear in extreme cold arctic	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.



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.

