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B1 Characteristics of Living Organisms & Cell Structure and Organization

----7 Characteristics of life----

Movement: An action by an organism or part of an organism that changes position or place.

e.g. plants grow in the direction of light

Respiration: Chemical reactions that break down nutrient molecules in living cells to release energy

nutrient molecules that provide energy: lipid and carbohydrates

aerobic and anaerobic

Sensitivity: The ability to detect or sense changes in the environment and to make responses

nerve and endocrine

e.g. Mimosa Pudica, the compound leaves fold inward and droop when touched or shaken, to defend themselves from harm. some plants also respond to temperature and light by facing it or growing in that direction

Growth: The permanent increase in size and dry mass by an increase in number of cells, cell size, or both

Reproduction: Progresses that make more of the same kind of organism

sexual and asexual

Excretion: Removal from organisms of toxic materials, the waste products of metabolism and substances in excess

metabolism: chemical reactions taking place in cells

toxic materials: urea, CO_2

excess substances: minerals, water, glucose

Nutrition: Taking in nutrients which are organic substances and mineral ions, containing raw materials and energy for growth and tissue repair, absorbing and assimilating them.

organic substances: glucose

mineral ions: salt, nitrate, NaCl, KCl

Absorption: A process by which a living thing takes in nutrients

e.g. a digestive system crosses the small intestine into bloodstream

Assimilation: After absorption of nutrients into the bloodstream, the nutrients get transformed to become part of the tissues/cells e.g. glucose converts to energy

-----Cells----

Features found in both plant and animal cells:

- **Cell membrane**: This is a partially permeable membrane separating the cell from the environment its made of lipid and protein, it controls movement of substances in and out, its strong but flexible.

- **Cytoplasm**: This is a jelly like substance, its made of mostly water, CO2, O2 and protein. Metabolic reactions occur in it, holds organelles in place
- **Nucleus**: This determines how the cell behaves and it contains chromosomes made of strings of DNA which also determines which proteins the cell should make etc.
- **Mitochondrion (singular: Mitochondria)**: structures that convert chemical energy from glucose to energy that could be used in moving; RESPIRATION

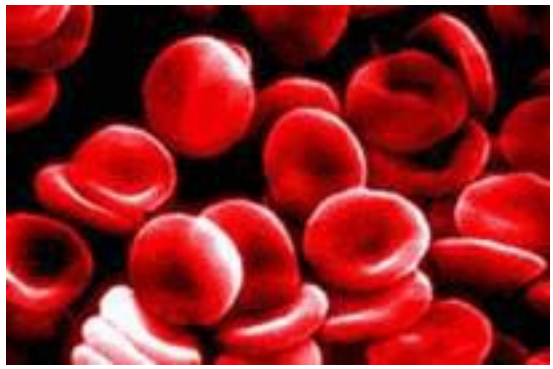
Features found in only plant cells:

- **Cell Wall**: This is a rigid layer surrounding the cell made of cellulose, it gives the plant its shape and gives support to plant.
- Chloroplasts: contains chlorophyll that absorbs light for photosynthesis (making glucose from carbon dioxide and water, using radiation energy)
- Vacuole: contains cell sap which pushes out on cell wall, help support plant, keep the cell turgid.

Animal cells store sugars in glycogen form but plant cells store it as starch. Animal cells have an irregular shape but plant cells have a regular shape.

Specialized Cells

Red Blood Cells:



Red blood cells are found in the blood of animals, it contains haemoglobin which help transport oxygen from the lungs to all the body cells, and carbon dioxide from the body cells to the lungs.

They are adapted by four ways:

- They have a biconcave disc shape that gives it a large surface area to carry more oxygen.
- The outer thin membrane allow oxygen to diffuse through easily
- They have no nucleus, the whole cell is full of haemoglobin, so it can carry more oxygen and CO2
- They are tiny enough to squeeze through capillaries.

Root Hair Cells:

They are located in the roots of plants. They contain no chloroplasts.
Function: to absorb water and minerals from soil by osmosis
Adaptations:

- they have extension that increases the surface area for more water intake
- they have a large number of mitochondria for respiration to become more active (breaks down nutrient molecules more efficiently)

- thin walls, easy for water to enter

Calculations for microscope:

Magnification = Drawing size ÷ Actual size

millimetres or micrometres (μm=10^{-3} mm)

---Movement in and out of cells---

Diffusion:

The net movement of molecules from a region of their higher concentration to a region of their lower concentration down a concentration gradient, as a result of their passive movement.

Rate of diffusion - diffusion tube
Ammonium Hydroxide moves from an area of high concentration - the cotton wool - to that of low concentration - the rest of the tube, down the concentration gradient. Towards the end of the experiment, the rate of diffusion slows down as ammonium hydroxide molecules diffused further away from the cotton. The further it goes, the fewer molecules are left to diffuse.

The more energy atoms have, or the smaller the molecules are, the faster they move about. Eventually, the mixture reaches a state of ***equilibrium,*** *in which the molecules of both substances are evenly mixed in the container.*

Diffusion through membrane experiment

1) iodine solution in visking tube, and starch solution outside in test tube
2) starch solution in visking tube, and iodine solution outside in test tube

iodine moves from high concentration area to low iodine concentrated area, the molecules are small enough to pass through visking tubing
ONLY iodine can move through visking tube

---Diffusion of gases---

We breathe in due to respiration. Our lungs fill with air; there is a concentration gradient between the oxygen in the lungs and the oxygen in the blood. There is a high concentration of oxygen in our lungs, there is a low concentration of oxygen in the blood. So oxygen diffuses from the lungs to the blood. The blood now rich in oxygen is being carried away, the concentration gradient is maintained.

- Oxygen goes out from the lungs to red blood cells in blood vessels
- Carbon dioxide goes into the lungs
- the blood capillary is constantly moving

Osmosis:

The diffusion of water molecules from region of their higher concentration (dilute solution) to a region of their lower concentration (concentrated solution), through a partially permeable membrane. (the diffusion of water molecules)

Plasmolysis:
Detachment of cell membrane from cell wall. Cytoplasm shrinks
Why do plant cells plasmolyse?
Due to water loss.
Cytoplasm contains a lot of water, water molecules move from cytoplasm to the outside which is low in H2O.
Cell walls retain the cytoplasm's position, only plant cells plasmolyse.
turgid vs. flaccid
turgid - firm
flaccid - floppy, the length decreases

- isotonic (the same concentration)
- hypertonic (concentrated, H2O moves out e.g. salt)
- hypotonic (diluted, H2O moves in)

B2 Nutrition and Transport in Plants

Types of nutrition:
Autotrophic: simple compounds are absorbed and built up into complex substances
Heterotrophic: complex compounds is broken down to simple substances

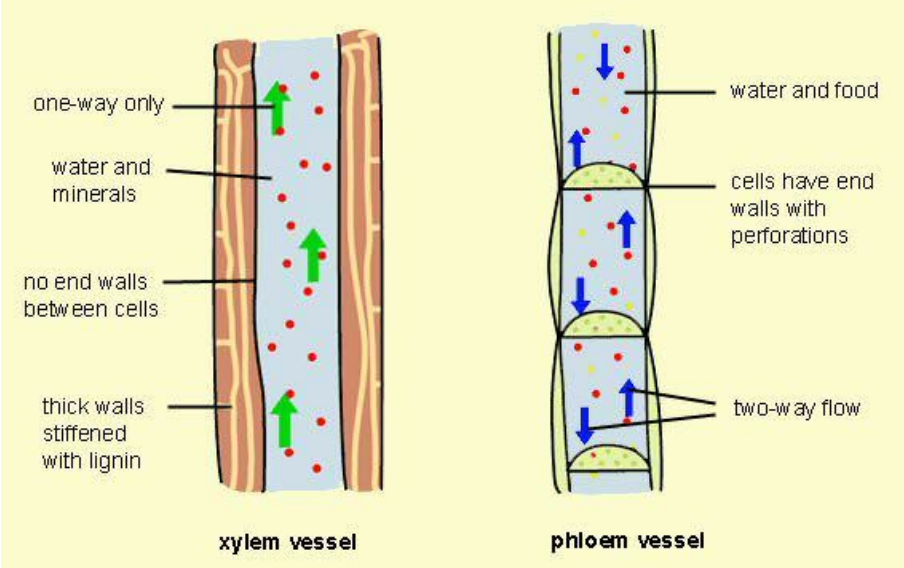
Photosynthesis:
Carbon dioxide + water -->glucose + oxygen
6 CO2 + 6 H2O ---> C6H12O6 + 6 O2

Stomata:
Stomata are openings in the cells underneath a leaf which allow gases to pass in and out. Guard cells on either side of the stomata control how far they open. They are also responsible for controlling water loss from the plant.

Chloroplasts:
They give the plant its green pigment (chlorophyll) and help with the absorption of light for photosynthesis
Chlorophyll:
-found inside chloroplasts

-traps sunlight and converts it into chemical energy

Vascular Bundle: commonly found in the cross section of a leaf
It's made up of a xylem and a phloem.



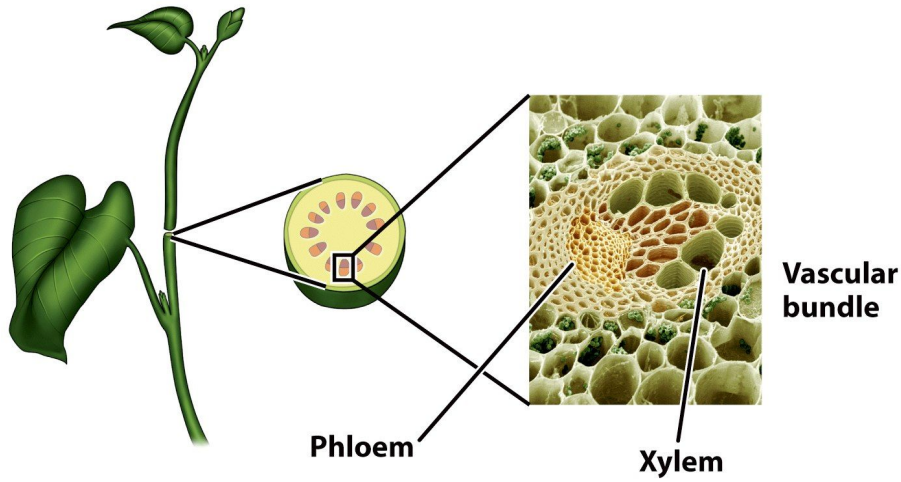


Figure 31-5 part 1 Discover Biology 3/e
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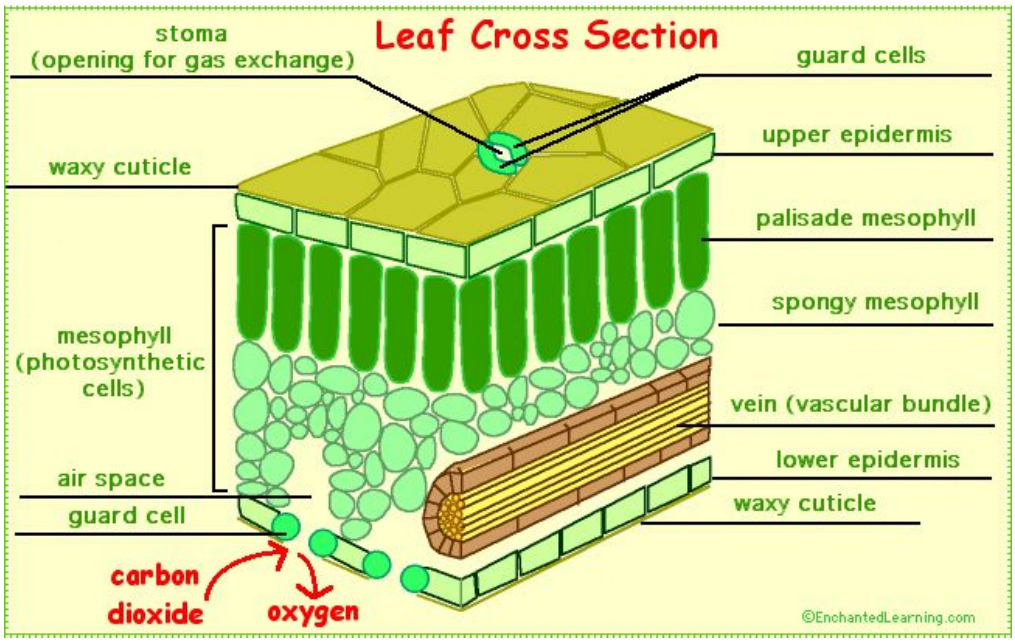
Transpiration:
Transpiration is the movement of water particles from the soil through the cortex of the root hair cells, up into the leaves to allow for evaporation of the water vapor.

Root hair cells are specialized for absorbing water and other minerals from the soil. They have large surface areas to absorb more, speeding up osmosis

The capillary action that travels upwards is the indication that the water molecules are pulled up by xylem. The xylem in the leaf is inside the veins and run throughout the leaf. Water leaves the xylem and moves by osmosis from the cell to cell. Some of it moves to cells for turgor or to be used in photosynthesis, but 90% of water leaves

via stomata. This water evaporates in the air spaces of the spongy mesophyll and exits as a gas. This process is called **transpiration. water loss through the stomata, and evaporate into the air**

Cross section of a leaf:

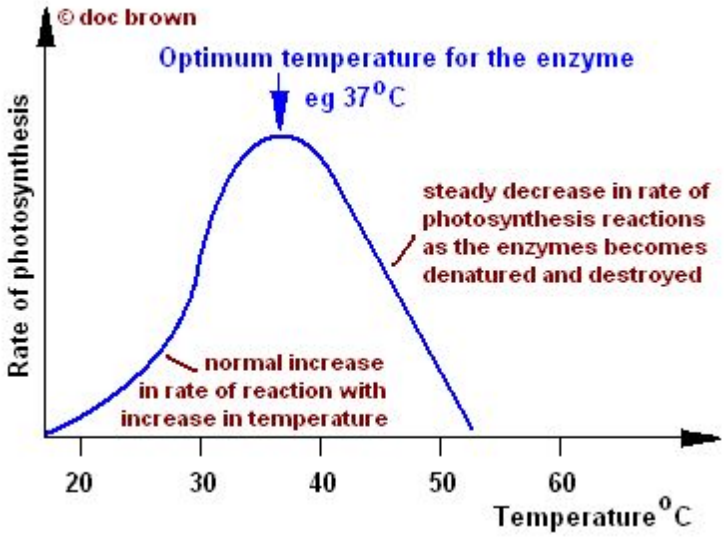


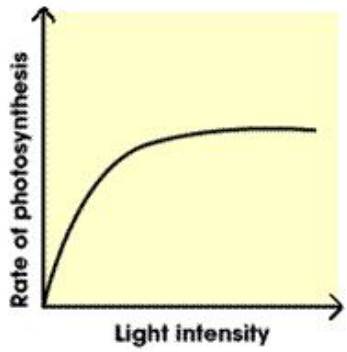
Structure	Function and Features
Waxy cuticles	-decreases water loss -transparent so that light can pass through
Upper epidermis	-supports the leaf when cells are turgid
Palisade mesophyll	-cells tightly packed -contain many chloroplasts for maximum light absorption -where photosynthesis takes place -longitudinal
Spongy mesophyll	-loosely-packed cells -allows diffusion of gases through large air spaces
Phloem	-transport nutrients -flow in both directions -translocation -passive (osmosis) and active transport (load and unloading sugar) -living tubes

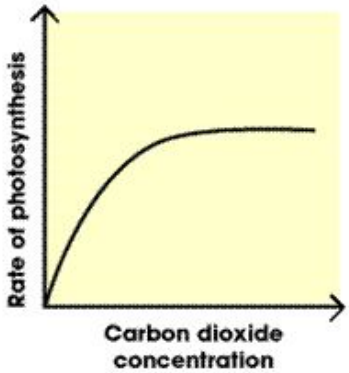
Xylem	-transport water from the roots to leaves -thick, lignified walls -flow upwards by osmosis -transpiration -dead, hollow tubes -cohesion of water particles and adhesion to the xylem wall
Lower epidermis	this layer has guard cells which controls the opening of stomata

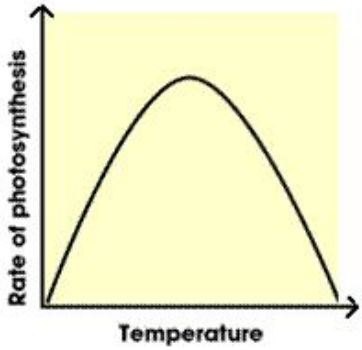
Factors that affect the rate of Photosynthesis:

- temperature
- CO2 concentration
- light intensity









As light intensity increases, the rate of photosynthesis is limited	Increasing carbon dioxide concentration causes a rapid rise in the rate of	If it gets too hot or too cold, plants cannot photosynthesize. The

by other factors, so the rate plateaus.	photosynthesis, which eventually plateaus when the maximum rate of fixation is reached.	enzymes will denature.

Minerals required by plants:
Plants need minerals for healthy growth. These are absorbed through the roots as mineral ions dissolved in the soil water.
nitrate - make amino acids, which are needed to make proteins
magnesium - for making chlorophyll
deficient in nitrate - plant will suffer from weak stem, dying leaves and stunted growth
deficient in magnesium - plant's leaves will turn yellow (lack of chlorophyll) and die

Why are nitrates important for the production of amino acids and therefore proteins?
By absorbing the nitrate, later on nitrogen can be separated along with other elements to produce amino acid. It is the only way plants can get nitrogen.

Eutrophication:
In order to prevent nitrate deficiency in plants, farmers often use ammonium nitrate fertilizer. This ensures that plants and crops receive as much nitrate ions as they need. Overuse of nitrate fertilizer has led to some serious problems.
Excess minerals -> excessive growth of plants -> death of plants -> increase in anaerobic bacteria -> end of ecosystem in that area

B3 Nutrients, Enzymes and Animal Nutrition

Nutrients:
Nutrition is the intake of nutrients (organic substances and mineral ions), which contain raw materials or energy, which are absorbed and assimilated and then can be used for growth and tissue repair.

Nutrient	Elements	Polymer (Chain of units)	Subunits (Monomer)
Carbohydrate	Carbon, hydrogen, oxygen	polysaccharides e.g. starch, glycogen, cellulose	monosaccharides e.g. glucose, fructose, galactose
Protein	carbon, hydrogen, oxygen, nitrogen	polypeptide e.g. enzymes, insulin, haemoglobin	amino acids

lipids (fats)	carbon, hydrogen, oxygen	triglycerides	fatty acids and glycerol

Nutrient	Role in the body	Example
Carbohydrates	-essential in respiration to release energy (mitochondria) -create cellulose which forms cell walls	bread, cereal
Protein	-helps build and repair body tissues -helps to build antibodies -make enzymes	fish, eggs, milk, peas, meat
Lipids (fats)	-Release high amounts of energy -Make cell membranes Store them under the skin to insulate heat. -Forming a layer of fats around organs to protect them from damage -Storing energy (better than glycogen)	meat, cheese
Vitamins		fruits
Minerals		milk, dairy products
Fibre	-not absorbed in the body -mostly cellulose which makes up the cell wall in plants	oranges, vegetables (carrots, broccoli)
Water	-As a solvent which reactants of metabolic reactions are dissolved in. -It makes up most of the blood plasma which red blood cells, nutrients, hormones and other materials are carried in. -It helps in lowering the body temperature in hot conditions by secreting it as sweat on the skin, the	

	sweat evaporates using heat energy from the body, thus lowering the temperature.	

Food tests:
-reducing sugar/glucose (Benedict's test)
blue to red
-starch (iodine test)
yellow/brown to blue/black
-protein (biuret test)
colorless purple
-lipids (Emulsion test/ethanol)
cloudy white suspension

Nutrient Deficiencies:
Vitamin C is essential for the formation of collagen (protects cells), makes skin healthy, helps absorb iron. It is present in citrus fruits e.g. oranges, limes etc. It also helps absorb Iron. Deficiency in Vitamin C can lead to Scurvy which is a disease that causes spongy gums, joints pain, loose teeth.

Vitamin D is essential to absorb calcium from the small intestines and deposit it into the bones. Animals receive Vitamin D by being exposed to ultraviolet light of the sun. Deficiency in Vitamin D can lead to Rickets which causes bone-softening, unexplained muscle weakness.

Calcium is needed in formation of bones and teeth. Deficiency in Calcium can lead to osteopenia (decreased bone mineral density) which causes memory loss and risk of bone fractures.

Iron is needed in the formation of red blood cells (carries oxygen specifically red pigment haemoglobin). Deficiency in Iron leads to anaemia which causes people to feel weak and tired.

Making Yoghurt
-Milk is pasteurised at 95˚C to kill any microorganisms
-it is left to cool down so that harmful microbes cannot grow
-Add Lactobacillus bacteria into the solution
-the bacteria breaks down lactose in milk into lactic acid through fermentation. lactic acid brings down the pH rate and denatures the milk protein.
-store the yoghurt at 4˚C so it solidifies

Enzymes:
Enzymes are biological molecules that are incredibly important to the functioning of any organism. They are complex molecules constructed from long protein chains. They can take many different shapes, but each one will be specific to its particular job.

Enzyme is a substance (protein) produced by a living organism which acts as a catalyst to bring about a specific biochemical reaction. It works on a specific substrate and speeds up the breaking down process.

Substrate is the molecule upon which an enzyme acts.

Active site is a small part in an enzyme where substrate molecules bind and undergo a chemical reaction.

Enzyme substrate complex is a non-covalent complex composed of a substrate bound to the active site of the enzyme.

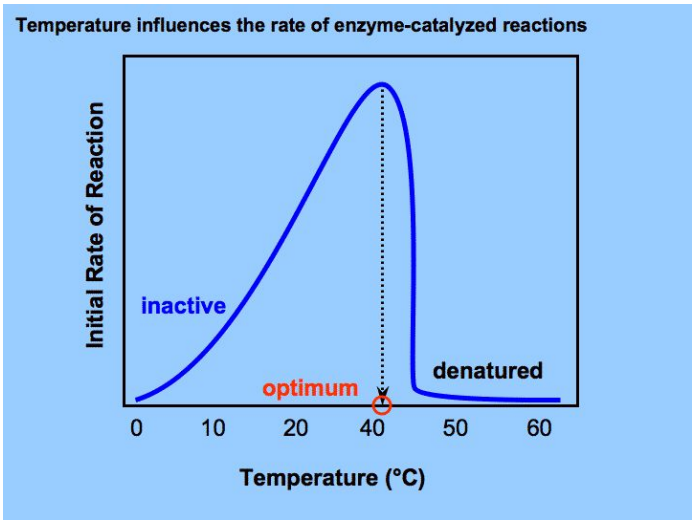
Products are the result of enzyme action on substrates.

Biological Catalyst is a substance that can cause a change in the rate of a chemical reaction without itself being consumed during the reaction.

Substrate that you wish to break down **fits into** the active site of the enzyme. The active site **have a specific shape** that will only fit **one** type of substrate. When the substrate enters the active site it forms the enzyme substrate complex. The reaction will occur and **two new products** will be released.

Factors affecting enzyme activity:
pH and temperature

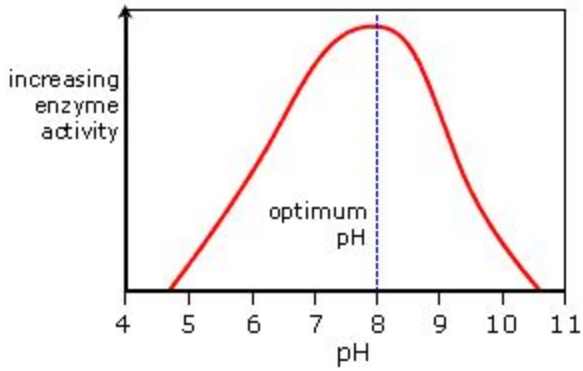
- At low temperature enzymes are inactive as they lack the kinetic energy for successful collisions between the substrate and enzyme active site
- As the temperature increases, the particles have more kinetic energy, which at the optimum temperature results in more frequent and energetic collisions



between substrates and enzyme, leading to a highest rate of reaction

- Enzymes begin to denature beyond the optimum temperature. Due to the heat energy bonds within the enzyme are disrupted and the active site loses its specific shape. This results in the substrate no longer fitting into the active site which results in a slower rate of reaction.

- Enzymes also have an optimum pH range, although this differs between the type of enzyme and where it is found in the body
- The optimum pH will be linked to its environment, i.e. pepsin in the stomach will have a low optimum pH due to the acidic environment of the stomach
- Outside this optimum, enzyme activity will drop off, as the weak bonds will be disrupted causing denaturation. This is not a permanent denaturation and returning the pH back towards the optimum should restore the enzyme's function.



Animal Nutrition:
A balanced diet is not the same for all people, it depends on the **age, sex and activity level.**

<u>Malnutrition</u>

Malnutrition	Causes	Symptoms	Treatment/suggested diet
Starvation	not consuming essential nutrients required due to drought, poverty, war etc.	-weight loss -lack of Iron leads to anemia (low amount of red blood cells) -Vitamin B1 deficiency -Scurvy (lack of vitamin C)	nutrients need to be reintroduced gradually into the system
Heart Disease	high amounts of sugar in blood, certain fats, cholesterol, drug	shortness of breath, swelling chest pain, lack of energy,	-reduce sodium intake -avoid food with fats and trans fats

	abuse, stress	sleeping/breathing problems	-replace with olive oil -reduce alcohol intake and smoking -exercise -medication+surgery -eat fish and soybeans
Obesity	-imbalance between calorie intake and energy expenditure -simple carbohydrates overdose	-breathlessness -increased sweating -snorting -sleeping difficulty -unable to cope with sudden physical activities	-exercise -balanced diet
Constipation	inadequate water intake, fibre, disruption of normal activity, eating disorders, inadequate activity, overuse of laxatives	-infrequent bowel movements -hard/small stools -abdominal pain or swollen abdomen	-drink more water (2L per day) -avoid caffeine -eat a well-balanced diet high in fibre (fruits and veg) -drink warm liquids

Digestion and the Digestive System

Food can be broken down in two ways

-mechanical digestion

- chewing in mouth with teeth and churning in stomach

-chemical digestion

- mouth: salivary amylase (breaks down starch only)

-stomach: gastric juices containing protease(pepsin) and HCl (protease acts in acidic conditions)

-small intestines (duodenum, jejunum, ileum): digestion and absorption

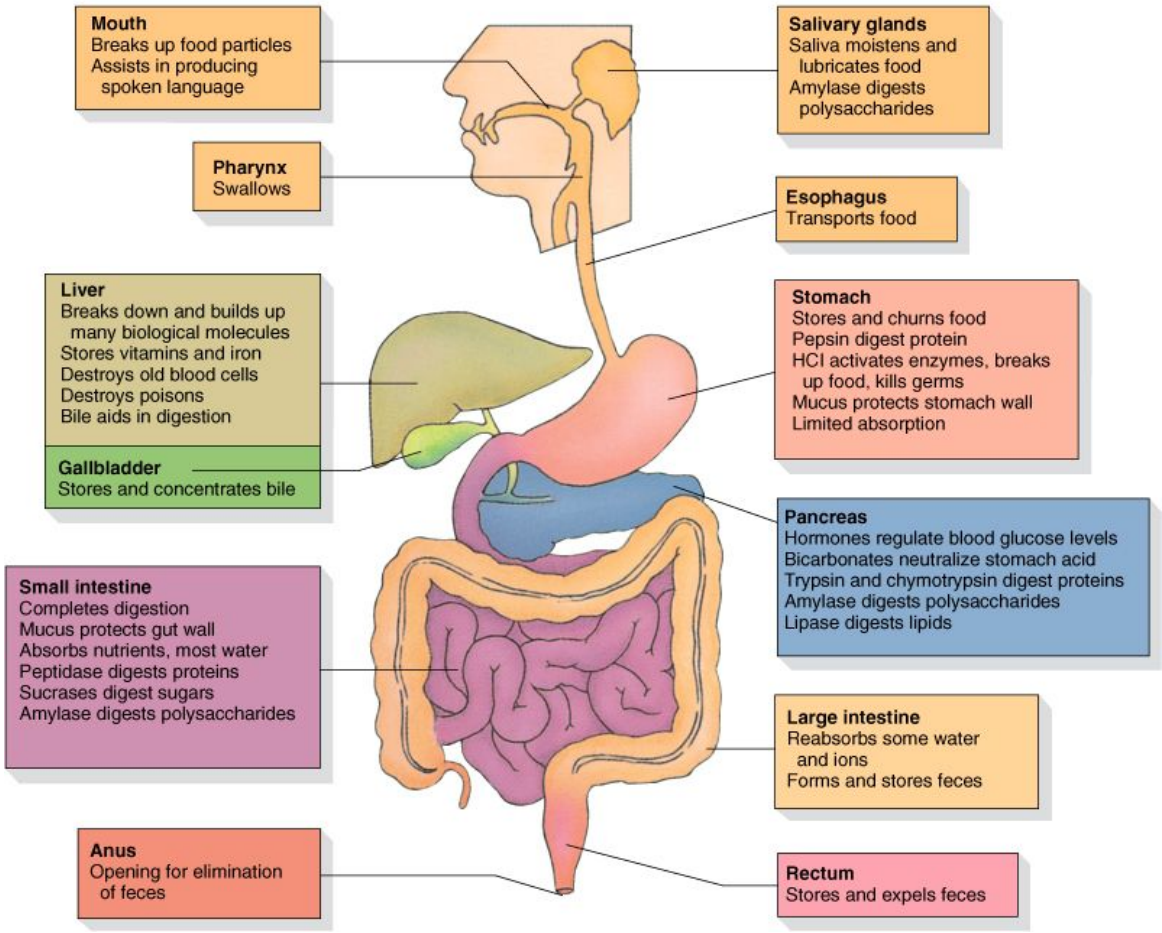
-pancreas: releases enzymes and alkaline

-liver: produces bile (stored in gall bladder) which breaks down fats

-large intestines: reabsorb water, manufactures vitamins, egestion

Along the alimentary canal, ingestion, digestion, absorption, assimilation and egestion occurs.

Process	Description	Parts of Digestive system
Ingestion	Taking food into the body	-mouth
Digestion	Large insoluble molecules are broken down into small soluble molecules. Starch digestion begins. Protein digestion begins. All types of digestion occur.	-mouth -stomach -small intestines
Absorption	The transfer of digested substances from the intestine into the blood. Majority of absorption Water absorption	-small intestines -large intestines
Assimilation	The soluble products of digestion are taken to cells and used to make structures in the cells. Examples: glucose converted to glycogen Amino acids built up into proteins Fatty acids and glycerol turned into lipid for storage	liver cells muscle cells fatty tissue under skin
Egestion	Removal of waste material that could not be digested	large intestines



<u>Teeth</u>

-mechanically break down items of food by cutting and crushing them in preparation for swallowing and digestion

Incisor: (8)

-small&sharp

-at the top

-cuts food e.g. bite an apple

Canine: (4)

-next to incisors

-sharp with long roots

-tearing food apart

Premolar: (8)

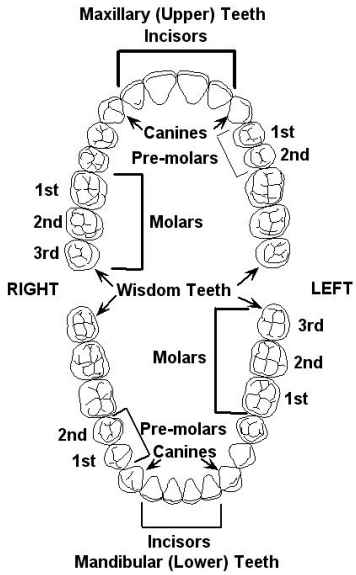
-transitional teeth

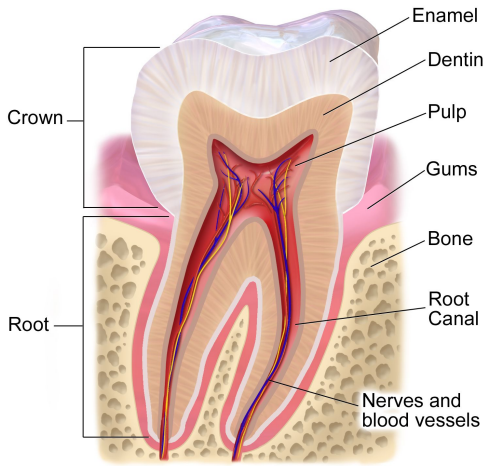
-they have two cusps that help chewing and holding food

Molar: (12)

-large flat biting surface

-chew, crush, grind food





Tooth Anatomy

Tooth decay

What is it? -bacteria reproduces in plaque -plaque hardens when protein and byproducts of food mix -erosion occurs and reaches nerves and blood vessels -result of an infection with certain types of bacteria that use sugars from food to make acids
Causes: -not brushing your teeth regularly -not seeing dentist -food high in sugar and other carbohydrates, which feed the bacteria in the mouth -not getting enough fluoride prevents tooth decay
Effects: -toothache -formation of cavities -gum disease -eventually loss of tooth
Treatment: -fluoride varnish -remove the soft decay and replace with a filling or crown -root canal treatment remove the teeth
Prevention: -brush regularly with fluoride toothpaste -drink water after eating -avoid sticky sweets -avoid frequently snacking or sipping drinks other than water

Absorption and Assimilation

Part of digestive system	Enzyme secreted from	enzyme	substrate	product
Mouth	salivary gland	amylase	starch	glucose
Stomach	stomach wall	protease (pepsin)	proteins	peptide
small intestine	pancreas	amylase	starch	glucose
stomach	gastric juice	protease	proteins	amino acids
pancreas	pancreas	lipase	lipids	fatty acids and glycerol

Bile

Bile is made in the liver and stored in the gall bladder. The function of bile is to neutralize the acidic contents from the stomach and enter the small intestine. It also breaks lipids into small droplets to increase the surface area for digestion by lipases. This is called emulsification.

Adaptation for Absorption

The inner lining of the intestine is highly folded, forming structures called villi. This allows for greater surface area available for absorption. This villi is also one cell thick to speed up diffusion. (thin membrane) Each villi has a rich blood supply and a lacteal at its centre. On the surface of the villi are microvilli, in order to further increase the surface area.

mitochondrion - active transport

use energy to bring large molecules

lacteal - lymph vessel -transport fatty acids and glycerols from the small intestines

low concentration gradient inside the blood capillary bed so nutrients (amino acids and sugar) diffuse quickly

Assimilation is the conversion of nutrient into the fluid or solid substance of the body, by the processes of digestion and absorption. (nutrients become part of the body tissue through metabolic processes)

liver releases glucose, fatty acids, amino acids, vitamins and minerals

veins in villus flow into the liver through hepatic portal vein

Fats vs. glycogen

Fats requires less space for storage and contains twice amount of energy

glycogen has good supply of immediate energy

B4 Ecology

food chain, food webs, trophic levels, pyramid(energy level)
efficiency (energy used or passed on /total energy<10%)
Add CO_2 into the environment - combustion, decomposition, respiration
Add oxygen into the environment - photosynthesis
absorb CO_2: photosynthesis
Ecosystem: the interaction of organisms and their environment in a given area
Food web: a network of interconnected food chains showing the energy flow through part of an ecosystem
Food chain: a chart showing the flow of energy from one organism to the next beginning with a producer
Population: a group of organisms of one species, living in the same area at the same time
Food pyramid: shows the relative sizes of different components at the various trophic levels of a food chain

Energy lost from food chain:

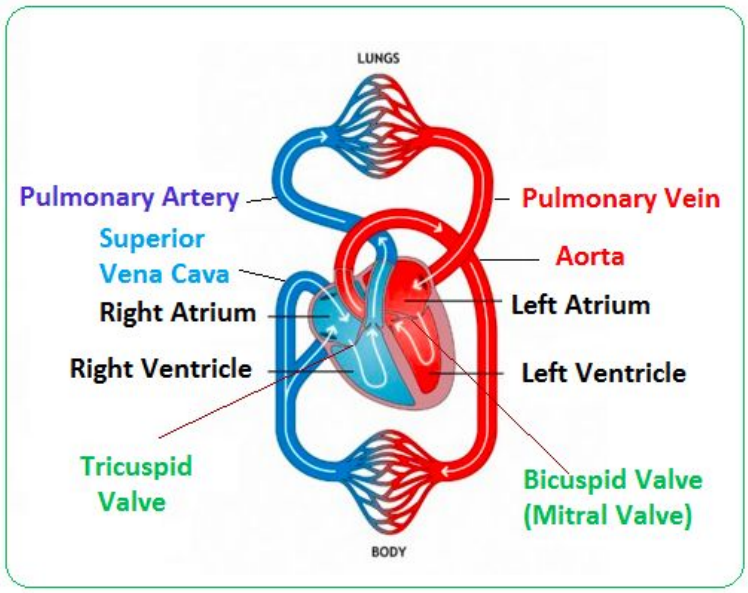
- Respiration; energy lost as heat
- Not all organisms are being eaten/fed on so this energy goes to decomposers' food chain
- Not all food digested/absorbed, so some energy lost in faeces

*Arrows used to represent the direction of energy flow, point towards the eater, away from plant

The sun should not be included in a food web/chain. It is the source of light and heat energy. Photosynthetic plants can trap light energy and convert it to chemical energy.

B5 Transport in Humans

The circulatory system in mammals transport essential chemical substances to and from all of the cells in our bodies. The heart pumps a network of blood vessels to reach out cells, which the lungs replace the oxygen used during respiration.
double circulatory system
-blood is sent to the lungs and rest of body each time the heart beats
-each circuit is kept separate so that it is more efficient to deliver oxygen to the tissues than single circulation



1. The left side of the heart pumps oxygenated blood from the lungs, through the pulmonary vein, through the aorta, to the rest of the body
2. Deoxygenated blood returns from the body to the right side of the heart via the vena cava
3. It is then pumped to the lungs through the pulmonary artery where it is oxygenated
4. Blood returns to the left side of the heart, via the pulmonary vein and the whole circulation repeats

Valves: Left BI, Right TRI

**Blood enters the heart in the right atrium. As these fill up, the tricuspid valves open and blood begins to fill the right ventricle. When these cause the muscle to contract, the tricuspid and bicuspid valves close to prevent backflow into the right atrium. Blood is forced into the pulmonary artery and the aorta. The atrioventricular valves then close, preventing backflow into the ventricles.

The sound of the heart: opening and closing of the valves, contraction and relaxation of heart muscles

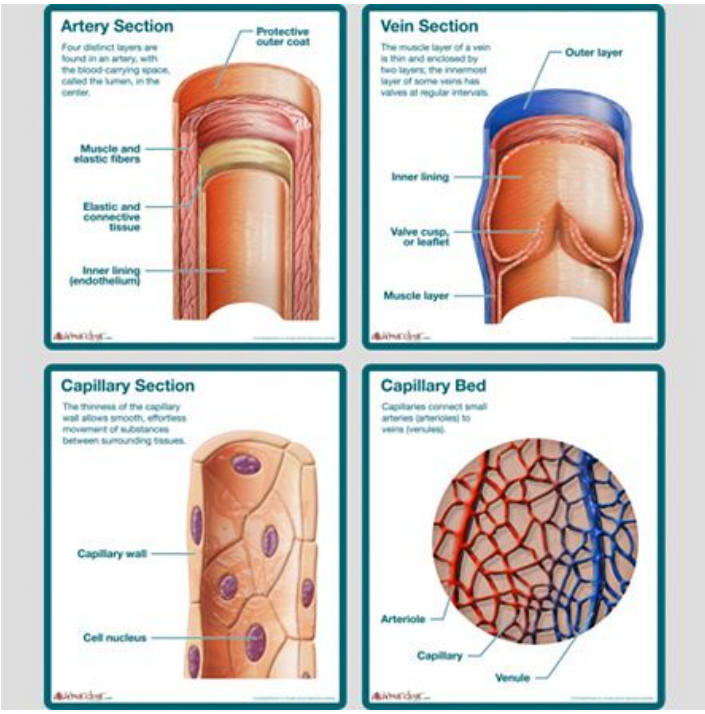
Prevent backflow
-atrio-ventricular valves - bicuspid and tricuspid - to prevent blood from flowing back to left and right atriums, it closes when the atria contracts, forcing blood into the ventricles
-semi-lunar valves prevent blood in the pulmonary artery and aorta to flow back into the ventricles

WHY aorta has more pressure than pulmonary artery:
-it has to pump blood to the rest of the body

-the left ventricle has thicker wall, therefore, when it contracts, the pressure is going to rise more

Why do the ventricles need more cardiac muscle than the atria?
Blood is under higher pressure to go further so more force required

Capillary, vein, artery

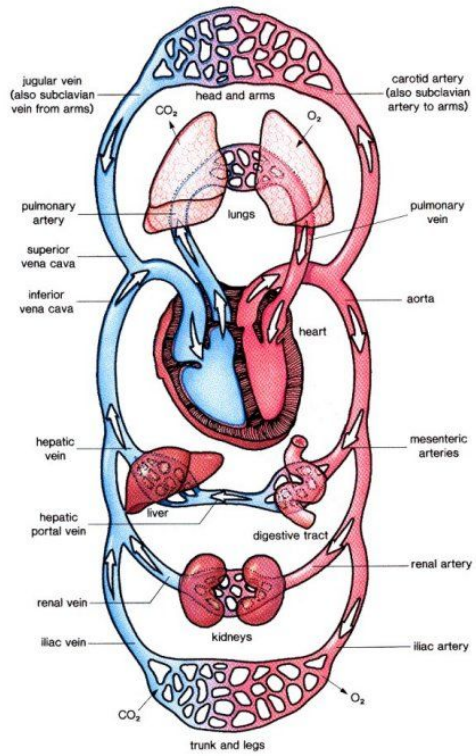


Arteries: (arteries away from heart)
They are blood vessels that carry blood to the body tissues e.g. pulmonary artery and aorta. Because arteries have to withstand the high pressure of the blood during each heartbeat, they have thick, elastic walls which substances cannot pass through
-small lumen, smaller width compared to veins
-NO VALVES except for pulmonary artery and aorta that have semilunar valves
-Elastic, muscular fibres allow artery to stretch (elastic and large surface area) when blood is forced into it

Veins: (veins towards heart)
-carry low pressure blood to the heart so there are only thin muscle layer
-valves to stop backflow EXCEPT pulmonary vein and vena cava
-large lumen (small passageways for blood)
-fewer elastic fibres

Capillaries: NO MUSCLE OR ELASTIC FIBRES OR VALVES
-transfer blood from veins to arteries

-lumen is the same width as one RBC (red blood cells are in contact with wall, short diffusion distance)
-microscopic, walls are one cell thick
-where gas exchange take place, O2 passes through the capillary walls and into the tissues, CO2 passes from the tissues to the blood
-very low blood pressure



REMEMBER: veins are DEOXYGENATED, goes back to the HEART, arteries pump blood to the REST OF BODY
The vessel taking blood to the kidneys is the renal artery
The vessel taking blood AWAY from the kidneys is the renal vein
The vessel taking blood to the liver is the hepatic portal vein (70%) and hepatic artery (30%)
The vessel taking blood AWAY from the liver is the hepatic vein

Blood

White Blood Cells

Platelets

- Clump together to form clots
- Protect the body by stopping bleeding

Plasma

- Fluid part of blood
- Carries carbon dioxide, hormones and waste

- phagocytes
    - non-specific
    - loped nucleus, irregular shape
    - engulf/ingest any foreign material/pathogens
    - release an enzyme to destroy them
    - send out chemical messages to help lymphocytes identify the type of antibody needed
- lymphocytes
    - each lymphocyte carries a specific type of antibody
    - produce antibodies to destroy pathogens
    - goes through cell division
    - B cells
        - make large amount of specific antibodies
    - T cells
        - kill virus-infected cells directly
        - help b-cells to make antibodies
        - send instructions to immune system (memory cell, initiates immune response when a previously encountered antigen attacks)

Red Blood Cells

- transport oxygen for aerobic respiration
- contain haemoglobin - a red protein that binds with O2
- no nucleus so more haemoglobin
- small and flexible to fit into blood vessels
- biconcave shape - larger surface area for O2 absorption
- thin membranes for diffusion - short distance from cell to wall

Coronary Heart Disease

When coronary arteries supplying blood to heart muscle are blocked by a buildup of fatty plaques containing **cholesterol**

If the artery is blocked, the blood supply to the brain and heart is cut off. This means that glucose and oxygen cannot reach some cells. The heart muscle won't work properly (hardly any energy - glucose and resources - O2) and will cause a heart attack. In the brain it will cause a stroke. The atheromas/plaque narrow the arteries, so a clot may block the artery completely.

Risk factors:

-poor diet consisting more saturated fat which can increase cholesterol levels

-stress

-smoking - increase blood pressure as CO stick to haemoglobin which transport oxygen, therefore, less oxygen is transported to the heart and other body tissues.

Also, tobacco damages artery walls, narrowing in the artery, increasing blood pressure
-lack of exercise and being overweight
Preventions:
-exercise more
-don't smoke, avoid passive smoking
-healthy diet low in cholesterol level
-regular check-ups

B6 Respiration

Breaking bonds releases energy, making bonds requires energy. This is true whether it is in a substrate of respiration or the energy transfer molecule ATP.
chemical reactions that break down nutrient molecules in living cells resulting in the release of ATP

Aerobic and anaerobic respiration

Aerobic - with oxygen: glucose + oxygen ---> carbon dioxide + water + energy
The energy is lost as heat, the rest is for:
-muscle contraction
-protein synthesis
-keeping warm
-passing nervous impulses
-growth and repair of cells
Anaerobic - without oxygen:
-animal muscle tissue: glucose--->lactic acid + small amount of energy

1. lactic acid builds up in the muscles
2. it diffuses from the muscles into the blood and is taken to the liver
3. liver breaks it down by combining it with oxygen
4. therefore, extra oxygen is needed
5. so you breathe faster when you just finished exercising to pay off oxygen debt

more oxygen is needed to pay off your O2 debt from your anaerobic respiration in order to break down/oxidize lactic acid

-plants and fungi (yeast) (fermentation): glucose ---> ethanol + carbon dioxide + little energy

Fermentation

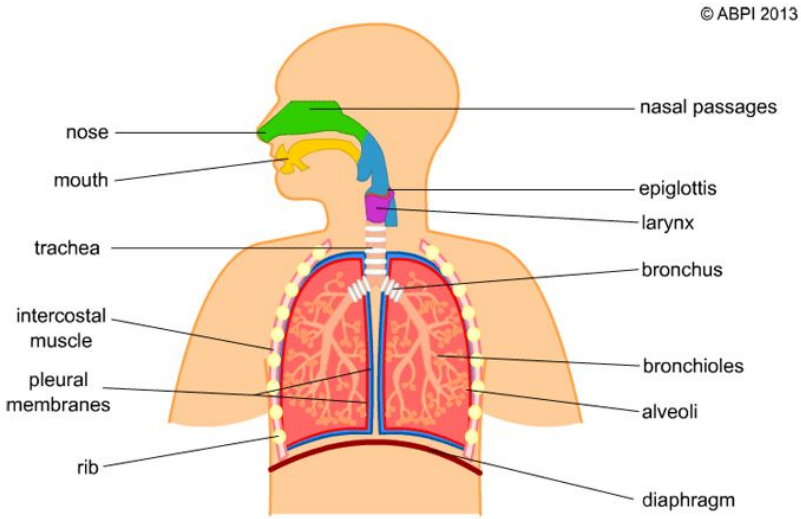
-turns starch into sugar with an enzyme
-glucose is broken down by enzymes from the yeast
-the yeast consumes sugar for anaerobic respiration (cannot get O2 while it is in a dough)
-CO2 makes the dough rise as gas bubbles spread through the dough giving it a spongy texture
-when its cooked, alcohol/ethanol evaporates and kills the yeast

- In bread-making, the yeast starts off respiring aerobically, producing water and also carbon dioxide to make the dough rise. When the air/oxygen runs out, the yeast begins to respire anaerobically.

test for carbon dioxide:

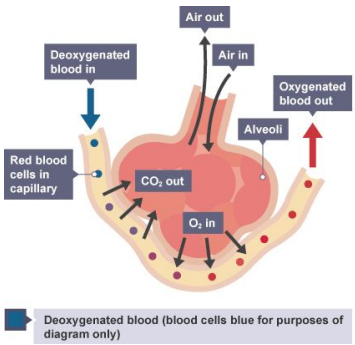
- Limewater turns cloudy white
- exhaled air contains more carbon dioxide than inhaled air
- CO2 dissolves in water to form a weakly acidic solution

The Breathing System - Gas Exchange



cartilage ring: acts as a cushion between joints
C-shaped: to prevent trachea from collapsing, keeping it open for air, allowing it to collapse slightly for food to go down the esophagus

Alveoli:
-large surface area for gas diffusion (O2 in and CO2 out)
-one cell thick walls, short distance for gas diffusion
-moist; to dissolve oxygen before it enters the blood



Smoking
tar - likely to cause cancer
paralyzes and damages cilia, destroys coronary blood vessels

nicotine - addictive, increases blood pressure
carbon monoxide - combines with haemoglobin in red blood cells, decreases the amount of oxygen which can be transported, blood pressure increases as heart beat increases

- When dirt and pathogens collect in the lungs, mucus is produced to trap them. Mucus is then pushed up and out of the lungs by ciliated cells.
- However, tar in cigarettes paralyses the cilia, the mucus builds up in the lungs and cannot be removed.
- Heat also damages cilia, which results in a buildup of mucus in the trachea
- smoking and excessive coughing damage the walls of the alveoli, making gas exchange difficult to take place
- damages the blood vessels; destroys layers of cells, allowing fats and plaque to stick to the walls

B7 Coordination and Response

Stimulus: change in the environment
Responses: actions taken by the body in order to cooperate with a stimuli
Receptors: parts in the body that detect a stimuli
Effectors: parts in the body that respond to a stimuli
Two organ systems are continuously working to detect and respond to stimuli, these organ system are called the nervous system and the endocrine system.

The nervous system:

- Central Nervous System (CNS)
    - brain and spinal cord
    - gives out orders to other parts of the body to perform certain jobs
- Peripheral Nervous System (PNS)
    - detect stimulus and send impulses to CNS
    - made up of receptors and nerves that carry impulses

Neurons:
-transmits electrical impulses
-axon
have dendrites coming out of the cell body

- Motor Neuron
- Sensory Neuron
- Connector/relay

Motor Neuron:

- from the CNS to the effectors

- cell body (in the CNS) → effector (muscle or gland)

Sensory Neuron:

- from the receptors to CNS

Relay Neuron:

- in the CNS
- pass electrical impulses from sensory neuron to the motor neurone
- synaptic endings -> axon ->cell body-> dendrites

Reflex Arc: involuntary

- Stimulus
- receptor stimulated
- sends signal along sensory neuron
- Signal passed along relay neuron
- Signal sent along motor neuron
- Effector muscle contracts in response
- some impulses are carried by other neurons to the brain and some are passed onto the motor neurones to the effector directly through spinal cord
- although the nerve impulses go into the brain, we do not need to think consciously about what to do

Features of Human eye:

Conjunctiva: front of the eye; thin, transparent membrane which helps protect the parts behind; is kept moist by a fluid made in the tear glands
Cornea: refracts light ray
Lens: change shape to focus light on retina
Ciliary muscles: contracts and relaxes to adjust thickness of the lens
Suspensory ligaments: loosens and tightens to adjust thickness of lens
Aqueous humour: water-based fluid between the cornea and the lens that maintains the shape of the eye, providing nutrition for the central cornea and lens as they do not have their own blood supply
Vitreous Humour: clear, transparent gel which occupies the space between the lens and retina
Iris: widens and narrows to control the amount of light entering the eye depending on light intensity
Choroid: middle layer surrounding the eye; absorbs all the light after it has been through the retina, so it does not get scattered around the inside of the eye; rich in blood vessels that nourish the eye
Sclera: outer most tough, protective layer of the eye; very thick
Retina: innermost layer, sensitive to light; has rods and cones
Fovea: very light sensitive spot (yellow spot) on the retina; where receptor cells are packed most closely together

Blind spot: where the optic nerve touches the eye therefore no light-sensitive cells in this area. If light falls on this place, no impulses will be sent to the brain.

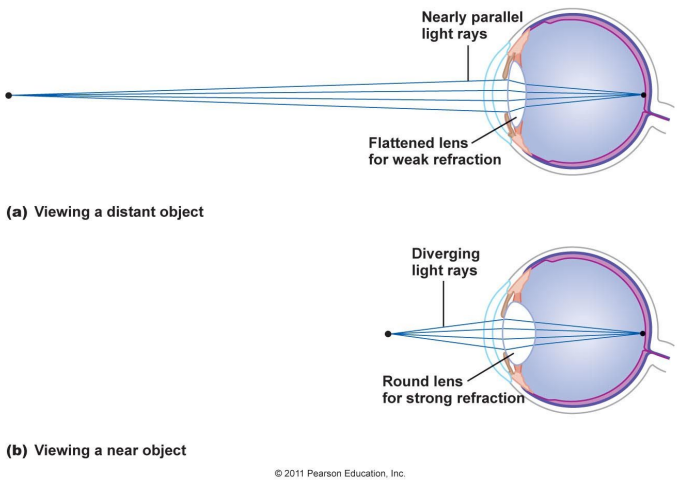
When a light ray reflected from the object hits your eye, you see the object. At the back of your eye, there is a spot on the retina called fovea. This spot is full of light sensitive cells. When the light ray falls on the fovea, the light sensitive cells generate electrical impulses that travel through the optic nerve to brain. When the electrical impulses reach the brain, the brain generates the image you see. fovea is where light is focused when you look straight at an object

Cornea and lens:
When the light ray hits the eye at an angle, it has to penetrate the cornea which refracts the light ray inwards. The cornea acts as a converging (convex) lens. Then the light penetrates the lens which refracts the ray a little more inwards focusing the light ray on the fovea. And thus the light ray is focused on the retina producing an upside down image. The brain interprets this so that you see it the right way up. When the ray hits the retina, the closer to the fovea the sharper the image is.

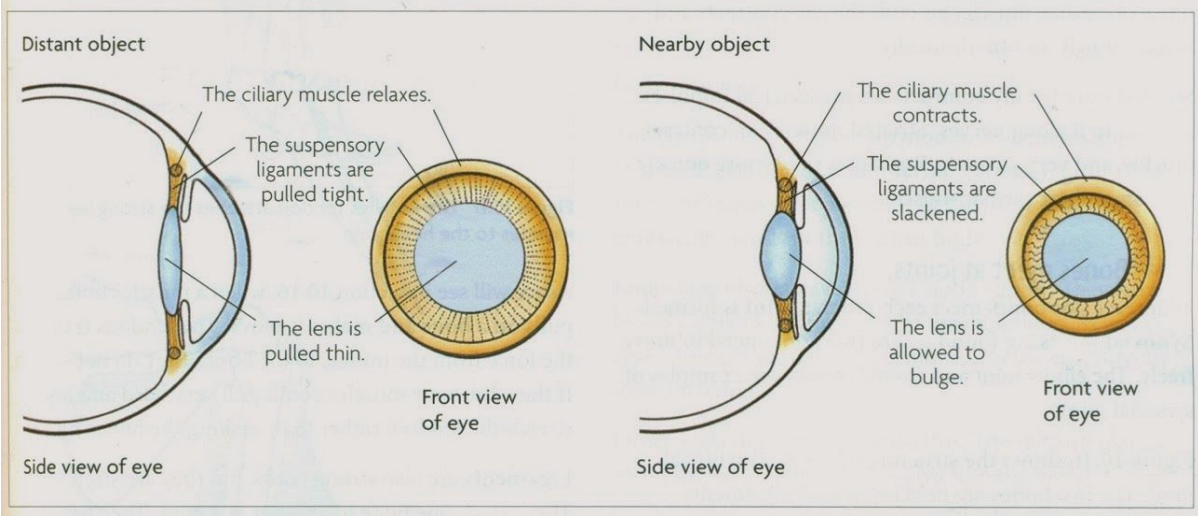
Cornea:
-bends the light rays
Lens:
-make fine adjustments

Light rays coming from a nearby object are going away from one another/diverging, therefore need to be bent inwards quite strongly.
very little refraction should be done for far light rays.

Ciliary Muscle
Contracts for
Close vision



Accommodation:



	Ciliary muscle	Suspensory Ligaments	lens	pupil
Near object	contract	loosen	thick and round (widens)	constrict/smaller
Far object	relax	tighten (to pull the lens)	thin and narrow	dilate

Ciliary muscle determines the shape of the lens while the suspensory ligaments determines the size of the lens.

Rods and cones:
The retina is full of light sensitive cells called photoreceptors. Rods and cones are specialized types of neurons.

<u>Rods</u>

- sensitive to dim light, do not respond to color.
- allow us to see in dim light but only in black and white
- spread all over the retina
- show a less detailed image

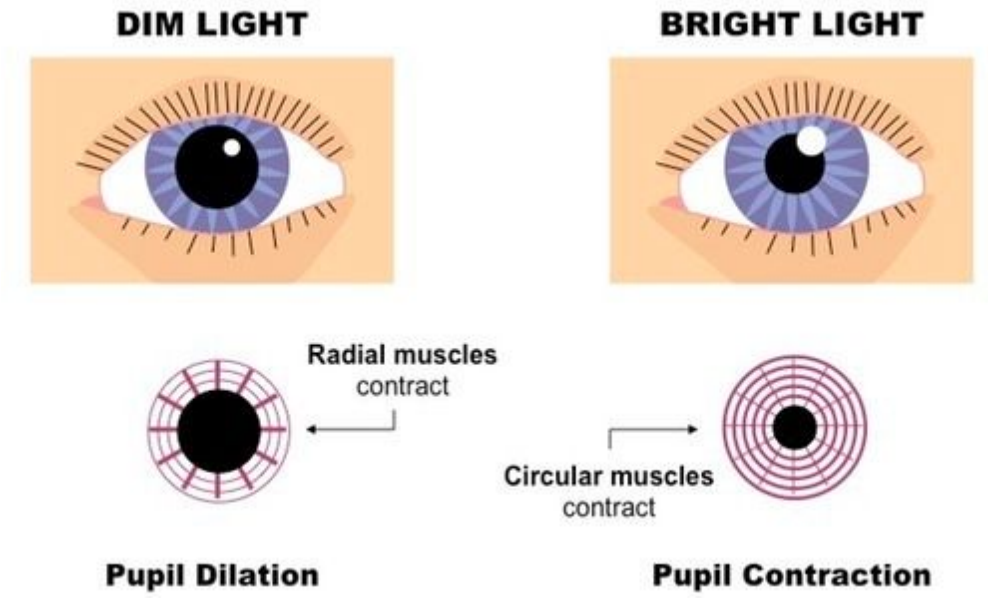
<u>Cones</u>

- sensitive to bright and coloured light
- only able to function in bright light
- packed in one area, the fovea

Pupil:
-surrounded by a colored ring structure called the iris
-the gap in the middle of the iris

-the iris and pupil change their size to control the amount of light entering the retina

Iris:
-contains pigments which absorb light and stop it getting through to the retina
-iris contains two sets of muscles: circular and radial



light intensity	circular muscle	radial muscle	pupil
bright	contract	relax	constricts
dim	relax	contract	dilates

Dark -> bigger pupil (to let more light in)
Bright -> smaller pupil (limit the amount of light to protect the retina from damage)

The Endocrine System:
Hormones: a chemical substance produced by a gland, carried by the blood, which alters the activity of one or more specific target organs and is then destroyed by the liver

Adrenaline:
- secreted in adrenal glands
- two adrenal glands, one above each kidney
- help us cope with danger by increasing heart rate, supplying oxygen to your brain and muscles more quickly, increasing the rate of metabolic activity which gives them more energy for fight/flight
- increase blood glucose concentration
    - causes the liver to release glucose into the blood

- provide extra glucose to the muscles so they can release energy by respiration and more energy for contraction

Comparison of the nervous and endocrine system in mammals

nervous system	endocrine system
made up of neurones	made up of secretory cells
information transmitted in the form of electrical impulses	information transmitted in the form of chemicals called hormones
impulses transmitted along nerve fibres (axons and dendrons)	chemicals carried dissolved in the blood plasma
impulses travel very quickly	chemicals travel more slowly
effect of a nerve impulse usually only lasts for a very short time	effect of a hormone may last longer e.g. growth hormones
very localized in terms of area of response	each hormone has more than one target organ
pupil reflex, pain withdrawal	controlling glucose, water potential, temperature and pH in the blood

Homeostasis:
-the maintenance of a constant internal environment
In the tissue fluid surrounding body cells, the temperature and amount of water are kept almost constant, so is the concentration of glucose. (For example, the liver can store or release glucose)

- Keeping a constant temperature of around 37˚C helps enzymes to work at the optimum rate
- Keeping a constant amount of water means the cells are not damaged by absorbing or losing too much water by osmosis
- Keeping a constant concentration of glucose means that there is always enough fuel for respiration

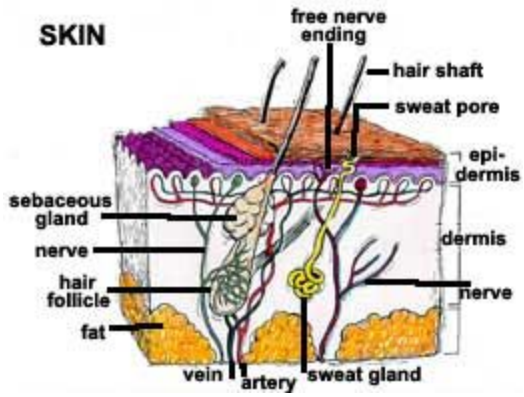
The control of body temperature:
- animals who can keep their temperature almost constant are **homeothermic or endothermic** because they get their heat energy from within themselves (‘endo’ means within)
- animals that don’t do this, such as reptiles, are **ectothermic** meaning their temperature varies with their surroundings

Importance of being homeothermic:

- If internal body temperature is kept at 37˚C, enzymes can always work efficiently no matter what the outside temperature is
    - metabolism can keep going even when it is cold outside
    - they get heat energy from food, by respiration; so they have to eat more

Skin:

- temperature regulation
- two layers: top is **epidermis**, lower layer is **dermis**



Controlling body temperature

Parts	If body temp falls	If body temp rises
sweat glands	shut down	activated sweat releases from hot skin water evaporates -> taking heat from skin with it, thus cooling the body
small arteries in skin	constrict, stop blood coming to the surface of skin (vasoconstriction). Blood flows through the deep-lying capillaries instead; because they are deep under the skin, the blood does not lose so much heat to the air	enlargement of capillaries (vasodilation) open up for blood blood temperature higher than outside, heat gradient forms and heat flows down the gradient to escape outside
Hairs	erect, producing goosebumps -trap a layer of insulation	-relax

	(air)	
erector muscles	-contract and relax very quickly to produce heat, causing shivering, warms the blood -increased metabolism to release more heat	

Controlling blood glucose concentration:

- when glucose level is too high: pancreas detect the high glucose concentration in blood, insulin is secreted which **stimulates** live cells to convert glucose into the storage compound glycogen.
- when glucose level is too low, pancreas detect and secrete glucagon which stimulates the liver to **break down** glycogen back to glucose which diffuses into the blood so the blood glucose concentration increase to normal.

Negative feedback:

- counteracting what the external factor is
- change sets off a response that cancels out the change
- insulin and glucagon example

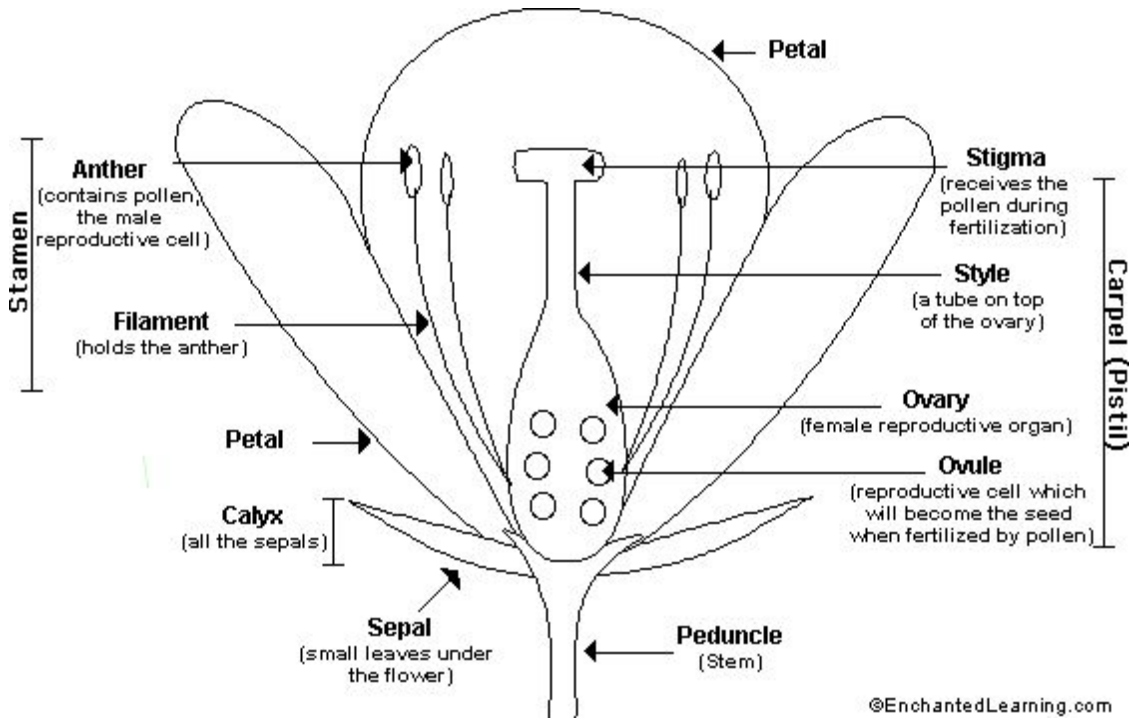
Tropical Responses:
plant hormone: auxin
Auxin
-made at the tip of a shoot
-diffuses downwards from the tip, into the rest of the shoot
-makes the cells behind the tip longer, so gravity acts on it and the shoot bends towards light
-when light shines from all around the shoot, auxin is distributed evenly around the tip of the shoot, so all cells grow at about the same rate, so the shoot grows straight upwards
-if light shines on a shoot from one side, auxin at the the tip concentrates on the shady side

B8 Plant and Human Reproduction

Asexual Reproduction: the process resulting in the production of **genetically identical offspring** from one parent
Sexual Reproduction: the process involving the **fusion** of haploid nuclei to form a **diploid zygote** and the production of **genetically dissimilar** offspring.

	Advantages	Disadvantages
Asexual Reproduction	- only one parent is required - young offsprings are identical to parent, so good features will be passed on - can exploit a suitable habitat quickly since population increases rapidly	- no variation of genes - diseases pass on - if exposed to changes in environmental conditions or diseases, all of its offsprings will be affected
Sexual Reproduction	- features inherited from both parents, produce variation in offsprings - good chance of a few surviving diseases - species can adapt to new environment	- need two parents, time and energy required - less efficient at passing genes - a favorable combination of genes can be broken

Plant Reproduction:



Flowers:
Pollination: the transfer of pollen grains from anther to stigma
Cross pollination: ~ of a different flower but the same species

- produce male sex cells (pollen grains)
- produce female sex cells (contained in the ovules)

Parts	Function
sepal	protects the unopened flower/supports petal
petal	may be brightly colored to attract insects
stamen	the male part of the flower, comprising an anther attached to a filament
carpel	the female part of the flower, comprising a stigma attached to the style
anther	produces the male sex cells (pollen)
stigma	The top of the female part of the flower, which collects pollen grains
ovary	produces the female sex cells (contained in the ovules)

Agents of Pollination: insects, wind and water

Insect-pollinated flower:

- brightly-colored petals to attract insects
- scented and has sugary nectar to attract insects
- anther and stigma are inside the petal
- moderate amount of pollen is produced because insects transfer them efficiently
- sticky or spiky pollen grains that stick to insects very well

Wind-pollinated flower:

- small, green or brown petals
- anthers outside the flower, loose on long filaments to release pollen grains easily
- stigmas are feathery, form a network to catch drifting pollen grains
- produce a lot more pollens because most are not transferred to another flower

- light, small and smooth pollen grains, easily carried by wind without clumping together

Fertilization: (Fusion of the nucleus of a male with the nucleus of a female gamete)

- pollen grain lands on the stigma
- pollen tube begins to grow through the style
- pollen grain travels down the pollen tube to fertilize the nucleus of the ovule
- fertilized ovule develops a zygote which divides to form an embryo plant which is now a seed and the rest of the carpel becomes a fruit

Difference between fertilization and pollination:
Pollination is the process whereby pollen grains move from the anther to the stigma on a flower's style, while **fertilization** is the fusion of the male gametes and female egg cells to form a new plant seed. **Pollination** comes before **fertilization** and depends on agents such as wind, water and insects.

Germination: (a process controlled by enzymes in which the seed begins to develop into a new young plant

embryo	the young root and shoot that will become the adult plant
cotyledons	starch for the young plant to use until it can photosynthesize
testa	a tough protective outer layer, breaks when it germinates
radicle	embryonic shoot
plumule	embryonic stem
micropyle	absorbs water

Environmental condition:
water: absorbs through micropyle, needed to activate enzymes to convert insoluble food stores (starch) into soluble food needed for growth and energy production
oxygen: needed for aerobic respiration, to release energy for growth and chemical changes for mobilization of food reserves
temperature: for enzymes to work at optimum temperature

Seed dispersal:

- a mean of colonizing new areas

- reduces competition for light and water between members of the same species

Wind dispersed fruit:

- dandelion
    - very light seeds
    - easily carried by wind
    - feathers on the seed
- sycamore
    - wings
    - spiral, spin over long distance

Animal dispersed fruit:

- succulent fruits e.g. berries/apples/plums
    - droppings in different place
- hooked fruits e.g. Burrs, Bixa
    - hooks attach to animal feather

<u>Human Reproduction:</u>

Male:

Testes: produce sperm and testosterone (epididymis stores sperm and transports it from the testes)

Scrotum: a sac that keeps testes cool outside the body

Sperm ducts: link testes to urethra

Prostate gland: produce alkaline fluid (semen)

Urethra: transports urea; transport semen from prostate gland to the outside of penis

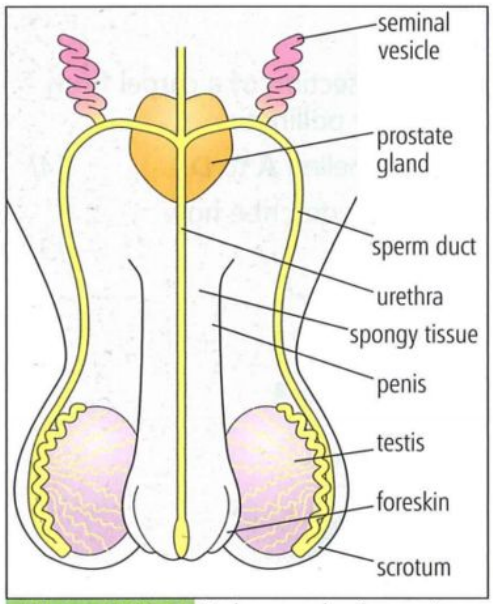


Figure 15.1.1 Male reproductive system: front view.

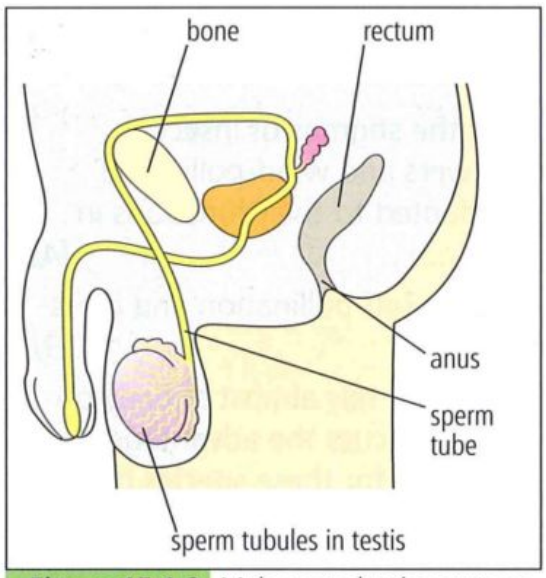


Figure 15.1.2 Male reproductive system: side view.

Female:
Ovaries: produce and store ovum/eggs, and produce estrogen
Oviducts/Fallopian tubes: carries ovum to uterus (**site of fertilization**)
Uterus: where fetus/embryo develops
Cervix: a ring of muscles that separate the vagina from the uterus
Vagina: receives sperm from erect penis during intercourse; birth canal

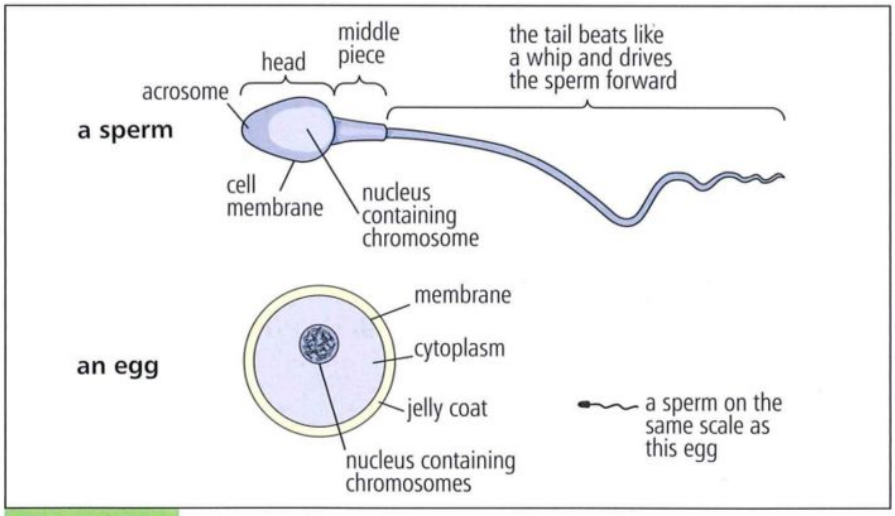


Figure 15.1.3 Structure of a human sperm (top) and an egg (bottom).

Menstrual cycle:
It is a recurring process in which the lining of the uterus is prepared for pregnancy, and if pregnancy does not happen/no eggs are fertilized, the lining is shed at menstruation. The cycle lasts about 28 days.

- Menstruation - uterus lining breaks down first 1-7 days
- Lining of uterus builds up
- Ovulation - One egg is released from the ovaries every month (Day 14)
- Lining is maintained (progesterone level goes up)
- the lining of the uterus becomes thick and spongy to prepare for a fertilized egg

Estrogen and Progesterone are secreted by ovaries. Oestrogen makes the lining of the uterus **repair** itself and grow again after menstruation. Progesterone is produced by the empty follicle in the ovary after the egg has been released. This hormone controls growth and **maintains the lining of the uterus** during the second half of the menstrual cycle.
If a woman becomes pregnant the follicle continues to produce progesterone and a placenta is formed. Placenta secretes progesterone throughout pregnancy. If

pregnancy does not occur, then both hormone levels drop towards the end of the menstrual cycle, the lining breaks down and menstruation occurs.

- Oestrogen is released in order to build up the lining of the uterus before menstruation
- Progesterone levels are high after ovulation. It maintains the lining of uterus.
- During menstruation, levels of both hormones are low.
- Progesterone is released throughout pregnancy to maintain endometrium.

Formation of fetus:

- One sperm may fertilize one egg to produce a zygote
- After ovulation, the egg is caught in the oviduct
- The egg will die if not fertilized by a sperm without 8-24 hours after ovulation
- Sperms swim into the vagina, through the cervix and uterus, into an oviduct
- Ovum pass down in oviduct
- A single sperm penetrates the membrane of ovum by secreting a protease enzyme
- The sperm nucleus and the ova nuclei fuse to form a diploid zygote = fertilization
- Zygote moves slowly down the oviduct, divides by mitosis
- Embryo sinks into the endometrium = implantation

The development of embryo:

- Amniotic sac produces amniotic fluid which surrounds and protects the developing embryo
- Placenta, connected by an umbilical cord, develops from the embryo

<u>Function of Amniotic Fluid:</u>

- Provides protection of the fetus from
    - Drying out
    - Temperature fluctuations
    - Unequal pressures acting on the fetus
    - Physical damage by acting as a shock absorber

<u>Function of placenta:</u>

- Transfer oxygen from mother to fetus
- Transfer nutrients from mother to fetus (umbilical vein)
- Transfer antibodies from mother to fetus
- Prevents the mixing of blood of mother and fetus
- Waste materials and carbon dioxide move from the embryo to the mother (umbilical artery carries deoxygenated blood)

No physical connection is present between the circulatory systems of the embryo and its mother, so their blood doesn't mix. Material passes by diffusion.

Advantages of the fetus having a separate blood system:
It helps to prevent bacteria passing from mother to fetus, the blood group of mother and fetus may be different.

	Breastfeeding	Bottle-feeding
Advantages	- Cost-effective, no need to buy bottled baby formulas - Antibodies in breast milk protects babies from illness and infections - Contains perfect proportion of nutrients - Easily digestible - Milk is always at right temperature - Available (without other supplies)	- Enable father bonding - Measurable - Suitable in public - Mother's food intake independent from baby's - Supplement nutrients contained - Supply available on demand
Disadvantages	- Time-consuming, lack of freedom - Diet modification - Infections like chickenpox, HIV can be passed on - Awkward in public - Milk consumption cannot be measured	- Not environmentally sustainable - Not enough antibodies - Has to be freshly made - Has to be warm - Need to sterilize bottles - Artificial nutrients can cause allergies

Methods of transmitting HIV:
- Sexual intercourse
- Unsterilized needles

How HIV affects the immune system in a person with HIV:
- Body will make antibodies to try to fight HIV
- Slowly wears down immune system, lowering the numbers of T cells

B9 Inheritance

Inheritance: transmission of genetic information from generation to generation
DNA: double helix that carries the genetic code of an organism
Chromosome: a thread of DNA, made up of a string of genes
Gene: a segment of DNA that codes for a protein
Allele: any of two or more alternative forms of a gene
Haploid nucleus: a nucleus containing a single set of unpaired chromosomes e.g. sperm and egg
Diploid nucleus: a nucleus containing two sets of chromosomes e.g. in body cells
Mitosis: a nuclear division giving rise to genetically identical cells in which the chromosome number is maintained by the exact duplication of chromosomes
Meiosis: reduction division in which the chromosome number is halved from diploid to haploid
Genotype: genetic makeup of an organism in terms of the alleles present
Phenotype: the physical or other features of an organism due to both its genotype and its environment
Homozygous: having two identical alleles of a particular gene
Heterozygous: having two different alleles of a particular gene
Dominant: an allele that is expressed if it is present
Recessive: an allele that is only expressed when there is no dominant allele of the gene present
Mutation: change in a gene or chromosome
Natural selection: the greater chance of passing on of genes by the best adapted organisms

Inheritance of gender is governed by the 23rd chromosome. Boys have an X and a Y, girls have two X chromosomes.

Cell division:

- Mitosis – used for growth, repair of damaged tissues, replacement of worn out cells & asexual reproduction
- Meiosis – used to produce gametes for sexual reproduction

Mitosis:	Meiosis:
• Produces 4 daughter cells • Daughter cells are diploid (23 pairs of chromosomes) • Genetically identical • Chromosomes in nucleus are copied	• Produces 2 gametes • Daughter cells are haploid (23 unpaired chromosomes) • Genetically different • Two cell divisions • Chromosomes make identical copies of themselves

• Chromatids pulled apart and moved towards poles • Chromosomes separate • Cell divides	• Similar chromosome pair up • Sections of DNA get swapped • Pairs chromosomes divide • Chromosomes divide

Punnett square shows how chromosomes or alleles may combine in zygotes.

- Chromosomes come in pairs (homologous chromosomes)
- Genes must also come in pairs, one from each of the paired chromosomes
- Every characteristic, we have two genes

Monohybrid crosses:
- Ratio of each phenotype
- Genotype in words e.g. homozygous dominant, heterozygous, recessive

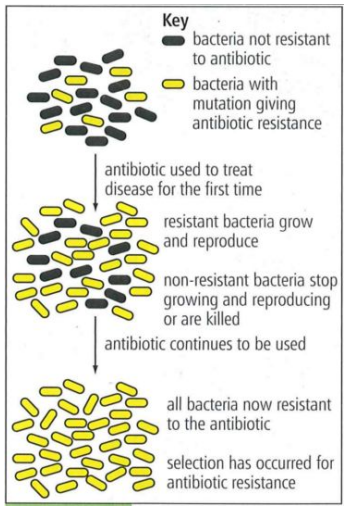
Variation:
- Continuous variation is influenced by genes and environment e.g. height, weight, intelligence, skin color, finger length, hand span
- Discontinuous variation is caused by genes alone e.g. blood types, earlobes

Mutation: - a rare, random change in the genetic code of a gene
- Likely to be harmless if it occurs in normal body cells, unless it leads to uncontrolled cell division (cancer)
- Can be passed on (mutations must occur in germ cells in this case)
- Rate of mutation increases with age
- Chemicals (carcinogens) and ionizing radiation can lead to mutations
    - Ionizing radiation will break the double stranded DNA and repair mechanism in the body can reattach the wrong piece of DNA (e.g. leukemia)

Natural selection: the greater chance of passing on of genes by the best adapted organisms
- Individuals in a species show a wide range of variation
- This variation is because of differences in genes
- Best-adapted Individuals are more likely to survive and reproduce
- The genes that allowed the individuals to be successful are passed to the offspring in the next generation

Antibiotic resistant bacteria:
E. coli's DNA can be damaged or changed during replication, and most of the time this causes the death of the cell. But occasionally, the mutation is beneficial - for the

bacteria. For example, it may allow resistance to an antibiotic. When that antibiotic is present, the resistant bacteria have an advantage over the bacteria that are not resistant. Antibiotic resistant strains of bacteria are an increasing problem in hospitals.



Artificial selection: A traditional method for improving crops and livestock, such as increasing disease resistance or milk yield. However, there is an increased risk of genetic disease caused by recessive alleles.