IGCSE Biology Notes

Refined by KmQ

Unit 1 : *Characteristics of living things*

Biology is the study of living organisms. For something to be alive it needs to perform all seven functions of living things.MRS GREN

Movement, Respiration, Sensitivity, Growth, Reproduction, Excretion, Nutrition.

1. Movement

Most organisms are able to move their whole body even plants can shift their stem towards the sunlight and their roots move towards healthy soil.

2. Respiration

IT is the breakdown of food inside a living organism IT IS VITAL for survival. 2 types

Aerobic Respiration which involves O2 & glucose breaking down to form CO2 water & ENERGY.

Anaerobic Respiration which is the incomplete breakdown of food. Happens when there is not enough oxygen. Equation, Glucose & O2 (not enough) to form CO2 Lactic Acid or Alcohol (depending on the organism) & a little ENERGY.

3. Sensitivity

It is the ability to detect and respond to a stimulus.

4. Growth

It is the permanent increase in size and quantity of cells using materials absorbed from the environment.

5. Reproduction

It is forming new individuals of the same species either sexual (2 parents) or asexual (1 parent) \

6. Excretion

It is removal of harmful products of metabolism. Egestion is the removal of undigested products which haven't entered the cell.

7. Nutrition

It is the intake of food material from the environment.

Autotrophic nutrition: Organisms that make their own food such as plants.

Heterotrophic nutrition: Organisms that need readymade food including herbivores, carnivores & omnivores.

Unit 2 : *Classification*

Classification is sorting organisms into smaller groups based on their similarities which then allows us to make comparison between them. Organisms are split into the following:

- Kingdom
- Phylum
- Class
- Order
- Families
- Genus
- Species

Many Organisms

Individual Organism

Few features in common

Many features in common

A specie is a group of organisms that share the many similar appearances and can bread with each other. Species are scientifically named by two names in Latin to avoid differences in languages. The first name is the name of the genus while the second name is the species name e.g. WOLF (*Cannis Lupus*) (must be italic and underlined)

The main groups of living are the 5 kingdoms. They don't include virus since it doesn't obey some characteristics of life. The five kingdoms are: Bacteria, Protoctista, Fungi, Plants, and Animals.

Virus

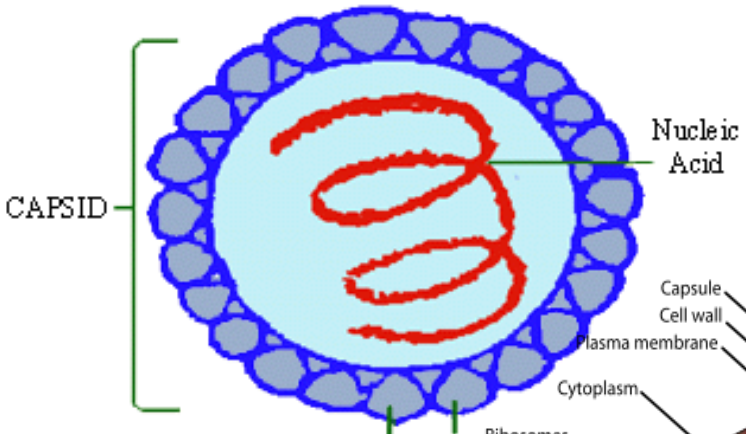
The size of a virus about 30-300 nm and its only visible with an electron microscope. IT has a protein coat around the DNA or RNA sometimes has spikes. It has no cell structures.

How a virus multiplies

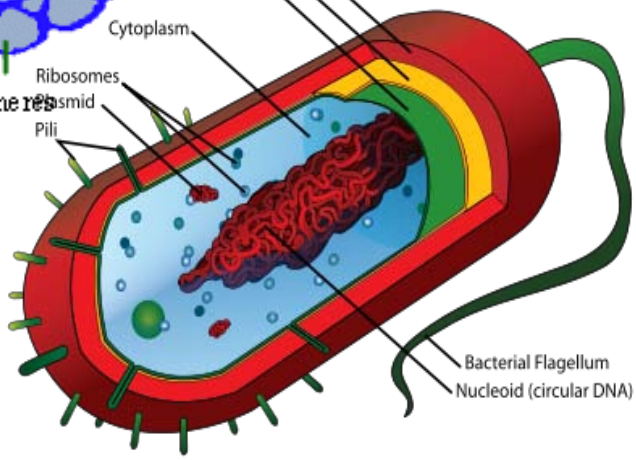
1. Virus ejects its DNA or RNA into the cell

2. The genetic material multiplies

3. Mew viruses are formed inside the cell and then burst out of the cell.



Bactria

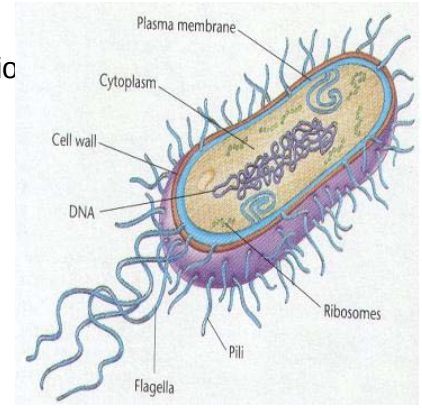


The size of bacteria is about 0.2 to 10 um. It is only seen under high powered microscopes. **Structure:** No Nucleus

- No mightocondria

- No chloroplast in most of them
- They are either saprophytes or parasites
- cell wall (not made of cellulose)

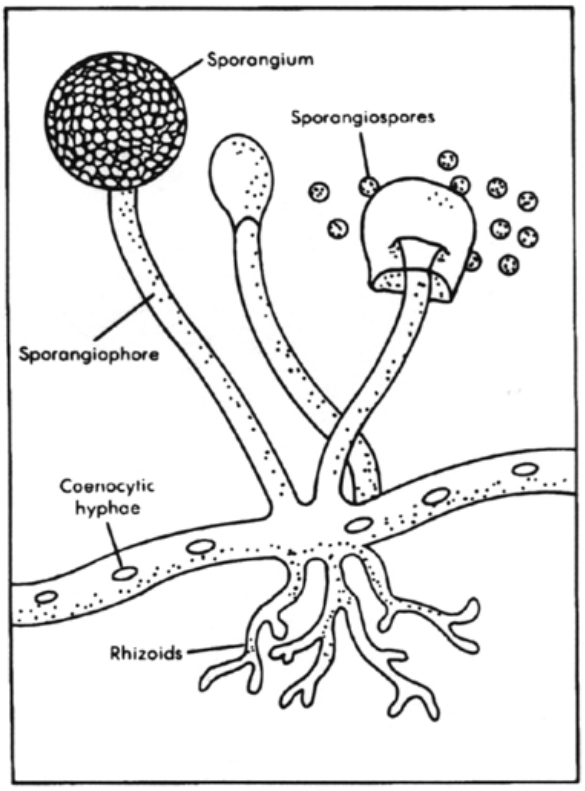
Bacteria reproduce asexually by binary fission every 20 min's (if conditio conditions are not well some species can for spores for survival.



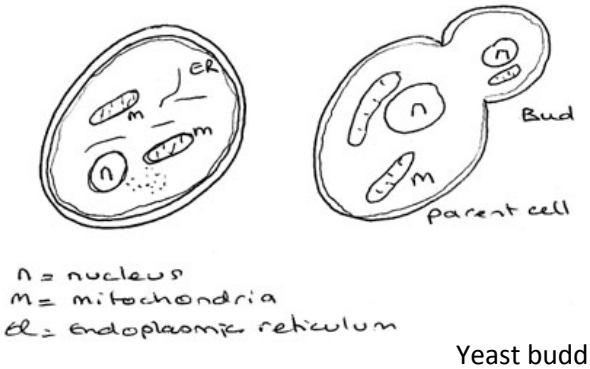
Fungi

- Mostly multicellular (many cells) (yeast is an exception)
- Cell wall made of chitin
- IT has cytoplasm & it may be a saprophyte or a parasite

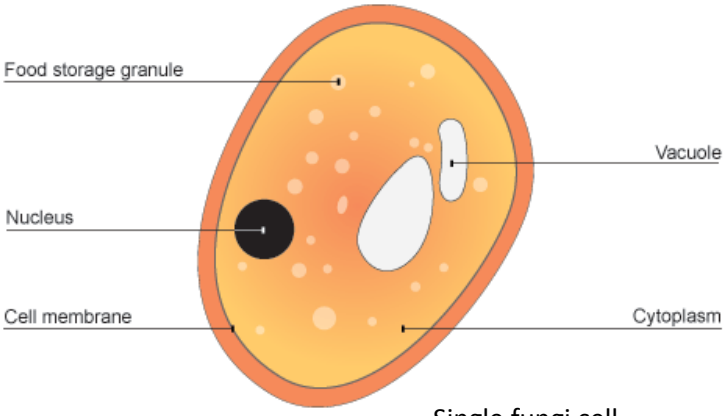
- It reproduces asexually by spore formation or by budding (in yeast) but in bad conditions it reproduces sexually for survival



Structure of a mould fungus



Yeast budding



Single fungi cell

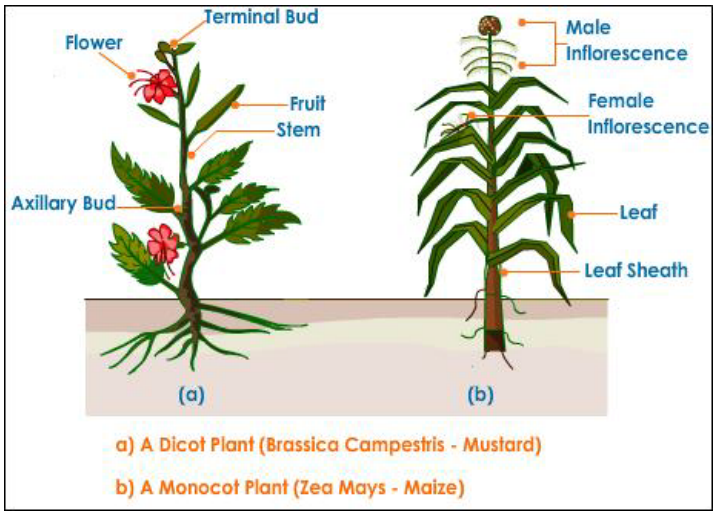
Budding is when a yeast cell splits into two cells and it keeps happening over and over again numbers can get up to millions in just a day.

A mushroom is an example of a parasitic fungus.

Plants

Plants produce seeds from inside the flower. The plant kingdom is divided into algae, ferns, mosses, and seed plants. Seed plants are divided into conifers and angiosperms. Angiosperms are devided into two groups Monocotyledons and Dicotyledons.

Feature	Monocotyledons	Dicotyledons
Seed	Seed containing one cotyledon	Seed containing two cotyledons
Leaves	Leaves containing parallel veins	Leaves containing branched veins
Root	Fibrous root system (adventitious)	Tap root system with lateral roots.



a) A Dicot Plant (Brassica Campestris - Mustard)

b) A Monocot Plant (Zea Mays - Maize)

Conifers

Ferns

Algae

Animals

There are two main groups in the animal kingdom. The chordates and the invertebrates. The invertebrates consist of Nematodes, Annelids, Molluscs and Arthropods.

Comparison between Annelids, Nematodes and Molluscs.

Annelid, nematode or mollusc?

	Annelid	Nematode	Mollusc
Body covering	Hard, slightly waterproof	Soft, not waterproof	Soft – shell helps to save water
Segments visible	Yes	No	No
Movement	Uses chaetae (bristles) to move from place to place	Wriggles but lives in one place	Creeps on foot from place to place
Feeding method	Herbivores	Mainly parasites	Mainly herbivores – some carnivores

Arthropods are divided into insects, crustacians and arachnids.

	1- Insect	2- Crustacian	3- Arachnids
Examples	Bees, butterflies, locust	Crabs, lobsters, shrimps.	Spider, scorpion
Body segment	3 body segment: head, thorax and abdomen	2 body segment: cephalothorax and abdomen	2 body segment: cephalothorax and abdomen
Jointed legs	3 pairs	More than 4 pairs	4 pairs of jointed legs
Antennae	1 pair	2 pairs sensitive to touch and chemicals	No Instead there is a pair of chelicerae to hold prey
Wings	1 or 2 pairs	No	No
Eyes	Compound and simple eyes	1 pair of compound eyes	Simple eyes
Breathing	Through tracheae "spiracles"	Gills	Book lungs

And 4- Myriapoda:

- Like Millipede and centipade.
- Two body segment.
- Many legs. 1 or 2 pairs of legs on every Segement of the body
- 1 pair of antenna.
- No wings.
- Simple eyes.

Adaptation to insects on life on lands

- Body covered in flexible chateaus exoskeleton
- 1 or 2 pair of wings
- Joined legs for quick movement
- Can live on all food materials
- Can camouflage to hide from enemies

Chordates (or Vertebrates)

Chordates are vertebrates which are animals with back bones they consist of: Fish, Amphibians, Reptiles, Birds, and Mammals.

1. Fish

- Body covered in moist scales
- Has fins to swim and gills for gas-exchange
- Lays eggs in large amounts (eggs are soft with no shells)

2. Amphibians

- Moist, smooth and non scaly skin.
- Some can camouflage e.g. frogs
- Young live in water & have gills & adults live on land & have lungs
- Have 4 limbs
- Lays soft non shell eggs
- Has an ear drum

3. Reptiles

- Covered in dry scaley skin to prevent water loss
- 4 limbs (except snakes)
- Lay water proof eggs with hard shells
- Has a third transparent eye lid for protection

4. Birds

- Body covered in feathers
- Beak for feeding
- 2 limbs and 2 wings
- Lays water proof hard shells

5. Mammals

- Body covered in hair
- 4limbs
- Breath through lungs
- Milk from mammary glands
- External ear pinna
- 4 kinds of teeth: Incisors, Canines, Premolar, and molars
- Have sweat glands
- Have a diaphragm

Unit 3 : *Cell Structure*

A cell is the smallest part of an organism all cels consist of a membrane, cytoplasm and a nucleus.

Difference between plant and animal cells

Feature	Plant cell	Animal cell
Cell wall	• Present and made from cellulose	• Absent
Chloroplast	• Present	• Absent
Vacuole	• Present	• Absent
Food stored within **Carbohydrates** **Protein** **fats**	• • Starch, glucose • Can store protein • Oil	• • Glycogen • Cant store protein • Fats
Shape	• Regular shape because of cell wall	• Irregular shape
Size	• Large	• small

Similarities of animal and plant cells

1. Cell membrane
2. Nucleus
3. Cytoplasm
4. Organelles
   Organelles are found in the cytoplasm each one has a specific job e.g. mitochondria.

Main cell parts description

1. **Cell wall:** Non living structure which is made of cellulose. It supports the plant from pressure and regulars its shape.
2. **Cell membrane:** A complex semi permeable structure which allows substances in and out the cell
3. **Cytoplasm:** jelly like substance where most chemical reactions happen
4. **Nucleus**: Contains DNA. It controls the activities of the cell and carries genetic materials.
5. **Vacuole:** A fluid made of cell sap. It contains some usefull materials and waste
6. **Chloroplast:** Large bodies containing chlorophyll e=where Photosynthesis takes place
7. **Mitochondria**: It consists of a double membrane and is the site of aerobic respiration.

Specialization of cells 1-4 (plants) 5-9 (animal)

1. Root hair cell: It has long hairs to increase surface area of the cell. It has a large number of mitochondria to provide energy for active up take.

2. Xylem vessels: It transports water and minerals to the plant. The xylem cells are dead and are made of long hollow tubes running throughout the root, stem, and leaves. It has thick cell walls.

3. Phloem cells: They transport sugar and amino acids to the body from the place they were made (the leaf). The phloem cells are long cells joined together. The cell wall where 2 phloem cells join together has holes which allows the cytoplasm of both cells to communicate passing down the dissolved food.

4. Guard cell (stomata): Allows O2 and CO2 to pass in and out the leaf. They can change their shape thus can open and close their holes.

5. Red blood cells: It transports oxygen from the lungs to tissues. It has no nucleus, t has hemoglobin which absorbs oxygen, its shape gives it a high surface area and it is small to fit in capillaries.

6. Nerve cells: they conduct electrical impulses which travel to & from the brain. They are very long and their chemical reactions cause impulses to travel through their fibers. They also have a layer of fat for insulation.

7. White blood cells: These occur in large amounts in the blood stream. They get rid of bacteria and viruses. They are able to change shape and can penetrate the blood vassals to enter tissues. They also contain enzymes that kill microorganisms in their cytoplasm.

8. Ciliared cell: These have cilia (hairs) which can move mucus away from the lungs by a wavy motion.

9. Muscle cells: These cam contract to move the body (they don't relax but they return to their original shape by the influence of other cells) they contain a lot of mitochondria to provide the energy needed.

Tissue, organs & systems

Cells are the *structural unit* of life many cells join together to form tissues. *Tissues* area group of cells working together to perform *a function*. Many tissues join together to make an organ. An *organ* is a group of tissues working together to perform a *job.* Organs join together to make *systems* which are groups of organs working together to make a *certain job.* Systems join together to make an *organism which is a living individual.*

Unit 4 : *Diffusion, active transport and osmosis*

All the chemicals reacting in the cells need to get in and out either by a **Passive process**: This doesn't need energy e.g. osmosis and diffusion or an **active process:** one that requires energy *e.g. active transport.*

1. Diffusion:

   It is the movement of a molecule from a reign of high concentration to a reign of low concentration down the concentration gradient which is the difference in concentration of the substance, the greater the difference the higher the rate of diffusion.

   The rate of diffusion depends on :

   - Concentration gradient
   - Temperature
   - Size of molecule
   - Surface area
   - Permeability of membrane

2. Osmosis:

   It is the movement of water from a reign of high concentration (a dilute solution) to a reign of low concentration (a concentrated solution) down the concentration gradient through a semi permeable membrane. A hypertonic solution has higher concentration of salt; a hypotonic solution has a higher concentration of water and an isotonic solution as an equal concentration of water and salt.

3. Active transport:

   It is the uptake of substances from a reign of low concentration to a reign of high concentration, against the concentration gradient requiring protein carriers.

Diffusion	*Osmosis*	*Active transport*
Not selective	Not selective	Selective, cells absorb what they need
Substances move down a concentration gradient	Water move down concentration gradients	Substances move against concentration gradient.
Do not need energy	Doesn't need energy	Needs energy
A partially permeable membrane is not necessary	A partially permeable membrane is necessary (living or non living)	A partially permeable membrane is essential (must be living).

Unit 5 : *Enzymes*

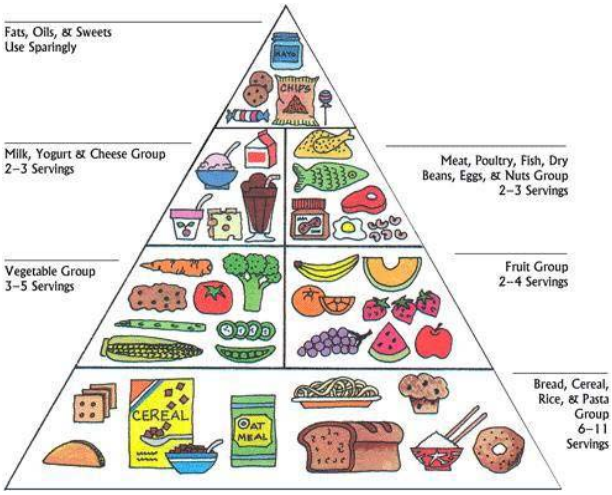
Enzymes are portions that act like biological catalysts which speed up reactions. Each enzyme is specific for 1 chemical reaction or in a stage in a series reaction. Most enzymes are inside the cell but some act outside it.

- General characteristics of enzymes:
- Catalyst: Speed up reactions
- Specific: their shape is specialized for 1 reaction only
- Temperature and PH : enzymes are sensitive to a certain temp and PH they work at an optimum temp or PH each enzyme has different optimums. If the PH is too high or too low then the enzyme will be denatured and won't work.

Enzymes are also used in washing powders as they can remove stains such as (blood and milk) they are quick but some people are allergic to them.

Unit 6 : *Nutrition and digestion*

Nutrition is obtaining food materials from the environment for growth and repair.



Food classes:

1. Protein
2. Fats
3. Carbohydrates
4. Vitamins
5. Minerals
6. Fibers
7. Water

Tests for Food

FOOD TEST

Type of food	Method	Positive observation	Negative observation
1-Starch	-Add iodine solution *(has a yellow brown color)*	-Blue black or dark blue colour	-The colour remains yellow brown
2-Reducing sugar or simple sugar (e.g. glucose)	-Add Benedict's solution and ***heat***. *(it has a blue colour* as it contains copper salts) **Precautions** 1- Hold the tube with a holder. 2- Direct the opening of the tube away from your face. 3- Do not fill more than half of the tube to avoid splashes when the solution boils. 4- It is preferable to use a water bath .	-Orange red or brick red precipitate is formed *(the gradual change in colour from blue to green, yellow, orange then red)*	- The color remains blue.
3- Proteins	(*This test is known as* ***biuret*** *test*) - Add potassium hydroxide ,then add drops of copper sulphate, the colour becomes blue .	-Purple color (mauve or lilac)	-The colour remains blue.
4- Fats or lipids.	(*This test is known as* ***ethanol or emulsion*** *test*) -Add ethanol , fats dissolve in ethanol forming clear solution. -Add drops of water to the clear solution.	-Milky emulsion or turbid solution is formed .	-The solution remains clear

Carbohydrates

Carbohydrates are made in the chemical structure of carbon , hydrogen and oxygen.

Monosaccharide's: they are the simplest carbohydrate units; they are soluble in water and have a sweet taste. E.g. glucose. Their formula, $C_6H_{12}O_6$

Disaccharides: e.g. sucrose. These are 2 monosaccharides joined together; they are sweeter than monosaccharide's and dissolve in water. Their formula C_{12}, H_{22}, O_{12}

Polysaccharides: e.g. starch. Made out of many mono and disaccharides, they are insoluble in water and don't have a sweet taste. Their formula $(C_{12}, H_{22}, O_{12})_n$.

Carbohydrates are very important because they produce energy. In plants cells they are stored as starch and in animal cells they are stored as glycogen. Carbohydrates are always stored as polysaccharides because this does not affect the osmotic pressure. Excess carbohydrates can be stored as fats under the skin.

Fats

Fats are a source of energy. They produce double the amount of energy produced by carbohydrates they are formed from fatty acids and glycerol and from the atoms carbon, hydrogen and oxygen. (the amount of oxygen in fats is about half the one in carbohydrates). Fats form a part of the cell membrane and they form a waterproof layer under the skin.

Proteins

Proteins are made from amino acids and the elements carbon, hydrogen, nitrogen and sometimes sulphur. They are present in foods such as milk and meat. They are used in growth and repair and in enzymes and make up antibodies.

Fibers

Fibers are present in all plant foods. They are not digested but give the stomach something to push against and work harder. They also clear all the remaining foods from the alimentary canal.

Minirals

MINERAL SALTS

Mineral	Sources	Importance	Deficiency symptoms
1-Calcium	-Milk and its products. -Many fruits and vegetables.	1-Necessary for formation of bones and teeth. 2- Necessary for blood clotting. 3- Necessary for lactation.	1- Brittle (soft) bones. 2- Brittle teeth. 3- Slow dentition in children.
2- Iron	-Liver. -Egg yolk. - Red meat. -Leafy vegetables.	- Necessary for formation of haemoglobin of the red blood cells.	- Anaemia *(rapid tiredness and shortness of breathing due to lack of haemoglobin which is used to carry oxygen to the different parts of the body to be used in production of energy by the process of aerobic respiration)*

More mineral salts are needed

a- In hot days or in case of carrying out strenuous exercise because perspiration rate is higher leading to loss of salts in sweat.

b- In cases of diarrhea due to rapid loss of mineral salts.

Vitamins

VITAMINS

DEFINITION : are organic substances only needed in small amounts in the body to perform specific functions.

Vitamin	Sources	Importance	Deficiency symptoms	Properties
C (also known as ascorbic acid)	-Citrus fruits such as orange and lemon. -Fresh vegetables	-Helps wounds to heal . -Keeps blood vessels healthy. -Keeps cement of teeth healthy. -Keeps gum and teeth healthy. - Helps the body to use iron. - Stimulates the immune system.	-Its lack causes a disease known as **scurvy.** **Symptoms of scurvy** 1- Pain in joints and muscles . 2-Bleeding from gum and other parts of the body. 3- Delayed healing of wounds.	-***Water soluble*** vitamin therefore it can not be stored in the body. - ***Spoils*** if food is heated or canned. -***Destroyed*** by being exposed to aire.g.if food is grated or minced as this activates enzymes in food which destroy vitamin C . - ***Refrigeration*** keeps the vitamin C content of the food but to a certain limit.
D (also known as calcifer-ol)	- Butter, eggs and cod- liver oil . -Can be formed in the skin by being exposed to sun rays .	-Helps absorption of calcium and phosphorus. -Helps the deposition of calcium and phosphorus in bones and teeth.	-***Rickets in children*** . *Causes bones to be soft and deformed* -Soft bones or osteomalicia in adults. -Slow dentition	-***Fat soluble*** vitamin, therefore it can be stored in the body (in liver).

Notice

1-Sailors are liable to be infected by scurvy **because** they use stored or canned food .

2-It is important to expose children to sun rays to avoid rickets, **because** vitamin D can be formed in their bodies by the effect of the ultra violet rays of the sun.

3- Modern opinions describe vitamin D as a hormone because it is made in a region (skin), then carried by blood to affect other regions
(It is necessary for absorption of calcium in the small intestine).

Digestion

- Ingestion: taking food into a living organism
- Digestion: Breaking down large insoluble food molecules into small soluble ones
- Absorption: The process by which food molecules enter the blood stream
- Assimilation: Making use of the absorbed food substances
- Egesting: Getting rid of undigested materials.

The digestive system is made up of the alimentary canal and the associated organs. The alimentary canal is lined with (epithelial, Goblet, and Muscle cells)

The mouth

Food is ingested and chewed. The teeth help to tear and grind the food into small pieces. This increases the surface area for the action of enzymes. The food is mixed with saliva which has two functions.

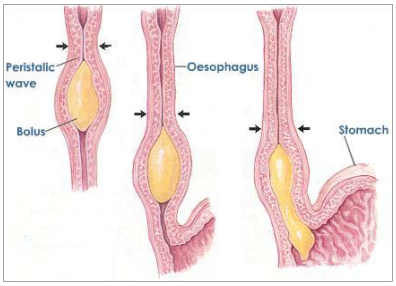
1. The saliva contains mucus which is a slimy substance which helps the food to be swallowed.
2. It contains the enzyme amylase which begins the digestion of starch into the sugar maltose. As food does not remain in the mouth for very long, only a small amount of starch is digested here.

The food is then turned to a bollus shape by the action of the mouth and then swallowed.

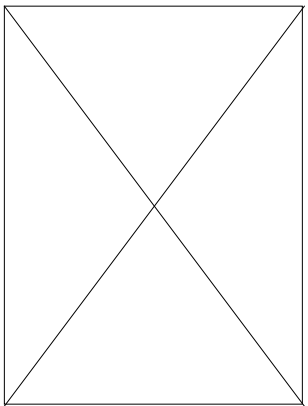
Oesophagus

This tube pushes the food to the stomach by way of rhythmic contractions. There are two sets of muscles in the oesophagus.

1. Circular muscles - these make the oesophagus narrower.
2. Longitudinal muscles - these make the oesophagus wider.



They work in conjunction with each other to force the food down to the stomach in a rhythmic wave. This is the way food is move all way along the alimentary canal. It is called *peristalsis*. The moment the food is swallowed a flap called the epiglottis closes so food isn't swallowed in the trachea.



Stomach

When the food reaches the stomach gastric juice is released from the stomach lining. Gastric juice contains two substances.

1. Pepsin - an enzyme which breaks proteins down into shorter chains called polypeptides.
2. Hydrochloric acid - needed to help pepsin work and also helps to kill any ingested bacteria.

The stomach has two rings of muscles at the top and bottom, called sphincter muscles which prevent food from leaving the stomach while it is being churned around. After a few hours, the food is now a mushy liquid called chyme. It is then allowed to continue on its journey a bit at a time.

Duodenum, Liver, Gall Bladder and Pancreas

When food enters the duodenum (the first 30cm of the small intestine) a number of secretions are added to it. Digestive enzymes from the wall of the duodenum and from the pancreas are added. There are a number of enzymes here which will complete the digestive process.

Another substance is added from the gall bladder. Bile, made in the liver and stored in the gall bladder, contains no digestive enzymes. It contains bile, which play a vital role in fat digestion. Fats and oils do not mix with water, but the enzyme lipase which digests them needs water in order to work. Bile salts breakdown the large fat drops into tiny droplets which can mix better with water to create an emulsion. This makes it easier for lipase digest the chemicals as it increases the surface area of the fat.

The pancreatic secretions contain hydrogen carbonate ions to neutralize the stomach acid. The

Digestive enzymes of the small intestine

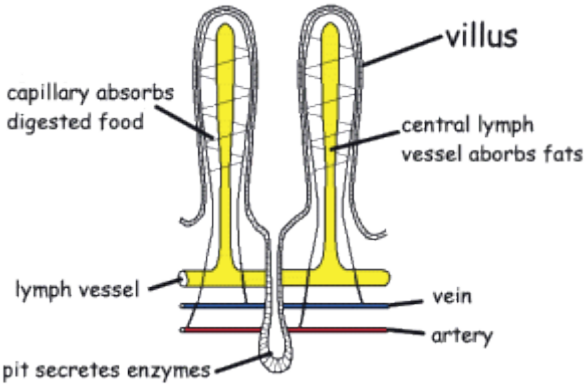
Enzyme	Food Type Digested	Products
Amylase	Starch	Maltose
Maltase	Maltose	Glucose
Protease (eg trypsin)	Polypeptides	Amino acids
Lipase	Fats and oils	Fatty acids and glycerol

enzymes of the small intestine work best in a slightly alkaline environment.

Ileum

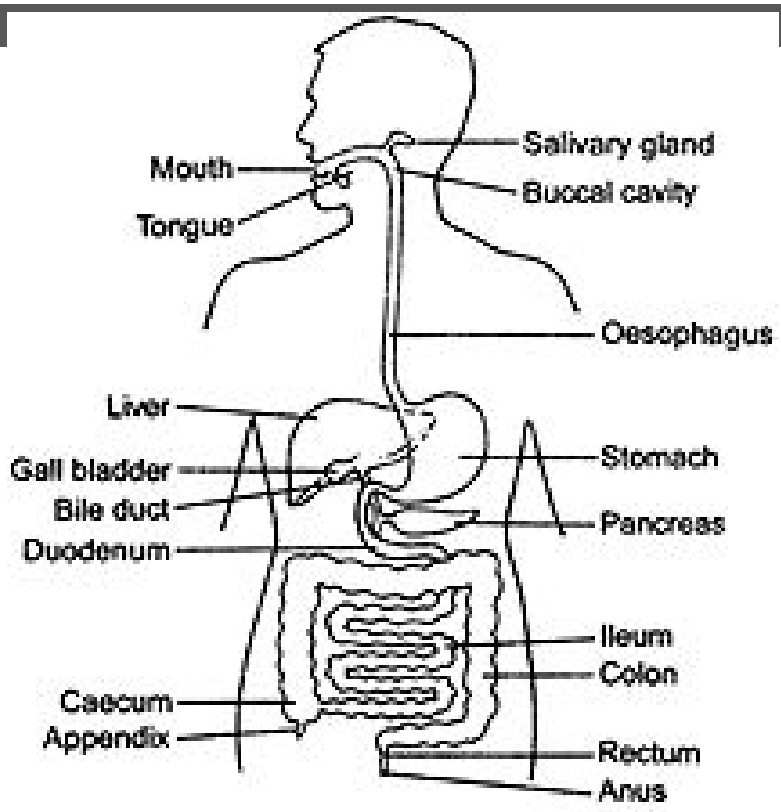
As food is digested the products are absorbed into the blood. There are a number of adaptations which increases the surface area for absorption.

1. The ileum is long and narrow which produces a larger surface area than a short broad tube.
2. The ileum is folded which increases the surface area.
3. The surface is covered with tiny (about 1mm long) fingerlike projections called *villi*.
4. The cells on the surface of the villi have tiny fingerlike projections on their cell membrane called *micro-villi*.



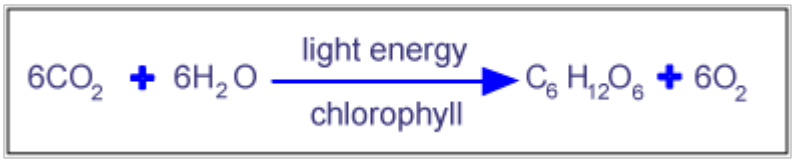
Colon

By the time the food reaches the large intestine all nutrients have been absorbed. What remains is indigestible fiber, bile salts and water. The water is absorbed here. The remaining substances are passed along to the rectum before passing out through the anus.



Unit 7 : *Plant nutrition (photosynthesis)*

Green plants make their own food from sunlight.

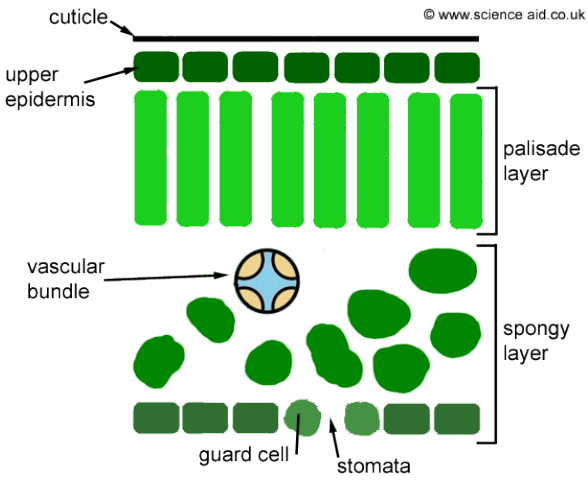


Carbon dioxide + water = glucose + oxygen

Test for starch

- A plant is left in a dark cupboard for a few days so it doesn't produce any more starch
- A leaf is boiled in a beaker to kill all cells
- It is then put in a boiling tube of ethanol and then boiled to remove chlorophyll
- The leaf is then left in a beaker of water to remove the ethanol
- Iodine solution is added (blue-black means starch h is present)

The structure of the leaf



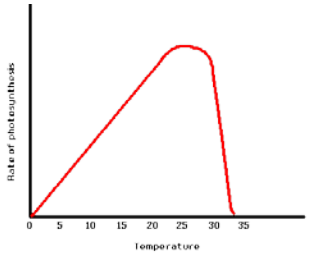
- The leaf has a waxy cuticle to stop it losing water and drying out.
- The epidermis is a protective layer of cells and contains no chloroplasts.
- The palisade layer contains the most chloroplasts as it is near the top of the leaf. It is here that photosynthesis takes place. The palisade cells are arranged upright so increases the chance of photosynthesis.
- The spongy layer contains fewer chloroplasts, enough to catch what the palisade layer cannot absorb.The spongy layer has air spaces to make it easier for gases to circulate in the leaf.
- The vascular bundle provides the leaf with water via the xylem vessels. Food, such as sugar, made in the leaf is transported in the phloem vessels to the rest of the leaf.
- The stomata (stoma - singular) are tiny pores that allow carbon dioxide to enter the leaf while oxygen leaves the leaf.
- Guard cells can open or close the stomata pores to regulate how much gas can enter or leave the leaf. At night the pores close, opening in the daytime.

Limiting factors

There are factors that affect photosynthesis changing these factors are: Temperature, Light intensity, and concentration of carbon dioxide.

Temperature

When the temperature rises the rate of photosynthesis rises also. This is because the particles in the reaction move quicker and collide more. There is an optimum temperature however. At this point the rate of photosynthesis progresses as fast as it can, limited only by the other factors. Beyond this temperature the enzymes controlling the reaction become denatured and the reaction quickly comes to a halt.

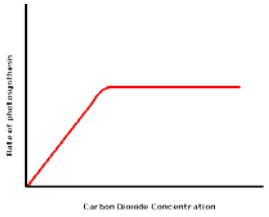


Light Intensity

The plant can photosynthesize faster as a result of a higher light intensity. As the light intensity decreases the rate of photosynthesis decreases. Light is a limiting factor at low light intensities. There comes a point though that any extra light energy will not increase the rate of the reaction. This is because the enzymes controlling the reaction are working as fast as possible. At this point light is no longer a limiting factor.

Concentration of CO2

When the concentration of carbon dioxide is low the rate of photosynthesis is also low. This is because the plant has to spend a certain amount of time doing nothing, waiting for more carbon dioxide to arrive. Increasing the concentration of carbon dioxide increases the rate of photosynthesis. There is a point at which further addition of carbon dioxide will not increase the rate of photosynthesis. The enzymes controlling the reaction are working as fast as possible, so the excess carbon dioxide won't effect.



Plant mineral requirements.

Plants need a number of minerals to live healthily. These mineral ions may be needed to make certain chemicals or needed to make certain reactions work properly. Plant absorbs these minerals from the soil when water is absorbed.

Below is a table of some of the common minerals and their uses.

Element	• Mineral Salt	• Why it is needed	• Deficiency Disease
Nitrogen	• Nitrates	• To make proteins	• Poor growth, yellow leaves.
Sulphur	• Sulphates	• To make proteins	• Poor growth, yellow leaves.
Phosphorus	• Phosphates	• Needed to make DNA and chemicals involved in respiration	• Poor growth,especially of roots.
Magnesium	• Magnesium salts	• To make chlorophyll	• Yellowing between veins of leaves.
Iron	• Iron salts	• To make chlorophyll; iron is not contained in chlorophyll but is needed for its manufacture.	• Yellowing in young leaves.
Potassium	• Potassium salts	• To keep correct salt balance for cells	• Mottled leaves

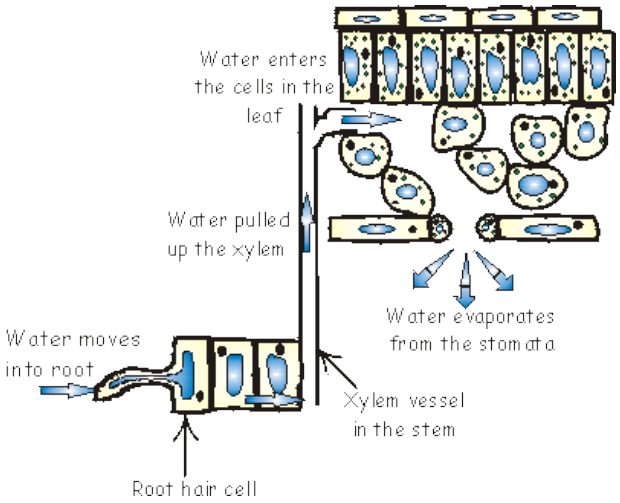
Unit 8: *Transport in plants*

Transport is the movment or flow of different substances within a living organism. The transport system in plants is the vascular bundles (xylem and phloem)

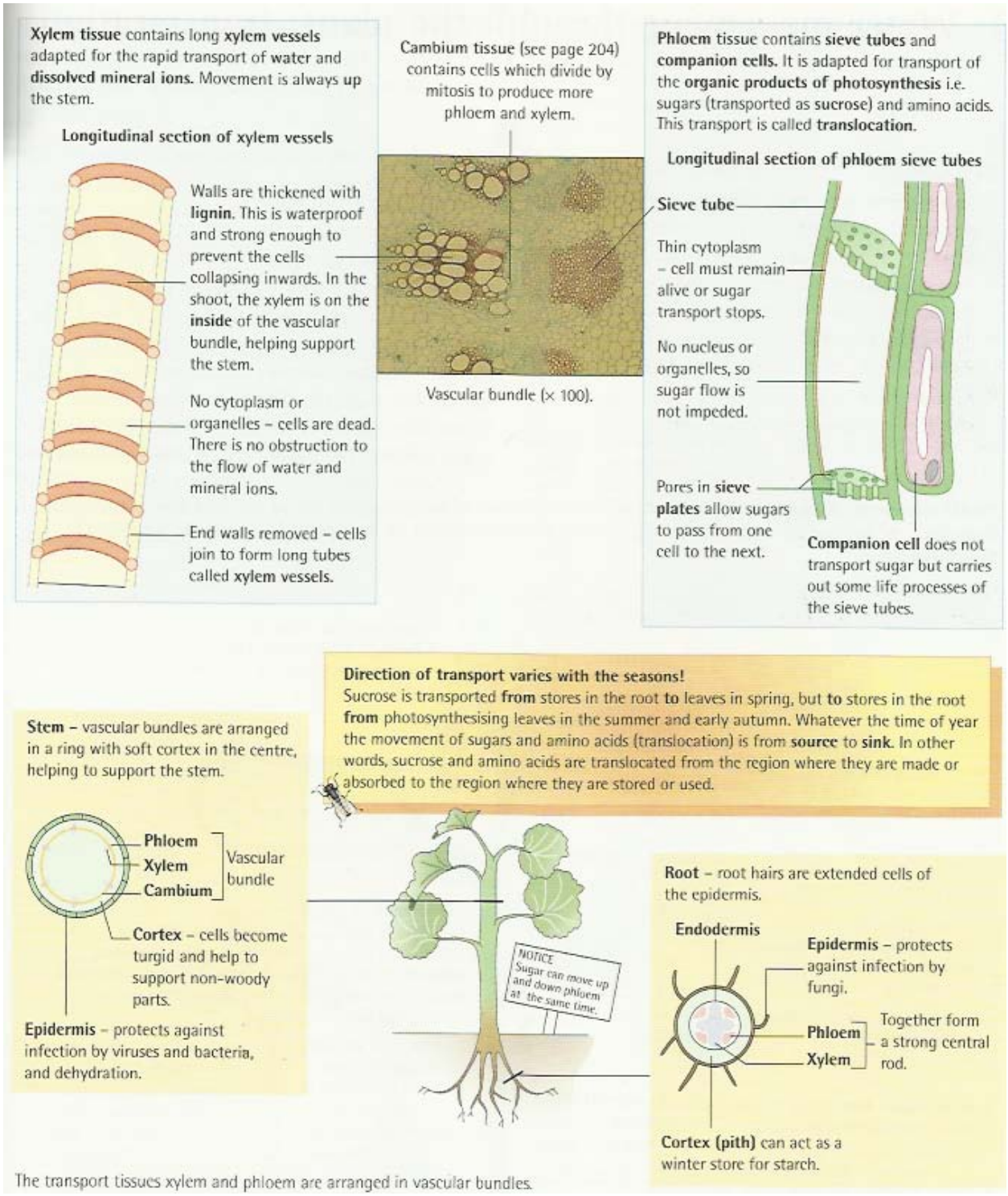
Comparison between xylem and phloem

Comparison	Xylem	Phloem
Description	Consists of non – living woody (lignified) cells (**elements**) joined together to form continuous tubes (**vessels**).	Consists of living cells (**seive elements**)
Substances carried	**Sap**: water and mineral salts	Solution of organic molecules made by the plant, including hormones and the products of photosynthesis.
Direction of transport	Unidirectional: mostly upward, from root to stem and leaves.	Bidirectional : movement of substances occurs downward and upward.
Mechanisms of transport	Mostly passive processes including osmosis. Capillary action and evaporation.	Mostly active processes. Involving the use of energy, the mechamisms are not fully understood.

Water enters the plant via the roots by osmosis they are then carried up the xylem vassals through transpiration which is when water is lost through the stomata. When water is lost through the stomata if forces the water to be sucked upwards.



The xylem vessels themselves are very thin tubes, like capillary tubes. They have very hard and waterproof walls. The cells which made the xylem vessels died to produce a continuous column or tube.



The transport tissues xylem and phloem are arranged in vascular bundles.

The rate of transpiration depends on:

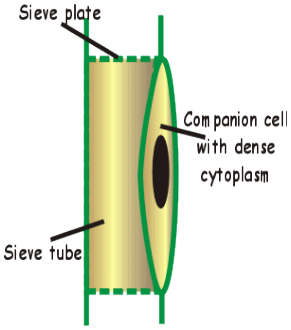
- Temperature: the higher the temperature the faster the uptake
- Humidity: The higher the humidity the lower the uptake
- Air current: The higher the air current the higher the uptake
- Water availability in soil
- Surface area of the leaf
- Density of stomata
- Thickness of cuticle
- Number of leaves

Adaptation

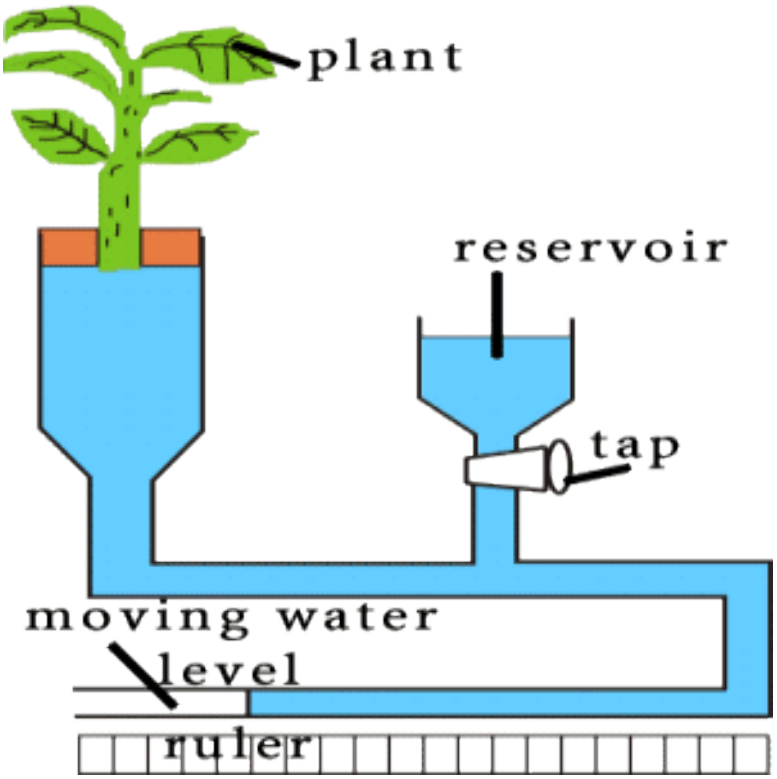
- Plants with a thick waxy layer will cut down on water loss through the leaves.
- Plants can have needle-like leaves. This cuts down the surface area of the leaf and thereby cuts down the numbers of stomata on each leaf.
- -like fibers. These trap air close to the leaf. It creates a microclimate around the leaf. As water is lost from the leaf the microclimate becomes very humid. The hairs prevent this humid air from being blown away. As humidity slows down the rate of transpiration the leaf conserves water.
- Leaves can be folded. Marram grass, which grows on sand dunes, is a good example. The leaf blade is curled in on itself so that the stomata are on the inside. This creates a humid micro-climate which slows down water loss

Phloem

The leaf is the site of photosynthesis, where food chemicals are created for the whole plant. These substances need to be transported to the parts of the plant which cannot make their own food. The chemicals are transported in phloem tubes. Sieve tube elements (the cells which make up phloem tubes) are arranged in long columns. Unlike xylem vessels they are filled with cytoplasm, though they have no nucleus. The cell walls at each end of the phloem cell are perforated to form sieve plates. The phloem cells have associated companion cells which do have a nucleus. The companion cell supplies the sieve tube elements with some requirements as the sieve tube element cannot make things like proteins on its own.

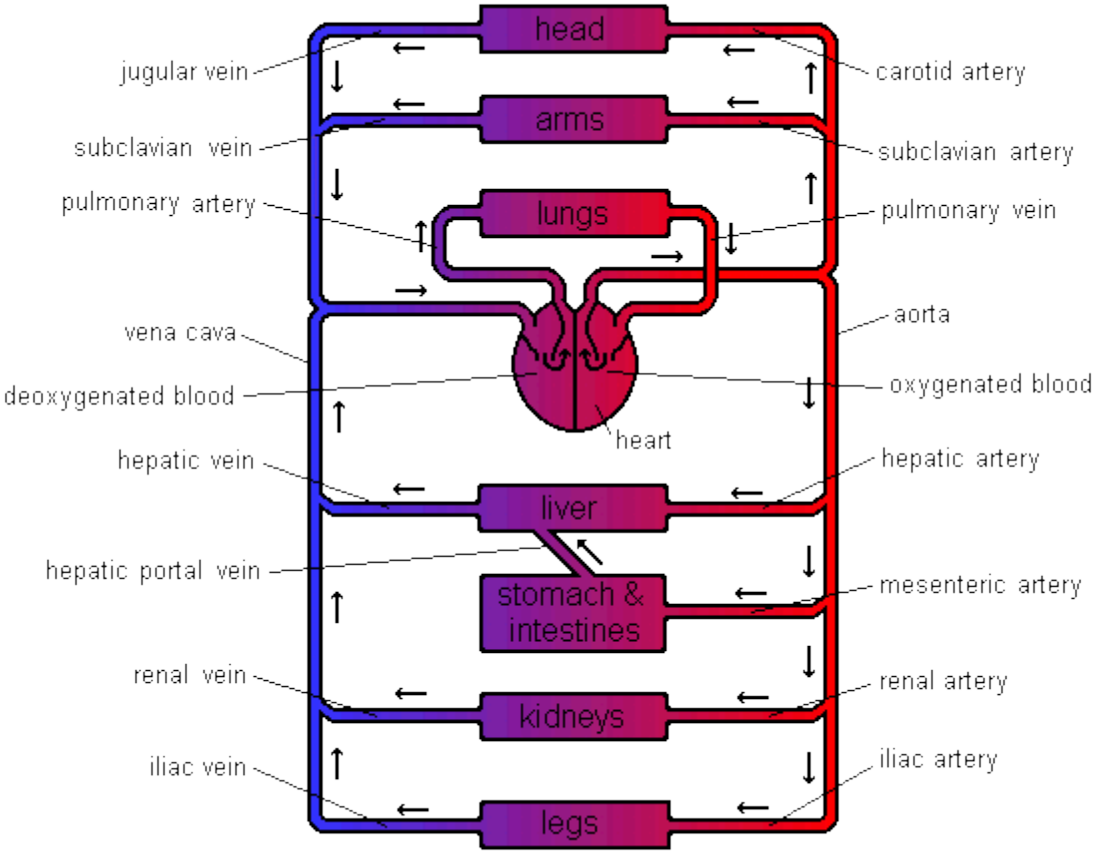


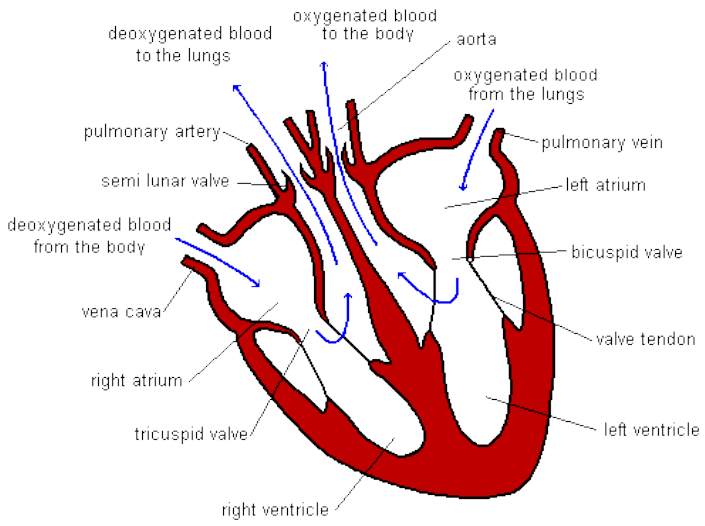
A piece of apparatus called a *potometer* can be used to investigate water loss from a plant in different environmental conditions. The effect of temperature, humidity, wind speed and light intensity can therefore be looked at.


plant
reservoir
tap
moving water
level
ruler

Unit 9: *Transport in humans*

Transportation in humans is done by the circulatory system which involves blood being pumped around the body by the heart. Humans have a double circulatory system which means that the blood is pumped twice around the body once to the heart and another to the rest of the body. Blood transports O2, CO2, nutrients, hormones and waste products so the movement should be quick. The blood traveling through to the body doesn't pass through them one at a time but rather the blood is separated amongst them such as a parallel circuit in physics.





The heart is really two pumps stuck together. There are two chambers to each side of the heart. The first chamber is called the atrium and is the smaller of the two chambers. The larger one is called the ventricle. This chamber is the more powerful of the two as it forces blood out of the heart. The right side of the heart receives deoxygenated blood from the body and pumps it to the lungs, however the left side of the body receives oxygenated blood and pumps it around the body so its force must be stronger. (both of the sides of the heart are separated by valves so the blood doesn't flow backwards).

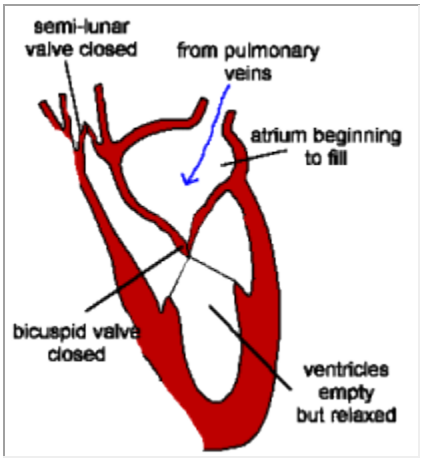
In the heart both sides are pumped together and at the same time. The blood must flow through the heart in one direction. Blood enters the atria from the veins and is then forced into the ventricles. The ventricles force the blood into the arteries. There are a number of sphincter muscles and valves that prevent blood flowing the wrong way. The valves are a little like parachutes. When blood flows the wrong way the valves bulge out, blocking the path.

Heartbeat involves three distinct stages:

1) relaxation phase - **diastole**

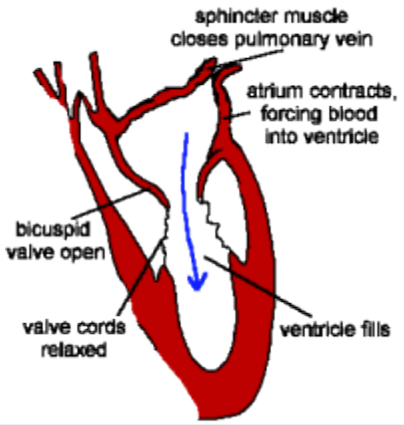
2) atria contract - **atrial systole**

3) ventricles contract - **ventricular systole**

Events in Phase	**Diagram (only one side shown)**
DIASTOLE 1) The atria and the ventricles relax. 2) The semi-lunar valves close, preventing back flow into the ventricles. 3) The elastic walls of the aorta & pulmonary artery contract, forcing blood towards the body & the lungs. 4) Blood from the veins flows into the atria, which begin to fill. Deoxygenated blood enters the right atrium, and oxygenated blood flows into the left atrium.	

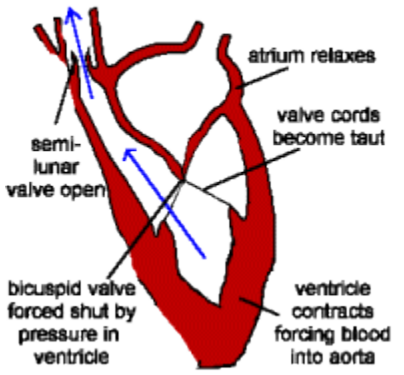
ATRIAL SYSTOLE

1) The atria contract, forcing blood into the ventricles, which fill.
2) Sphincter (ring) muscles closing off the venae cavae and the pulmonary veins prevents backflow from the atria into the main veins.



VENTRICULAR SYSTOLE

1) The ventricles contract, forcing blood into the aorta & pulmonary artery.
2) The main heart valves (tricuspid & bicuspid) are forced shut, so preventing backflow into the atria. This happens because the pressure of blood in the ventricles is higher than the pressure in the atria. The valve cords prevent the valve being pushed back too far.
3) The walls of the aorta & pulmonary artery expand.



Phase	Atria	Ventricles	Cuspid valves	Semi-lunar valves
Diastole	Relaxed	Relaxed	Closed	Closed
Atrial systole	Contracting	Relaxed	Open	Closed
Ventricular systole	Relaxed	Contracting	Closed	Open

The heart rate can be measured by measuring the heart pace. There are muscles in the wall of the heart that receive hormones from the brain telling it to speed up or slow down e.g. adrenaline.

The vessel supplying the heart with blood is called the coronary artery. This is one of the most important arteries in the body because it supplies the heart with all the nutrients it needs. If this artery is blocked then the heart will slow down then stop causing a heart attack. This is how coronary heart diseases (CHD) happen by the buildup of fats on the inside of the vessel. The more fats build up the slower the heart is and the more the heart gets tiered and the person is unhealthy.

Reasons for CHD:

- Inheritance
- Fatty diet: eating too much fats.
- Smoking: it contains nicotine which increases the rate of fat deposition
- Stress and lack of exercise

Blood vessels are tubes, which carry the blood around the body. There are different types of blood vessels. Arteries carry blood away from the heart. These vessels split up into smaller ones called arterioles. Arterioles split up into tiny blood vessels called capillaries. It is from these vessels that movement of particles to & from the blood takes place. Capillaries join together to form larger vessels called venules which join together to form veins .

Veins	**Arteries**
Blood travels to heart	Blood travels away from heart
Large Lumen	Narrow Lumen
Thin wall with few elastic fibres	Thick wall with lots of elastic fibres
Thin muscular layer	Thick muscular layer
Valves present to prevent back flow	No valves
Blood travels constantly	Blood travels in pulses
Blood under low pressure	Blood under high pressure
Blood moves slowly	Blood moves rapidly

Blood

The blood transport5 nutrients, gases, waste, hormones and heat The blood is also the main defense against diseases as it has platelets that form clots and they have white blood cells which have phagocytes which engulfs bacteria and lymphocytes which produce antibodies.

There are about 5-7 liters of blood in an adult body the distrobution is as follows: 55% is olasma which is 90% water and 10% soluble materials and the other 45 % are the cells.

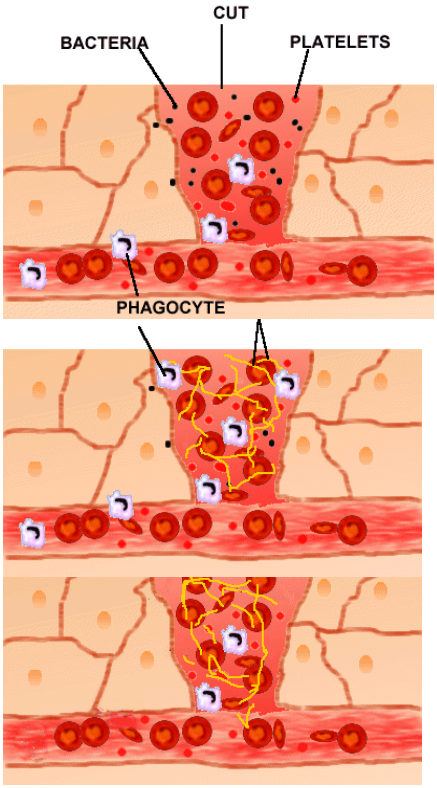
Clotting

When we cut ourselves we not only lose blood but we also make it easier for bacteria to get inside our bodies. Therefore the body must stop the flow of blood and block the breach in the skin to prevent blood loss and infection. For this to be effective it needs to be quick.

Platelets in the blood carry an enzyme. This enzyme is released into the plasma when the platelets come into contact with air or damaged cells.

The enzyme changes the soluble plasma protein fibrinogen into the insoluble fibrin. Fibrin is sticky and forms long threads creating a net, which traps some red blood cells. This makes a plug called a blood clot. Phagocytes, attracted to the damaged site, engulf the pathogens.

The clot hardens and becomes a scab. This protects the wound as the skin heals beneath.



White blood cells and immunity

There are two types of white blood cell, phagocytes and lymphocytes. Their role in defence against disease is different.

Phagocytes wander around the blood looking for foreign bodies. When these are encountered a phagocyte will surround the foreign body and engulf it. The phagocyte then digests the body, killing it.

There are two types of lymphocytes, B-lymphocytes and T-lymphocytes. They work in different ways.

B-cells make special proteins called antibodies. These proteins will stick onto the surface of foreign bodies. They work in a number of ways but all ways are effective.

T-cells hunt foreign cells, cells infected by viruses and cancer cells. When they find them they inject them with toxins, which destroy them.

Immunity

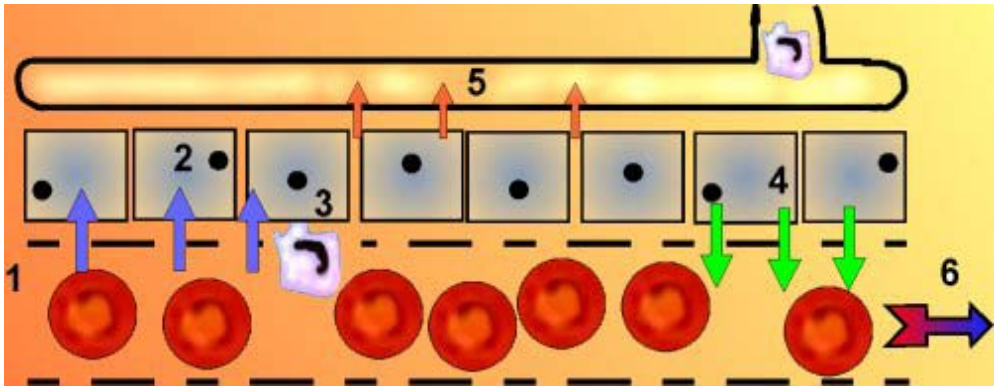
When you become ill through a disease-causing organism you eventually recover as your body's defenses defeat the invading pathogen. When you encounter the pathogen again, your body remembers the past infection and is ready to fight it. The invader is usually defeated before you even get any symptoms of being ill. This is known as immunity. The cells responsible for immunity are the lymphocytes. All cells have on their surface proteins, which are called antigens. The lymphocytes learn the antigens, which belong in the body, and therefore all others are foreign.

Transplant

Sometimes people get transplant s from other people with organs that have different antigens so the body might attack the new organ. That’s why the donors tissues are checked to see if the antigens are close to the one of the actual person, the closer the antigens are the less the chance of a failure transplant.

Material exchange

Blood travels via arteries until it reaches smaller vessels called capillaries. It is here that materials are exchanged between blood and the tissue cells.



1. The blood enters a capillary bed. These vessels are very leaky and are only wide enough for one cell at a time to pass through. The capillary walls are only 1 cell thick!
2. The blood pressure forces some of the blood plasma to leak out of the capillary. This fluid is high in nutrients and oxygen (from the red blood cells). Large objects like red blood cells and protein molecules cannot pass through the walls of the capillary. The fluid that is surrounding the tissue cells is called *tissue fluid*. It is from this fluid that materials will diffuse into the cells.
3. White blood cells are the only cells, which can leave the blood, so they can hunt down pathogens.
4. Waste materials like carbon dioxide and urea diffuse from the cells into the tissue fluid. This fluid is drawn back into the blood capillary by an osmotic pressure supplied by the large proteins in the blood.
5. Not all the tissue fluid flows back into the blood. If it did not return the tissues would swell with fluid. Sets of vessels, called lymph vessels, drain this tissue fluid and carry it away from the tissues. Eventually the fluid (called lymph) drains back into the blood.
6. The blood leaves the capillary beds and travels back to the heart via veins.

Respiration

Respiration is the chemical breakdown of food molecules to release energy. **Breathing** is the mechanical movement to ventilate the respiratory surface, it includes inhaling and exhaling. **Gaseous exchange** is diffusion of O2 on a moist surface into an organism and the diffusion of CO2 out of the organism**. 2 types of respiration:**

Aerobic respiration

It is the breakdown of glucose in the presence of O2. In this process glucose is completely oxidized into carbon dioxide and water. This process is slow and is controlled by many enzymes & the energy produced is not used immediately but stored as ATP. **The energy released from ADP can be used in many activities such as ;**

- Cell division
- Maintaining temperature
- Active transport in the membrane
- Conduction of nerve impulses

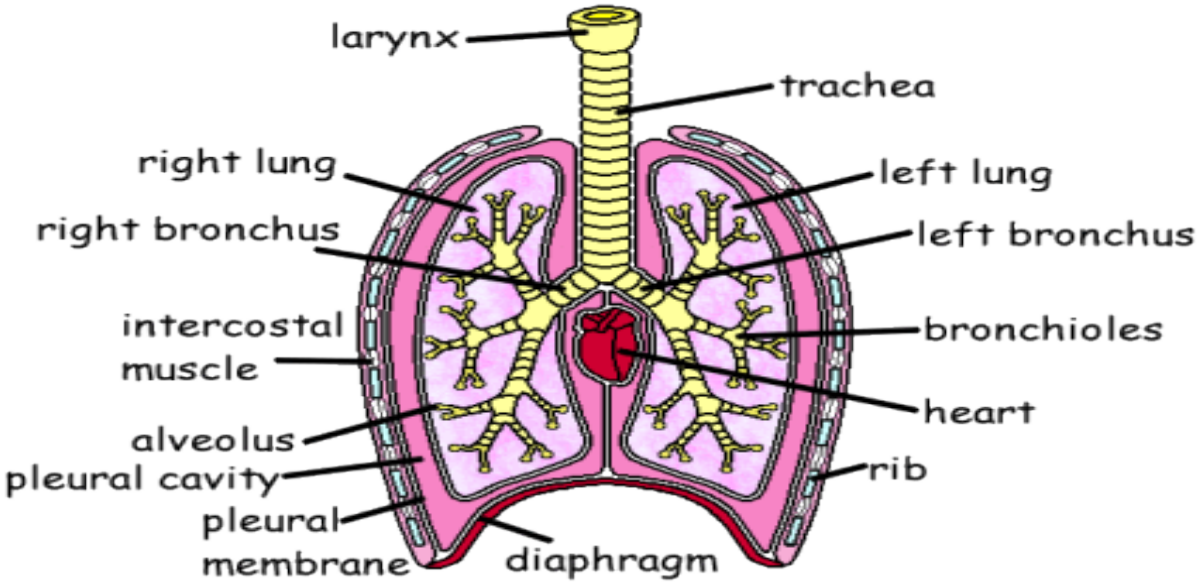
Anaerobic respiration

This is the breakdown of glucose without using oxygen. In this process the energy produced is relatively small and the product is variable.

Alcohol can be produced when anaerobic respiration happens in the fermentation in yeast. In the human body lactic acid is a product to anaerobic respiration during heavy exercise. The lactic acid produced needs to be broken down further more by oxygen. That's why we continue breathing heavily after exercise the breakdown of lactic acid is called **Oxygen dept**.

Unit 10 : *Gas Exchange*

The lungs are located in the chest inside a lubricated membrane called the pleural membrane.This allows the lungs to move freely inside the pleural cavity. The lungs are connected to the outside via the trachea (windpipe). The trachea is a tube kept in a rigid shape due to rings of cartilage. The larynx or voice box is located at the top of the trachea while at the bottom end it branches into two bronchi. These lead into the lungs.



The bronchi in turn branch off into smaller and smaller bronchioles. These end in tiny air sacs called alveoli. It is here that gaseous exchange takes place. The surface area of all these alveoli is very large so as to be able to absorb oxygen very quickly.

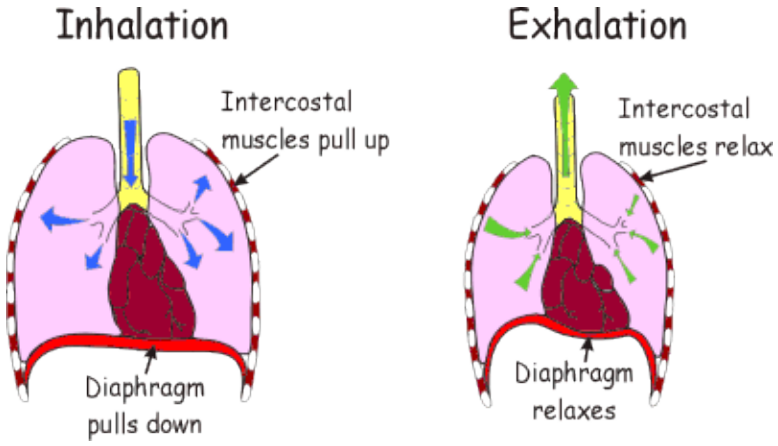
The lungs are very delicate and can easily be damaged. The cells lining the airways have very tiny hair like structures called cilia on them. These cilia are coated in a sticky mucus. The beating cilia force the mucus and any particles of dirt up out of the lungs. It eventually drops down into the esophagus so the mucus is attacked by the stomach acid, destroying any pathogens.

Characteristics of the alveoli

- Large surface area: Big amounts of O2 can diffuse
- Thin walls so gas exchange can happen
- Rich supply of capillaries
- Moist so gas dissolves in water

The diaphragm and breathing

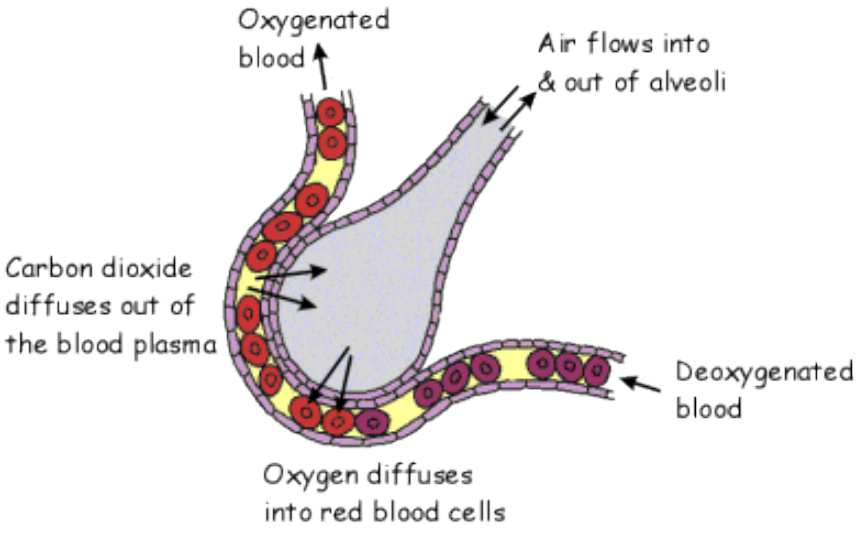
When we breathe in the diaphragm muscle contracts, pulling the sheet down. The intercostal muscles in between the ribs also contract which pulls the whole ribcage upwards and outwards. These together increase the volume of the chest. Air is drawn into the lungs because the the pressure inside them is lowered as the chest volume is increased.



When we breathe out the diaphragm relaxes as does the intercostal muscles. This decreases the volume of the chest, increasing the pressure. This forces air out of the lungs. So it is the changing volume of the chest which causes air to enter and leave the lungs. The lungs themselves are just like balloons which are inflated and deflated.

The exchange

The walls of the alveoli are very thin and so are the walls surrounding the alveoli so that's why diffusion of O_2 and CO_2 happens. Note that other gasses don't diffuse because the concentration of them in and out of the body are not different.



Smoking

Smoking causes a number of diseases, some of them life threatening.

- **Nicotine** This is the substance which makes smoking addictive. Nicotine is a stimulant which can make the heart beat faster and increase the amount of adrenaline released. It also makes the smoker more shaky. It causes stress.
- **Carbon Monoxide** This is created due to incomplete burning of the tobacco. This gas binds irreversibly to the haemoglobin in red blood cells preventing them from carrying oxygen. If the smoker is pregnant then the baby will get less oxygen than usual.
- **Tar** is a mixture of many different chemicals. It prevents the cilia in the lungs from working and so the dirt and tar cannot be removed from the lungs. Also damages the alveoli and decrease the lungs surface area.

Unit 11 :*Excretion*

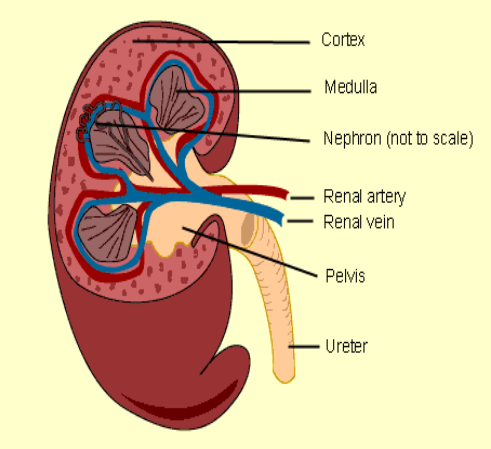
It is the removal of waste products of metabolism and substances in excess of requirements from organisms. (don't mix it with egesting).

Organs that excrete:

Mammalia excretory organs :

Organs	*Excretory products*
1- the lungs	CO_2, water vapour " expired air"
2- the kidneys	Water, urea, uric acid, excess salts, drugs and inactive hormone in the form of urine
3- the liver	bile pigement result from destruction of old RBCs released with bile, in faeces.
4) the skin	Water, salt and few urea " sweat" N.B sweat is a response of rise in temperature & not due to change in blood composition so it is not considered as real excretory organ.

The urinary system consists of two kidneys, two ureters a bladder and a urethra. The job of the kidney is to purify the blood as it enters it. The blood is entered to the kidney by the aorta and id filtered the clean blood then returns to the heart and the urine then goes down the ureters and to the bladder then to the urethra. The outside part of the kidney is called the cortex and the inner part is called the medulla and the part connecting to the ureters is called the pelvis (the very part in the middle). Urea is a harmful substance made in the liver it is made when proteins are broken down.

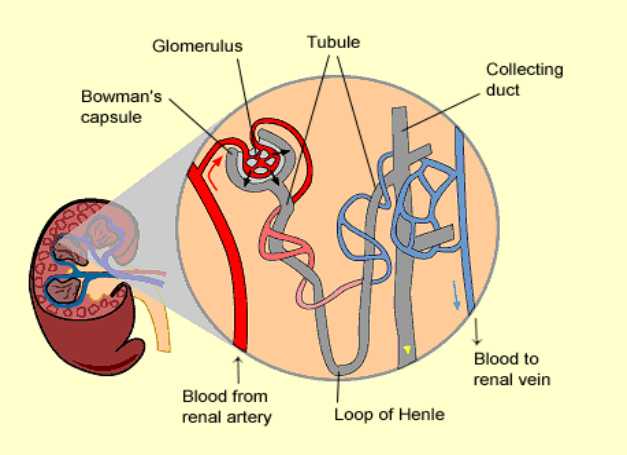


The kidneys have four functions:

- Regulation of blood water levels
- Reabsorption of useful substances into the blood
- Adjustment of the levels of salts and ions in the blood
- Excretion of urea and other metabolic wastes

A nephron is a the smallest unit that filters the blood

Blood at high pressure entering the aorta passes through the walls of the bowman's capsule except the blood cells and protein (O2, CO2 glucose, Urine salts and amino acids only enter). Most substances including O2 glucose most of the water and some salts are absorbed at the tubules to join the renal artery. The rest of the substances then go down the loop of Henle. Then the rest of the unwanted substances are passed to the urter and then out of the body. Most of the nephrone is in the cortex only the loop of Henle is in the medulla and the collecting duct heads to the pelvis and collected as the ureter (there are about 1 million nephrons in each kidney.)



Osmoregulation

Is keeping the water and salt levels constant in the blood. They are regulated by the hypothalamus. If the concentration of water is too low e.g. during heavy exercise as a lot of water is removed by sweating the blood becomes too concentrated so the hypothalamus senses too little water in the blood. A message is sent to the pituitary gland to release anti-diuretic hormone. This makes the membranes of the collecting ducts become more permeable to water so more water passes. Usually when someone goes to the toiled during exercise the urine is concentrated and is a t low quantity. If the concentration of water in the blood is too high then water moves into the cells by osmosis and could cause them to burst so the water in the blood stops the hypothalamus signalling the pituitary. The membranes of the collecting ducts become lass permeable to water and large amounts of dilute urine produced. The concentration of urine depends on many factors e.g. diet, exercise and temperature.

Kidney failure

This is when a kidney of a person faiols then he has to either get a transplant or get dialysis

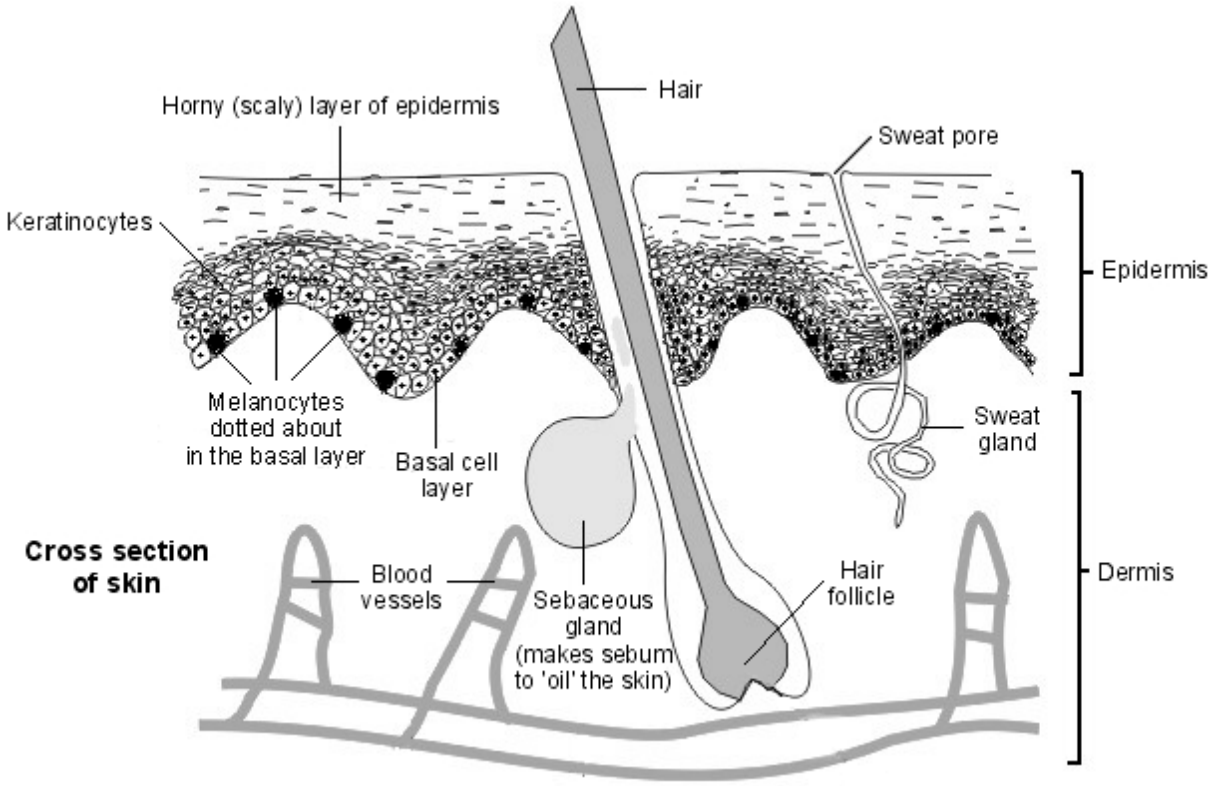
- Transplant:
  This is when the diseased kidney is surgically removed and replaced by a fully functioning kidney from a deceased or a live donor. It is only possible after a satisfactory tissue-match. Even after a successful tissue-match the recipient's immune system has to be drugged or suppressed to stop it from rejecting the new kidney.
- Dialysis:
  In the absence of a suitable donor kidney, the alternative solution is for the patient to be hooked-up to a dialysis machine every 2 - 3 days. A dialysis machine mimics the functioning of the kidney. Blood from an artery in the patient's arm is pumped into the kidney machine which removes **urea** and excess salts from it. The blood is checked for air bubbles before being returned to a vein in the arm.

Unit 12: *Homeostasis and Hormones*

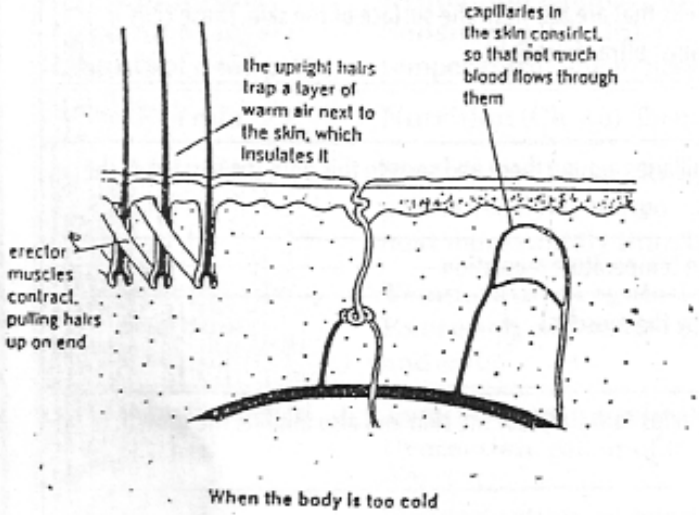
IT is the maintenance of the conditions of the internal body environment. The conditions are maintained by hormones which are secreted by some organs. Hormones are chemical messages and chemicals released from an endocrine gland into the blood controlled by the brain. Negative feedback is when the hormone has done its affect and the brain orders it to stop.

Temperature cam be maintained by the skin.

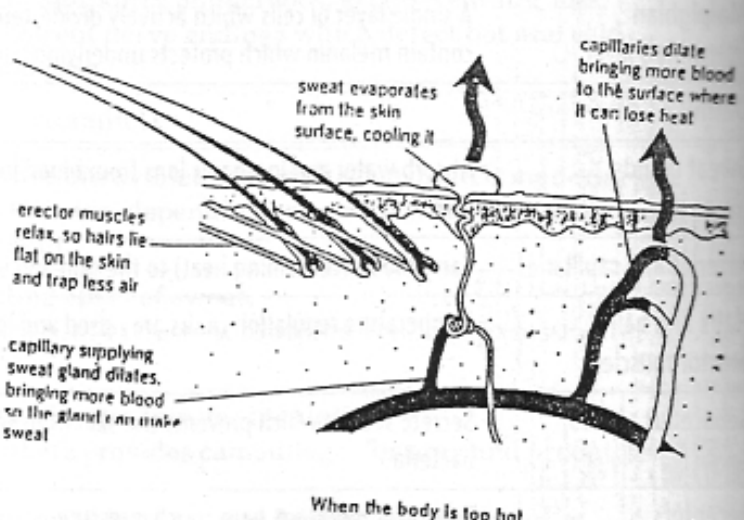
- Sweat glands: Release sweat which evaporates by taking heat from the body decreasing the body temperature.
- Hair: Sleeps and stands up to trap air which insulates temperature.
- Blood vessels: become narrower and wider to heat and cool.



	On a cold day	On a warm day
1-Detection by skin receptor and hypothalamus in the brain	Message are immediately sent out in nerves to switch on the warming mechanism.	Messages are immediately sent out in nerves to switch on the cooling mechanism.
2- Blood vessels (arterioles)	**Vasoconstriction** – arterioles become narrower so that less blood flows through the capillaries	**Vasodilation** – arterioles dilate so that more blood flows thhrough the capillaries close to the skin surface, more heat lost from the skin
3- Hairs	Hair erector muscles **contract** causing hairs to stand on. Thick trapped layer of air between the hairs."thick insulater layer"	Hair erector muscles **relax** causing hairs to become flat. The layer of air trapped is very thin Heat is easily lost from the body by radiation and convection
4- sweat glands	Less active so that latent heat is not lost from the body	Very active more water is brough to the sweat glands during vasodilation, thus more sweat is secreted and more latent heat is lost when sweat evaporates
5- Metaboolic rate	Increases More heat is produced. Shivering due to involuntary contraction of the muscles	Decreases Less heat produced



When the body is too cold



When the body is too hot

Blood sugar levels should be maintained. This is how it is maintained:

- *Blood sugar is too high*
- Messages sent to pancreas to produce insulin
- Insulin converts glucose to glycogen
- Sugar level maintained
- Message sent to pancreases to stop insulin.
- *Blood sugar too low*
- Messages sent to pancreas to produce glucagon
- Glucagon converts glycogen to glucose
- Messages sent to pancreas to stop glucagon.

Diabetic people can't control their blood sugar level so they take in insulin pills e.c.t to try to maintain the blood sugar level. A symptom of this illness is the presence of glucose in urine.

Plants hormones

Tropisms:

Growing in response to a stimuli is called a tropism. Phototropism is growth in response to light. This is an example of a positive tropism, growing towards the stimulus. Hydrotropism is a response to water whereby the roots grow towards it. Geotropism is a response to gravity. Roots show positive geotropism while shoots show negative geotropism (in that they grow away from gravity).

Uses of Plant Hormones:

Plant hormones including auxins have been used in agriculture and by horticulturalists for number purposes. Plant hormones are used in rooting powder to stimulate the development of roots from plant cuttings. They are also used in fruit ripening to make sure that all the fruit ripens at once to aid harvesting.

Unit 13 :*The nervous system*

Any nervous action is a result of a stimulus.

- **A Stimulus**

  is any change either internal or external which leads to a response. This could be a noise, smell or the changes in blood sugar level.

- **A Receptor**

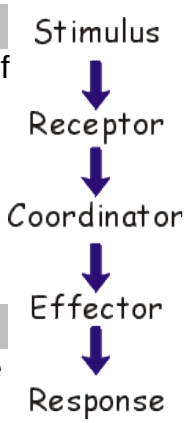
  is a specialized cell which can sense the stimulus. There are lots of different types of receptors; some can sense light, while others can sense heat etc.

- **A Coordinator**

  is a cell or organ which 'decides' what to do. It gives a message to the effectors to do something.

- **The Effectors**

  is an organ which responds to the stimulus. This could be a muscle which contracts or organs like the liver which may perform a complex task like lowering the blood sugar levels after a meal.



- **The Response**

  is what happens when the organism reacts to the stimulus.

  A stimulus cam be internal or external. External stimulus's can be like light from the sun, this will be the stimulus, and the receptor will be the light sensitive cells on the retina, the coordinator is always the brain and the effecter is the muscles of the iris and the response will be the iris narrowing down. An example of an internal stimulus will be an increase in body temperature.

  The nervous system

  The nervous system is made up of the Brain, the spinal cord (CNS central nervous system) and the nerves.

Nerve cells

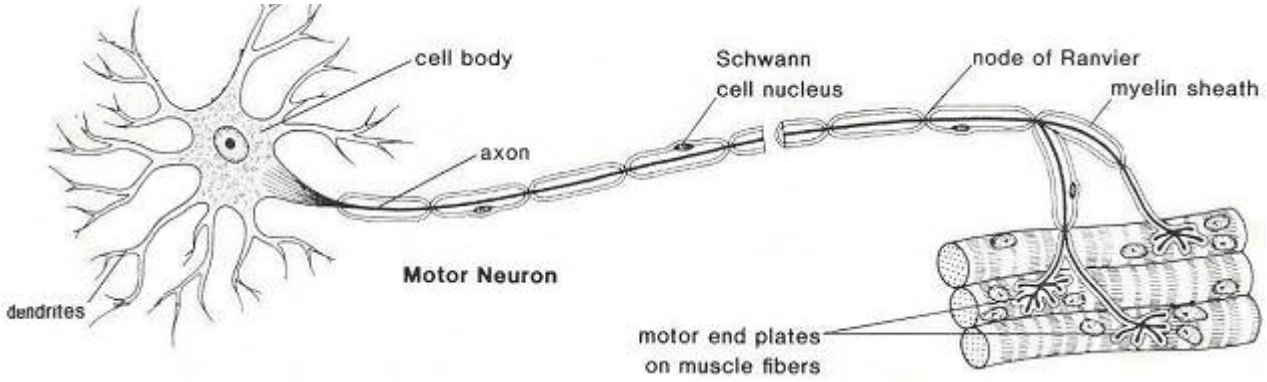
- **Motor neurons:** transmit impulses from the CNS to the effecter muscle
- **Sensory neuron:** transmits messages from the sensory neuron to the CNS
- **Relay neuron:** Links the motor with the sensory neuron.

Info about neurons

- Made up of a bundle of axons which are surrounded by myelin sheath.
- A synapse joins two neurons together. It contains chemical messages.
- Have branched ends that receives impulses.

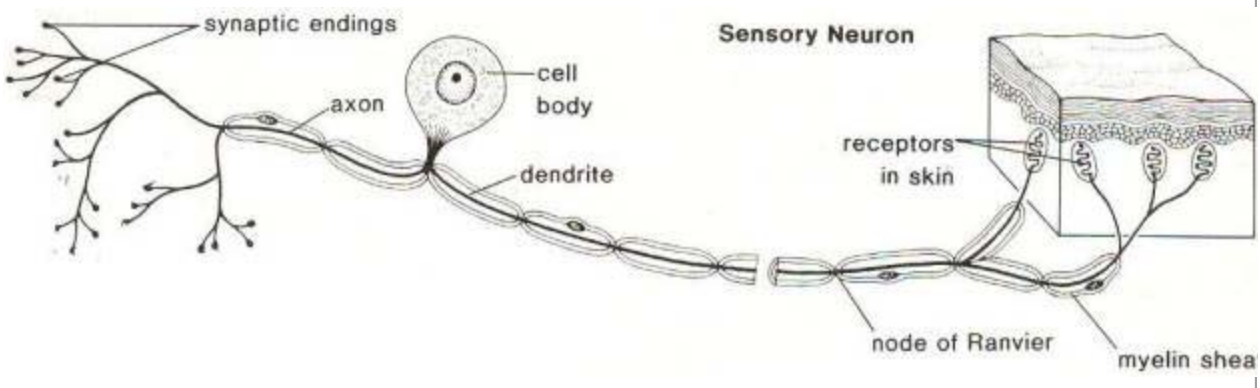
Motor Neurone:

- Efferent Neuron – Moving toward a central organ or point
- Relays messages from the brain or spinal cord to the muscles and organs



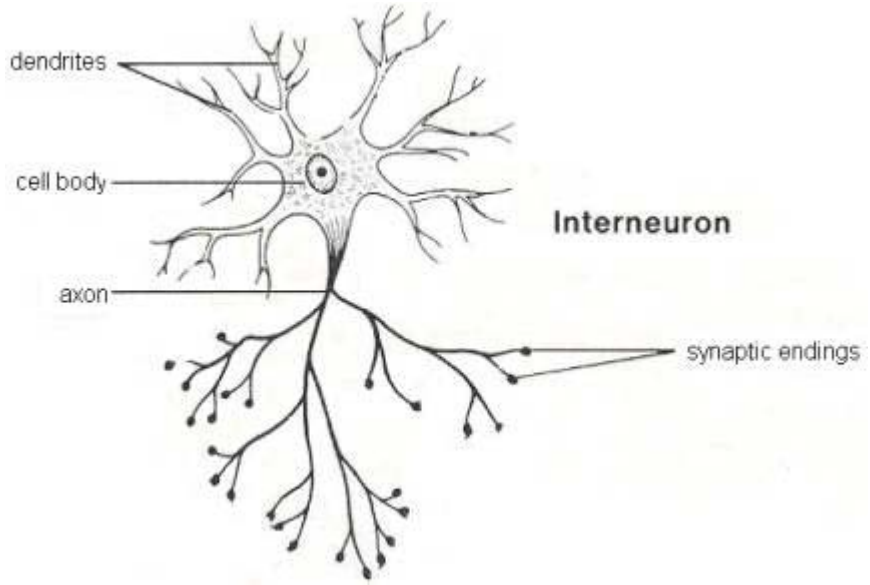
Sensory Neurone:

- Afferent Neuron – Moving away from a central organ or point
- Relays messages from receptors to the brain or spinal cord

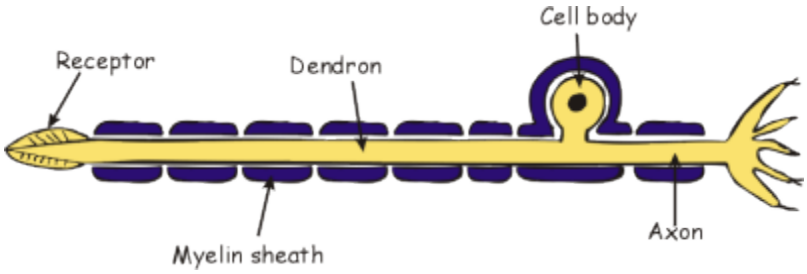


Interneuron (relay neurone):

- Relays message from sensory neurone to motor neurone
- Make up the brain and spinal cord

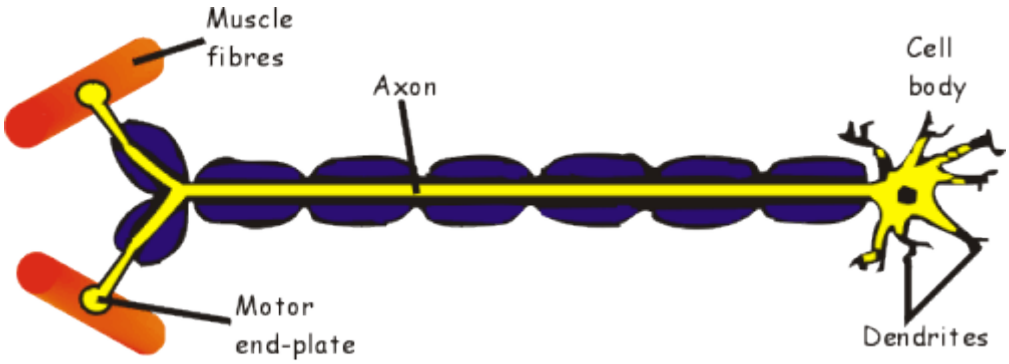


Sensory neurone



The sensory neuron gathers information from the senses and passes it on to the central nervous system (*CNS*). It is attached to special receptor cells or in some cases the nerve's end is a receptor itself. When stimulated it carries an electrical impulse along its length, passed the cell body and down the axon to the nerve endings. It is here that the cell meets with another neuron (or neuron) at a junction called a synapse. The cell bodies of sensory neurons can all be found together in a nerve. This causes a swelling called a ganglion.

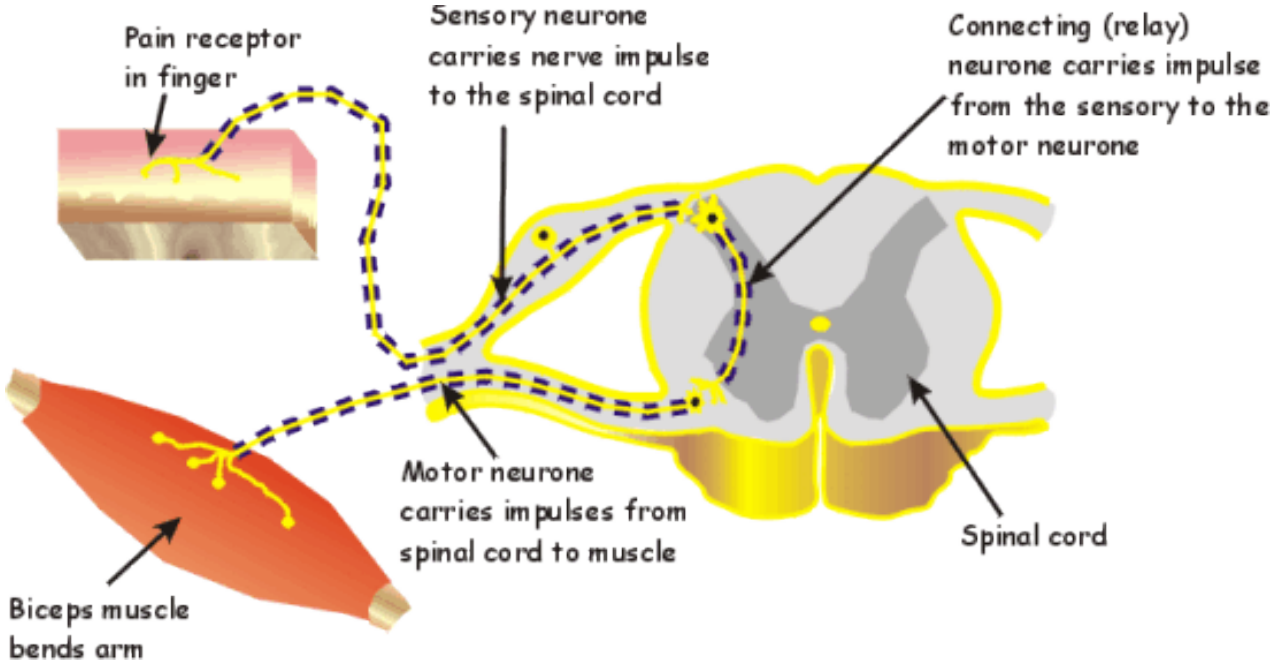
Motor neuron



These neurons carry impulses away from the CNS towards effecter organs like muscles or glands. These cells have very long axons at the end of which are motor end plates where the nerve cell can stimulate the effecter organ.

The reflex arc

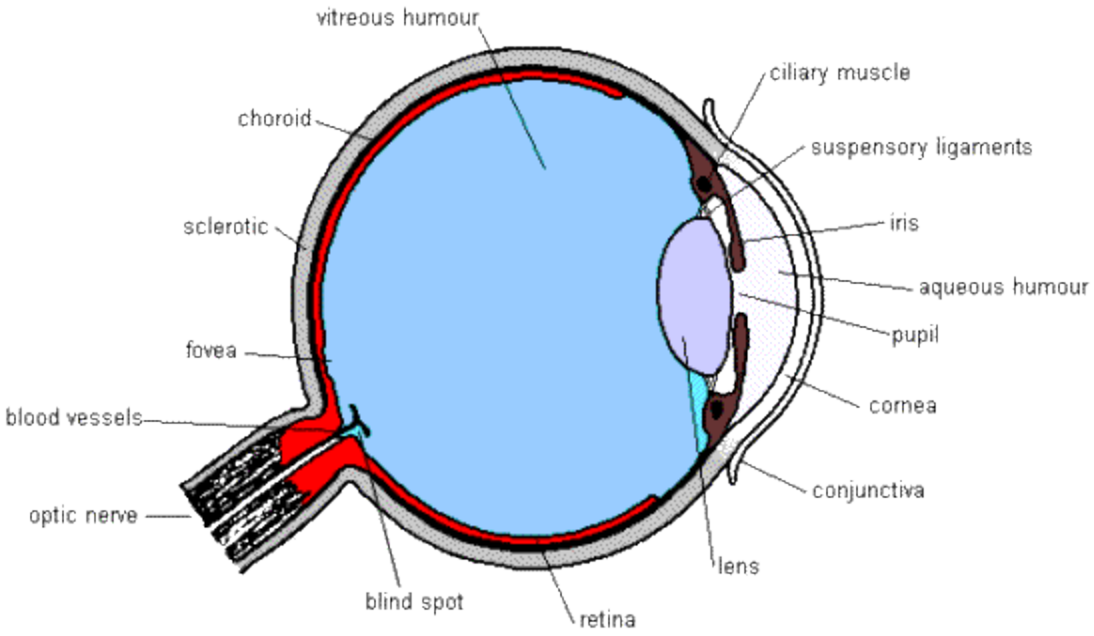
A reflex action is usually quick passive action it is usually for protection. The spinal reflex does not need to pass through the brain but pass through a relay neuron. So a stimulus happens and a receptor (the sensory organ) passes the impulse to the sensory neuron and then to the relay neuron and then to the motor neuron.



Synapse

The synapse is a junction where two or more nerve cells meet. The synapse allows the nerve cells to pass on their electrical impulse to another cell. The synapse is also a way of controlling the direction in which impulses travel. They can only travel one way through a synapse. When an impulse reaches the synaptic knob, it releases vesicles of a chemical called a neurotransmitter to be released into the synaptic cleft. They quickly diffuse across the gap and bind with receptors on the surface of the connecting neuron. When enough of the receptors have been filled an electrical impulse is triggered in this neuron and off it travels.

Unit 14 : *The Eye*



The Structure of the Eye

- **Sclera**: a tough coat that protects the eye from the inside.
- **Choroid**: A layer that absorbs light so no internal reflection happens
- **Retina**: contains light sensitive cells.
- **Yellow spot**: The highest concentration of rods and cones
- **Blind spot**: the least concentration of light sensitive cells
- **Optic** nerve: Transmits impulses generated by the retina.
- **Vitreous humour**: Helps maintain the shape of the eyeball
- **Lense**: Responsible for the refraction of light in the eye
- **Suspensory ligament**: Adjust the lenses shape
- **Iris**: Controls the entry of light.
- **Pupil**: The circular opening which lets light in
- **Cornea**: The outer layer of the eye (transparent)
- **Aqueous Humour**: Maintains the curvature of the choroid
- **Rectus muscles**: Adjust the position of the eyeball
- **Tears**: contain NACL, water, sodium bicarbonate and lysozem

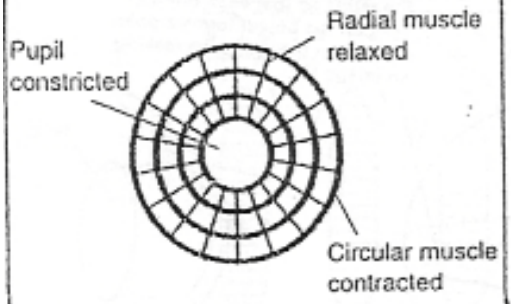
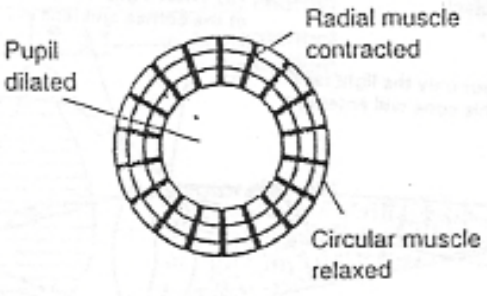
The retina is the light sensitive layer which is responsible for 'seeing' light. The retina is composed of two types of light sensitive cells.

Rod cells

These cells are capable of seeing only different degree's of light intensity and cannot distinguish colour. As a result they can only see in black and white. They are able to sense low levels of light and so are used for seeing in dim light such as at night but do not work in bright light.

Cone Cells

There are three different types of cone cell, each sensitive to a different colour of light. The three cells are sensitive to the three primary colours of light, red, green and blue. These cells need a great deal of light in order to work and as a result are not able to 'see' in dim light. The cells are mixed together so that different colours can be seen.

BRIGHT LIGHT	DIM LIGHT
More photoreceptor cells in the retina are stimulated by an increase in light intensity	Fewer photoreceptor cells are stimulated due to decrease in light intensity
Greater number of impulses pass along sensory neurones to the brain	Fewer impulses pass along sensory neurones to the brain
In the iris diaphragm, circular muscle contracts and radial muscle relaxes	In the iris diaphragm, circular muscle relaxes and radial muscle contracts
Pupil constricts	Pupil dilates
Less light enters the eye	More light enters the eye
Anterior view of iris and pupil 	Anterior view of iris and pupil 

not to damage photo-receptor cells on the retina.

Accommodation

It means the ability of the lens to detect far and near objects by changing its thickness to be able to see far and near.