IGCSE

Biology

OL

17th edition

New syllabus

016

WAHID WANIS

Introduction to O.L.biology

- **This book is designed in a well organised pattern to be an exciting guide to O- level that you can study easily.**
- **It includes all the topics required in the new syllabus.**
- **It includes practical work which contains the basic facts and techniques that open the door to answer any question.**
- **The important scientific terms are written italic and underlined.**

How to use this book for highest achievement

- Read carefully the topic for understanding.

- Rewrite the main scientific terms which are written in italic, bold and underlined, so that you can remember the correct spelling.

- On a paper write the main titles of the topic, then try to write the points covering each title from your own mind, if are written well this means that this topic is well studied as a first step, if not, restudy the weak points and repeat the last step.

- Use the book (answers to past papers, prepared by WAHID WANIS) to find out the questions related to this topic , try to answer the questions by yourself, recheck the answer.

I hope that it will help to maintain your interest in biology, and that it will play a valuable role in developing your knowledge and understanding.

WAHID WANIS

Contents

The Main Characteristics Of Living Organisms

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

Nutrition : Taking nutrients which are ***organic substances and mineral ions*** to be used in ***growth, tissue repair,development and production of energy.***

Excretion : Removal of toxic materials , waste products of metabolism ***(metabolism means chemical reactions in cells including respiration)*** and substances in excess of requirements.

Growth : Permanent increase in ***size and dry mass*** (dry mass means mass of the organism after removal of all its water content) by an increase in ***cell number or cell size or both***.

Reproduction :The processes that make more of the ***same kind*** of organism.

Movement **:(or locomotion)**
An action by an ***organism or part of an organism*** causing a change of position or place.

Sensitivity **:(or irritability)**
Ability to ***detect or sense*** changes in the external or internal environment (stimuli) and to ***make responses***.

Stimuli

- Singular is ***stimulus***
- A stimulus is a change in the external or internal environment of an organism such as heat, light , pain …etc.

Dry mass

Mass of an organism after ***removal of its water content***.

How to prepare a dry mass

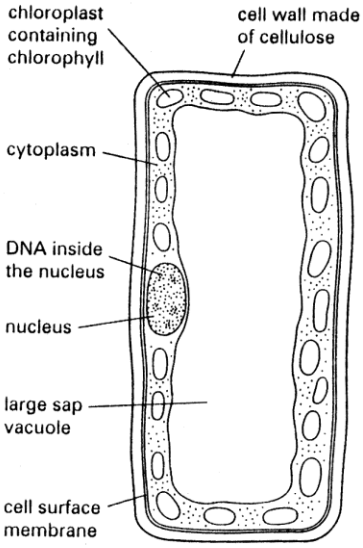
- Heat gently in an ***oven or an incubator*** at a low temperature.
(about 80 ^{o}C to increase rate of evaporation without burning the organic matter)

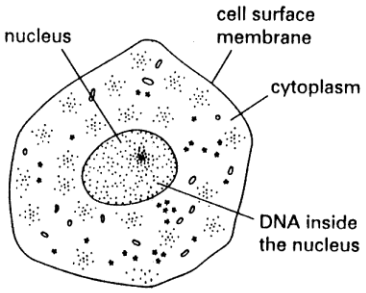
- After a suitable period of time, leave it to cool and weigh it.

- Repeat heating and reweigh it until ***two successive weights become equal*** to make sure that it has lost all its water content.

CELL STRUCTURE AND ORGANISATION

plant cell **animal cell**





Example: palisade cell *(cell from plant leaf)* **Example** : liver cell

The main properties and functions of different parts

Structure	Properties	Functions
Cell wall	~ Found in ***plant cells only***. ~ Made of ***cellulose*** (non living). ~ ***Fully permeable*** (mans allow different molecules to pass through it freely) .	~ Supports, protects and gives the cell its shape. ~ Allows the ***freely movement*** of the different molecules
Cell membrane	~ Found in both ***plant and animal cells*** ~ Made of ***carbohydrates, proteins and fats.*** ~ ***Semi-permeable*** (partially or selectively permeable)	~ ***Surrounds*** the cell contents. ~***Controls*** the movement of different molecules into and out the cell.
Nucleus	~ Contains DNA which is the ***genetic material***.	~ Controls the activities of the cell. ~ Carries the inherited information.
Cytoplasm	~ Consists mainly of proteins .	~***Contains and supports*** the cell organelles. ~ May contain ***stored food***.

Chloroplasts or chloroplastids	Contain chlorophyll.	Absorbs ***light energy*** and converts it to ***chemical energy*** in photosynthesis.
Mitochondria (singular: Mitochondrion)	Are very small organelles.	Site of production of ***energy*** by the process of ***aerobic respiration***.
Vacuole	Consists of fluid surrounded by a membrane.	- It helps in supporting the cell - Regulates absorption of water - Contains stored food.
Ribosomes	Found on the rough ***endoplasmic reticulum*** (ER).	Used in synthesis (formation) of protein.

Similarities in both plant and animal cells

Both have:

~ cell membrane. ~ cytoplasm. ~ nucleus.
~ mitochondria. ~ ribosomes. ~ ER.

Differences between plant and animal cells

plant cell	animal cell
Has a ***cell wall*** made of cellulose.	has no cell wall
Has a large permanent ***sap vacuole***.	has no or temporary small vacuoles known as ***(vesicles).***
Usually contain ***chloroplasts***	no chloroplasts.
Usually contains stored ***starch.***	usually contains stored ***glycogen***.

Notice

- **Cells which have *no nucleus* such as bacteria are called *prokaryotes*.**
- **Prokaryotes have *no mitochondria* and *no rough endoplasmic reticulum*.**

Levels of organization

Level	Definition	Examples in plants	Examples in animals
Organelle	is a ***living structure*** in a cell such as nucleus, chloroplast, vacuole and mitochondria	Chloroplast Ribosomes. Mitochondria	Mitochondria Ribosomes.
Cell	the ***structural and functional*** unit of all living organisms	Palisade cell	Liver cell
Tissue	***A group of cells*** with similar structures, working together to ***perform a specific functions***.	Xylem Phloem	Muscular tissue Nervous tissue
Organ	A structure made up of a ***group of tissues*** working together to ***perform specific functions***.	Leaf Root	Heart Stomach

Organ system or system	A group of organs with related functions, working together to perform body functions.	root system	digestive system respiratory system

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Modification: means a change in shape or structure or both , to be adapted to carry out particular function.

Modified cell : means a cell changed in shape or structure or both than the typical form to be adapted to perform a particular function.

Examples of modified cells

1-Root hair cell

A cell modified for absorption of water and minerals

2- Xylem vessels

Modified cells for:

1 - conduction of water and minerals.
2 - support.

3-Muscle cells

Are modified to carry out contraction for movement.

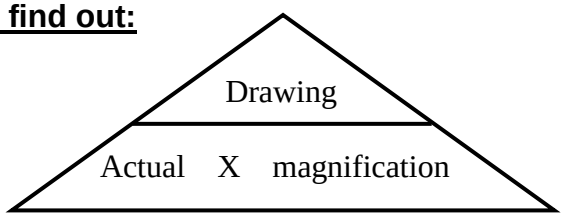
Size of specimen

Actual or real size or length is equal to the length in drawing or photograph divided by magnification

Magnification

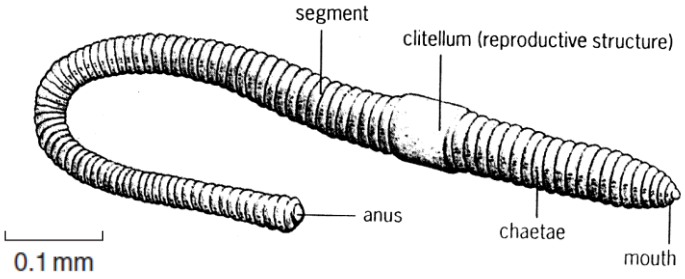
Means how many times the image is seen larger compared with the object

To calculate magnification or actual length use the following triangle, cover the value you need to find out:



Notice
Millimeter = 1000 micrometers (µm)

Example



To determine the actual length of this organism, measure the length of the line shown below the diagram, it is the ***length in drawing***, its ***actual*** is shown as 0.1mm,determine magnification (length in drawing divided by actual).
Measure the length of the organism , ***divide it by magnification*** to determine its actual.

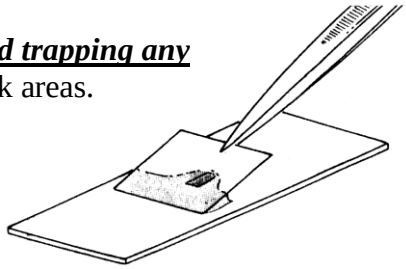
Practical work

Preparing a sample of plant cells for light microscope

1- Cut a piece from an ***onion bulb***, peel a piece of its thin skin using a ***forceps***.
2- Add a ***drop of water*** onto a centre of a clean microscope slide, put the piece of onion skin onto it.

(Water is added to avoid dryness of the sample and to keep it turgid enough to be seen easily)

3- Gently lower a ***coverslip*** onto it as shown below ***to avoid trapping any air bubbles*** that may affect viewing by formation of dark areas.
4- Use a ***filter paper*** to clean up the slide .
5- Look at the sample using the ***low power*** lens of the microscope.



Preparing a sample of animal cells for light microscope

1- Gently rub off a little of your cheek cells using your finger nail or a tooth brush.
2- Put the obtained cells on a clean ***microscope slide***, and gently spread them out.
3- Put on few drops of ***methylene blue*** to stain the cells to see the different parts easily.
4- Gently lower a ***coverslip*** onto it to avoid trapping any air bubbles that may affect viewing by formation of dark areas.
5- Use a ***filter paper*** to clean up the slide .
6- Look at the sample using the low power lens of the microscope.

Diffusion

The ***net movement*** of ***particles*** from a region of their ***higher*** concentration to a region of their ***lower*** concentration down a concentration gradient, as ***a result of their random movement***.

Down and up or against concentration gradient

- ***Down*** a concentration gradient means from ***higher*** concentration to ***lower*** concentration
- ***Up or against*** concentration gradient means from ***lower*** concentration to ***higher*** concentration

What causes diffusion

1- Random movement of the different molecules that provides energy for diffusion.
2- Presence of a difference in concentration of a certain substance.

Factors affecting the rate of diffusion

1- Temperature

Increase in temperature increases the rate of diffusion as it increases the ***kinetic energy*** of the molecules.

(If you hold a tube containing a substance such as ammonia in your hand, rate of diffusion increases as the molecules of the substance gain heat from your hand)

2- Distance of diffusion

The ***longer the distance***, the ***longer the time*** taken for diffusion and ***vice versa***.

3-Air current

If the direction of current is ***similar*** to that of diffusion, it ***increases*** the rate of diffusion and vice versa.

4-Stirring

It increases the rate of diffusion as it ***increases the kinetic energy*** of molecules.

5-Size of molecules

Increase in size of molecules ***decreases the rate of diffusion*** and vice versa.

6-Surface area to volume ratio

When ***increases*** , it leads to an ***increase*** in rate of diffusion.

7-Concenteration gradient (difference in concentration)

Increase in difference of concentration leads to an ***increase*** in rate of diffusion

Importance of diffusion of gases

1- Necessary for ***exchange of gases*** in all living organisms.
2- Necessary for obtaining ***carbon dioxide*** and release of ***oxygen*** in the process of ***photosynthesis***.

Active transport or active uptake

Definition

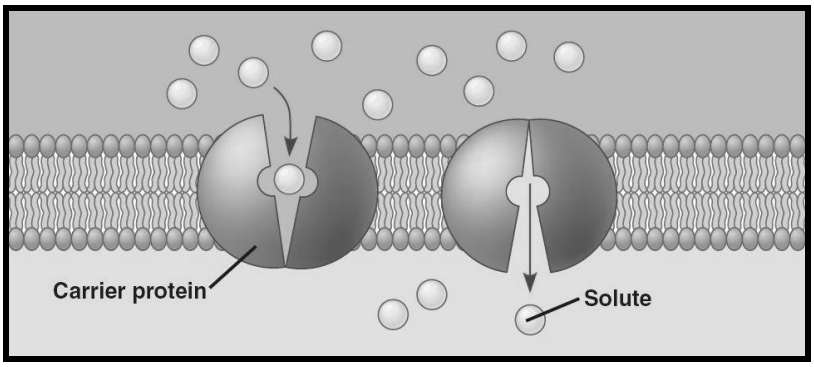
Movement of ***particles*** in or out of a cell ***through the cell membrane***, from a region of their ***lower*** concentration to a region of their ***higher*** concentration against a concentration gradient, ***using energy released during respiration***

Carrier proteins

- Protein found in cell membranes that force particles ***against their concentration gradient***.
- Carrier proteins are ***specific*** (means each type of carrier has a specific precise shape that can bind with specific particle).

How carrier proteins act

- The solute(molecule or ion) is taken in the ***binding site of the carrier*** molecule.
- The carrier molecule ***rotates using energy*** to transfer the solute from region of its ***lower*** concentration to region of its ***higher*** concentration.



Factors affecting active uptake:

1- Number of ***mitochondria*** as in the mitochondria energy is released by the process of ***aerobic respiration***, this energy is used in active uptake.

2- ***Concentration of oxygen***:
Increase in oxygen concentration increases rate of aerobic respiration, as a result of this more energy is produced to be used in increasing rate of active uptake .

3-Number of ***carrier proteins*** in the membrane.

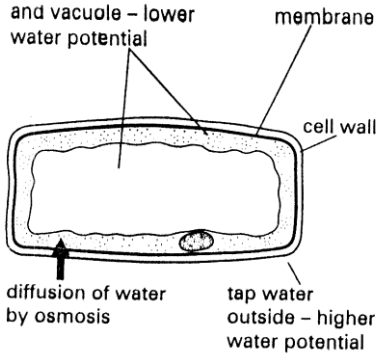
OSMOSIS

What is osmosis

Net movement of water molecules from a region of higher water potential ***(dilute solution)***to a region of lower water potential ***(concentrated solution)*** through a ***partially permeable*** membrane.

Plant cells and osmosis

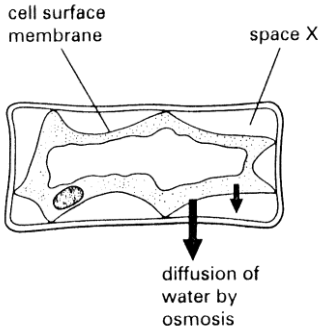
If a plant cell is placed in high potential of water (e.g. distilled water or diluted solution.)



The cell gains water by osmosis

- The vacuole enlarges and the cell becomes ***turgid.***
  (Turgor pressure *is the pressure acting against an inelastic cell wall.)*
- The turgidity is necessary for ***supporting*** the plant.
- The ***pressure*** inside the plant cell can be increased due to absorption of water ***without being burst*** as it is surrounded by a ***rigid cellulose cell wall***

If a plant cell is placed in low potential of water (e.g. high concentrated solution of salt or sugar).



The cell loses water by osmosis

- **If it loses a small amount of water** The vacuole **shrinks**, and the cell becomes **flaccid**, but the cell membrane remains ***attached to the cell wall***.
- If the cell gains water, it gains its turgidity once more (reversible process)
- If it loses more water, the cell membrane separates away from the cell wall and the cell becomes **plasmolysed.**
  (the space labeled X in the above figure is occupied by the surrounding solution.)

Plsmolysis

- It is the ***shrinkage of cytoplasm*** of a plant cell ,so that the cell membrane begins to tear away from the cell wall .
- It is an ***irreversible*** condition because it damages the cell membrane when it tears away from the cell wall .
- It is a ***condition*** caused by the ***process*** of osmosis .

Animal cells and osmosis

If an animal cell is placed in higher water potential

- The cell gains water and ***bursts***, therefore the pressure inside the animal cell cannot be higher than that inside the plant cell.

If an animal cell is placed in lower water potential

- Cytoplasm ***shrinks*** and the cell ***shrivels up***.
  (It is not plasmolysed as plasmolysis includes separation of the cell membrane away from the cell wall and the animal cell has no cell wall.)

Comparison

Diffusion	Osmosis
1- It is applied for movement of any type of molecules 2- A partially permeable membrane is not always involved	-It is applied for the movement of molecules of water only. - A partially permeable membrane must be involved .

The differences between uptake of water and uptake of minerals by the root hair cells

1- Uptake of water takes place by the process of ***osmosis*** which is a ***passive*** process (does not need energy) while uptake of minerals takes place by the process of ***active uptake*** which is an active process (needs energy).

2- In uptake of water, the molecules of water move from regions of their higher concentration (potential), while in uptake of minerals the molecules move from regions of their lower concentrations to regions of their higher concentrations (against their concentration gradient).

Remember that

No active transport for water or gases

Water potential of a substance:

- It is the measure of how much water there is in it, and how easily the water molecules can move around .
- A substance containing a lot of water has a ***higher*** water potential, while a substance containing little water has a ***lower*** water potential.

What is meant by water potential gradient

Presence of a difference in water potential of different media. Water molecules move down concentration gradient, means move from region of higher water potential to region of lower water potential.

Importance of osmosis to plants

- Absorption of water by the root hair cells.
- Prevents ***wilting*** of the plant and provides ***support by turgidity***.

Practical work

1- **If a piece of plant such as potato tuber is placed in a concentrated solution of salt or sugar its length decreases**

This due to loss of water from the cells where water potential is higher to the surrounding solution where the water potential is lower.

*(Decrease in length is represented as a **negative value** e.g. –1, -2 …etc.)*

2- In the above condition

If a weight is hanged to the potato tuber as in figure below , the tuber becomes unable to support the weight as its cells become ***flaccid)***

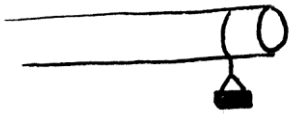
3- If a piece of plant such as potato tuber is placed in distilled water or a dil. solution of salt or sugar its length increases

This is because it gains water from the surrounding solution where water potential is higher than that of potato tissues.

*(Increase in length is represented as **a positive** value e.g. +1, +2 …etc.)*

4- In the above condition

If a weight is hanged to the potato tuber as in figure below, the tuber becomes able to support the weight as its cells become ***turgid.***



5- Salting (e.g. salting of fish) or sugaring of food (e.g. making jam) are important ways in food preservation. Explain why.

As most microorganisms such as bacteria and fungi cannot live in media of high concentration of salt or sugar, because such media have low water potential, as a result of this microorganisms lose water by osmosis and then die.

6-Plants die as a result of irrigation with sea water .

Sea water has high concentrations of salts i.e. low water potential therefore water molecules move by osmosis from plant roots (where water potential is higher) to the outside (where the water potential is lower) ***as a result of this plants wilt and die.***

7- Mean or average length of samples = The total length of the samples divided by the number of samples.

Example

If 5 potato strips of the same length (e.g. 30 mm) are used and are placed in the same dish of water for the same period of time and then final length is measured, the results are,

31,32,31,33and 37, to calculate the mean add the lengths then divide the produced value by 5.

In the above example how to get a more reliable value

Exclude the value 37 as it seems to be anomalous (wrong or abnormal) and calculate the mean of the other 4 values.

8- Why repeating an experiment several times is important before taking a conclusion

For ***more reliable*** results as taking the average reduces the effect of errors that may be produced due to defect in one or more of the samples or as a result of personal errors in measurements.

9- How to determine glucose concentration in potato

Put potato rods of the ***same length*** and obtained from the ***same potato*** in different concentrations of glucose , the concentration of glucose that result in ***no change*** in length of potato is equal to that in potato because at this concentration ***net movement*** of water is zero (means that the amount of water lost is equal to that gained)

10-If a plant stem is cut vertically as shown and each of the produced parts is placed in a different concentration of sugar

The outer layer is ***a waxy , waterproof*** layer therefore it is ***not affected by changes in water potential*** and therefore it does ***not change in length*** , but the inner soft tissue in the one placed in ***high concentrated*** sugar solution ***lost water by osmosis*** causing cells to shrink or become plasmolysed, therefore it ***decreases in length*** than its outer waxy layer while the other one placed in ***distilled water (zero sugar) gained water by osmosis*** therefore its cells become turgid and ***increase in length***.

Nutrition And Nutrients

Importance of food

1- For growth .
2- For tissue repair.
1- For production of energy.
2- For protection against diseases.

Classes of food :

1- proteins. 2- fats or lipids. 3- carbohydrates or saccharides
4- vitamins. 5- minerals. 6- roughages.
7- water .

Carbohydrates or Saccharides

Chemical structure

Composed of the three elements only which are carbon , hydrogen ,and oxygen , in the ratio 1: 2: 1.

Importance of carbohydrates

1- Production of energy by the process of respiration .
(One gram of carbohydrates produces about 17 kJ)
2- Stored in the cells:
- in plant cells it is stored in the form of ***starch*** .
- in animal cells it is stored in the form of ***glycogen*** .
3- Cellulose is used in formation of cell walls of plant cells .

Groups of carbohydrates

Name	Examples	Sources	Formula	Properties
Monosaccharides	glucose fructose galactose	grapes fruits	$C_6H_{12}O_6$	1- Are the basic units of carbohydrates. 2- Are called simple sugars . 3- Are soluble in water . 4- Have sweet taste . 3- Can be found in the form of crystals or white powder .
Disaccharides	maltose lactose sucrose	Barley milk sugar cane	$C_{12}H_{22}O_{11}$	1- Each molecule can be decomposed into two molecules of monosaccharides. 2- Soluble in water. 3- Sweeter than monosaccharides. 4- Can be found in the form of crystals or white powder.

Polysaccharides	starch cellulose glycogen	potatoes vegetables liver	$(C_{12}H_{22}O_{11})_n$ n = many	1- Each molecule can be decomposed into many molecules of mono and disaccharides. 2- Insoluble in water . 3- No sweet taste. 4- Only starch is a white powder .

Storage of carbohydrates

- Carbohydrates are stored in the form of polysaccharides ***because*** this insoluble form has no osmotic effect.
- In mammals excess carbohydrates are stored in ***liver*** and ***muscles*** in the form of ***glycogen***.
- Excess carbohydrates are also converted into ***fats*** to be stored under the skin and around certain organs such as kidney

Notice

starch, glycogen and cellulose are ***formed of glucose.***

LIPIDS

Chemical structure : are composed of the ***three elements*** which are carbon , hydrogen , and oxygen .**But** the amount of oxygen in fats is less than that in carbohydrates

The basic units : ***fatty acids and glycerol*** .

Lipids are fats and oil

- Fat is a lipid which is ***solid*** at room temperature such as butter.
- Oil is a lipid which is ***liquid*** at room temperature

Importance of fats

1- Release of energy by the process of respiration .

(The energy produced by fats is nearly double that produced by carbohydrates, it is about 39 kJ/gram)

2- Form a part of the cell membrane .

3- Stored in the body:

- as a food reserve .
- to protect and support certain organs such as kidneys.
- to act as an insulating layer that reduces the rate of heat loss.

4-Form a water proof layer for skin, fur, and feathers.

Sources of fats

Animal sources : meat, milk, cheese, butter and eggs
Plant sources : palm oil, maize, and cotton seed oil.

Carbohydrates are used as a source of energy for players and not fats although the energy produced by fats is more than that produced by carbohydrates because the metabolism of fats takes longer time

PROTEINS

Chemical structure : it is formed of the following elements **carbon, hydrogen, oxygen, nitrog**en and sometimes sulphur.

The basic units : are known as **amino acids**.

Sources of proteins

Animal sources : meat, milk, fish, and eggs.
Plant sources : leguminous plants such as beans and lentils.

Importance of proteins

1- As a source of energy in case of starvation .
(one gram of proteins produces 17kJ)
2- Growth and tissue repair .
3- Formation of enzymes and hormones.
4- Protection against diseases as antibodies produced by white blood cells are made of proteins .
5- Formation of haemoglobin which is found in red blood cells to transport oxygen.

VITAMINS

Are organic substances only needed in small amounts in the body to perform specific function .

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 cannot be stored in the body. - ***Spoils*** if food is heated or canned. -***Destroyed*** by being exposed to air e.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***.

Scurvy

Bleeding in gum , fall of teeth

Rickets

Scurvy

Bleeding under skin

Anaemia

Test for vitamin C

When added to a blue dye known as **DCPIP** it decolorizes it (causes it to be colourless)

How to compare vitamin C content of two types of juice

1-In two test tubes put ***equal volumes*** of DCPIP of the ***same concentration***.

2-Using a graduated dropper, pipette or a syringe, add the juice ***drop by drop*** on the DCPIP until it becomes colourless, the one that ***requires smaller volume or number of drops*** to decolorize DCPIP is the one that contains ***higher conc. of vitamin C***.

How to investigate the effect of storage on the vitamin C (ascorbic acid) content of a fruit juice for example lemon juice

1-Take ***two equal samples*** of lemon juice , use one sample to ***determine the number of drops*** needed to decolorize certain volume of DCPIP.

2-Leave the other samples ***stored in lab. for 12 hours***, then determine the number of drops needed to decolorize the ***same volume of DCPIP***.

3-***Larger number*** of drops needed in the ***sample which is stored*** indicating that conc. of vitamin C decreased after being stored.

MINERAL SALTS

Mineral	Sources	Importance	Deficiency symptoms
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.
Iron	-Liver. -Egg yolk. - Red meat. -Leafy vegetables.	- Necessary for formation of haemoglobin of red blood cells.	- Anaemia *(it is 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(sweat) rate is higher leading to loss of salts in sweat.

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

More mineral salts are needed

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

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

WATER

Importance of water

1-It is the main component of the ***blood plasma***.
2-Water secreted in the form of ***sweat is necessary for cooling*** down the body during hot days.
3-Environment for marine organisms.

Importance of water as a solvent

- ***Dissolved oxygen*** in water is necessary for respiration of marine organisms.
- ***Excretory products*** can not be excreted except dissolved in water.
- ***Enzymes and hormones*** cannot be secreted and work except dissolved in water.
- ***Digested food*** can not be absorbed except dissolved in water.
- ***Plants*** can not absorb mineral ions from soil except dissolved in water.

ROUPHAGES (FIBERS)

Definition : fibrous, indigestible food (mostly cellulose). It stimulates the muscles of the digestive system to move the food by a movement known as ***peristalsis*** **.**

Importance of rouphages

1- ***Stimulates peristalsis*** in the digestive system therefore it ***prevents constipation***.
(because the muscles of the digestive system work more when there is harder, less digestible food)

2- Reduce the risk of cancer of colon because cancer can be started off by certain chemicals in food ,if this food remains for a long time in the alimentary canal. These chemicals remain stuck to the fibers without affecting the alimentary canal.

3- Helps in diet by providing feel of stomach fullness.

Sources of rouphages

1- All plant foods (as their cell walls contain the indigestible cellulose).
2- Cereal grains and barley.
3-The whole meal bread (bread contains bran).
4- Brown or unpolished rice.

ENERGY VALUE OF FOOD

Definition : it is the amount of energy produced by complete combustion of a unit mass of food .

Units of measuring energy :
Joules (J) ,kilo joules (kJ), and calories

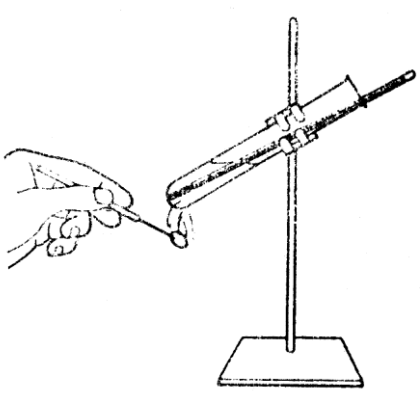
Units of measuring energy value of food :
joule per gram (J/g) , kilo joule per grams (kJ /g) and calorie per gram.

One calorie = 4.2 joules
One kilo-joule = 1000 joules

Practical work

Comparing energy values of two types of food

1- Two equal samples (one of each type of food) are burnt to be used in heating water in the test tube as in figure.
2- By comparing the increase in temperature in the two tubes we can conclude which one of the two foods has a higher energy value than the other.



Practical precautions:

1- For fair comparison

a- The two pieces of food must be equal.
b- The volume of water in the two tubes must be equal.
c- The distance between the piece of food and the test tube must be equal, as increase in distance increases the amount of heat lost to the surrounding air .
d- Two similar tubes must be used, as the difference in surface area exposed to the flame affects the amount of heat gained by water, also the thickness of the wall of the tube or its material affect the amount of heat that passes to the water.

2- Not all the heat produced by the food is recorded by the thermometer, because:

a- An amount of heat is lost to the surrounding air.
b- An amount of heat is gained by the needle or any other object used in holding the piece of food.
c- An amount of heat gained by the glass of the tube.
d- An amount of heat lost during evaporation of water.

3- How to reduce heat loss in this experiment?

a- Put a stopper or a cotton wool in the top of the test tube.
b- Insulate the sides of the container using a substance such as aluminum foil.
c- Use a flat bottomless container under which the flame can spread out to reduce rate of heat loss in the surrounding air.

Energy content of potato increases when cooked in oil

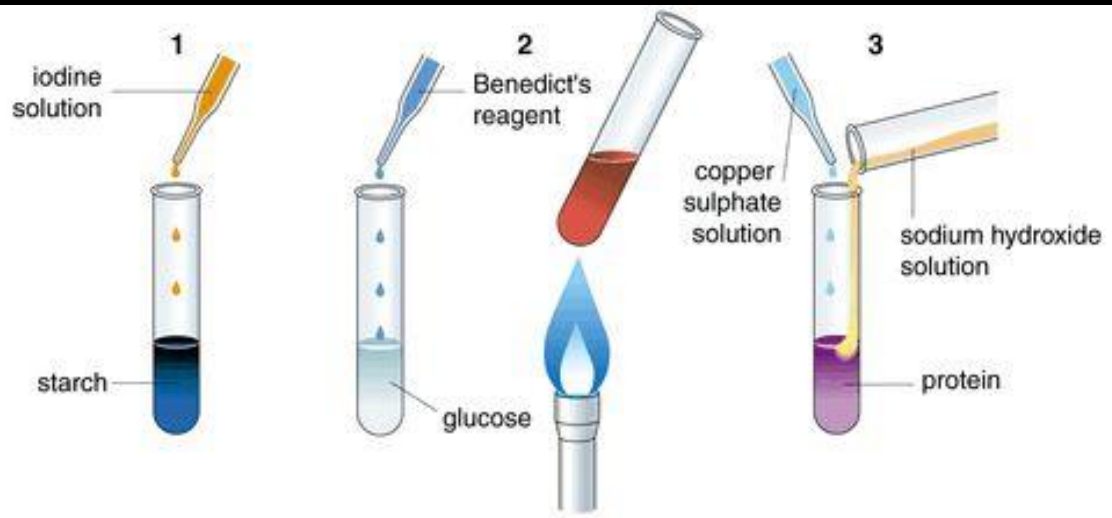
Energy content would increase as potato gains oil which has high energy content.

Potatoes cooked in water is healthier

Because it contains ***less fat and cholesterol*** therefore it does not lead to heart disease such as atherosclerosis(blood vessels become narrow and less elastic) or formation of thrombus (blood clots).

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. lucose)	- 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



1-test for starch **2- test for reducing sugar** **3- test for protein.**

Enzymes are proteins therefore anything that contains enzymes gives positive result with ***biuret*** test.

How to compare fat in two samples of food such as leaves and meat

prepare ***equal masses of leaves and meat***, grind up each, put each in a beaker, add ***equal volumes of ethanol of the same concentration*** to dissolve fats, add ***equal volumes of water***, the more ***cloudy*** the medium ,the more fat is present.

How to compare reducing sugar concentration in two samples of food

Get ***equal masses*** of the two fruits, ***crush*** each one and put the product of crushing of each fruit in a test tube, add ***equal volumes*** of water and ***equal volumes*** of Benedict's solution in each test tube, put the tubes in a water bath, the one which becomes ***orange or orange red*** first contains a higher concentration of reducing sugar.

The ***safety precautions*** in this experiment is to wear goggles, lab coat and to hold tubes using a holder and to keep opening of the tube away from your face to avoid splashes during heating.

How to compare protein concentration in two samples of food such as two different beans

Soak seeds of the two different types of beans , weigh ***equal masses*** of each type.

For each type ***grind up the seeds and dissolve*** as possible as you can, Add ***equal volumes*** of potassium hydroxide followed by equal drops of copper sulphate, ***compare*** the produced colours, the darker the purple ,the more protein is present.

(also a ***colourmeter*** can be used to compare the degree of the produced coloures.)

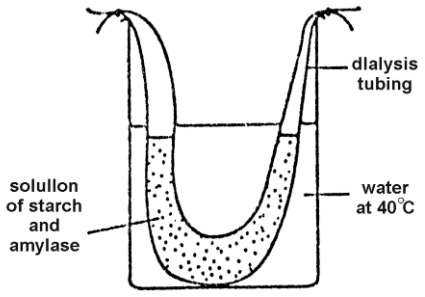
Practical applications

The dialysis or visking tubing

- A tube made of artificial fibres or cellulose.
- It is partially permeable, this means that it allows small molecules to pass through it but prevents the large ones.

Examples

- It allows sugar molecules to pass and prevents starch molecules.
- It allows amino acids to pass and prevents protein molecules.



In the front figure

after time ***sugar can be found*** in the surrounding water because ***amylase*** can act on starch to be digested into sugar that can diffuse out the tubing.

Metabolism

- All the chemical changes that take place within an organism .

Types of metabolism

1- Catabolism : are the metabolic reactions through which complex substances are broken into simpler ones.
Examples : digestion and respiration.

2- Anabolism : are the metabolic reactions through which complex substances are built from simpler ones.
Example : photosynthesis.

Glands

- Are the organs or cells which produce certain chemicals (secretions)

Types of glands:

1- Exocrine or ductile glands
- Have ducts (tube- like structures through which their secretions pass).
- Their secretions are called *enzymes*.

2- Endocrine or ductless glands
- Have no duct .
- Their secretions are called *hormones*, that reach their target organs through blood.

Enzymes

Protein that acts as biological catalyst .

Biological catalysts

- Are the substances which speed up a metabolic reaction without being changed or change the products.

Substrate :

- Is the substance on which an enzyme acts .
- Each enzyme has a certain substrate on which it acts .

Examples :

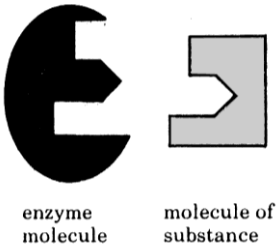
1- The enzyme ***pepsin*** which is secreted by the walls of the stomach its substrate is ***protein***

Protein $\xrightarrow{\text{Pepsin}}$ polypeptides

2- The enzyme ***amylase*** which is secreted by salivary glands its substrate is ***starch***.

Starch —Amylase→ maltose (a type of sugar)

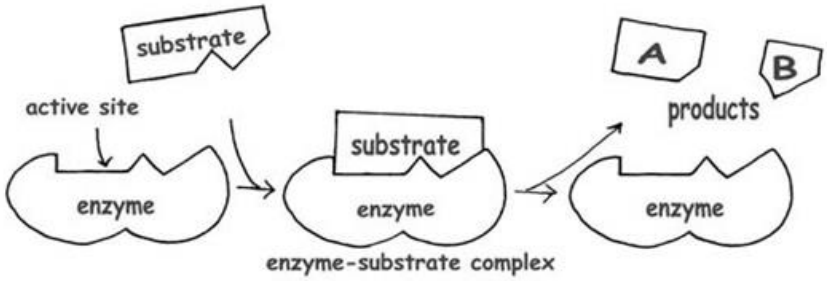
The main characteristics of enzymes



- Enzymes are specific in their function

- Means that each enzyme speeds up a certain reaction only because each enzyme has a region called the ***active site*** where its substrate fits exactly, and this allows the enzyme to act on a certain substrate or substrates , this means that the enzyme acts as a ***lock*** while its substrate acts as a ***key.***

Enzyme and its substrate form enzyme-substrate complex.

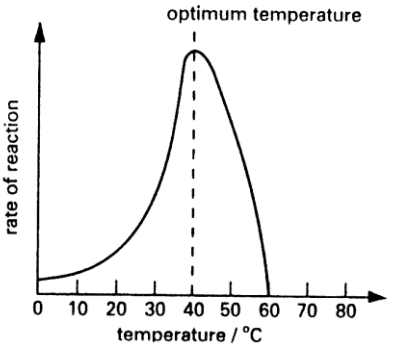


Notice

Different ***sequences*** and number of different ***types*** of amino acids are responsible for giving protein a ***certain shape***, for example it gives the ***shape of the active site***.

Enzymes are affected by temperature

-The activity of most enzymes ***increases*** by the increase in temperature till about 35°C to 40 °C then any increase in temperature leads to a ***decrease*** in the activity of the enzyme.

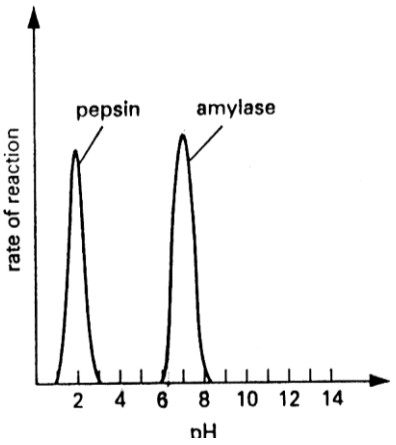


- Increase in temperature increases rate of reaction as it ***increases kinetic energy*** of molecules of both enzyme and its substrate making them move around faster and this increases frequency of effective collisions which increases the chance to bind together.

-Above 50°C the enzyme ***denature*** (means that it loses its activity and can not regain it even if the temperature changes to its optimum)

Optimum temperature of an enzyme

It is the temperature at which the enzyme works best.



Enzymes are affected by the pH value

Each enzyme has a certain pH at which it works best . Any increase or decrease around this pH decreases the activity of the enzyme.

Extremes of pH changes ***may denature*** some enzymes.

Optimum pH of an enzyme

It is the pH value at which an enzyme works best .

Examples

The optimum pH of amylase is about 7 to 7.5

The optimum pH of pepsin is about 2 to 2.5.

Why changes in pH affect enzyme activity.

pH is the measure of ***hydrogen ions*** in the medium , the changes in pH leads to a change in concentration of hydrogen ions which ***alter the charges of the amino acids***.

The changes in charges lead to changes in the ***chemical bonds*** that maintain the precise shape of the active site of the enzyme leading to changes in activity of enzymes.

Role of enzymes in the germination of seeds

Seeds contain stored ***insoluble*** food with inactive enzymes, ***when water enters the seed, and in suitable conditions*** the enzymes in the seed become active to catalyse the gradual breakdown of stored insoluble food in the seed to a soluble form that can be absorbed and used by the embryo ***till it forms green leaves*** which are used in making food by photosynthesis.

Example of such enzymes

1- ***Amylase*** which catalyses the breakdown of stored insoluble starch to a soluble sugar known as maltose .

2- ***Proteases*** which catalyse the breakdown of stored insoluble proteins into soluble amino acids.

Role of enzymes in biological washing powder

Biological washing powders contain ***enzymes*** , to act on the insoluble molecules of stains to be broken down into soluble molecules so they can be washed and removed by water.

Examples of the enzymes used in washing powders

Lipases : enzymes which catalyse the breakdown of fats to fatty acids and glycerol, and this is important in removing greasy stains.

Proteases : enzymes which catalyse the breakdown of insoluble proteins into soluble amino acids and this is important in removing protein stains such as blood and egg stains .

Advantages of biological washing powder:

A- Save expense of boiling as enzymes can act at low temperature (e.g.40^{o}C).

B- Avoid the damage of clothes by boiling and rubbing

Notice

4- Enzymes cannot be used for silk, wool or leather, which contain proteins, as it may be damaged by the proteases in the biological washing powder.

5- Hands should be washed after using these powders in order not to be harmed by the enzymes in biological washing powders.

Enzymes in food industry

1- Pectinase enzyme used in juice making

Pectin is a substance found in plant cell walls, when ***pectinase enzyme*** is used, it acts on pectin to be ***broken down into sugar***, this is useful in the following ways:

- Makes it much easier to squeeze juice from fruit.
- Helps in increasing the volume of the juice produced.
- Makes juice clear rather than cloudy.

2- Protease enzymes used in making baby foods

Act on proteins in food to be broken down into ***small polypeptides or amino acids*** to be easily absorbed by their digestive system.

3- Amylase used in obtaining sugar from starch

Potatoes, are crushed and ***amylase*** is added to act on starch for making ***maltose***.
Maltose is digested by effect of ***maltase*** enzyme to form ***glucose*** which is used in sweet making.

4- Lactase enzyme is used to break down lactose of milk

Lactase acts on ***lactose of milk*** to be digested into ***glucose and galactose*** to help those have problems in digesting lactose of milk.

5- Enzymes and cheese making

An enzyme called ***rennin*** extracted from stomach of animals (and now it is produced by genetic engineering) This enzyme clots milk at the first stages of making cheese.

6-Isomerase enzyme is used in convering glucose into fructose which is

- Used by ***diabetic persons***.
- Used by those ***applying diet*** as It provides sweeter taste with less sugar.

Many fruits such as apple change colour when cut open and left exposed to air

Enzymes in apple cells ***catalise*** the reaction between oxygen in air and substances (such as iron) in the apple cells causing change in colour therefore ***changing pH*** or being ***exposed to heat*** caused enzyme to be ***denatured*** so this reaction cannot take place and therefore no change in colour occurs.

How to investigate the effect of pH on colour change in apple

- Prepare solutions of different pH values such as 2, 4, 6, 7, 8 and 9 using ***buffer solutions***.
- Cut pieces of equal volume from the same apple.
- Put two pieces in each Petri dish and add to its surface a pH solution (not to immerse it) . ***Measure the length of time needed to start changing colour*** of apple surface, repeat and take the average then plot the results in a graph.
- The ***shorter*** the time needed to change colour, the ***optimum*** the pH.

Notice

Enzymes are important in all living organisms to speed metabolic reaction at a rate which is necessary to sustain life

Practical work

1- If a dropper is used in obtaining different samples

It has to be washed and dried each step to avoid mixing of different samples affecting the results.

2- A control experiment

An experiment contains all the conditions except the factor under investigation

Example :

If an experiment is set up to investigate the effect of a certain enzyme on milk, its control experiment is the same experiment without adding the enzyme or adding denatured enzyme.

The aim of the control experiment to ensure that the changes that take place during the experiment are due to the factor under investigation (the factor in the above example is the enzyme) .

3- To obtain extract of plant leaves

The leaf is cut into pieces and then ground in a mortar with sand and water.

Sand : to help in damaging the cells by its sharp edges so the extract can flow out the cells.

Water : to dissolve the extract.

4- If starch is added to agar jelly

- The jelly becomes cloudy.
- If a germinating seed is placed on this jelly, the enzymes of the germinating seed will act on the starch to be digested into simple sugars, therefore if iodine solution is added, the region around the seed will remain yellow brown.

5- If an enzyme is added to a sample at 20 ºC and then the temperature is raised to 30 ºC, the rate of the reaction will increase because;

a- The activity of the enzyme at 30 ºC is higher than that at 20 ºC.

b- The rate of diffusion of the enzyme among the molecules of the substrate is higher at 30 ºC than that at 20 ºC

6- If a Petri dish containing - non sterile or non disinfected - agar jelly is left in air for about two days, colonies of microorganisms can be seen on the jelly because:

a- There is enough food substance in the jelly.

b- There is suitable temperature.

7-How to determine the time needed for digestion of a certain volume of starch using amylase

Each minute take a drop of the mixture, add to it a drop of iodine solution, observe the colour formed, repeat several times until no change in the colour of iodine solution takes place indicating that all starch is digested into maltose.

8-How to investigate the effect of pH on activity of amylase

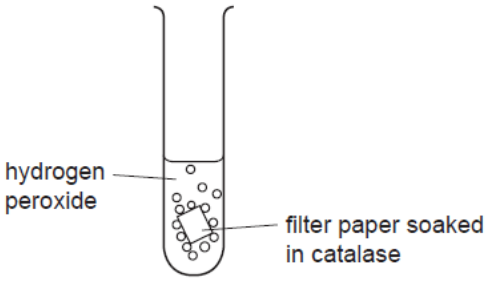
Put ***equal volumes*** of identical starch solutions in 4 test tubes, adjust the pH values in the test tubes as follows 2, 4, 6 and 8 with the help of ***pH indicator or buffers*** , add ***equal volumes*** of amylase (the same conc.). Keep the ***temperature constant*** test for starch at intervals of 1 min to determine the time taken for complete breakdown of starch at each pH. ***repeat*** the same experiment , calculate the average , plot a graph to determined the optimum pH.

9-How to investigate the effect of temperature on activity of amylase

Put ***equal volume*** of identical starch solutions in 8 test tubes, put each in a water bath of one of the following temperatures 20,25,30,35,40,45,60 and 65.
Add ***equal volumes*** of amylase (the same conc.).
test for starch at intervals of 1 min to determine the time taken for complete breakdown of starch at each temperature. ***repeat*** the same experiment , calculate the average , plot a graph to determined the optimum temperature.

10-Catalase enzyme

It is present in all living cells, it speeds up breakdown of ***hydrogen peroxide (H_2O_2)*** which is a toxic material produced in living cells into ***oxygen and water***.



The filter paper ***soaked in catalase*** rises because hydrogen peroxide is broken down into water and oxygen , this oxygen evolves forcing the filter paper upwards, the higher the rate of the reaction , the shorter the time needed for filter paper to rise to the surface.

PHOTOSYNTHESIS

Photosynthesis

A process by which plants manufacture carbohydrates from raw materials using energy from light.

Equation of photosynthesis

Carbon dioxide + Water $\xrightarrow{\text{light + chlorophyll}}$ Simple Sugar (Glucose) + Oxygen

$6\ CO_2 + 6\ H_2O \longrightarrow C_6H_{12}O_6 + 6\ O_2$

Raw materials — End products

Intake of raw materials

Intake of carbon dioxide : by diffusion through stomata .
Intake of water : by osmosis through the root hair cells.

Trapping of energy

- Chlorophyll traps **light energy** and converts it to **chemical energy**.
- Chemical energy is used in photosynthetic reactions.

Formation of food substance or uses of glucose

1- Glucose is the first substance formed by photosynthesis.
2- Glucose can be converted into starch to be stored.
3- Glucose can be converted into cellulose which is used in formation of cell walls.
4- An amount of glucose is used in production of energy by the process of respiration.

Importance of photosynthesis

- It is the main source of oxygen which is used for aerobic respiration of all living organisms.
- It is the main source of food for all living organisms.
- It is necessary for regulating the concentration of carbon dioxide and oxygen.
- It is the process which traps energy of the sun which later can be found in the fossil fuels such as coal and petroleum .

Rate of photosynthesis and respiration

1- In ***high light intensity***, rate of photosynthesis is higher than the rate of respiration, therefore ***oxygen*** is produced.

2- In ***dim light*** the rate of photosynthesis becomes equal to the rate of respiration. This point is known as **compensation point**
*(At the compensation point **no gases are produced** from the plant because the oxygen produced due to photosynthesis is equal to that needed for respiration, and the carbon dioxide produced due to respiration is equal to that needed for photosynthesis)*

3- ***In dark*** , only respiration takes place therefore carbon dioxide gas is produced .

Notice
- Green plants absorb all the colors of spectrum and reflect only the green colour ,therefore plants can not carry out photosynthesis in green light .

Conditions necessary for photosynthesis

1- Light 2- Chlorophyll
3- Carbon dioxide 4- Water.
5-suitable temperature which affects activity of enzymes that take part in photosynthesis.

LIMITING FACTORS

Limiting factor

Something present in the environment in such short supply that it restricts life processes.

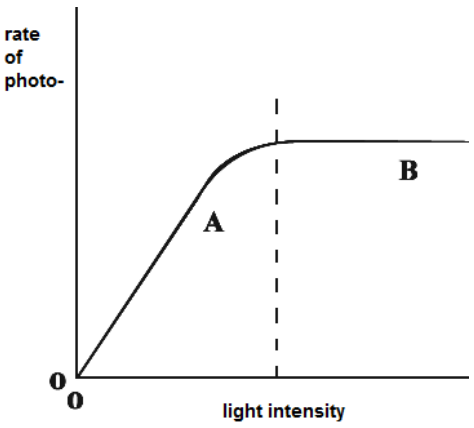
Example : *In shortage of light the rate of photosynthesis slows down .In this case light is considered as a limiting factor .*

The main limiting factors

A- External limiting factors
1 -Light intensity .
2 -Concentration of carbon dioxide
3-Temperature

B- Internal limiting factors
1 - Number of stomata
2- Number of chloroplastids.
3- surface area exposed to light

- During stage (A) light is the limiting factor, therefore increase in light intensity causes an increase in rate of photosynthesis.
- During stage (B) light is not the limiting factor because the increase in light intensity does not affect the rate of photosynthesis.



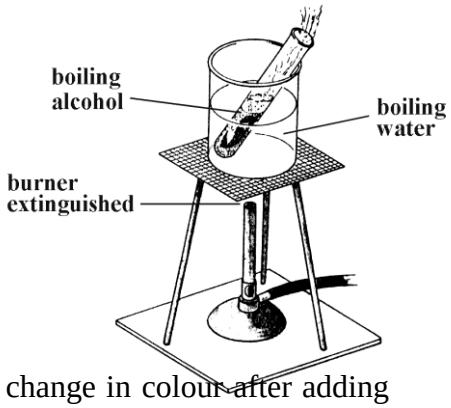
PRACTICAL WORK

Destarching a plant

- Means the removal of the stored starch in a plant
- It takes place by placing the plant in a ***dark place for about 48 hours*** to consume all its stored starch in carrying out its metabolic activities without building new food due to absence of light.

Importance of destarching:
- To be sure that any starch can be detected is formed during the experiment, not stored before experiment.

How to test for starch in a plant leaf ?



1- Put the leaf in **boiling water** for about 30 minutes to:
   a- denature the enzymes and to prevent any further chemical changes.
   b- make the cell more permeable to iodine solution.

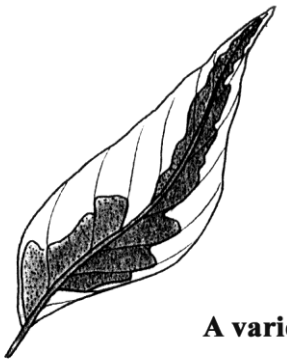
2- Put the leaf in **boiling alcohol** using a water bath:
   - to dissolve the chlorophyll, to be able to observe the change in colour after adding iodine solution clearly.
   (water bath is used because alcohol is flammable)

3- Put the leaf in ***hot water to soften*** it because alcohol makes it brittle .

4- Put the leaf in a Petri dish ,and add iodine solution:
   - if the colour remains **yellow brown** this means that starch is absent.
   - if the colour changes to **dark blue (blue black)**, this means that starch is present.

How to prove that chlorophyll is necessary for photosynthesis

1- Get a plant of ***variegated*** leaves .
   (variegated leaves means leaves with parts containing chlorophyll while the other parts are free from chlorophyll)
1- Destarch this plant by placing it in a dark place for about 48 hours.
3- Expose the plant to light for suitable period of time.
4- Take one of its leaves ,and draw it carefully to show where chlorophyll is found.
5- Test for starch in this leaf


A variegated leaf

Observation

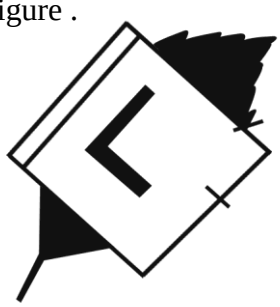
- The parts were previously green turn ***blue black*** **.**
- The other parts gain the ***yellow brown*** color of iodine solution .

Conclusion :

- Chlorophyll is necessary for photosynthesis.

How to prove that light is necessary for photosynthesis

1- Get a potted plant ,and ***destarch*** it.
2- ***Cover*** a part of one of its leaves with aluminum foil as shown in figure .
3- Let the plant exposed to light for about three hours .
4- Test the leaf for starch using ***iodine solution*** .



Observation:

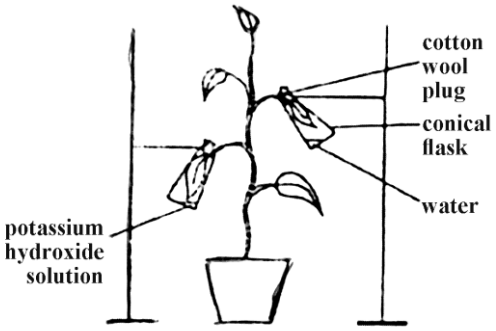
- The ***covered parts*** gain the yellow- brown color of iodine solution .
- The ***parts exposed*** to light gain dark blue color .

Conclusion :

Light is necessary for photosynthesis .

How to prove that carbon dioxide is necessary for photosynthesis

1- Get a potted plant and ***destarch*** it by being placed in a dark place for about 48 hours.
2- Put one of its leaves in a flask containing ***soda lime, potassium hydroxide or sodium hydroxide solution*** to absorb carbon dioxide .
3- Put other leaf in another flask containing distilled water *(to be used as a control experiment.)*
4- Expose the plant to light for a suitable period of time .
5- Take the two leaves and test for starch .



Observations

- No starch can be detected in the leaf which is found in the flask that contains potassium hydroxide.
  (The colour of iodine solution remains yellow brown.)

- Starch can be detected in the leaf which is found in the flask that contains distilled water.
  (The colour of iodine solution becomes blue black)

Conclusion

- Carbon dioxide is necessary for photosynthesis.

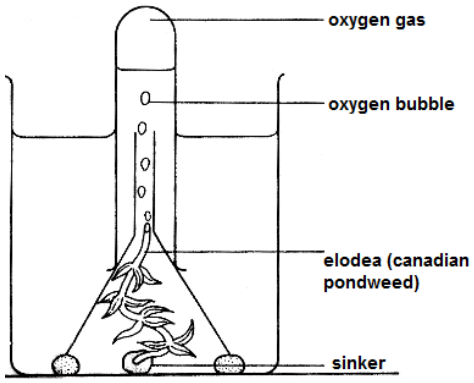
Notice

In the above experiment and the other experiments where gases are used it is better to add ***petroleum jelly or Vaseline*** *around the rubber bung to make an* ***air tight seal****.*

How to prove that oxygen evolves during photosynthesis

- Prepare two apparatuses as in fig.

(hydrogen carbonate or bicarbonate is used as a source of carbon dioxide as it decomposes releasing carbon dioxide)



- Leave one of them exposed to light and keep the other one in a dark place (to be used as a control experiment).

Observation :

- Bubbles of a gas evolve in the apparatus which is placed in light.

(Test for this gas using a glowing splint ,you observe that it relights.)

Conclusion :

Oxygen evolves during photosynthesis .

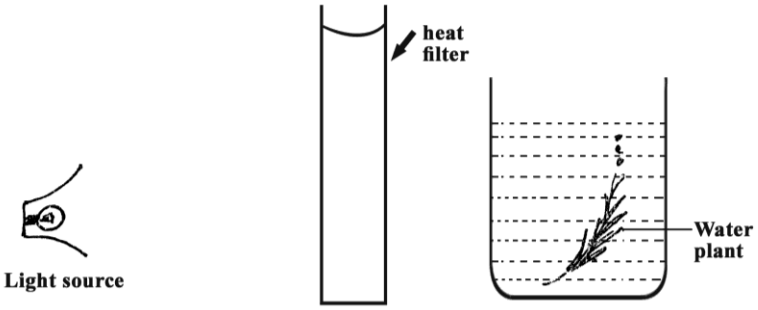
Practical applications

1- In the above experiment, the funnel is placed above a support

To keep the funnel off bottom (higher than bottom) to allow circulation of water as the oxygen produced replaces the water in the tube therefore this replaced water has to find a way to pass out.

2- The above experiment can be used to measure the effect of light intensity on rate of photosynthesis as follows :

In a ***dark place or in dim light*** put a light source (e.g. electric lamp) in front of plant as shown in fig. below.



- *In this case a heat filter is used because the lamp produces heat and ligh , and we are going to investigate the effect of light intensity only.*
- *The heat filter may be a vessel containing water, that absorbs heat and allows light to pass.*

Increase the distance between the plant and the lamp (to decrease intensity of light.) and

record the number of bubbles.
Decrease the distance between the plant and the lamp (to increase intensity of light.) and record the number of bubbles.

(After changing the distance, it is better to wait for a short period of time before counting the number of bubbles , to provide the plant with enough time to detect and respond to the new condition, and to be sure that it is not affected now by the previous condition)

Notice

The above experiment cannot be carried in a brightly lit room as the idea of the experiment depends on keeping light acts as a limiting factor, but in a brightly lit room light does not act as a limiting factor.

How to know which is a limiting factor at a certain point?

Increase this factor, if rate of photosynthesis increases, you conclude that this factor acts as a limiting factor at this point.

Examples :

In the above experiment, how to know that:

a- Temperature is a limiting factor at a certain point.

Remove the heat filter, as a result of this temperature increases, if rate of production of bubbles increases you conclude that temperature acts as a limiting factor at this point.

b- Carbon dioxide is a limiting factor at a certain point.

Increase the concentration of carbon dioxide by adding ***sodium hydrogen carbonate*** *which decomposes releasing carbon dioxide that dissolves in water . If rate of production of bubbles increases you conclude that carbon dioxide acts as a limiting factor at this point.*

(Avoid increase in concentration of carbon dioxide by breathing out air through water as the bubbles produced due to breathing out makes a confusion during counting bubbles of oxygen produced.)

The above experiment can be used also to measure the rate of photosynthesis as follows :

a- By counting the number of bubbles produced per unit time, but this process is not accurate Because:

-Bubbles may be of ***different volumes*** therefore no fair comparison can take place during comparing rates of photosynthesis.
-Rate of production of bubbles may be ***too high*** to be counted accurately.
-Many bubbles may be ***too small*** to be seen.

b- By measuring the volume of the gas produced per unit time, this can take place by using a graduated tube or a gas syringe.

Other ways to measure the rate of photosynthesis:

1- By measuring the rate of ***uptake of carbon dioxide***.
2- By measuring the amount of ***starch formed*** per unit time.

Hydrogen carbonate indicator

- Its original colour is ***red*** .
- Increase in concentration of carbon dioxide makes it ***yellow*** (increase in concentration of carbon dioxide makes the medium acidic as carbon dioxide is ***acidi***c gas) .
- Decrease in concentration of carbon dioxide makes it ***purple*** .

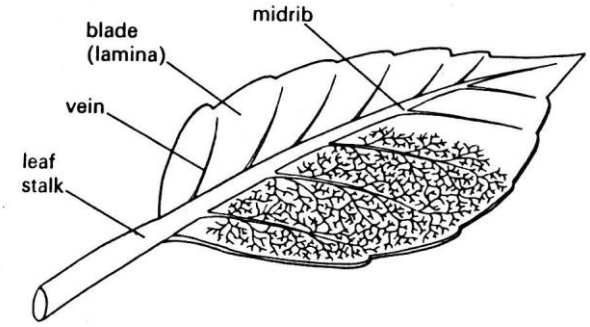
(removal carbon dioxide from the medium makes it ***alkaline***).

Example

- If a ***plant*** is placed in this indicator , its colour becomes ***purple*** as the plant ***absorbs*** carbon dioxide during photosynthesis.
-If a ***small invertebrate*** is placed with the plant in the indicator, ***no change*** in colour takes place (it remains red) because the carbon dioxide absorbed by the plant is replaced during respiration of the invertebrate.
-If ***more invertebrates*** are placed with the plant, the colour of the indicator becomes ***yellow*** because the carbon dioxide released during respiration of the invertebrates is more than that absorbed by the plant during photosynthesis.

LEAF STRUCTURE

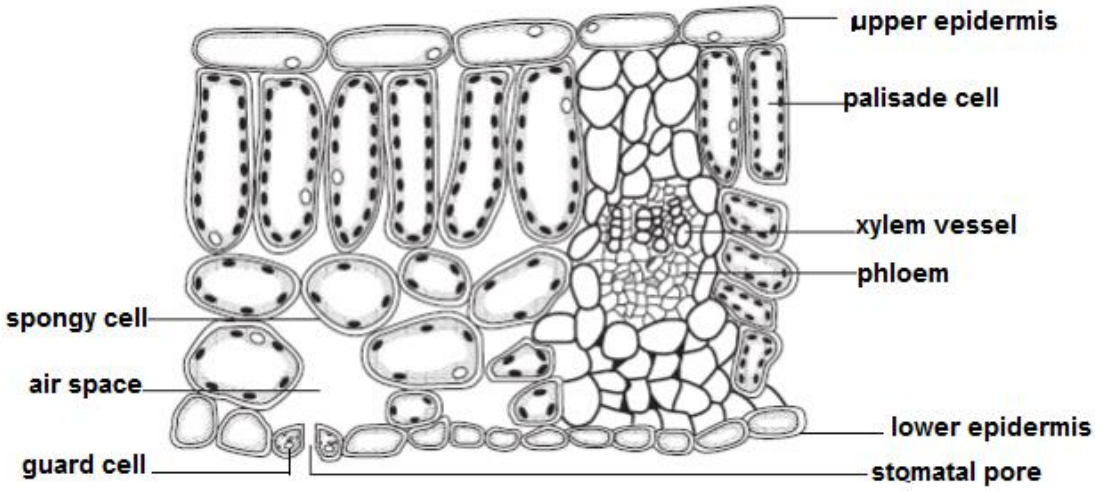
External structure of a dicot. leaf.



Leaf blade

-It is ***supported*** by the stem, petiole and its veins to be well exposed to light and to obtain carbon dioxide easily.
-It is ***thin*** to allow the passage of light to the inner tissues of the leaf, and to allow diffusion of gases to inside and outside of the leaf easily.
-It is ***broad*** to increase surface area to obtain as maximum light as possible .

Internal structure of a dicot. leaf.



Epidermis

Upper and lower epidermis

- Its function is to protect the inner cells of the leaf.
- **Each consists of one row of thin walled cells which are :**
  - ~ ***transparent*** to allow light to penetrate them .
  - ~ ***lens -shaped*** cells to converge light rays .
  - ~ ***Secrete cuticle*** (waxy layer) to reduce the rate of water loss .

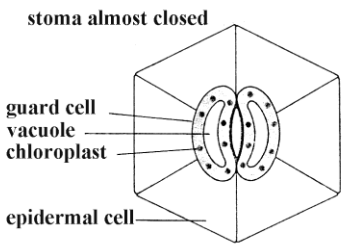
-Contain stomata to

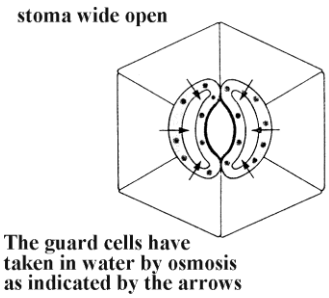
- ~ allow ***exchange of gases*** during photosynthesis and respiration .
- ~ allow diffusion of water during ***transpiration*** .

- The number of stomata in the lower epidermis is greater than that in the upper epidermis because the upper epidermis :

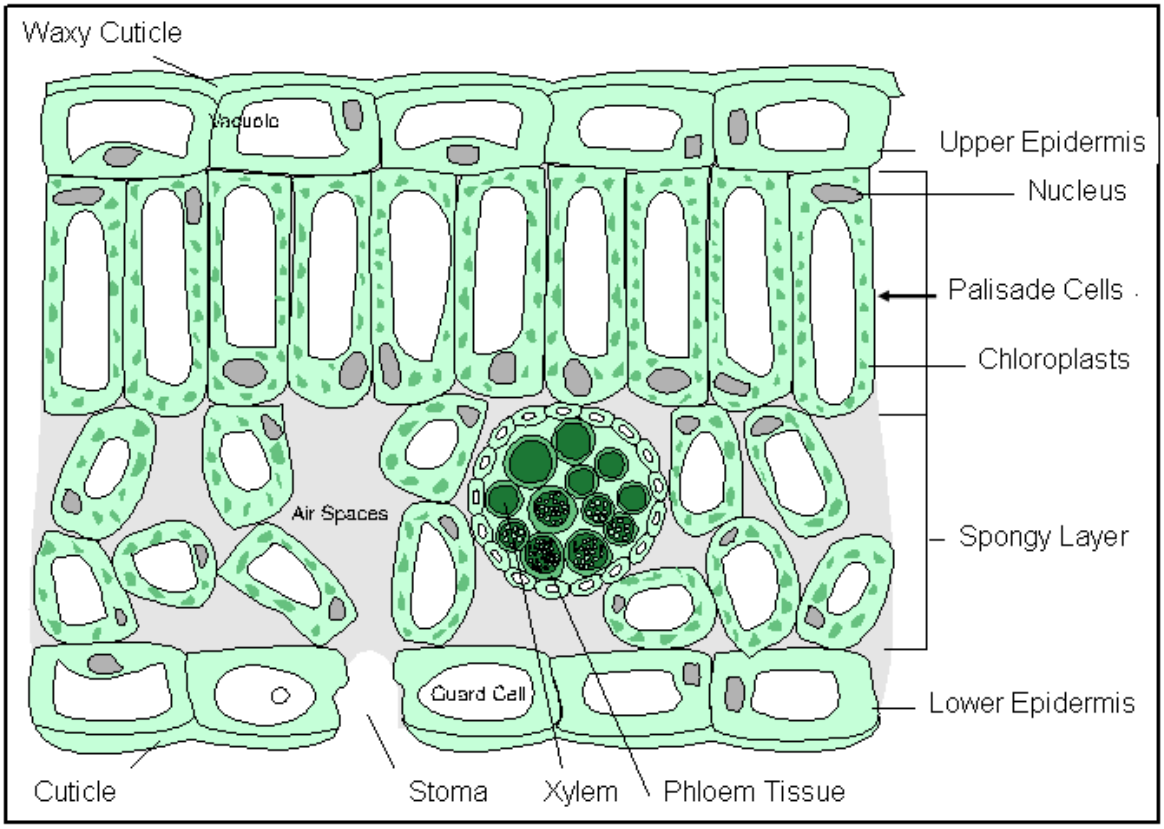
- ~ is exposed to accumulation of dust .
- ~ is more exposed to agents of evaporation of water such as heat and light .

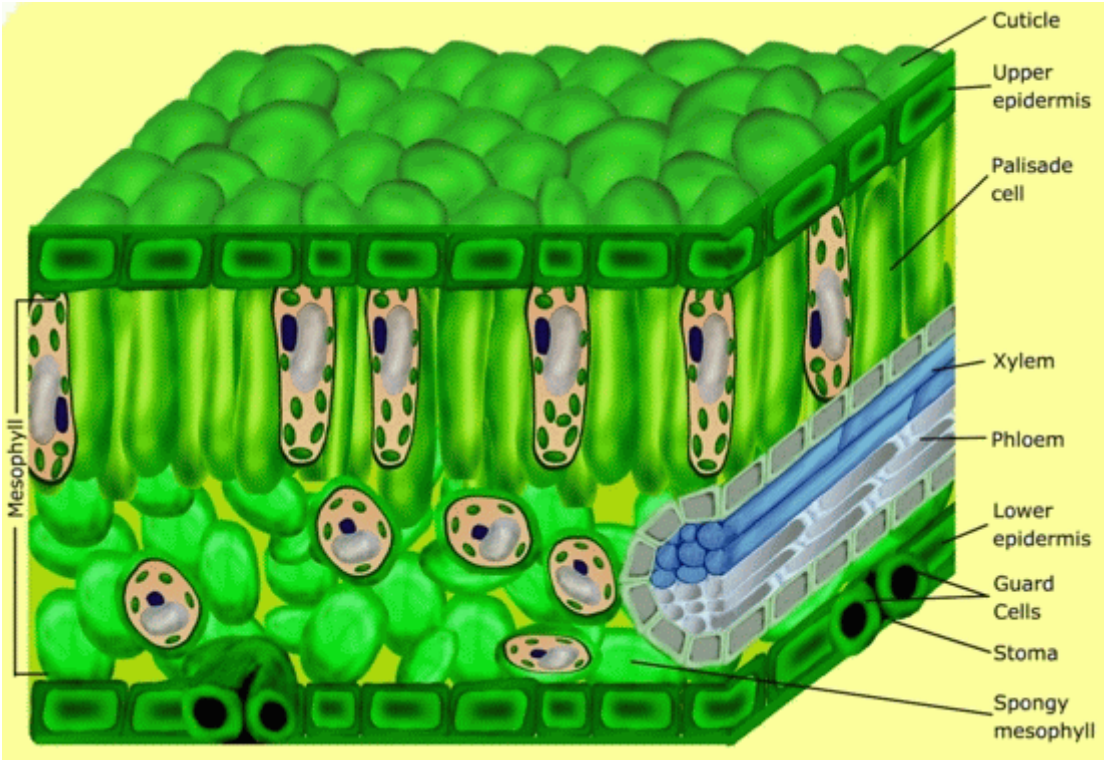
- ***Each stoma is formed of two cells known as guard cells and a stomatal pore :***

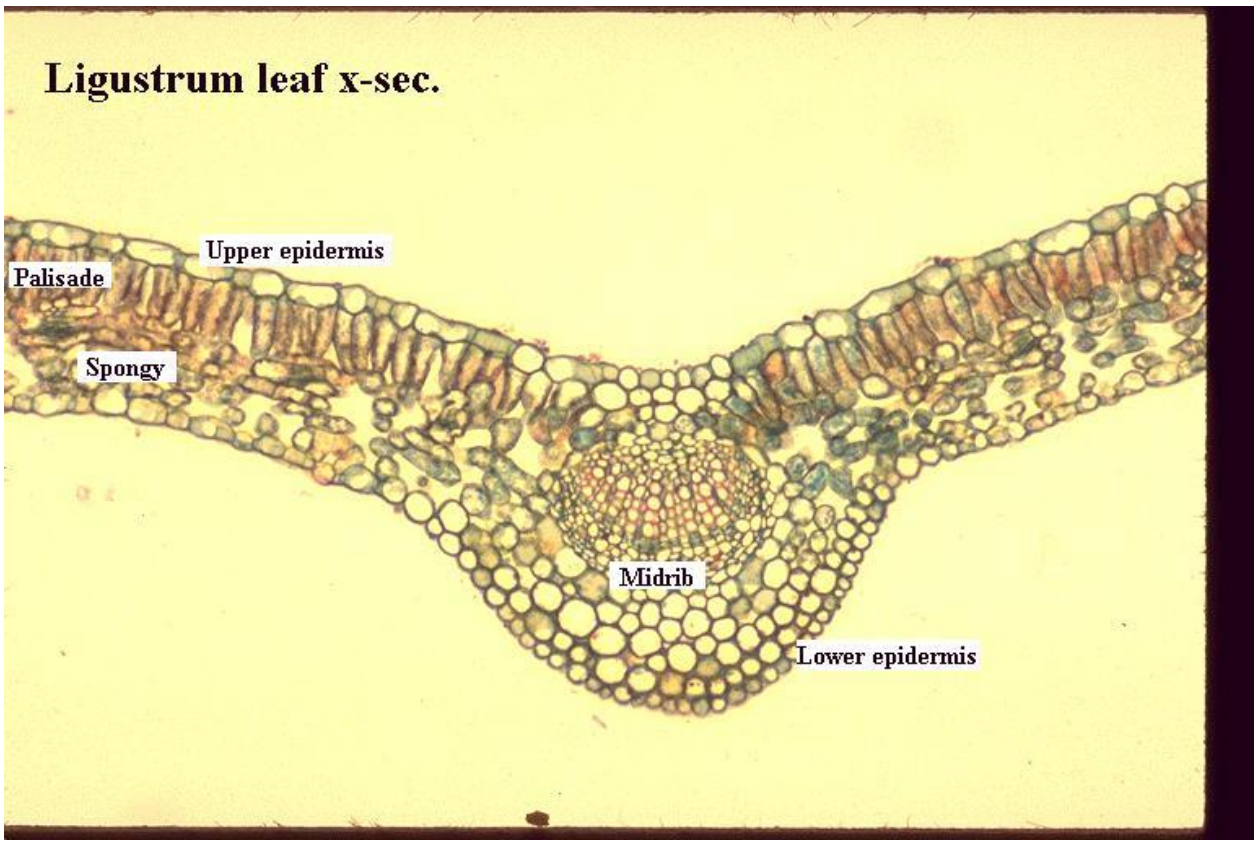




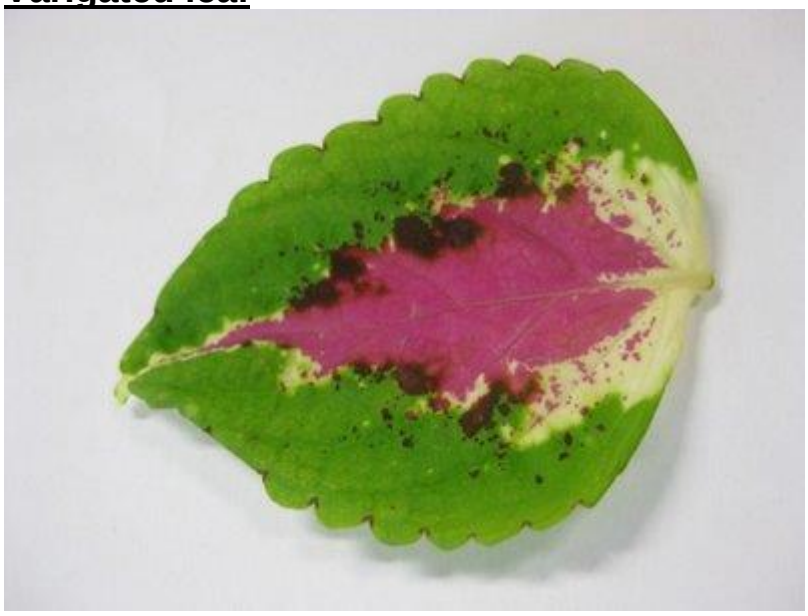
- ~ Guard cell contains chloroplast although epidermal cells do not contain chloroplast.
- ~ the wall of the guard cell is thicker in the side facing the stomatal pore than the other side therefore when the guard cell becomes turgid the inner surface cannot stretch as much as the outer surface, therefore the guard cells curve away from each other causing the stoma to open.


Waxy Cuticle
Vacuole
Upper Epidermis
Nucleus
Palisade Cells
Chloroplasts
Air Spaces
Spongy Layer
Guard Cell
Lower Epidermis
Cuticle
Stoma
Xylem
Phloem Tissue


Cuticle
Upper epidermis
Palisade cell
Xylem
Phloem
Lower epidermis
Guard Cells
Stoma
Spongy mesophyll
Mesophyll



Varigated leaf



Elodea plant

Mesophyll layer

Consists of two layers ***palisade*** **layer** and ***spongy layer*****.**

1- The palisade layer:

Its function is to carry out photosynthesis .therefore it :

A- Contains chloroplasts that contain chlorophyll which traps light energy .

B- The chloroplasts in the palisade cells are closely packed to absorb as maximum light as possible.

C- The chloroplasts in the palisade cells are found close to the cell membrane to obtain water and carbon dioxide easily .

D- The palisade cells are elongated to :

~ carry more chloroplasts .

~ allow the movement of the chloroplasts to be able to obtain enough light.

E- The palisade cells are perpendicular to the upper epidermis to obtain as maximum light as possible.

F- The palisade cells have thin cell walls to facilitate obtaining of water and carbon dioxide.

2- the spongy layer:

-It contains **chloroplasts** but the number of chloroplasts in the spongy layer is ***less than*** that of the palisade layer, therefore it helps in the process of photosynthesis**.**

- It contains air spaces to allow circulation of gases.

Vascular bundle

Contain :

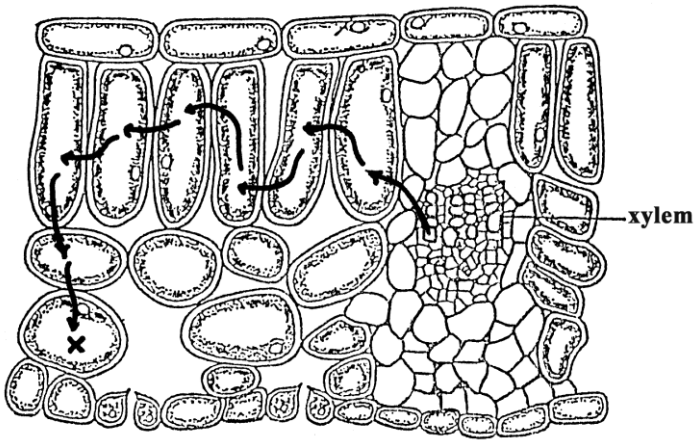
- ***xylem*** for support and transport of water and minerals.

- ***phloem*** for translocation of the food made by photosynthesis.

The pathway of water inside the leaf

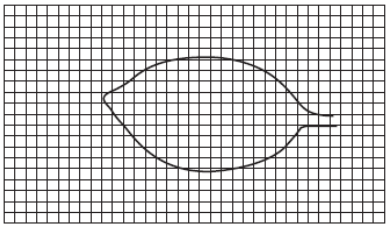
Water moves from xylem vessels to the adjacent cells then from one cell to another by osmosis or through cell walls but you have to know that water moves through the ***points of contact*** *between cells as shown below and not through air spaces.*

Example : movement of water from xylem to the cell x



How to determine surface area of a leaf

1-Put the leaf on a graph paper as shown below



2-Draw a line around the leaf to determine its position, remove the leaf

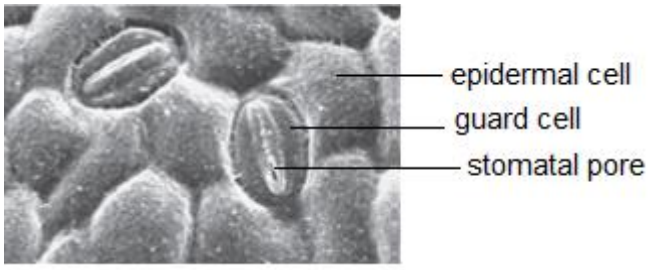
3-Count the whole squares covered by the leaf then add the number of squares that contain more than half covered by the leaf.

4-Multiply the number of squares by the area of each square.

How to determine number of stomata in a plant leaf

Paint an area of one of the surfaces of the leaf using ***transparent nail varnish*** , leave it to dry , then ***peel it carefully*** so that cells of epidermis are removed with it, isolate a certain area e.g. 1mm , put it on a slide of a microscope , ***stain and cover it*** with a cover slip, use the microscope to cont the number of stomata in this area, repeat using other parts of the same surface of this leaf, calculate the ***average number of stomata*** in this area apply this average on the total area of the leaf.

Epidermal cells and guard cells as seen under light microscope



Now try to explain how a leaf is adapted for photosynthesis.

GREEN HOUSE (glass house)

What is a green house?

A building made of glass or transparent plastic above a fertile soil in which plants can grow.

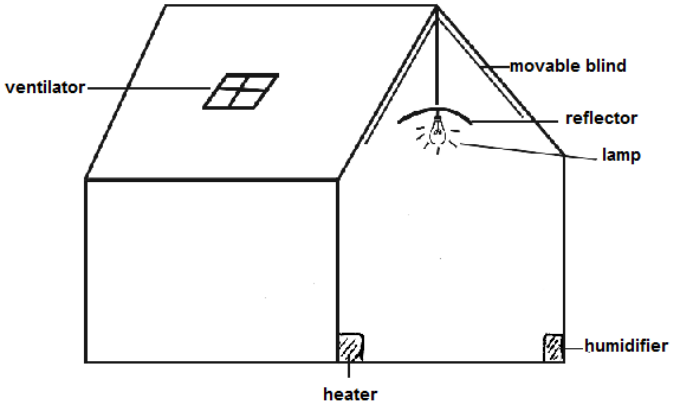
Importance of using green house:

1- In the green house crops of summer can be cultivated in winter.
1- In the green house , crops of hot region can be cultivated in cold regions.
2- In the green house different conditions can be adjusted for optimum rate of photosynthesis.

Green house can be enriched with optimum carbon dioxide :

- By connecting it to a place in which animals live or by a factory where the waste carbon dioxide is produced.

- In ***Northern Europe*** increasing concentration of carbon dioxide in the green house does not lead to an increase in rate of photosynthesis because in such countries ***not only carbon dioxide acts as a limiting factor*** but there are other limiting factors such as light intensity and temperature (there is a cold weather and also a low light intensity).



Green house can be provided with optimum light intensity:

a. If the light intensity is insufficient ,artificial light can be added.
(In case of using artificial light a reflector is used to reduce the loss of light energy by converging light directly on the plant)

b. If the light intensity is more than the optimum, a blind is used to reduce the light intensity that may harm certain types of plants.
(A blind is a non transparent material.)

c. The blind is used also to decrease the time during which the plant is exposed to light, as certain types of plants may be harmed if exposed to light for long time.

Green house can be provided with optimum temperature :

a- If the temperature becomes above the optimum, certain windows are opened to get rid of the excess heat (The windows in this case are called ventilators).

b- If the temperature is lower than the optimum, a heater is used to attain the optimum temperature.

In case of cultivating new seedlings (young plants)

The green house is provided with a ***humidifier*** (apparatus that increases humidity) to reduce the rate of water loss from seedlings because they have no enough cuticle to be used in controlling water loss.

The idea of the green house

Glass or transparent plastic allow the heat energy *(infra red rays with short wave lengths*) to penetrate them and prevent its escape , therefore the temperature inside the green house becomes higher than the surrounding medium .

The green house effect(global warming)

- The increase in the concentration of greenhouse gases such as ***carbon dioxide and methane*** in atmosphere leads to an increase in the temperature of the earth's surface because carbon dioxide acts like glass which allows heat energy to enter and resists its back flow.
- This increase in temperature above certain limits may cause the ice of the two poles to melt leading to dangerous floods.

MINERAL REQUIREMENTS

Importance of nitrogen containing ions:

- Plants use nitrogen ions for making proteins .
- Plants can not use nitrogen as a gas but only in the form of compounds dissolved in water.

Nitrogen fixation:

- It is the process of building nitrogen compounds such as ammonia and nitrates.

Importance of magnesium ions:

- For formation of chlorophyll.

(therefore lack of magnesium ions makes the plant leaves yellow .)

Nitrogen fertilizers

- Are compounds added to the soil to provide nitrogen ions for plants to form proteins .
- Nitrogen fertilizers may be ***natural or organic*** such as plant and animal remains(manure) or ***artificial or inorganic*** such as ammonium nitrates

Effect of nitrate deficiency

1-Poor growth.
2-Yellow leaves.

Effect of magnesium deficiency

Yellowing between veins or leaves making plants less efficient in making photosynthesis.

Balanced diet

Balanced diet

The daily intake of food containing all the food stuffs in right proportions according to age ,sex ,work ,and climate .

Special requirements

1- Babies need:
- calcium , phosphorus and vitamin D for building their bones .
- proteins for rapid growth.
- no need for iron in the early age as the baby is born with stored iron in his liver.

2- Young children:
- need high energy food for their muscular activity.
- need proteins for growth .

3- Old people need:
- fruits and vegetables for vitamins.
- rouphages to activate their intestines.
- less fats to avoid their precipitation in their blood vessels.

1-Females:
- need more iron to replace the blood they lose during ***menstruation***.
- during pregnancy they need more calcium ,iron ,phosphorus and proteins for growth of embryo .

2- Males :
- need more proteins as they build more muscles.

Heavy workers need more fats and carbohydrates to produce the energy required for this work .

In cold countries people need more fats and carbohydrates to produce enough energy to maintain their body temperature and to form an insulating layer under their skin to reduce heat loss.

Notice

- If a person is transferred from a light work to a heavy work, he loses weight, because he has to break down amounts of the stored food to produce the energy required for the heavy work.

Malnutrition

A condition caused by eating an unbalanced diet (food lacking one or more types of food or an increase in quantities of one or more types of food)

Starvation

An expression refers to massive lack of food of all types .

Effects of malnutrition

Malnutrition and heart disease

- Eating too much fats which are rich in **saturated fatty acids and cholesterol**, may lead to heart attack.

Malnutrition and constipation

- Lack of rouphages in food causes constipation **because** rouphages being indigestible they form bulks, the friction between these bulks and walls of intestine stimulate the **peristalsis**, that pushes the food remains to be egested.

Malnutrition and obesity

(obesity means over weight .)

- ***E***ating too much fats and carbohydrates leads to their storage in the body mainly in the form of fats and this causes increase in the body weight.

Harms of obesity

1- Gets tired more quickly .
2- Unattractive feature ,which leads to psychological problems .
3- Heart diseases and high blood pressure .
4- Increase in liability to diabetes .
5- Increase in liability to cancer .

How to avoid obesity

1- Eating more rouphages gives the sensation of fullness ,and this decreases the feel of being hungry .
2- Decrease in the amount of carbohydrates and fats in food .
3- Regular exercise .

Effects of protein-energy malnutrition

Kwashiorkor

- Caused due to ***lack of protein***.
- Children seen ***underweight*** or look ***fat due to eating mainly carbohydrates***.
- If start eating protein they ***can grow normally***.

Marasmus

Severe shortage in ***energy food*** causing the body mass to be ***lower than 60%*** of the normal

Marasmus

Kwashiorkor

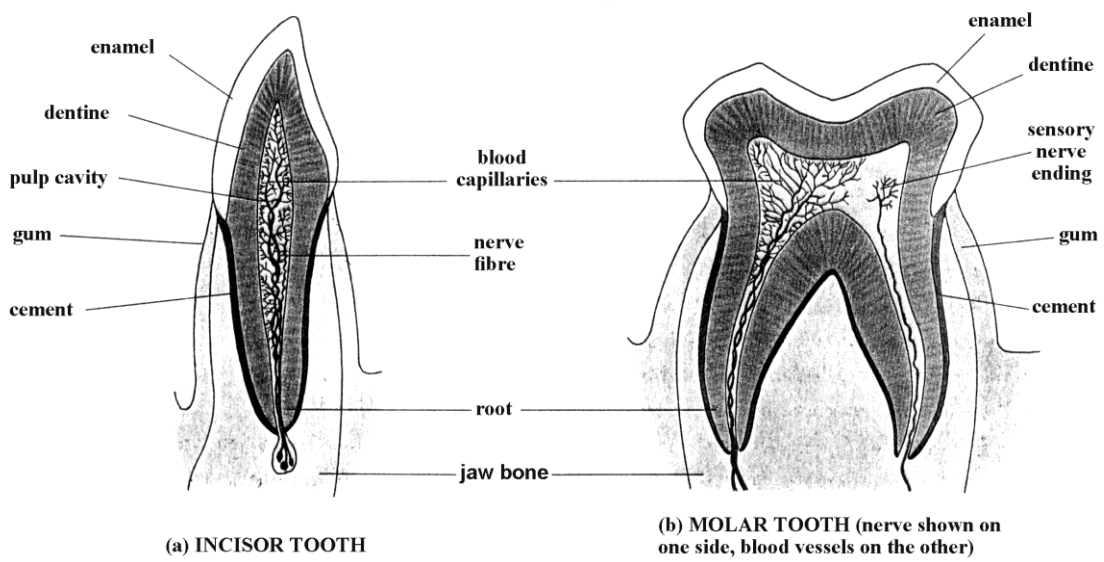
TEETH

Each tooth consists of two regions

1- Root : the part of the tooth embedded in the gum .

2- Crown : the part of the tooth found above the gum.

Structure of a tooth



(a) INCISOR TOOTH

(b) MOLAR TOOTH (nerve shown on one side, blood vessels on the other)

1- Enamel

- It is the outer layer of the tooth.
- It is the hardest substance made by the body .
- Can be dissolved by acids .

2- Dentine

- living regions contains channels of cytoplasm .
- It is quite hard but not as hard as enamel.

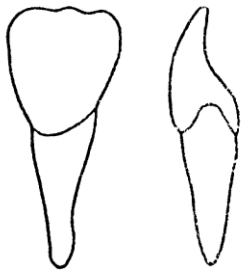
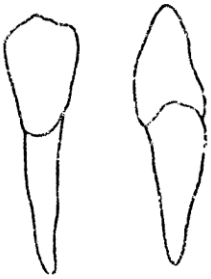
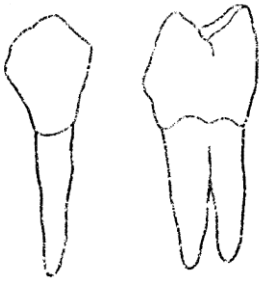
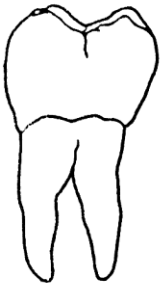
3- Pulp (cavity)

- Contains nerves for sensation .
- Contains blood vessels to supply food and oxygen .
- Contains cells which make dentine .

4- Cement

- It is a bone - like substance .
- Have fibres growing out of it to attach the tooth to the jaw bone , and to allow the tooth to move slightly.

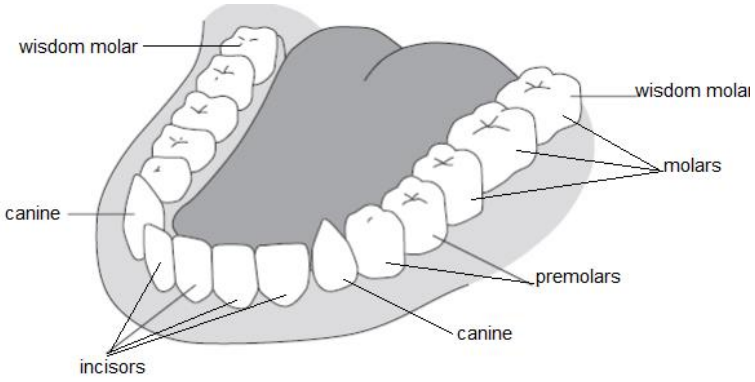
Types of teeth

incisors	canines	premolars	molars
 Front view Side view	 Front view Side view	 Front view Side view	
- Have sharp edges for cutting and biting of food. - Found in the front of the mouth. - Are four in each jaw	- Are more pointed to tear food. - Are two in each jaw.	- Are four in each jaw, two in each side. - Each has one or two cusps. - Broad for grinding and crushing food.	- Larger and broader than premolars. - Each has four or more cusps. - Used for crushing and grinding.

Function of cusps

- When the jaws close, the cusps interlock and slide against each other for grinding and crushing of food.

Arrangement of teeth in humans



General functions of teeth

1- Help with the ***ingestion*** and ***mechanical digestion*** of food.
2- ***Bite*** off pieces of food.
3- ***Chop, crush or grind*** food into smaller pieces and this gives the food a ***larger surface*** area, which make it easier for the enzymes to work, and helps to dissolve the soluble parts of food, it also ***facilitates swallowing*** of food.

Wisdom teeth:

- Are the teeth found at the back of the jaw.
- Are so called because they grow later than others .

Two sets of teeth in the life of humans

Milky or deciduous teeth	Permanent teeth
- Begin to grow when the child is 5 months - By the age of 18 to 20 months most children have a set of 20 teeth. - They begin to fall when the child is about seven years old ,to be replaced by permanent teeth.	- Are 32 teeth , 16 in each jaw . - By 18 years old most people have them all. - Harder than the milky teeth . - Cannot be replaced .

Herbivores (plant eaters)pend more time eating more than carnivores(meat eaters)

because ***plant leaves*** contain less fats and protein therefore herbivores need to obtain more food to get enough protein and the required energy as ***energy value of carbohydrates*** is smaller than that of fats also because longer time is needed for ***chewing fibres*** that are found in leaves.

What is meant by dental decay ?

- The dissolving of a hole in enamel and dentine by the effect of the ***acids produced by certain bacteria*** that feed on the food remains in mouth especially sugars .
- Infection may reach pulp where nerves are found, and this is very painful.
- Infection can spread rapidly through the pulp , and may form an ***abscess*** at the root of the tooth.

What is plaque?

- Some bacteria with substances from saliva form a sticky film over the teeth, especially next to the gum and between the teeth, this is the (***plaque***.)
- Bacteria in plaque may infect the gum, which swell and becomes inflamed and bleed.
- Bacteria may work around the root and makes the tooth fall out.
- It accumulates on the teeth surface especially near gum.

How to determine pH of plaque

Take a sample of plaque, dissolve it as you can, test for pH using universal indicator to determine its pH using universal indicator colour chart.

Dental hygiene (care of teeth)

1- Do not eat much sugar
(because bacteria feed on sugar producing acids which dissolve the enamel .)
2- Use a fluoride tooth paste because:
- *fluoride makes your teeth more resistant to decay.*
- *fluoride helps in healing by formation of new enamel .*
- *regular brushing helps to remove plaque .*

3- Make regular visits to a dentist .
4- Your food should contain enough calcium , phosphorus and vitamin D which are necessary for formation of enamel
5- Take enough vitamin C which makes the cement substance healthy .

Chewing process

Importance of chewing:

1- Facilitates swallowing .
2- Increases the surface area of food for the enzymes to act .

Mechanism of chewing :

1- The chewing muscles contract and relax to move the lower jaw up and down .
2- This movement makes the food squeezed by teeth to be cut and crushed.
3- Tongue helps chewing by moving food between teeth.
4- Mucus in saliva facilitates movement of teeth against cheek.

The Human Digestive System

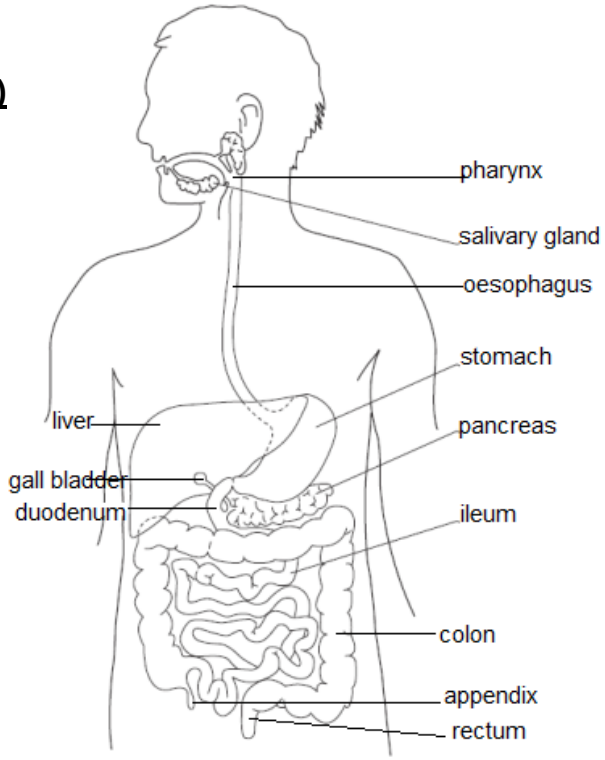
It consists of :

1- The human alimentary canal (gut) includes :

a- mouth b- pharynx
c- oesophagus d-stomach
e- small intestine f- large intestine

2- The associated organs or the digestive glands :

a- liver b- pancreas
c- salivary glands.



Definitions

1- Ingestion

It is the process of taking food and drink into a living organism through the mouth.

2- Chemical digestion

It is the breaking down of ***large insoluble*** food molecules into ***small water soluble*** molecules using mechanical and chemical processes to be easily absorbed and transported.

3-Mechanical digestion

Breakdown of food into smaller pieces without chemical change of food molecules

4- Absorption of food

Movement of digested food ***molecules or ions*** through the wall of the small intestine into the blood or lymph.

5- Assimilation of food

It is the movement of digested food molecules into the cells of the body where they are used

and becoming part of the cells.

5- Egestion:

It is the passing out of food that has not been digested, as feces, through the anus .

The human alimentary canal is lined with

1- Epithelial cells

- Small soft cells able to divide rapidly to replace the worn out cells due to the friction with food.

2- Goblet cells

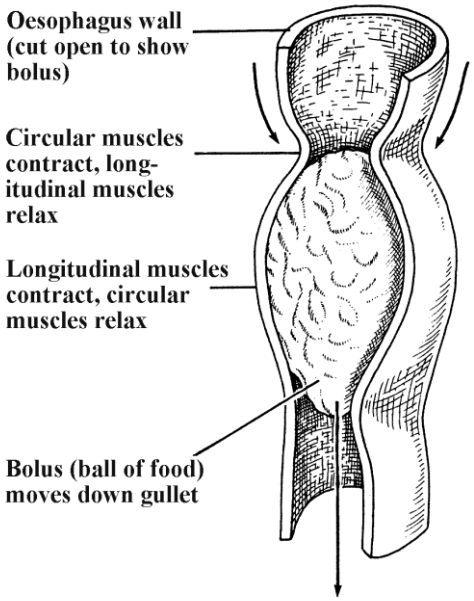
- Secrete mucus to reduce the friction between food and the alimentary canal.

3-Muscles

- Mainly circular and longitudinal to contract and relax in a movement called ***peristalsis.***

Peristalsis

- It is the rhythmic contractions of the muscles in the walls of tubes such as the alimentary canal to squeeze the contents along .

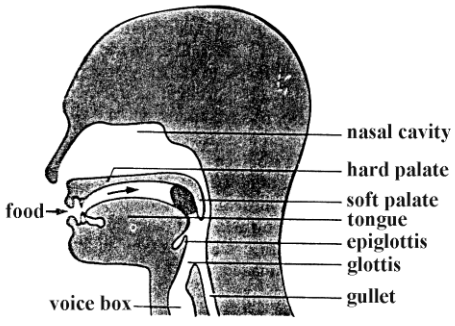


Action of peristalsis:

When a piece of food (bolus) reaches a part of the alimentary canal such as oesophagus or intestine:

- *Above the piece of food the circular muscles contract while the longitudinal muscles relax.*
- *The opposite takes place around the bolus.*
- *As a result the food is pushed along the alimentary canal*

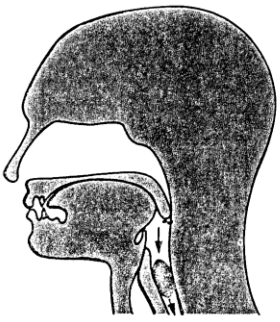
1- MOUTH



It contains :

1- Tongue

- Necessary for swallowing .
- It is the organ of taste .
- Moves the food between teeth .
- Mixes food with saliva.



2-Teeth

- For chewing food .

3- Salivary glands

- Are three pairs .

- They secrete a juice known as saliva.

Components of saliva

1- Water and mucus

- Moistens food to be easily chewed and swallowed .
- Decreases friction between teeth and cheek cells.
- Help to get rid of the food remains found between teeth .

2- Amylase enzyme

- Acts on ***starch*** to be broken down into ***maltose sugar*** .
- It acts in a neutral or slightly alkaline medium

3- Bicarbonate or hydrogen carbonate

- Creates a suitable pH value for the enzyme amylase to act .
- Protects the teeth against decay by neutralizing the acids produced by bacteria in mouth

Notice

Amylase cannot finish its work because food is not kept in the mouth for long time.

2-Pharynx

- It is the common passage for both food and air.
- The effect of salivary amylase continues in the pharynx.
- It contains a part known as **soft palate** to close the **nasal cavity** during swallowing.
- It contains a piece of cartilage known as **epiglottis** to close **trachea** during swallowing to avoid the flow of food into the respiratory system.

3- Oesophagus

- It transfers food from the pharynx to the stomach by peristalsis.
- Effect of ***salivary amylase*** on starch continues in oesophagus.

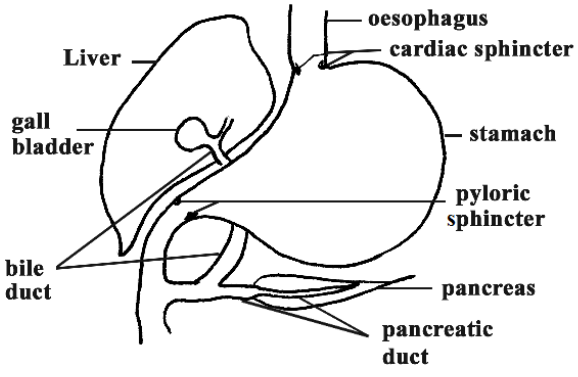
4- Stomach

- It is the widest part in the alimentary canal .
- It is controlled by two sphincter muscles :
  - A- **Cardiac sphincter** : when it relaxes food passes to the stomach .
  - B- **Pyloric sphincter** : when it relaxes food leaves the stomach to the small intestine .
- It secretes a juice known as ***gastric or stomach juic***e .

Components of the gastric juice

1-Hydrochloric acid

- To kill microbes that may enter with the food as it denature their enzymes by lowering pH .
- To activate the enzyme ***pepsinogen*** into the active form ***pepsin*** .



2-Pepsinogen

- An inactive enzyme.

- It is activated by hydrochloric acid to form ***pepsin*** .
- Pepsin acts on ***proteins*** to be digested into ***polypeptides .***

3-Mucus:

To protect the wall of the stomach against hydrochloric acid and pepsin.

Mechanical digestion in the stomach

- ***Churning movement*** (contraction and relaxation of the stomach muscles) makes the food semi- fluid

Notice

1- **Stomach digests proteins but doesn't digest itself because** :
   - pepsin is secreted in an inactive form .
   - stomach secretes a protective layer of mucus .
2- The enzymes that digest proteins are known as ***proteases*** .
3- Proteases are secreted in an ***inactive*** form in order not to digest the cells producing them as the cells are made of proteins .
4- The effect of ***salivary amylase*** stops in the stomach as it acts in slightly alkaline medium while the stomach is acidic .
5- The food mixed with the gastric juice and that leaving the stomach is known as ***chyme***, it is acidic .

Peptic ulcer or stomach ulcer

- It is an ulcer in the wall of the stomach when it is attacked by the gastric juice .
-This takes place due to the excessive secretion of gastric juice and lack of secretion of mucus.
- Smoking , alcoholic drinks and nervous stress are the main causes .

5-Small intestines

- It is the longest part in the alimentary canal .

Its functions

a- complete digestion of food .
b- absorption of digested food .

Juices received by the small intestine

- ***Bile*** from liver
- ***Pancreatic juice*** from pancreas
- ***Intestinal secretions*** from the walls of intestine

Bile

- Greenish yellow .
- Formed in the liver .
- It is stored in the gall bladder .
- It is not considered as an enzyme as it does not act as a catalyst for metabolic reaction .

Its components:

A- Bile pigment

- Formed in the liver due to the destruction of dead red blood cells.
- Excreted with faeces giving its characteristic colour .

B-Bile salts

- Are used to emulsify fats
  (Means breaks down the large droplets of fats into smaller droplets)
- Also it contains ***bicarbonates*** to neutralize the acidity of ***chyme*** and to create a slightly alkaline medium as the enzymes of this part work in a slightly alkaline medium .

Pancreatic juice

A- Bicarbonates

- To neutralise the acidity of chyme .,and to create a ***slightly alkaline*** medium because the enzymes in the small intestine act in a slightly alkaline medium.

B- Pancreatic amylase

- Like salivary amylase it acts on ***starch*** to be digested into ***maltose sugar .***

C- Lipase

- Acts on ***lipids (fats)*** to be digested into ***fatty acids and glycerol .***

D- Trypsinogen

- An ***inactive*** enzyme .
- It is activated by certain chemical secreted by the walls of intestine forming the active ***trypsin***
- Like pepsin it acts on ***proteins*** to be digested into ***polypeptides.***
  (pepsin and trypsin are called proteases as they act on proteins)

Intestinal enzymes

(Are not known as juice because they are secreted by the cells of intestine but remain attached to the cell membranes of cells and not released into lumen of intestine.)

1- Lipase :

- Like the pancreatic lipase it acts on ***lipids*** to be digested into ***fatty acids and glycerol*** .

2- Peptidase:

- Acts on ***polypeptides*** to be digested into ***amino acids*** .

3- Maltase :

- **A**cts on ***maltose*** to be digested into ***glucose*** .

Summary of digestion of the different food materials

starch salivary amylase and pancreatic amylase → **maltose** maltase of intestine → **glucose**

protein pepsin of stomach and trypsin of pancreas → **polypeptides** peptidase of intestine → **amino acids**

or

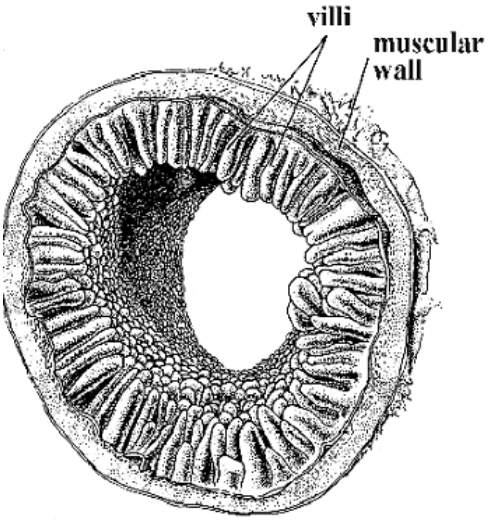
protein proteases → **amino acids**

Fats (lipids) bile → **emulsified fats** lipase of pancreas and lipase of intestine → **fatty acids and glycerol .**

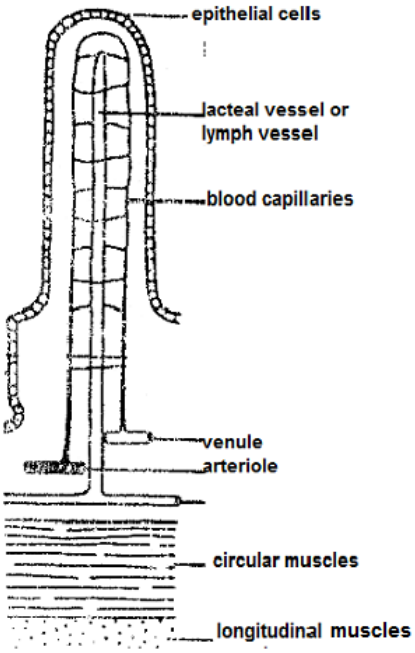
Absorption of digested food

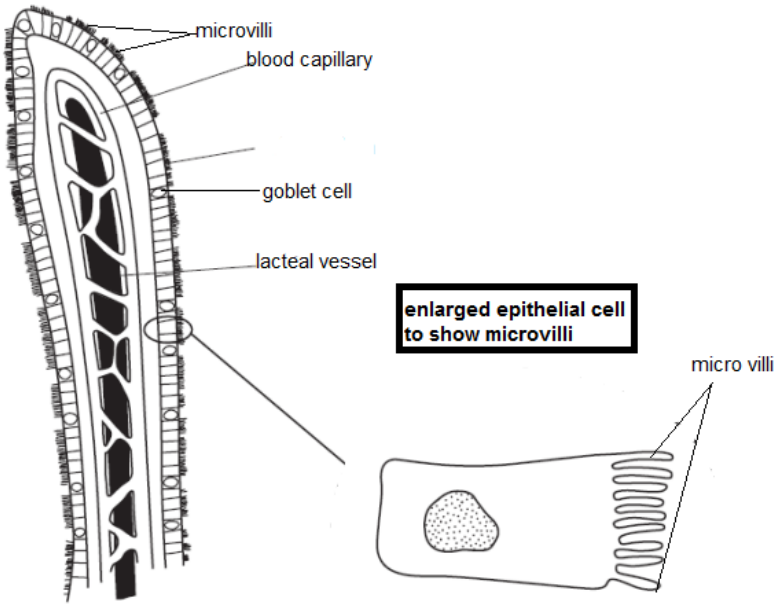
-Takes place mainly in ileum .

Cross section (T. S) in ileum



Structure of a villus





Adaptation of ileum for absorption

1- Long to provide a ***large surface area*** for absorption .

2- ***Narrow to slow down*** the movement of food and this increases the rate of absorption .

3- **Lined with villi which are adapted for absorption as follows :**

a- Lined with epithelial cells with ***thin walls*** to make food pass easily .
b- Contain ***digestive enzymes*** to complete digestion of food before being absorbed .
c- Contain a ***network of capillaries*** to transport the absorbed food .
d- Contain ***lacteal vessels*** to carry the absorbed ***fatty acids and glycerol*** .

e- The epithelial cells of villi contain microscopic projections known as ***micro-villi*** to ***increase the surface area*** of absorption .

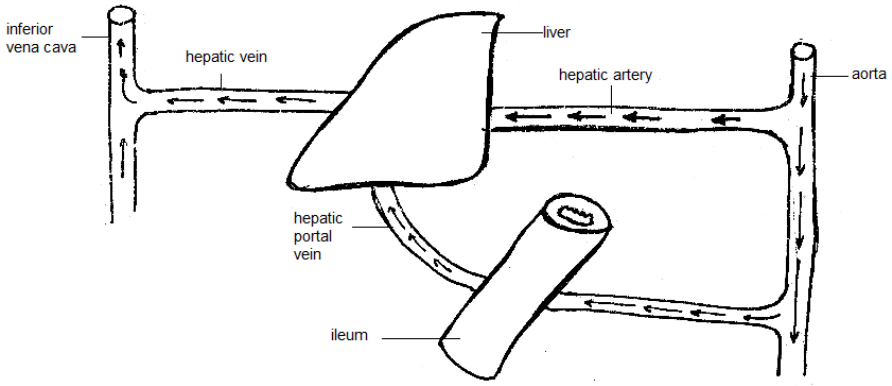
f- Its cells contain a ***lot of mitochondria*** to produce the energy required for absorption by active uptake .

Villi contain muscles to move villus so that it affects its ***surface area*** to be exposed to more food and this ***increases rate of absorption*** of food, also this helps ***movement of blood*** in blood vessels that carry digested food and ***lacteal vessels*** that carry absorbed fatty acids and glycerol.

Mechanism of absorption of digested food

1- Amino acids, monosaccharides, water, minerals and water soluble vitamins:

- pass through the epithelial cells of villi into the blood capillaries .
- blood capillaries of villi join together forming a blood vessel known as hepatic portal vein.
- hepatic portal vein carries the absorbed food to the liver .
- liver is the first organ that receives the absorbed food because of the following reasons:
  - ***a- To store the excess glucose in the form of glycogen***
  - ***b- To break down the toxic materials by a process known as detoxification .***
  - ***c- To break down the excess amino acids by a process known as deamination producing urea.***



2- Fatty acids and glycerol :

- Pass through the epithelial cells of villi to be carried mainly by the ***lacteal vessels***.
- Lacteal vessels are parts of the ***lymphatic system***.

Comparison

Hepatic portal vein.	Hepatic vein.
1- It joins ***small intestine and liver***.	- It joins the ***liver and the inferior vena cava*** .
2- It contains a ***higher concentration*** of ***glucose***.	- It contains a ***lower concentration*** of glucose as the liver ***stores the excess glucose*** in the form of glycogen.
3- It contains a ***higher concentration*** of ***amino acids***.	- It contains a ***lower concentration of amino acids*** , because the liver breaks down excess amino acids by a process known as deamination.
4- It contains a ***lower concentration of urea.***	- It contains a ***higher concentration of urea*** which is formed as a result of deamination.
5- May contain ***toxic materials***.	- ***No toxic materials*** as the liver breaks down the toxic materials by a process known as detoxification.

Notice

The blood supply to the liver is unusual

Most body organs receive oxygenated blood through an artery, and the blood leaves this organ through a vein. BUT:

1- The liver receives blood through two blood vessels an artery known as hepatic artery and also through a vein known as hepatic portal vein.

2- The liver receives oxygenated blood through the hepatic artery and also receives deoxygenated blood through the hepatic portal vein.

Comparison

Hepatic artery	Hepatic vein
1- Is branched ***from aorta***.	- Leads to the ***inferior vena cava***.
2- Carries ***oxygenated*** blood.	- Carries ***deoxygenated*** blood as the liver uses oxygen in production of energy by the process of respiration.
3- Carries ***less urea***.	- Carries ***more urea*** which is formed as a result of deamination .
4- Has a ***high blood pressure***.	- Has a ***low blood pressure***.
5- has ***thicker*** walls.	- Has ***thinner*** walls.

LARGE INTESTINE

Functions of the large intestine

1- The main function is ***absorption of water*** from the undigested food.

2- ***Pushes the food remains*** outside the body by its peristaltic movement .

3- Certain ***bacteria which feed on remains*** producing vitamin B and K.

Notice

Small intestine absorbs 5- 10 dm^3 per day while ***colon*** absorbs 0.3 – 0.5 dm^3 per day.

What happens if rate of absorption of water decreases

- Loss of water from the body leading to ***diarrhoea and dehydration*** and excessive loss of ***ions*** such as sodium and potassium.

- In case of diarrhoea ***rehydration therapy*** is needed.
- ***Rehydration*** involves giving a drink containing ***water with small amounts of different salts and sugar.***

Digestion can be divided into mechanical and chemical digestion

Mechanical digestion involves

- Effect of teeth in chewing.
- Peristalsis.
- Churning movement in stomach.

Chemical digestion involves

Effects of enzymes in digestion such as effect of amylase ,lipase and protease.

Importance of water in the alimentary canal

- Facilitates ***chewing, swallowing and egestion***.
- Facilitates ***movement of food*** along the alimentary canal.
- Acts as ***solvent*** for food materials and enzymes.
- Needed for breakdown of large food molecules into smaller molecules (this process is known as ***hydrolysis*** and it is catalysed by enzymes)

FUNCTIONS OF LIVER

1- Detoxification or detoxication:

(Means breaks down the toxic materials to be excreted with urine .)

Examples of the toxic materials *;*

Drugs are modified in the liver before being excreted.

Hormones(after finishing their effect) are converted in the liver into inactive compounds

2- Production of heat due to its high metabolic activity .

7- Manufacture of plasma proteins such as fibrinogen .

8- Regulation of level of glucose in blood .

a- ***If the glucose level is high (above the normal level which is 90:100 mg/cm blood):***

- Pancreas secretes the hormone ***insulin*** to stimulate the liver cells to store the excess glucose in the form of ***glycogen .***

b- If the glucose level is low (below 80 mg/ 100 cm blood)

pancreas secretes the hormone ***glucagon*** *to stimulate liver cells to breakdown glycogen to glucose.*

9- Deamination of excess amino acids

Deamination is the removal of nitrogen containing part of amino acids as urea followed by release of energy from the remainder of amino acid.

During deamination excess amino acids are broken down into

a- **Organic acid**

Which is then converted into fats or carbohydrates .

b- **Amine group (NH_2)**

- *reacts with hydrogen forming* ***ammonia*** .
- *Ammonia combines with carbon dioxide forming* ***urea***.
- *Urea is excreted with urine .*

Assimilation of amino acids in liver

An amount is used by liver cells in ***building proteins*** for formation of new ***cells, enzymes and plasma protein*** such as ***fibrinogen*** which is needed for blood clotting .

TRANSPORT IN PLANTS

Importance of water to plants:

- Keep the cell ***turgid*** and this is necessary for ***support***.
- Used in ***photosynthesis***.
- Forms part of ***cytoplasm and vacuole***..
- ***Water transpired helps in***:
  - conduction of water and minerals from root.
  - cools down the plant during hot days.
- ***Mineral ions*** are absorbed and transported dissolved in water.
- ***Plant food*** is transported dissolved in water.

Uptake of water by the root

1- By osmosis

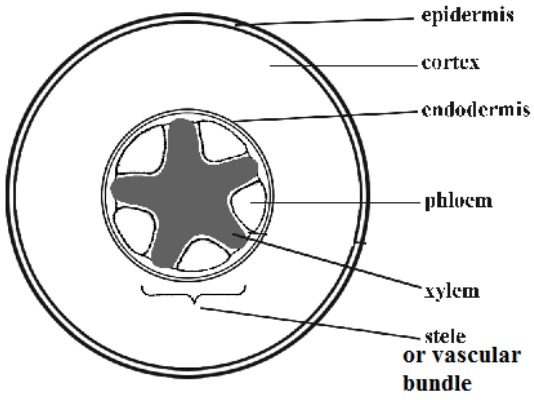
- The water potential (concentration of water) in the soil is higher than that inside the root hair cells .
- The cell membrane of the root hair cell is partially permeable .
- Therefore water enters the root hair cells by osmosis .

2- By soaking

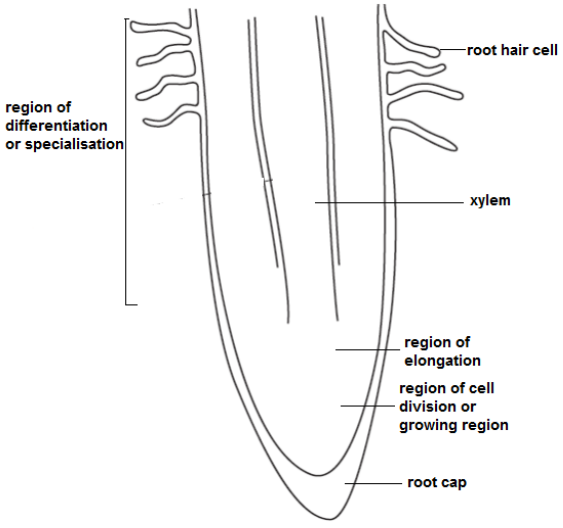
- An amount of water is soaked by the cell wall , and passes through it from one cell to another.

Structure of a dicot. root

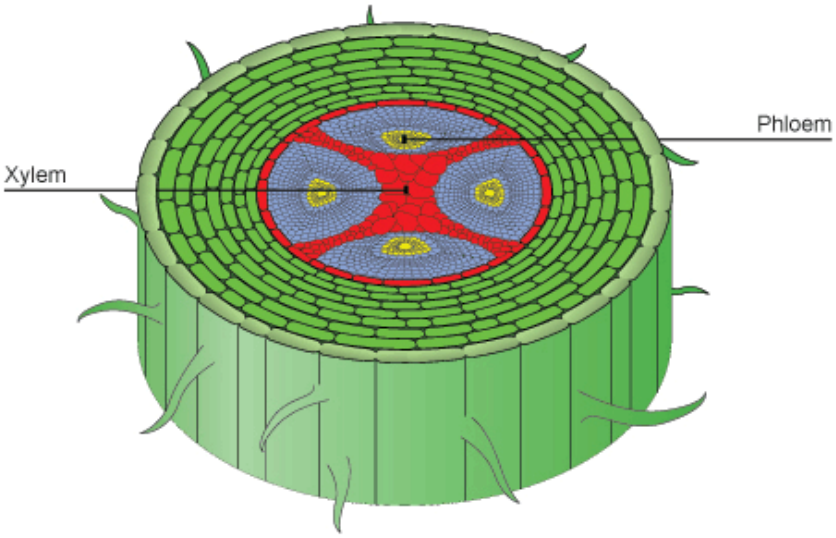
Transverse section



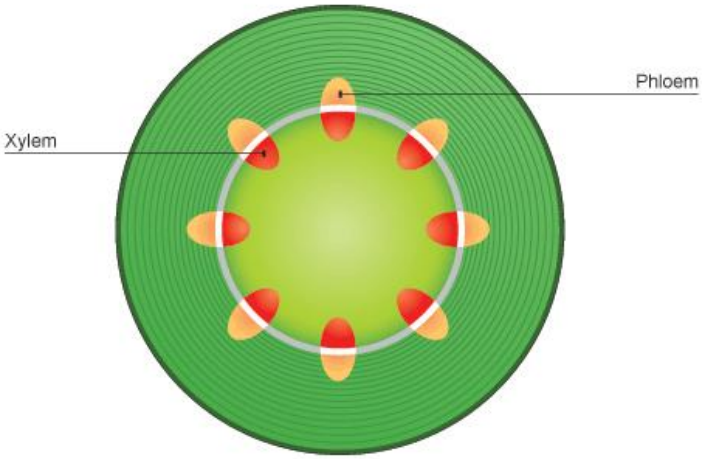
Longitudinal section



Transverse section(TS) in a root



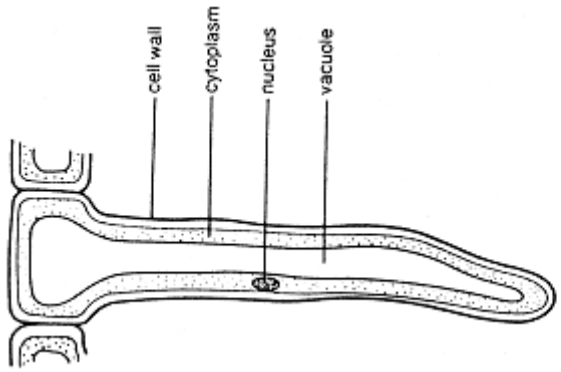
Transverse section(TS) in a stem



Wilting (when a plant lost water more than that absorbed)

Root hair cell

A cell modified for absorption of water and minerals



Adaptation of the root hair cell to its function

1-Large in number and has ***finger- like projection*** to increase the surface area of absorption.

2- Contains a lot of ***mitochondria*** for production of the energy required for absorption of minerals by a process known as ***active uptake***

3-Contains a large ***concentrated sap vacuole*** for absorption of water by ***osmosis***.

4- Secretes ***viscous***(colloidal) substance :
- to imbibe(or soak)water.
- to grow without being ruptured by the soil particles.

Pathway of water taken by the root hair cells

It passes through ***cortex cells*** to reach vascular bundle where it is carried by ***xylem*** of the root to reach xylem of stem then xylem found in leaf stalk, midrib and veins to reach ***mesophyll cells*** where an amount of water moves between the cells where it ***evaporates*** and diffuses through the ***stomata*** to the outside of the leaf . this evaporation is known as ***transpiration*** **.**

Xylem vessels

Modified cells for

1 - conduction of water and minerals.
2 - support.

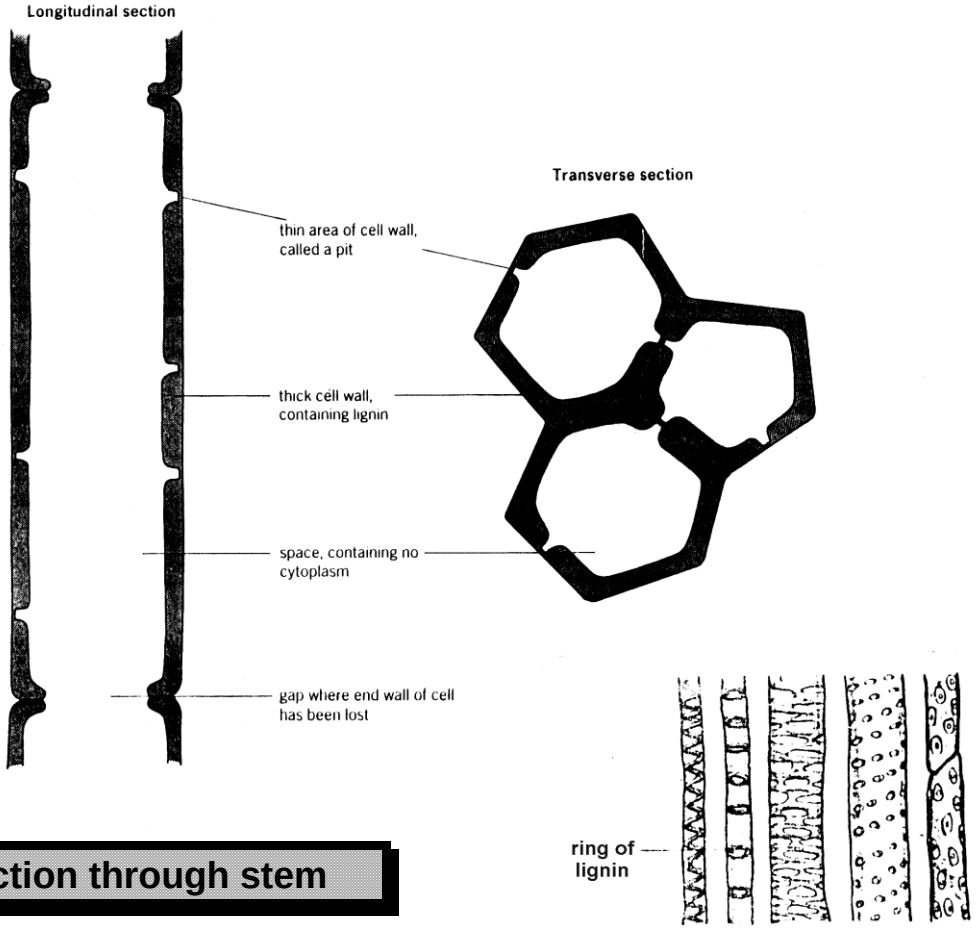
Adaptation of xylem to its function

1- Are fine tubes to help in the ascent of water by ***capillary action***.

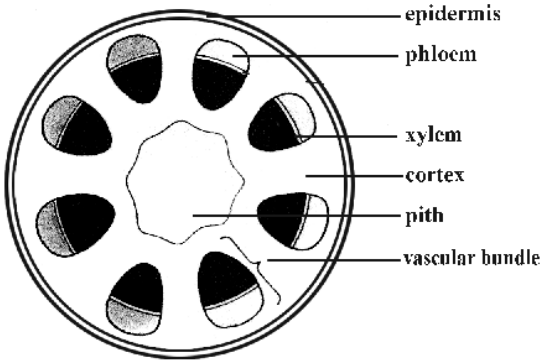
2- Have ***lignified walls*** for support and to be impermeable to water.

3- Have ***pits*** at certain points for distribution of water and minerals.

4- Have ***no cross walls ,no cytoplasm or nuclei*** in order not to resist the movement of water and minerals.



Section through stem



Experiment to investigate the pathway of water through the above- ground parts of a plant

- Cut a plant shoot and immerse ***its lower end a coloured solution***, leave it for few hours.
- ***Make sections through the shoot*** , observe the sections under a microscope to find the pathway of the coloured solution.
- Investigate the ***colour changes in the veins*** of leaves and petals of flowers.

Transpiration

Transpiration is the ***evaporation of water*** at the surfaces of the ***mesophyll cells*** followed by ***loss of water vapour*** from plant leaves, through the ***stomata.***

Factors affecting transpiration

External factors

(The factors related to the surrounding environment)

1- Air current

The increase in movement of air causes an increase in the rate of transpiration because air carries water molecules away from the leaf causing the surrounding air to become less saturated than the air inside the air chambers inside the leaf , therefore water vapour flows outside the leaf .

2- Temperature

The increase in temperature increases the rate of transpiration as it increases the rate of evaporation of water by providing kinetic energy for the water molecules .

3- Light

Increases the rate of transpiration because in presence of light stomata open for obtaining carbon dioxide for photosynthesis .

4- Humidity :

Increase in humidity decreases the rate of transpiration (inversely proportional) .

(therefore if a plant is placed in a plastic bag, rate of transpiration continues high until air inside becomes more humid then it begins to decrease, other factor responsible for this decrease is that it is protected against the effect of air currents)

Internal factors

(Are the factors related to the structure of the plant)

1-Number of stomata

- Increase in number of stomata increases the rate of transpiration)

2- Air spaces in the leaf

- Increase in air spaces increases the rate of transpiration .

3-The exposed surface area

- Increase in the exposed surface area increases the rate of transpiration

4- Thickness of cuticle

- Increase in thickness of cuticle decreases the rate of transpiration .

How to show that water is lost from plant shoots

Cover plant shoot with ***polythene bag***, after period of time ***drops become condensed*** on the inner walls of the bag, if tested (e.g. ***using anhydrous copper sulphate***), we can find out that it is water.

Cobalt chloride paper and transpiration

(cobalt chloride paper its colour ***is blue***, it changes to ***pink*** in presence of water)

Place cobalt chloride papers on both surfaces of the leaf, the colour of the one placed on the ***lower surface changes first*** as it contains more stomata.

WILTING

Wilting means that a plant loses water to the extent that the cells of its leaves become flaccid.

Causes of wilting

- When the rate of transpiration is higher

than the rate of water uptake (in presence of hot weather or strong wind .)

- When the conc. of water in the cell sap is higher is higher than the surrounding medium .

Example: presence of the plant in salty soil, or when sea water reaches the soil

Mechanism of movement of water in the plant

1- Transpiration force :

- Transpiration produces a ***tension pull*** from above creating a water potential gradient in xylem , drawing ***cohesive*** water molecules up the plant.
- The loss of water from the leaves ***reduces the water potential*** at the top of the xylem , and this creates a ***water potential gradient*** along the plant , as a result the potential of water at the base of the plant becomes higher than above , this causes the water to ascend in the plant .

-This is the ***main force*** used for ascent of water and minerals .

-The plant transpires about 98% of the water it absorbs .

2- Root pressure

- It means that the accumulation of water in the cells creates a ***turger pressure*** which forces water from one cell to another .
- It is a ***weak force*** .

Translocation

It is the movement of ***sucrose*** and ***amino acids*** from regions of production or storage to regions of utilization in respiration or growth .

Notice

Translocation takes place ***in phloem***.

Translocation takes place by ***diffusion and active transport*** .

Regions of production of food in plants such as leaves are known as ***source***

Regions of utilization or using food in plants are known as ***sink***

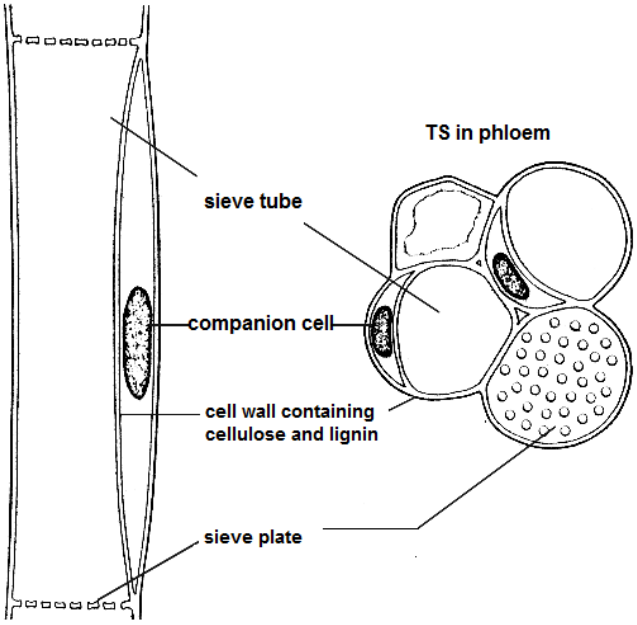
Structure of phloem

1- Sieve tubes :

- no nucleus , less cytoplasm and few organelles in order not to resist flow of translocated materials.
- Have cross perforated walls to allow movement of translocated materials.
- Formed of modified cells, each is known as sieve tube element.

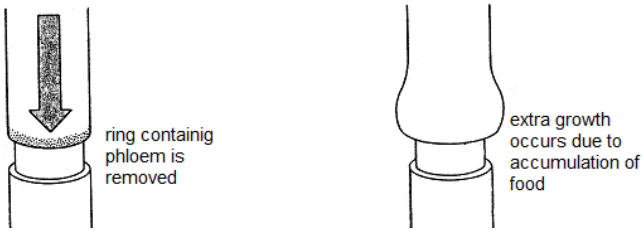
2- Companion cells

- Has a nucleus
- Contains mitochondria to produce the energy needed for active transport.



Notice

- Food is translocated in the from of ***sucrose*** because it is less reactive than glucose .
- In a tree trunk, the phloem is found in the soft inner part of the bark, therefore , if a ring of bark is cut out from round a trunk food substance **Can not get down the trunk , So :**
  - a- A bulge as in fig. will be formed due to the accumulation of food substances .
  - b- The roots become starved ,and so the plant begins to die .



Comparison

Xylem	Phloem
- Transports water and minerals	- Transports manufactured food in the form of ***sucrose*** and ***amino acids***
- Has lignified walls	- No lignified walls.
-Consists of fine tubes called ***xylem vessels .***	-Consists of ***sieve tubes*** and ***companion cells***.
- Contains no cytoplasm.	- Lined with cytoplasm.
- Contains no nucleus.	- Companion cells contain nucleus .
- Has no transverse walls .	- The transverse walls are perforated.
- Considered as ***dead*** tissue .	- Living tissue.
- Can not carry out active transport	- Translocates food by active transport.
Transport	**Translocation**

- It is the movement of ***water*** and ***minerals*** inside plants. - Takes place in ***xylem.*** - Takes place ***down upwards***. - It is a ***physical*** process, does not need energy.	- It is the movement of ***sucrose*** and ***amino acids*** from regions of production or storage to regions of utilization . - Takes place in ***phloem*** - Takes place in ***all directions*** - It is a ***biological*** process needs energy.

Source and sink differ at different times

- ***During germination*** cotyledons act as source while embryo acts as sink.
- ***During growth of the plant***, leaves act as source while non-photosynthetic parts such as root act as sink.
- When there is ***difficulty in formation of food by photosynthesis***, regions of storage of food such as root act as source while shoot acts as sink.

➢

TRANSPORT IN HUMANS

Systems responsible for transport

1- Circulatory system **2- Lymphatic system**

Circulatory System

It is a system of tubes with a pump (which is the heart) and valves to ensure one-way flow of blood

Consists of

1- Blood **2- Blood vessels** **3- Heart**

1-Blood

- About 6 liters
- Slightly alkaline (pH 7.4)

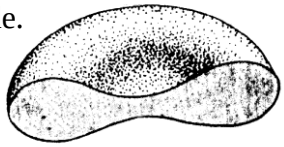
Blood consists of

1- Red blood cells or (red corpuscles)
2- White blood cells or (white corpuscles)
3- Platelets
4- Plasma

1- Red blood cells (RBC's)

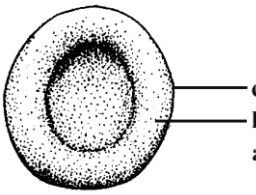
Function

-Transport of O_2.
- Transport small amount of carbon dioxide.



Cross- section of red cell showing bi - concave shape

A Red blood cells



Are formed in

-Bone marrow

Its haemoglobin

-Composed of protein and iron .
-Combines with O_2 forming unstable ***Oxyhaemoglobin*** and the blood is called ***oxygenated***
- ***Oxyhaedmoglobin*** decomposes releasing O_2 around tissues , and the blood becomes ***deoxygenated .***

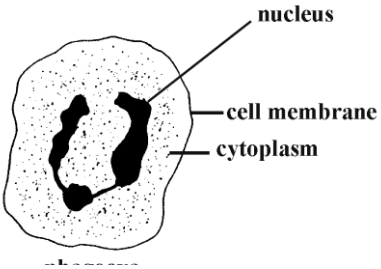
Adaptation of red blood cells

1- ***Very small*** to be able to pass through the fine capillaries.
2- Have ***elastic walls*** to squeeze themselves in the fine capillaries .
3-Contain ***haemoglobin*** to transport oxygen .
4-***Biconcave*** to increase surface area for combination with oxygen .
5-Contain ***no nucleus*** to carry more haemoglobin to transport more oxygen.
6-Produced in very high rate, because they have short life (about 120 days).

2- White blood cells or (white corpuscles)

Function

- Defense (immunity)

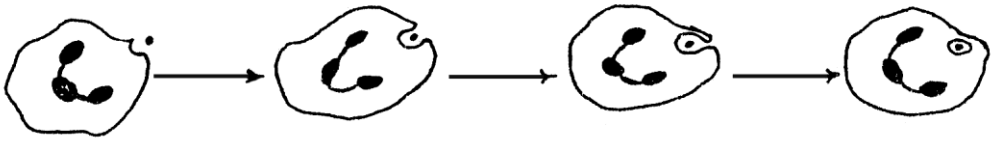


-There are two main types:

1- Phagocytes

- Its function is to ***engulf foreign bodies*** such as bacteria, microbes or germs.

How engulfing takes place

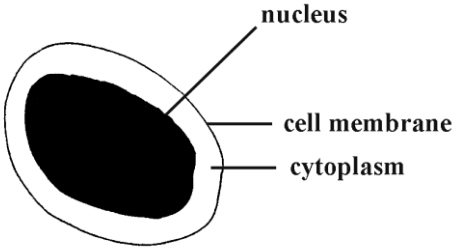


Phagocyte surrounds bacteria to be taken inside it, then it secretes enzymes to digest and use it as food.

2- Lymphocytes

- Its function is to produce ***antibodies*** (proteins) that attack microbes, germs or pathogens .

Lymphocyte



Effect of antibodies

-Make germs burst .
-Make germs clump to be easily engulfed .
-Marking germs to be easily engulfed .

Formation of WBC's

-Are formed in bone marrow and lymph nodes.

3- Platelets

Function

- Necessary for blood clotting

Formation

-in bone marrow

Platelets

4- Blood Plasma

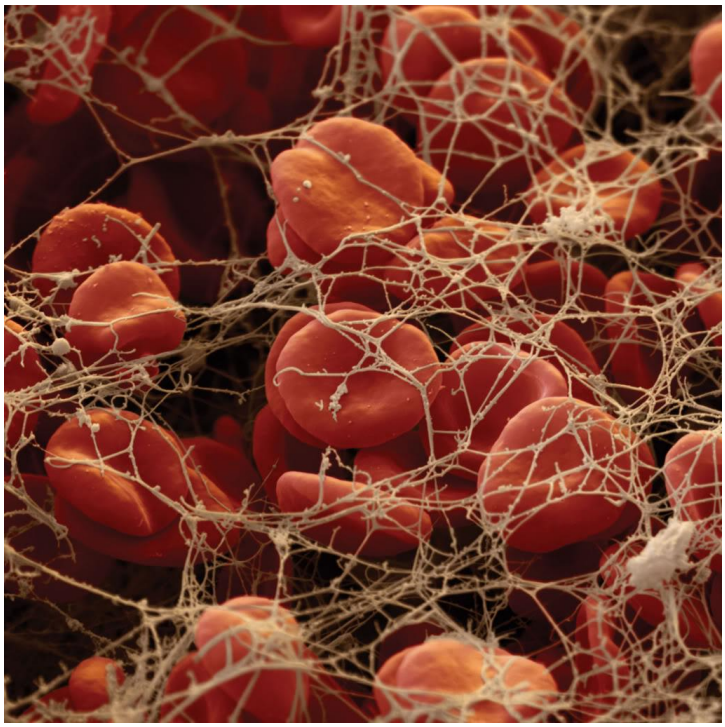
Function

-It is the fluid that in which blood cells and platelets flow, it transports different materials in a soluble form such as urea , hormones , digested food, antibodies, water and salts.

Formed of

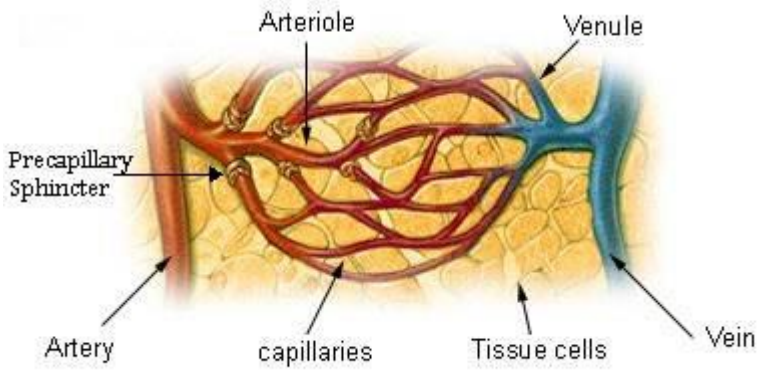
-***Water and ions*** such as sodium, potassium , calcium and chlorine.
-***Plasma proteins*** such as fibrinogen and globulin which are formed in liver .

Blood clotting showing fibrin trapping blood cells

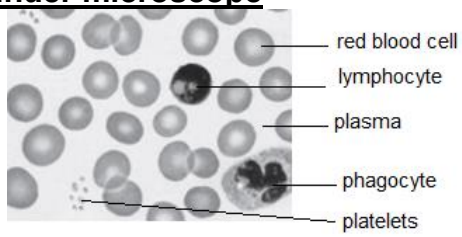


Biconcave red blood cells

Blood vessels



Blood sample as seen under microscope



BLOOD CLOTTING

Importance of blood clotting

1- Protection against bleeding.
2- To avoid entering of pathogens in wounds.

Mechanism of blood clotting

1- When a blood vessel is cut, soluble protein in blood known as ***fibrinogen*** into an insoluble form known as ***fibrin***.
2- Fibrin is a ***sticky , thread-like protein*** that accumulate in the wound forming a ***mesh*** which traps blood cells and platelets forming a ***temporary plug*** .

Functions of blood

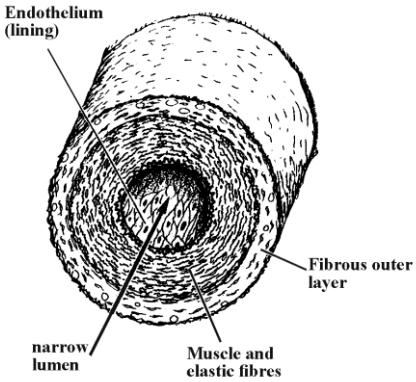
1-Transport of :	2-Homeostasis	3- Immunity
- Oxygen - CO_2 - .Digested food . -Waste products such as urea . - Hormones . - Antibodies .	- Distributes heat from liver.	-Forms blood clot to prevent bleeding and germs . - Phagocytes engulf bacteria . - Lymphocytes produce antibodies to attack microbes .

Blood vessels

1- Arteries **2- Veins** **3- Capillaries**

1- Arteries

Are blood vessels carry blood from the heart to the body.



Properties

-Narrow lumen.
-Thick walls.
-High pressure.
-Rapid irregular flow of blood.
-The small arteries are called ***arterioles***

Adaptation of arteries to their function

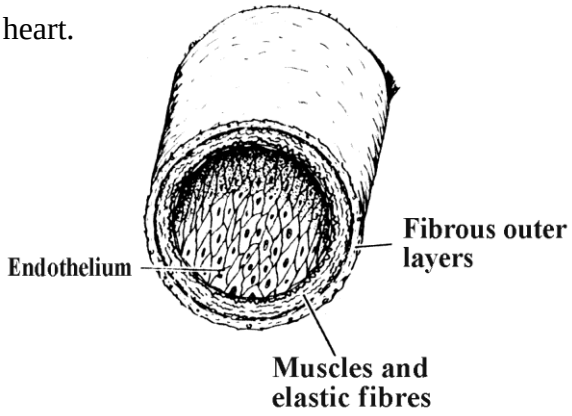
- Have ***thick walls*** to withstand the high blood pressure.
- Have ***elastic walls*** to help in forcing blood.
- ***Embedded*** in muscles to be away from injury because they are difficult to be healed due to the high pressure inside them .

Notice

Artery has thick elastic walls therefore if its walls are stretched to increase its diameter (for example if a mass is suspended to its walls) it can return back to its normal diameter.

2- Veins

Are blood vessels carry blood from the body to the heart.



Properties

-***Wider*** lumen than arteries.
-***Thinner*** walls.
-***Lower pressure*** than arteries and capillaries.
-***Slow*** regular flow of blood.
-The smallest veins are called ***venules***
-Body muscles help blood to be squeezed in veins .

Adaptation of veins

-Have wide lumen in order not to resist the blood flow .
-Have many semi- lunar valves to prevent the back flow of blood .

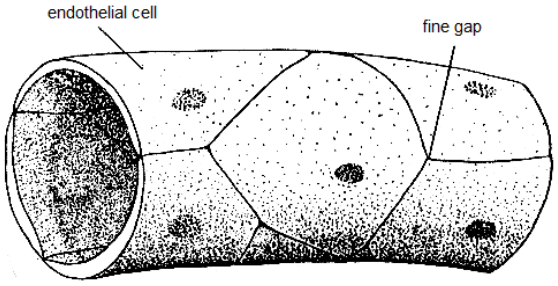
3- Capillaries

Definition:

Are very fine vessels (one cell- thick walls) connect arteries and veins.

Adaptation

-Have fine gaps between cells of its wall to allow exchange of materials .
-Large in number to increase the surface area of exchange of materials between blood and body tissues.



What can pass through capillary walls

- Phagocytes
- Components of plasma such as water, salts (plasma proteins cannot pass as they are too large to pass.
- dissolved waste products, food materials such as glucose and amino acids.

shunt vessels

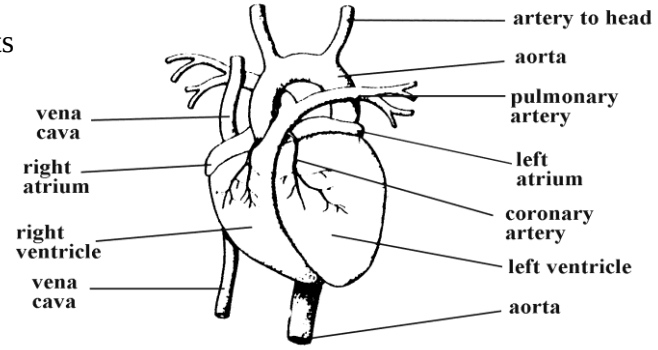
A blood **vessel** that links an artery directly to a vein, allowing the blood to ***bypass the capillaries*** in certain areas. **Shunt vessels** can ***control blood flow by constriction and dilation***.

THE HUMAN HEART

It is amuscular organ, its muscle known as cardiac muscle.

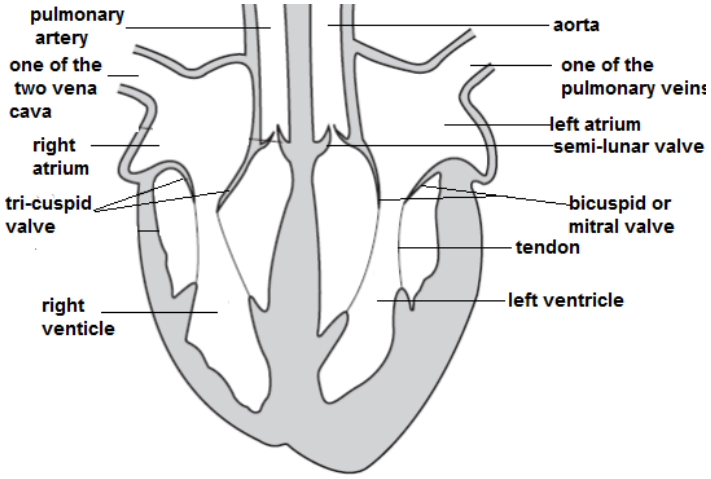
Its function

Pumps blood to the different parts of the body



External view of the heart

Longitudinal section(L.S.)through the heart



The two sides of the heart are separated by septum

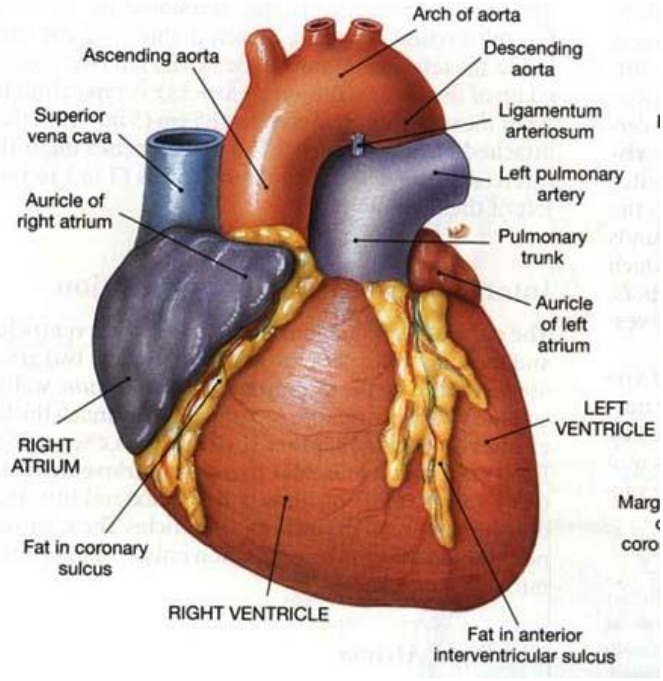
It ***separates*** oxygenated blood and deoxygenated blood.

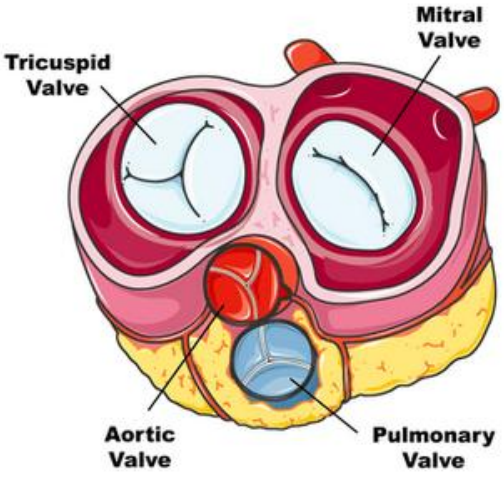
The human heart consists of four chambers

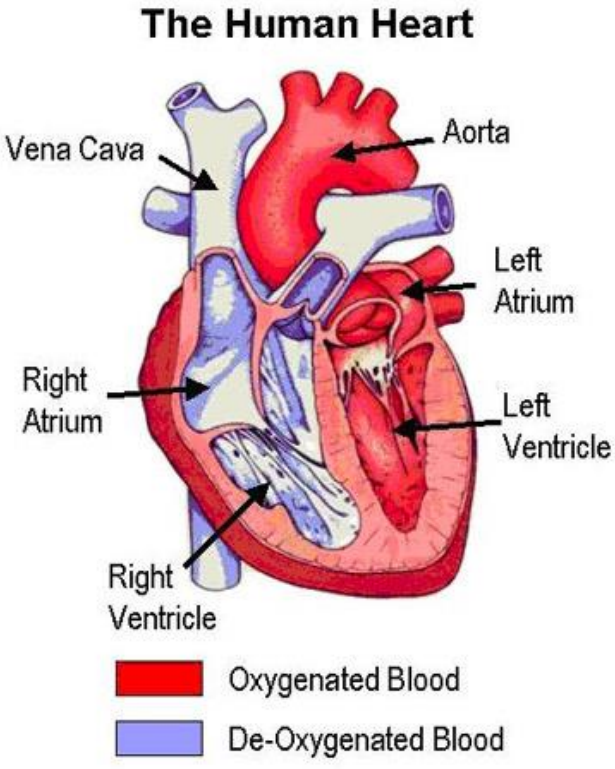
- The two upper chambers are known as ***atria*** (singular is atrium)
- Atria are also known as ***auricles***
- The two lower chambers are known as ***ventricles*** .

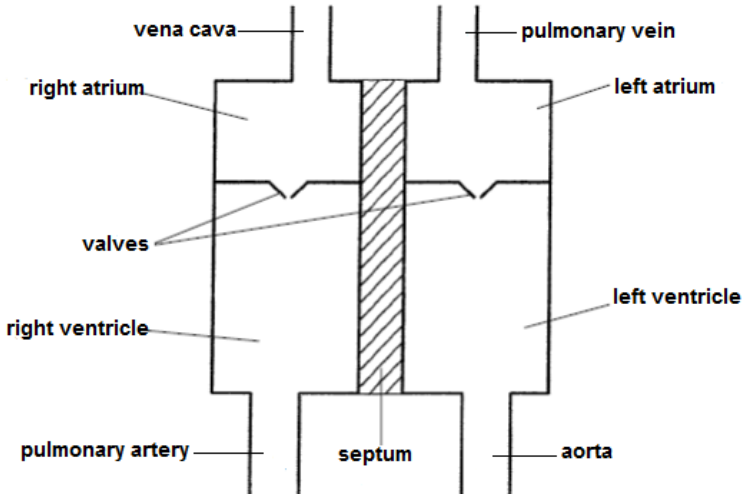
The atria and ventricles are separated by valves :

- The right atrium and the right ventricle are separated by a valve known as ***tricuspid valve*** as it consists of ***three flaps*** .
- The left atrium and the left ventricle are separated by a valve known as ***bicuspid or mitral valve*** as it consists of ***two flaps*** only.
- Both bicuspid and tricuspid valves are described as ***atrio-ventricular*** valves as they are found between atria and ventricles.


Arch of aorta
Ascending aorta
Descending aorta
Superior vena cava
Ligamentum arteriosum
Left pulmonary artery
Auricle of right atrium
Pulmonary trunk
Auricle of left atrium
LEFT VENTRICLE
RIGHT ATRIUM
Fat in coronary sulcus
RIGHT VENTRICLE
Fat in anterior interventricular sulcus


Mitral Valve
Tricuspid Valve
Aortic Valve
Pulmonary Valve


The Human Heart
Vena Cava
Aorta
Left Atrium
Right Atrium
Left Ventricle
Right Ventricle
Oxygenated Blood
De-Oxygenated Blood



Function of valves in the heart

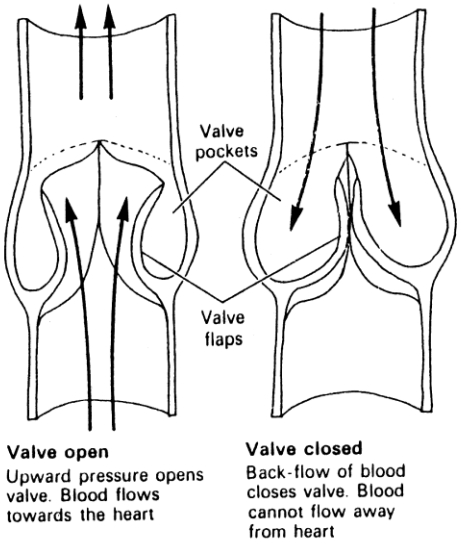
To prevent the back flow of blood , and this allows blood to flow in one direction only .

How valves work in the heart

-Blood coming from atria forces them to open .
-Flaps float over blood to close the opening .
-The ***tendons*** prevent them from being turned back towards atria.

How semi-lunar valves work in the blood vessels

- The flaps of semi-lunar valves act as pockets
- When blood tries to flow back, the pockets become filled with blood and close .
- ***No semi-lunar valves*** in arteries ***except*** at their beginnings as blood is not liable to flow back due to the high blood pressure in them.



Functions of the blood vessels connected to the heart

1- Superior vena cava :

- Collects ***deoxygenated*** blood from the ***upper parts*** of the body to the ***right atrium*** .

2- Inferior vena cava:

- Collects ***deoxygenated*** blood from the ***lower parts*** of the body to the ***right atrium*** .

3- Pulmonary artery :

- Carries ***deoxygenated*** blood from the ***right ventricle*** to the ***lungs*** .
-In the lungs deoxygenated blood leaves carbon dioxide and carries oxygen to be ***oxygenated*** blood .

4- The four pulmonary veins :

-Carry ***oxygenated*** blood from ***lungs*** to the ***left atrium*** .

5- Aorta :

- It is the largest artery in the body .
- It carries ***oxygenated*** blood from the ***left ventricle*** to all parts of the body .

6- Coronary arteries

-Are branched from aorta to supply the heart muscle (cardiac muscle) with food and oxygen .

-Leads to coronary veins which carry wastes of metabolism to ***vena cava***.

.

Notice .

- All arteries carry oxygenated blood except ***pulmonary artery*** .
  *(and the **umbilical** artery which carries deoxygenated blood from foetus in the uterus to his mother)*
- All veins carry deoxygenated blood except ***the 4 pulmonary veins*** .
  *(And the **umbilical vein** which carries oxygenated blood from mother to her foetus in the uterus)*

How heart works

The sequence of events which make up one heart beat is called ***cardiac cycle***.

Stages of cardiac cycle

1-Atrial systole(contraction)

-The two atria ***contract***, so pressure in atria becomes higher than that in ventricles.

-***Atrio- ventricular valves*** (tricuspid & bicuspid) open so blood flows from atria to ventricles.

-***Ventricles relax***, therefore aortic and pulmonary valves close to prevent backflow of blood to the ventricles.

2- ventricular systole(contraction)

-The two ***ventricles contract***, so pressure in ventricles becomes higher than that of atria, therefore ***atrio-ventricular*** valves close.

- ***Aortic and pulmonary valves*** open causing blood to flow from ventricles into aorta and pulmonary artery.

-***Atrial diastole (relaxation)***, causing blood to enter atria through pulmonary veins and vena cava.

3-Ventricular diastole, atrial diastole

-Blood enters atria through pulmonary veins and vena cava and falls to ventricles.

-During this stage blood in aorta and pulmonary artery cannot flow back because the semi-lunar valves (aortic valve and pulmonary valve) become closed.

Adaptation of the heart to its function

1-Contains ***valves*** to prevent the back flow of blood.

2-The walls of ***atria are thinner*** than those of the ventricles because the function of atria is to push blood to the ventricles only while the function of the ventricle is to push blood to a longer distance.

3- The walls of the ***left ventricle*** are thicker than those of the right one because the left

ventricle pushes blood through aorta to all the body while the right ventricle pushes blood to the lungs only .

4- The heart is made of a certain type of muscles ***(cardiac muscle)*** which never get tired.

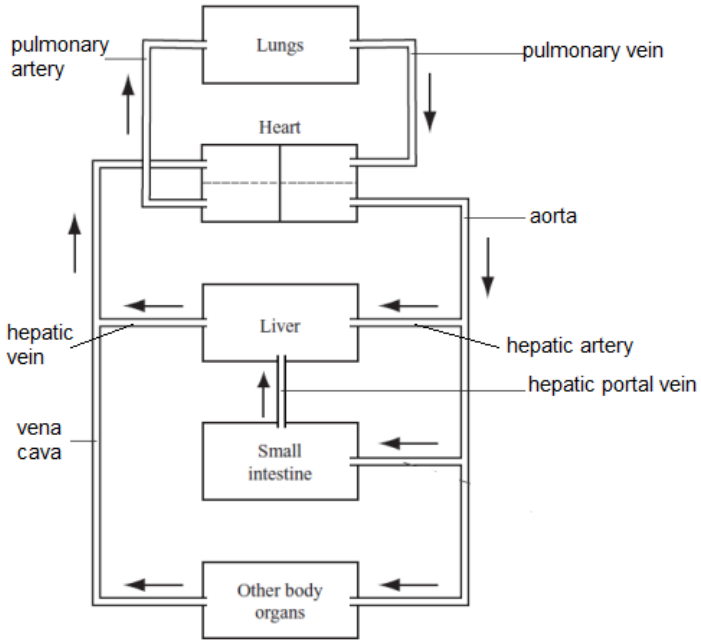
5- The heart is protected by a membrane called ***pericardium*** .

6-Contains the ***pacemaker*** in the walls of the right atrium which produce impulses to allow contraction of the heart .

Our circulatory system

-Is a ***closed circulatory system*** because the blood does not flow mainly outside the blood vessels .

-Is a ***double(or dual circulatory system)*** because the blood goes though the heart twice in one complete journey around the system.



The double(or dual) circulation

1- Pulmonary circulation

- Its pump (its start) is the ***right ventricle*** and ends in the ***left atrium***.
- Its importance is exchange of gases as deoxygenated blood carried from the heart in the pulmonary artery to reach the lungs where blood becomes oxygenated, then it is carried back to the left atrium.

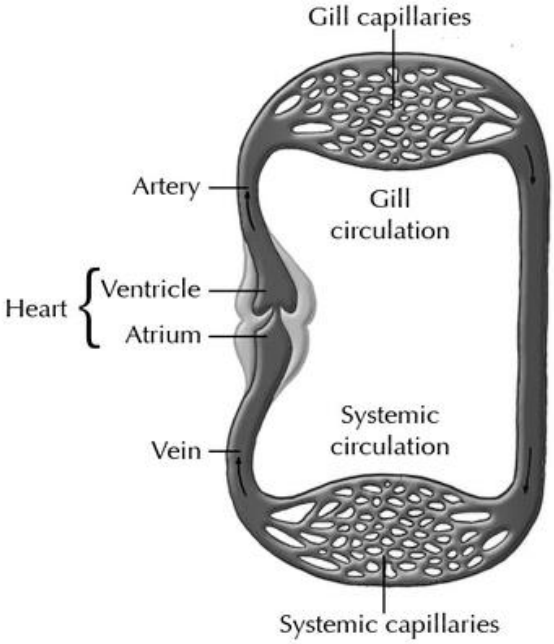
2- Systemic circulation

- Its pump (its start) is the ***left ventricle*** and ends in the ***right atrium***.
- Its importance is distribution of food , oxygen and other useful materials and to collect waste products.

Advantages of double circulation

During flow of blood in fine blood vessels, it ***loses a lot of pressure***, when returns back to the heart it ***gains enough pressure*** to be forced back to reach the different body parts, ***supplying enough food and oxygen and to remove waste products of metabolism*** especially from active organs.

Single circulation in fish



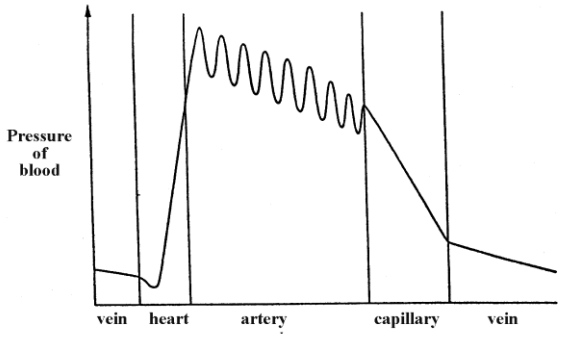
Disadvantage of single circulation

A lot of pressure is lost during flow of blood in fine capillaries of gills, this makes flow of blood in the body very slow decreasing supply of oxygen to the body.

Blood pressure

- It is the pressure created in arteries due to the ***flow of blood*** during heart beats.
- It is measured by an apparatus known as ***sphygmomanometer.***
- The normal blood pressure is 120/80 mm/Hg.
- 120 is ***systolic pressure*** ,it is the pressure during contraction of the ventricles while 80 is known as ***diastolic pressure*** , it is the blood pressure during relaxation of the ventricles.

Figure shows blood pressure in the different parts of the circulatory system.



The rhythmic sounds made by the heart

Lob : due to closure of the two values between arteries and ventricles.
Dup : due to the closure of the semi-lunar values in the aorta and pulmonary artery.

Pulse

- Is the ripple of pressure which passes down on an artery due to heart beats.
- The rate of pulse represents the rate of heart beats.

How to measure pulse

- Use the first two fingers of your ***right hand*** and lie them on the inside of your left wrist, feel for the ***tendon*** near the outside of your wrist, then you can feel the artery in your wrist pulsing as your heart pumps blood through it. Count the number of ***ripples*** of pressure per minute.
- ***Repeat*** this step and take the average for accuracy.

Effect of exercise on heart beats

- In normal conditions the heart beats 60-80 / min .
- ***The rate decreases*** during sleeping or relaxation as the energy needed by the body during this period is low.
- ***During exercise*** the rate goes over 100 / min **. *because*** the muscles need more energy therefore the heart has to pump more blood carrying food and oxygen to the muscles to produce the required energy for this exercise and also to carry away the waste products of metabolism. .
- The normal heart beats of players and those who carry out regular exercise are ***less than*** the other people ***because***
    a- their heart muscle becomes stronger, able to perform the required functions with lower number of beats.
    b- volume of the heart chambers increases therefore their ***stroke volume*** becomes greater.

Factors affecting heart rate

- Adrenaline which is a hormone secreted by adrenal glands, it increases rate of heart beats.
- Exercise, drinking coffee and smoking increases rate of heat beats.
- Sleep, decreases rate of heart beats.

What causes an increase in heart rate during exercise

- More ***carbon dioxide*** is produced as a result of respiration , this carbon dioxide ***lower pH*** of blood .
- Low pH is ***detected by certain receptors*** in brain.
- Brain increases ***frequency of nerve impulses*** to the pacemaker to increase heart rate.

How activity of the heart can be monitored

1- Measuring ***pulse rate.***
2- Using ***stethoscope*** to hear heart sound
3- Electrocardiograph (ECG)
little electrodes are stuck onto the patient's body so that the electrical activity of the heart can be recorded.

Heart attack or cardiac arrest

Usually takes place when one of the ***coronary arteries*** becomes blocked causing the heart muscle to be starved due to the lack of food and oxygen .

The main causes of this blockage (or risk factors of heart attack)

1-Eating too much animal fats which precipitate on the inner walls of arteries leading to reduction in their lumen and elasticity and this is known as ***atherosclerosis*** which reduces the ability of arteries to transport blood and makes them more subjected to blockage by ***thrombus***.

2-***Too much salts*** which increase the blood pressure ***(Hypertension)*** increasing the chance of damage of arterial walls and formation of ***thrombus*** .

3-***Smoking*** which helps in precipitation of fats.

4-***Stress*** which causes increase in blood pressure.

5-Age.

6- Genetic factors
When inherited it makes the person more likely to be affected by CHD.

How to avoid heart attack (preventive measures of heart attack)

1-Avoid smoking .
2-Regular exercise (to consume fats)
3-Avoid stress.
4-Eating diets that do not contain too much animal fats and salts.
5-Using drugs, such as
Statin to reduce cholesterol level in blood.
(Statin has unpleasant side effects, therefore eating less animal fat is better).

Aspirin lower risk of formation of blood clots.

Surgery to treat heart attack

1-Stents

little ***mesh tube*** inserted in the artery to keep artery open.

2-Angioplasty

Tiny ***balloon*** is inserted in the blocked artery then ***inflated using Water*** to push the artery open, the balloon is then removed.

3-By-pass

If there is a blockage in a branch of the coronary arteries, this part is replaced by a vein from the same patient by means of a surgical operation.

- The ***advantage*** of this is ***to avoid tissue rejection*** which takes place if an artery from another person is used .
- The ***disadvantage*** of this is that, the vein has thin walls and may be unable to withstand the high blood pressure that flows in the artery.
- During transplant of this vein it has to be fixed in the right way ***because*** if it is fixed in an opposite direction its semi-lunar valves resist the flow of blood .

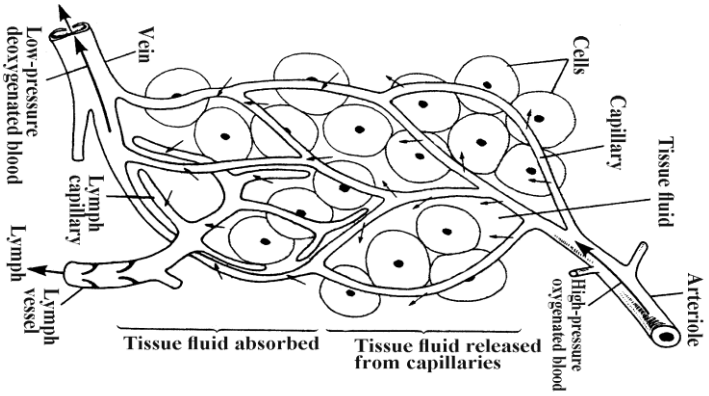
Notice

- People live at ***high altitudes*** have larger number of red blood cells than others because at high altitudes there is ***lower concentration of oxygen*** therefore more red blood cells are produced to overcome this difficulty.
- Oxygenated blood is ***more bright*** than deoxygenated blood .

Tissue fluid

Definition

It is the components of blood which leak outsides capillaries to bath the body cells (tissues) , it is ***similar*** to plasma but contains some while blood cells(which can change their shape to be squeezed through the gaps of capillaries)



Importance of the tissue fluid

- To supply the tissues with food, hormones, minerals, antibodies and water.
- To carry waste products of metabolism.
- Some white blood cells (phagocytes) can squeeze outside capillaries and get into the tissue fluid to attack microbes.

Collecting the tissue fluid

- **Small proportion of tissue fluid can return back to the blood capillaries .**
  (Because the pressure of the tissue fluid is lower than the pressure inside vessels.)
- **By lymphatic vessels**
  (This takes place by simple diffusion and active transport .)

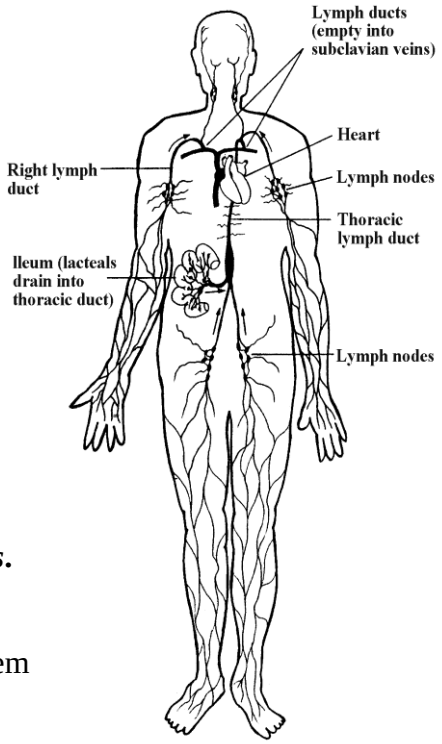
Functions of lymphatic system

1-In transport

- Transports the tissue fluid from the surrounding of the tissues and pours it into the ***subclavian vein***.
- Transports fats, fatty acids and glycerol from the ileum through the ***villi*** and pours them in the ***subclavian vein*** to be transported to the heart through the ***superior vena cava***.

2-In immunity

- Development of lymphocytes which produce antibodies that attack germs.



Lymphatic vessels (Lymphatics)

- Like veins they contain valves to prevent the back flow of lymph but have blind end.

How lymph is moved in the lymph vessels

Movement of *body muscles* that surround lymphatic vessels and the breathing movements cause lymph to be squeezed in the lymphatic vessels without flowing back because lymphatic vessels contain *semilunar valves*.

Lymph nodes

- Are swellings spread in certain parts of the lymphatic system

Their function :

- Production and storing of antibodies.
- Contain phagocytes.

The immune system

Includes the following

a- Antibody production.
b- Phagocytosis .
c- Tissue rejection.

Tissue rejection .

Organs or tissues that may be transplanted from one individual to a patient may be ***attacked by the immune system*** because the antigens of the transplanted organs or tissues are considered as foreign chemical to the white blood cells of the patient.

RESPIRATION
and the human respiratory system

1- Breathing

The muscular movements that keep air enter and leaves the respiratory system

2- Gaseous exchange

The exchange of gases across respiratory surfaces such as obtaining oxygen by blood and release of carbon dioxide from blood into lungs.

3- Respiration

It is the release of energy form food substances in all living cells.

Types of respiration

1- Aerobic respiration :

It is the release of a relatively large amount of energy in cells by the breakdown of food substances in living cells ***in the presence of oxygen*** .

Equation of aerobic respiration :

glucose + oxygen $\xrightarrow{\text{living cells}}$ carbon dioxide + water

$C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6\ H_2O$

2- Anaerobic respiration :

It is the release of a relatively small amount of energy by the breakdown of food substances in living cells ***in the absence of oxygen*** .

Equation of anaerobic respiration in some organisms such as yeast :

glucose $\xrightarrow{\text{living cells}}$ ethanol (alcohol) + carbon dioxide

$C_6H_{12}O_6 \longrightarrow 2\ C_2H_5OH + 2\ CO_2$

Equation of anaerobic respiration in animal cells (example muscle cells)

glucose $\xrightarrow{\text{living cells}}$ lactic acid

$C_6H_{12}O_6 \longrightarrow 2\ C_3H_6O_3$

Comparison between aerobic and anaerobic respiration

Aerobic respiration	Anaerobic respiration
• Needs oxygen . • More energy is produced . • No alcohol or lactic acid is made • CO_2 is always made . • Takes place in mitochondria .	• Oxygen is not needed . • Less energy is produced • Alcohol is made in yeast and plant cells while lactic acid is made in animal cells. • CO_2 is made only in yeast and plant cells. • Takes place in cytoplasm .

Uses of energy in the body of humans

1. In formation of new substances such as protein for growth , development and tissue repair .

2-In active transport ..
3-In movement as contraction of different muscles requires energy.
4-In generation of nerve impulses .
5-Production of heat, to keep the body warm.
6-In cell division

Differences in composition between inspired and expired air

Inspired air	Expired air
20 –21 % oxygen	16 % oxygen
0.03- 0.04 % carbon dioxide.	4% carbon dioxide.
Less water vapour.	More water vapour.
Lower temperature.	Higher temperature.

- The inspired air contains the normal concentration of carbon dioxide and oxygen in air.
- No difference in concentration of nitrogen and the other inert gases between inspired and expired air.

Brewing or Fermentation

- It is the process of conversion of sugar into alcohol and carbon dioxide by yeast(by means of anaerobic respiration.)

Role of Brewing

1- In alcoholic drinks

(A) Beer

- Yeast is dissolved in a warm liquid containing the sugar maltose which is obtained form germinating barley seeds.
-The liquid is covered to allow anaerobic respiration to breakdown maltose into alcohol and CO_2.
-CO_2 makes the beer fizzy while alcohol gives the drink its effect on the nervous system.

(B) In wine .

-Similar way like beer is used, but the sugar comes from grapes .

2-In bread making

Yeast respire in dough releasing carbon dioxide that ***causes dough to rise*** and when placed in oven, carbon dioxide expand causing dough to be ***porous and has a spongy texture.***

3-in production of ethanol and biofuel

- Maize is treated with ***amylase and maltase*** to produce glucose.
- ***Yeast*** is added, ***anaerobic*** respiration takes place.
- Ethanol is extracted from the mixture by ***distillation***.
- Ethanol is ***mixed with gasoline*** to make a fuel known as biofuel .

Advantages of using biofuels

- Growing more maize enables to produce more fuel.
- Less carbon dioxide is produced as it is used during cultivating crops to produce biofuel.

Disadvantages of using biofuels

- Land is used for cultivating crops to produce biofuels instead of food.
- Crops like maize will be expensive due to their shortage because they are used in making

biofuels

- Produce less energy per litre.

Notice

In an air tight flask containing yeast pH decreases due to accumulation of carbon dioxide which is an acidic gas.
In anaerobic conditions number of yease decreases due to increase in level of alcohol and shortage of food.

Production of lactic acid in muscles during exercise

During exercise, a lot of oxygen and food is needed for production of energy in muscles to contract, therefore :

- Rate and depth of breathing increases to obtain the oxygen needed for exercise and to remove the waste products such as carbon dioxide.
- The heart beats faster to pump more blood to supply the muscles with enough food and oxygen .

At certain limit , heart and lungs can not supply oxygen to the muscles any faster but more energy is still needed ,therefore :

- Extra energy can be produced by anaerobic respiration producing lactic acid
- When you stop exercise you go on breathing hard to take extra oxygen to oxidise lactic acid i.e. to recover the oxygen debt.

Oxygen debt

- A condition occurs in muscle tissues during strenuous exercise , when oxygen is consumed faster than it can be supplied by blood.

Disadvantages of anaerobic respiration:

- Less energy is produced .
- Accumulation of lactic acid leads to change in pH causing muscular fatigue.

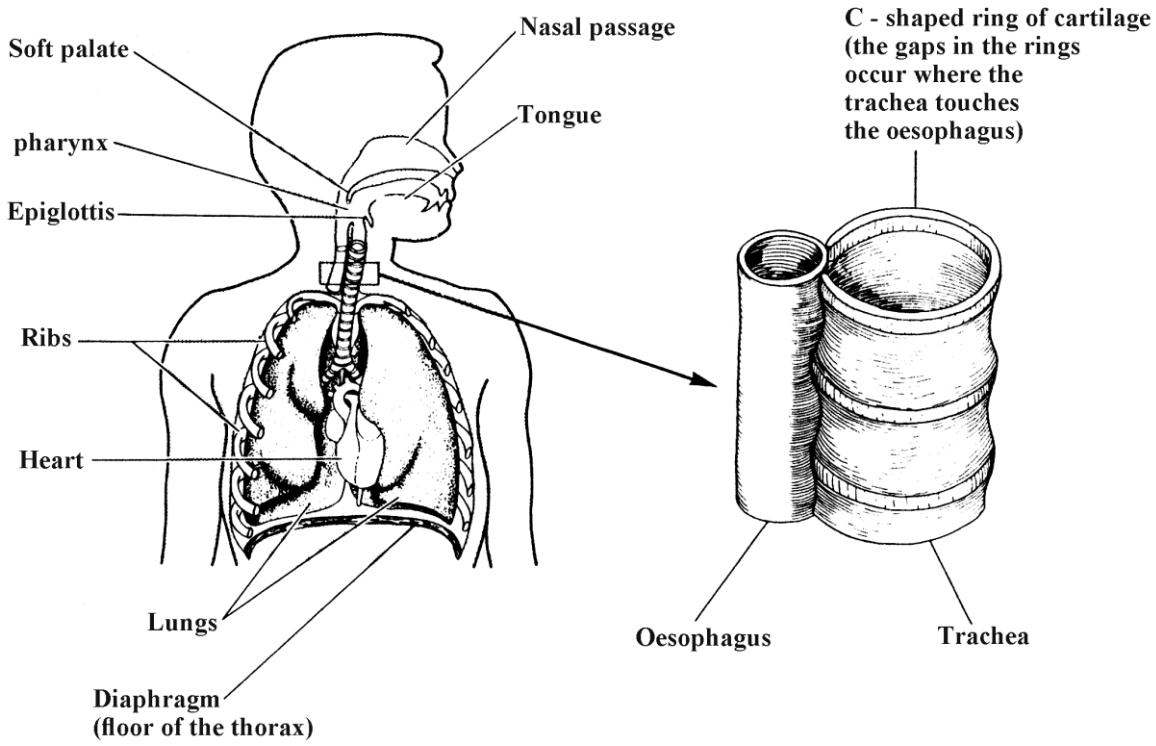
High ventilation rate during exercise

Because during exercise ***aerobic respiration*** takes place leading to increase in level of carbon dioxide in blood which is detected by ***respiratory centre*** in the brain which sends order to increase rate and depth of breathing to remove the carbon dioxide even after exercise.

Recovery of oxygen debt

After exercise ***heart and breathing rate*** remain high for a period of time to transport lactic acid and oxygen to the ***liver*** to oxidize the lactic acid formed as a result of anaerobic respiration.

The human respiratory system



It consists of :

1-Nose

- Lined with mucus and contains hair to trap dust and microbes.
- Lined with blood capillaries to warm inhaled air in order not to harm the respiratory system.

2-Pharynx

The common passage for both food and air therefore :

- It contains ***soft palate*** to close the nasal cavity during swallowing .
- It contains ***epiglottis*** to close the trachea during swallowing .

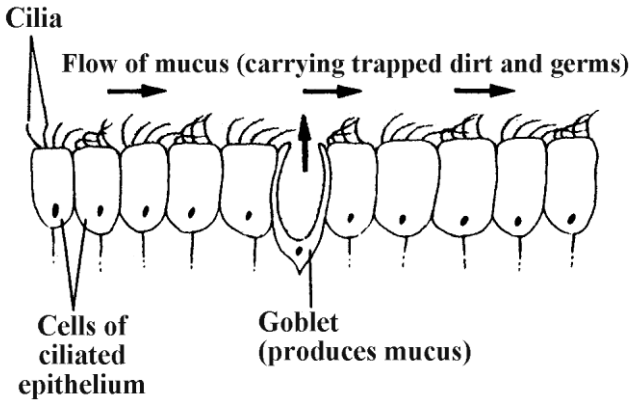
3-Larynx (Voice box)

- It contains vocal cords which vibrate during movements of air producing sound.

4-Trachea or windpipe

- Lined with ***ciliated epithelial cells*** which contains ***cilia*** that beat to move the foreign particles away and to sweep mucus.
- Contains ***goblet cells*** to secrete mucus to trap dust particles and microbes.
- Lined with incomplete rings of cartilage :
  - -To keep it open and to avoid its collapse .
  - -To allow the expansion of oesophagus during movement of food through it.
  - -For support .

-



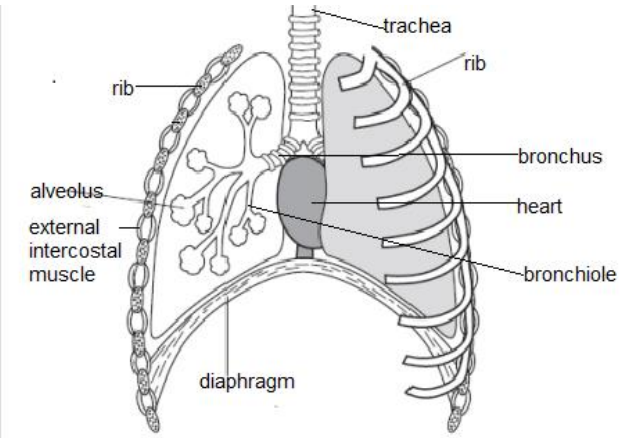
5- Bronchi (singular: bronchus)

- Each bronchus enters a lung .
- Lined with ***cilia*** to move the foreign particles away .
- Contain ***goblet cells*** to produce mucus to trap dust particles and microbes Lined with cartilage for support .

6-Bronchioles

- The smaller branches of bronchi, end with air sacs (alveoli) .

7-Lungs



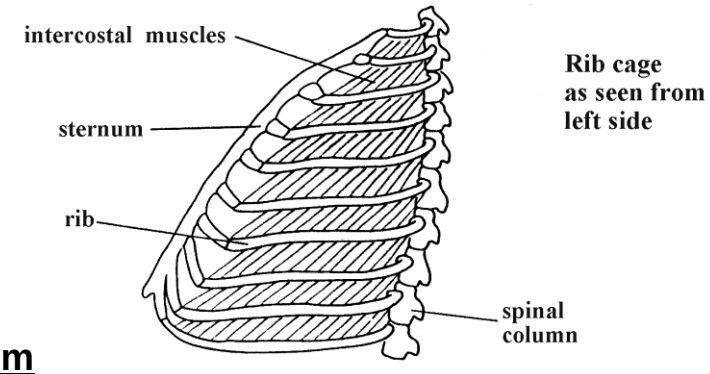
- The left lung is smaller than the right one as the heart bends to the left .
- The left lung consists of ***two lobes*** only while the right one consists of ***three lobes***.
- It is protected by membranes called ***pleural membranes*** encloses a pleural fluid to decrease friction between lungs, ribs and heart .
- ***Pleural membranes*** also ensure that the lungs adhere closely to the moving ribs and no air between lungs and rib cage, if air enters like in accidents it makes lungs collapse.
- Contains air sacs or alveoli.(which are the respiratory surfaces in higher animals such as birds and mammals)

8-Intercostal muscles

- Are two sets of ***antagonestic muscles***, external and internal intercostal muscles.

(antagonstic means two sets of muscles oppose each other at each side of a joint, when one contracts the other relaxes.)

- Found between ribs.
- Their function is to lower and raise the ribs.

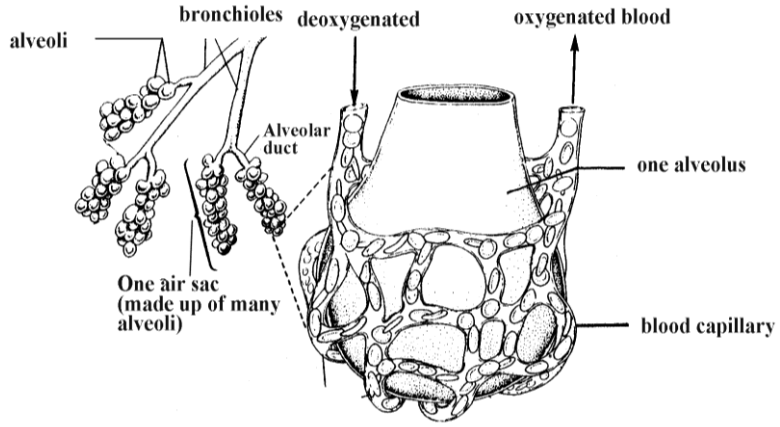


9- Diaphragm

- a dome - shaped muscle separates thorax and abdomen .

Features or characteristics of gaseous exchange surfaces in animals (air sacs or alveoli)

1- Have thin walls to facilitate diffusion of gases.
2- Have large surface area to increase the rate of diffusion of gases.
3- Are permeable to gases.
4- Must be well ventilated.
5- Must be connected to a blood supply to transport gases.
6- Moist to facilitate diffusion of gases and to stop the cells of alveoli from drying out.



Effect of physical activity on the rate and depth of breathing

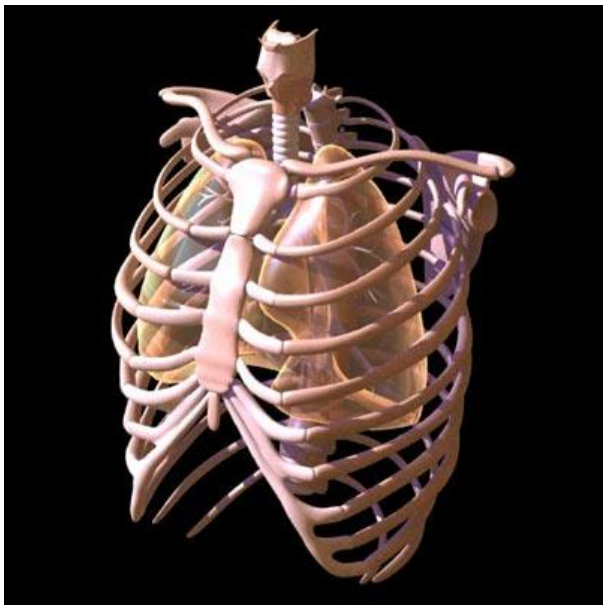
Exercise increases concentration of carbon dioxide and decreases pH value in blood.

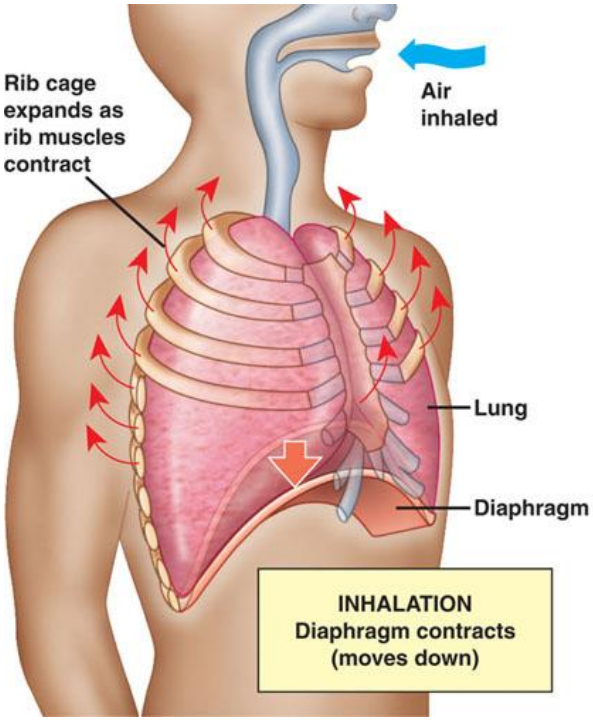
(this can be detected by the respiratory centre in the brain which sends impulses to increase rate and depth of breathing)

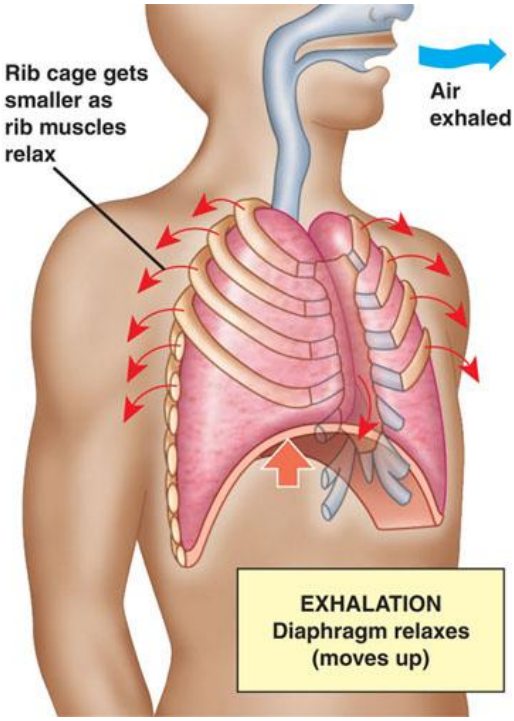
Increase depth and rate of breathing to obtain enough oxygen to be used in production of enough energy , as a result of this:

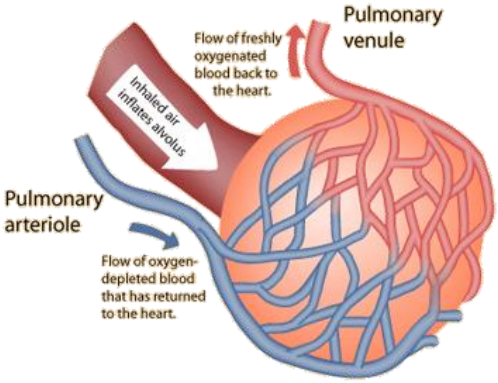
- The diaphragm and intercoastal muscles are made to work harder.
- The elasticity of the air sacs is increased, increasing the ability of lungs to obtain more oxygen .
- Blood flow both to and from the lungs is also improved.

Rib cage and lungs **trachea and bronchi showing cartilage**



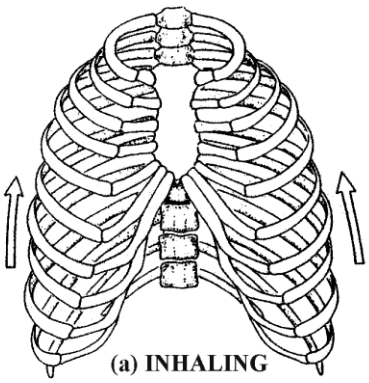




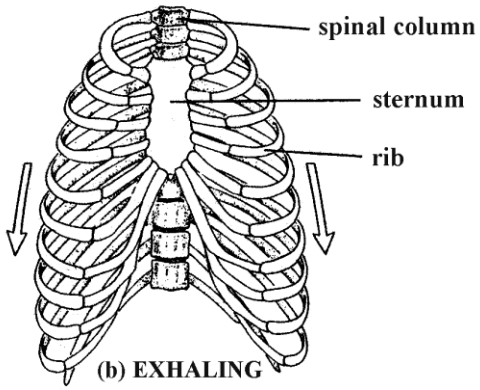


A capillary network covers the surface of the alveolus to facilitate oxygen and carbon dioxide exchange.

The respiratory (Breathing) cycle



Ribs swing up and increase volume of thorax



Ribs swing down and reduce volume of thorax

Movement of rib cage during breathing

Inspiration (inhalation)	Expiration (exhalation)
• Means taking air into lungs .	• Means to expel air out lungs.
Its mechanism :	***Its mechanism*** :
- The ***external intercostal*** muscles contract causing ribs to move upwards and outwards	- The ***internal intercostal*** muscles contract while the external intercostal muscles relax, causing the ribs to move downwards and inwards.
- The diaphragm contracts and flattens, pushing down the contents of the abdomen, therefore : ** Volume of thorax increases* **The pressure inside it decreases so the lungs become inflated and air rushes inside them.*	- The diaphragm relaxes and become domed , therefore : ** Volume of thorax decreases .* ** The pressure inside it increases.* ** The elasticity of the lungs causes them to become deflated so air is pressed outwards.*

The effects of cigarette smoke

Cigarette smoke contains tar, nicotine, carbon monoxide, and other harmful particles

1-Tar.

- It is a carcenogenic substance (leads to cancer.)
- Irritates the lining of the trachea causing the production of more mucus and the cilia stop beating therefore :-
  - ** Coughing takes place to expel mucus .*
  - ** Coughing damages the lining of the bronchioles, and allow it to be attacked by viruses and bacteria causing* ***chronic bronchitis****.*
  - ** Excessive coughing can breakdown the thin walls of alveoli decreasing the surface area of gaseous exchange and this is called* ***emphysema.***

chronic bronchitis and emphysema are chronic obstructive pulmonary diseases (COPD)

2-Nicotine

- It is a ***stimulant***(makes you more alert and active).
- It is ***addictive***, means that once your body has got used to it, it is very hard to do without it

.

- Affects the ***nervous and the circulatory system*** in general it acts as a stimulant by increasing the release of adrenaline hormone , this increases the rate of heart beat and increases blood pressure by causing constriction of many blood vessels.
- It also increases the tendency for fatty deposits to form inside blood vessels causing blood vessels to lose their elasticity and to become narrow(this is called ***atherosclerosis***)

3-Carbon monoxide

- Combines with haemoglobin forming carboxy-haemoglobin which reduces the oxygen carried by blood
- Babies born to mothers who smoke tend to be smaller as a result of lack of oxygen.

Smoke particles

When inspired, ***inflammation*** takes places causing the inner lining of the gaseous exchange surface to ***swell***, so lumen of the respiratory pathway decreases leading to difficulty in breathing, ***abnormal cough*** and may lead to ***emphysema***.

Evidence for the link between smoking and lung cancer

- Smokers are more likely to develop lung cancer than non-smokers.
- ***One third*** of all cancer deaths are due to smoking
- ***25%*** of smokers die of lung cancer.
- The risk of developing lung cancer starts to decrease ***as soon as*** smoking is stopped
- Risk of developing lung cancer increases in those start smoking in ***early age*** ,also increases by increasing ***number of cigarettes*** and ***tar content*** of cigarettes.

Other effects of smoking

a- Physical dependence

Because tobacco stimulates nervous system, stop smoking leads to symptoms such as sleeplessness, muscle pain, headache and nausea.

b- Psychological dependence

- Many people cannot stop smoking because they think that , smoking increases self confidence, or increases nervous concentration.
- Many people can not stop smoking because it is linked with some activities such as drinking coffee, watching TV..etc.

c- Tolerance

Means that the smoker must smoke more and more to get the same effect.

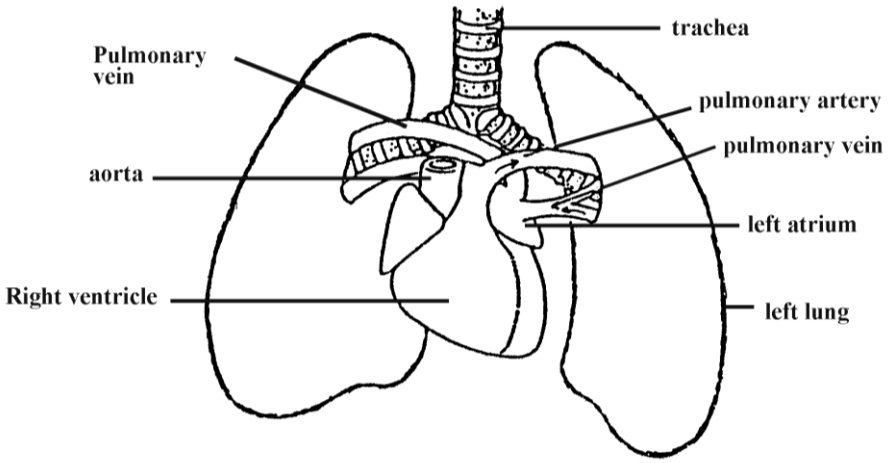
Passive Smoking

Inhaling smoke of cigarettes from the surrounding air by non smokers.

Larynx cancer

Lip cancer

Blood vessels joining heart and lungs



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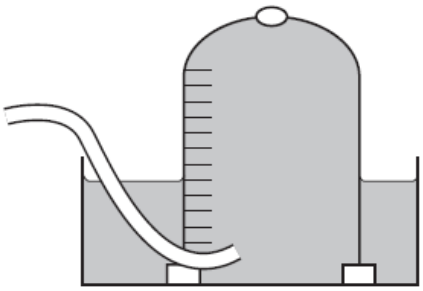
Practical applications

Test for carbon dioxide

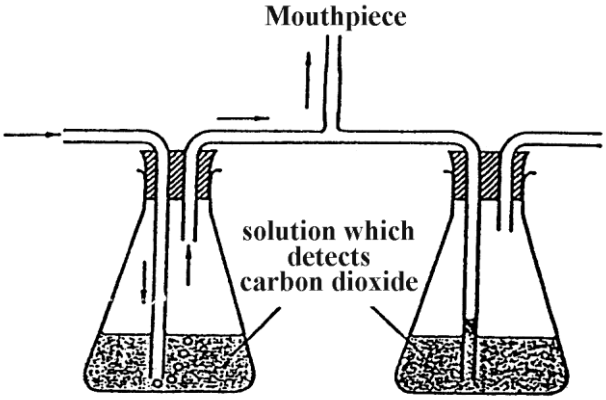
Bubble a sample of gas in lime water , it turns milky or cloudy.



How to measure the lung volume of a person

Breath out fully so that an amount of the liquid is replaced by expired air, read the scale, repeat the procedure several times and take the average.

- **In experiments of gases like that shown below, the apparatus has to be air tight, so vaseline or petroleum jelly is used in sealing the different parts making it air tight**



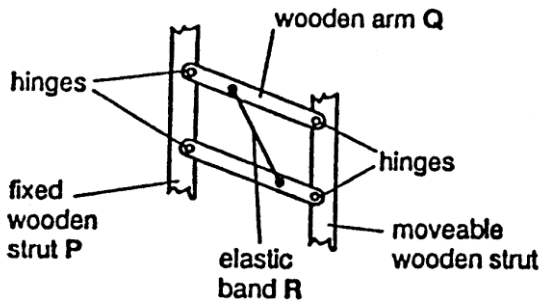
- **The above experiment can be used also to compare concentration of carbon dioxide in expired and inspired air**

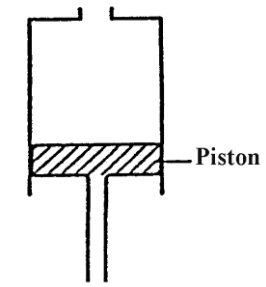
- Lime water in the right side flask becomes milky at first because expired air contains higher concentration of carbon dioxide than inspired air.
- Breathing out must take place slowly during this experiment to avoid increase in pressure in the left side flask causing the indicator to be forced out, and to provide enough time for carbon dioxide to affect lime water.

How to show that bacteria is a living organism

By putting the bacteria produced from bacterial culture in a closed test tube joined to a thermometer and a gas syringe, the reading of the thermometer increases and by testing the collected gas using lime water it becomes milky indicating the process of respiration of bacteria.

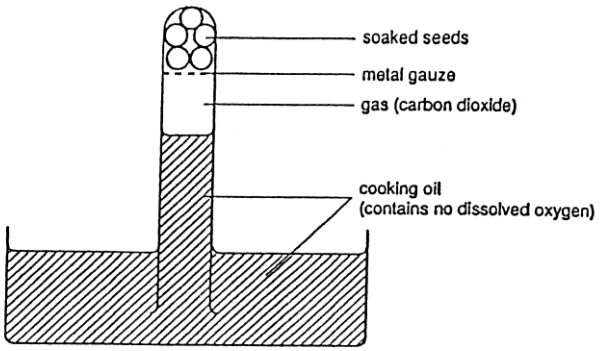
- **A model of respiratory system**





In the above model

P represents the ***backbone***.
Q represents ***rib***.
The movable wooden strut represents ***sternum***.
R represents ***intercostal muscles***.
The walls of the syringe represent the ***walls of the thorax***.
The piston represents ***diaphragm***

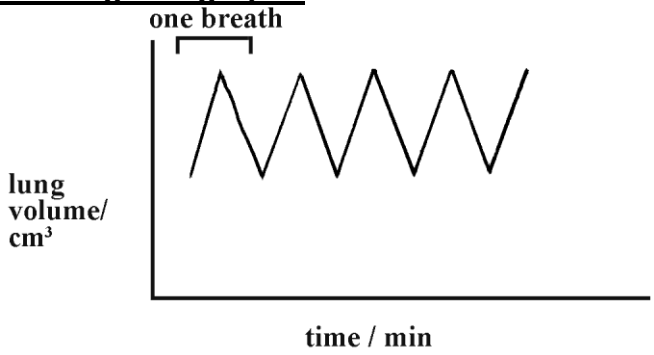


Germinating seeds respire

- The oxygen produced by respiration pushes oil downwards.
- To prepare a test tube filed with oil and inverted as shown, fill the tube with oil and cover it, then invert it in the basin that contains oil, remove the cover, the pressure of air on the surface of oil in the basin causes the tube to remain filled.

- **Boiled water contain no dissolved oxygen.**

Breathing and graphs



EXCRETION IN HUMANS.

Importance of excretion

- Avoid accumulation of waste products
- Some products of metabolism are toxic, therefore they have to be removed.
- For homeostasis as excretion removes excess substances.
- For osmoregulation

(Osmoregulation is the process by which the balance of water and dissolved solutes is regulated.)

formation of urea in the liver

The main excretory organs

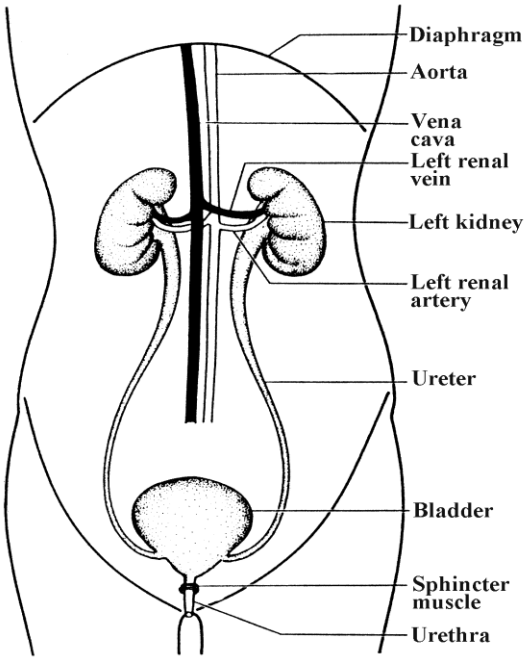
1- lungs : excrete CO_2 , H_2O

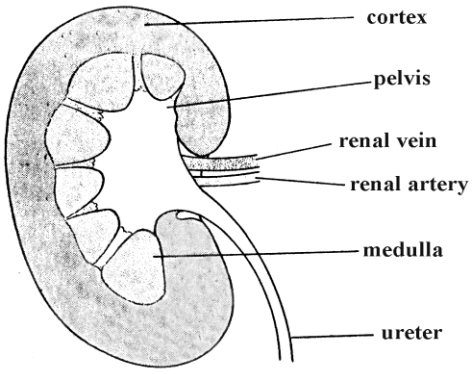
2- Kidneys : excretes urine which consists mainly of urea, uric acid , salts, water ,and modified hormones.

3- Skin : excretes sweat which consists mainly of water, salts , low concentration of urea .

4- Liver : excretes bile.

The human urinary system

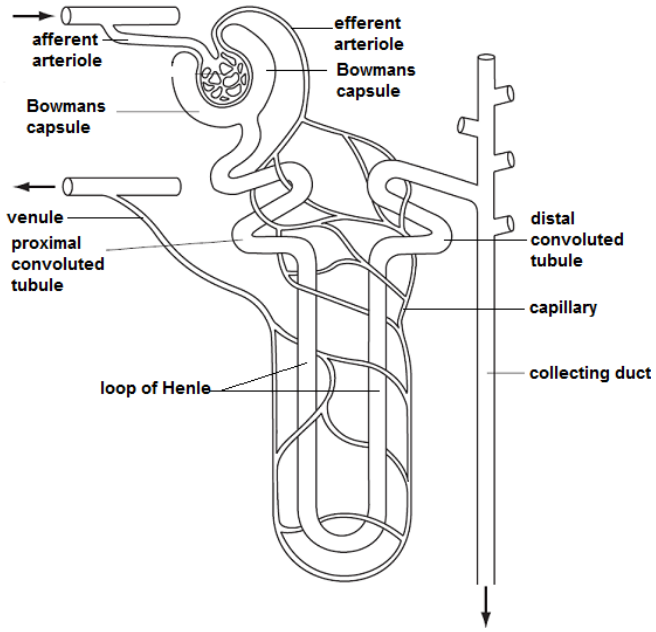




Section through the kidney to show regions

- The functional unit of kidney is known as ***nephron.***

Structure of nephron



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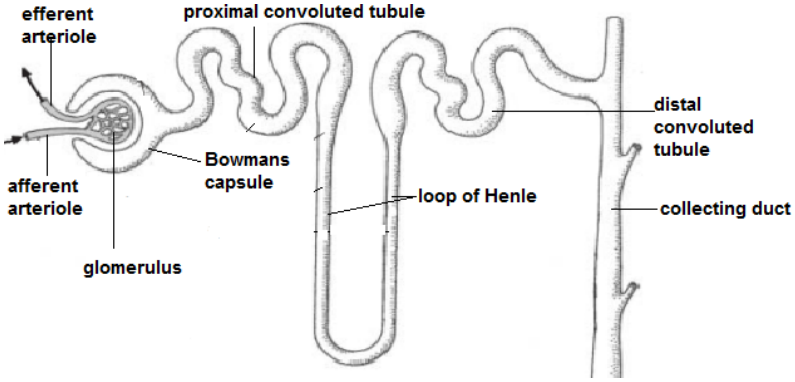
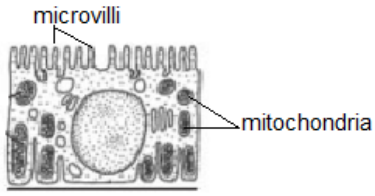
Nephron without blood vessels





cell from proximal convoluted tubule

Extraction of urine in nephron takes place in two main steps

1- Ultrafiltration

2- Selective reabsorption

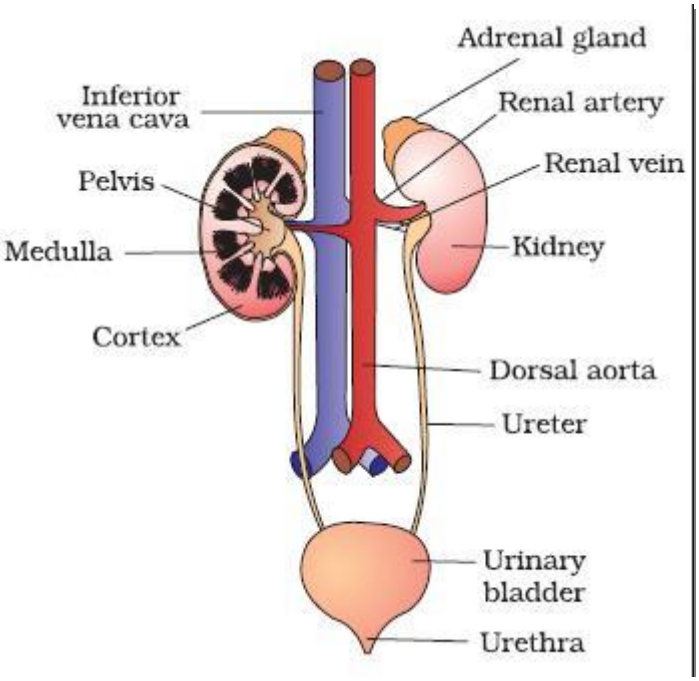
Ultra filtration in Bowman's capsule

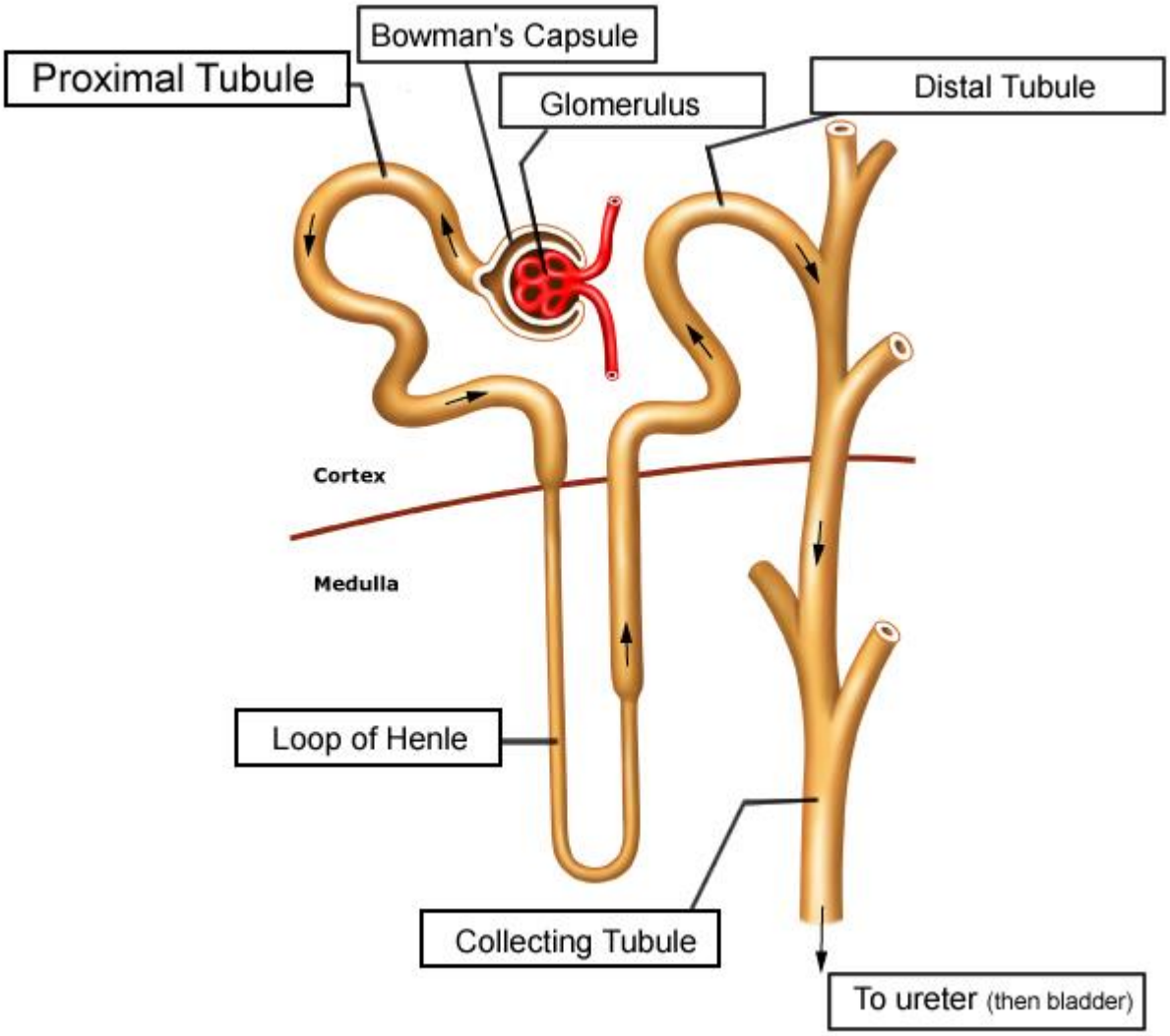
1- Because the ***afferent*** arteriole has a wider lumen than the ***efferent*** arteriole , the blood pressure in ***glomerulus*** is higher than most of the other blood capillaries in the body, and because the blood capillaries of glomerulus are ***permeable*** , part of the blood plasma leaks through the capillary walls .

2- The filtrate does not contain blood cells or plasma proteins as they are too large to pass through capillaries.

3- The ***glomerular filtrate*** consists mainly of water, dissolved salts, glucose , amino acids , urae and uric acid.

4- The filtrate from glomerulus collects in the renal capsule (Bowmans capsule) and passes down in the renal tubule.


Adrenal gland
Inferior vena cava
Renal artery
Renal vein
Pelvis
Kidney
Medulla
Cortex
Dorsal aorta
Ureter
Urinary bladder
Urethra


Bowman's Capsule
Proximal Tubule
Glomerulus
Distal Tubule
Cortex
Medulla
Loop of Henle
Collecting Tubule
To ureter (then bladder)

Selective reabsorption

1- As filtrate passes through the ***first or proximal convoluted tubule***, amounts of useful material such as glucose and amino acids are reabsorbed by active transport to pass to the surrounding blood vessels in order not to be lost with urine.

2- An amount of water which is required for the body is reabsorbed by the cells of ***loop of Henle*** and that of the ***collecting duct*** to reach the surrounding blood vessels in order not to be lost with urine.

Adaptation of the wall of the first or proximal convoluted tubule for its function

- Convoluted and its cells contain ***microvilli*** to increase surface area for reabsorption.
- The cells forming walls of proximal convoluted tubule contain more mitochondria to be used in production of energy by aerobic respiration to be used in active uptake .

Role of kidney in osmoregulation

It excretes excess water and salts to maintain proper water potential in the body

- If the blood contains ***too much water***, less water is reabsorbed ,leaving more to enter the bladder.
- If blood is ***too concentrated*** , more water is reabsorbed back into the blood from the kidney tubules.

Pathway of urine

- ***Renal artery*** enters the kidney carrying ***food , oxygen and waste products*** such as urea, uric acid, modified drugs and hormones.

- The cells of kidney use food and oxygen releasing carbon dioxide, which is carried in the form of ***deoxygenated*** blood to the ***renal vein***..

- The waste products are carried to the ***ureter.***

- Ureter conducts waste products to the urinary bladder by ***peristalsis.***

- Urinary bladder consists of a muscular walls and controlled by a sphincter muscle .When it becomes filled with urine the (voluntary) sphincter muscle relaxes allowing urine to flows outside.

Factors affecting the amount of urine

1-The amount of water taken.
2-Taking salts or sugars that leads to more water - intake.
3-Temperature .
The higher the temperature, the less urine because more sweat is excreted.
In this case urine becomes more concentrated, as the main component of sweat is water.
4-Excersise.

Urine analysis and disease

- When there is ***glucose*** in urine the person is ***diabetic***.
- When there is ***protein*** in urine the person has ***kidney malfunction***
  (as protein being of large molecules can not filter out the blood capillaries in kidney.)

Notice

Urea is formed in liver as a result of breakdown of excess amino acids by a process known as ***deamination.***
Alcohol , drugs and hormones are broken down in liver and then excreted by kidneys with urine.

kidney failure

When the two kidneys become unable to work.

Harms of kidney failure

- Increase in the amount of water in the body.
- Accumulation of urea that leads to coma and then death.
- Useful materials such as proteins can pass out with urine.

Main causes of kidney failure

- Bacterial infection.
- Damage of nephrons by poisons such as mercury.
- Accidents that cause kidney damage.
- Inadequate flow of blood.

Ways to overcome kidney failure

- By kidney transplantation.
- By using dialysis machine.

Kidney transplant

Problem facing kidney transplant .

- To find suitable donors.
- Tissue rejection.
- Expensive.
- Risk of surgical operation.

How to overcome tissue rejection ?

- Choosing donors which have tissues as similar as those of the patient.
- By using ***immuno- suppressive drugs*** which suppress the production of lymphocytes and their antibodies.

(but these medicines have disadvantages as they reduce the immunity of the patients therefore he may be affected easily by germs).

Dialysis or partial permeability

It is the separation of small molecules from large molecules in a solution by a partially permeable (or semi-permeable.) membrane.

The dialysis machine

Aim of dialysis

To maintain glucose and protein concentration in blood and diffusion of urea from blood to dialysis fluid.

consists of :

1- Dialysis tubing

-It is a partially permeable tube allows only small molecules to filtre out of it .

2- A water - bath or dialysis solution :

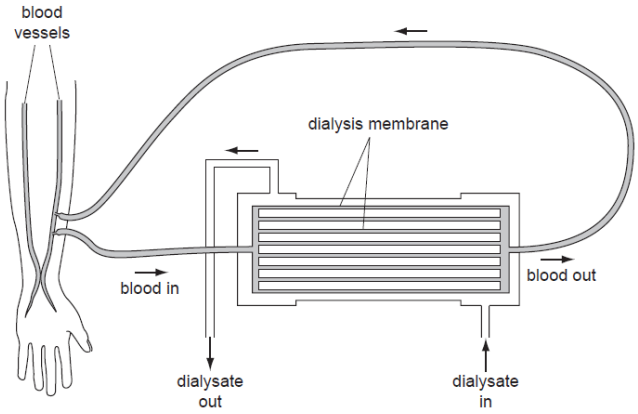
-Consists of salts, sugars and other substances in the correct proportions like blood .

3- Pumps

-To pump the blood from the patient to the machine and from machine to the patient by a proper pressure.

3- **Filter** to trap air bubbles as presence of air in circulatory system is harmful.

4- **Anticlotting substance** is added to ***stop clotting*** during flow of blood outside blood vessels to flow through the machine.



The work of the dialysis machine

- Patient's blood from an artery in the patients arm is pumped gradually with suitable pressure into the dialysis machine where urea, modified hormones and excess salts pass out the dialysis tubing ***because*** they have small molecules and are not found in the dialysis solution .

- Other components in blood have small molecules such as glucose and amino acids but they can not diffuse outside the dialysis tubing ***because*** their concentration inside the tubing is similar to their concentration in the dialysis solution .

- The dialysis solution has to be replaced regularly to avoid back diffusion of urea from the dialysis solution to the patient's blood when its concentration in the dialysis solution increases .

- Blood is pumped back gradually into the patient's blood vessel.

	Kidney transplant	Dialysis
Advantages	Long term solution. Save time of dialysis. Can have wider diet. Better quality of life.	No need for a donor. No risk of surgical operation.
disadvantages	Donor is needed. Risk of surgical operation.	Time consuming (twice or three times a week) Expensive. May transmit disease such as AIDS .

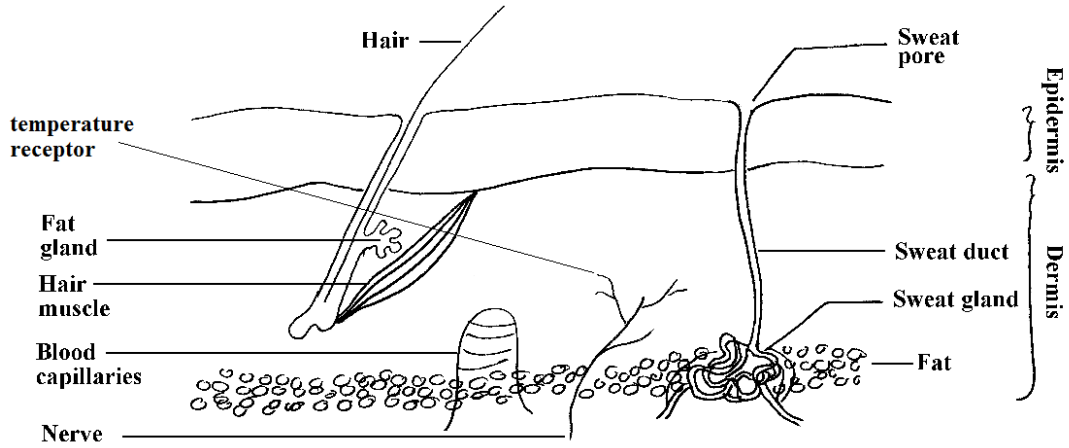
Homeostasis

It is to maintain the internal environment of an organism's body constant .

Organs responsible for

1- Lungs : keep the conc. of CO_2 and O_2 constant .
2- Skin : Regulates body temperature.
3- Kidneys : Regulate the conc. of water and urea.
4- Liver : Regulates the blood sugar level.

Structure of Skin



Ways of loosing heat

1- Evaporation of sweat.
2- Excretion of warm urine.
3- Excretion of warm feaces.
4- Expiration of warm air.

Regulating body temperature

- Brain contains temperature recetors.
- If temperature of blood rises above the normal , brain sends messages along nerves to the parts of the body to reduce temperature.
- If the temperature becomes lower than normal, the opposite takes place.

(Only birds and mammals have a constant body temperature they are called homeothermic or endothermic while other organisms are cold blooded, they are called poikilothermic or ectothermic.)

Role of skin in regulating body temperature.

1-In case of over-cooling :

(a) Vasoconstriction

- It means that the blood vessels of skin constrict, this reduces excretion of sweat and heat loss from warn blood when it comes near the body surface.

(b) Erection of hair

- The hair erector muscles contract to erect hair
- Hair traps air .

(Air is a bad conductor of heat therefore it reduces the rate of heat loss.)

(c) Storing fats under the skin .

(*fats are bad conductors of heat therefore they reduce the rate of heat loss)*

.

(d) shivering

shivering ***reflex*** causes ***Muscle*** groups around the vital organs begin to shake in small movements in an attempt to create warmth by expending ***energy***.

2- In case of over-heating

(a) By vasodilatation :

- Means to keep the blood vessels in the skin wider.
- This helps in getting rid of the excessive heat from the warm blood to the surrounding.

(***b) By lowering of hair*** :

- This helps in getting rid of the excessive heat by reducing the amount of trapped air that acts as an insulator

(c) - By production of sweat.

Evaporation of sweat requires heat energy, an amount of this energy is gained from the body decreasing its temperature.

Negative feed-back.

Definition

- It is the process by which the different internal conditions of the body such as level of circulating hormones is controlled, to maintain homeostasis
- ***This process includes sequence of steps***.

  1-A sense organ, detects a change.

  2-A control center sends a message to the responding organ to decrease or increase its production .

  3-The information from the responding organ is detected by the sense organ.

Example

A- When blood glucose level increases ;

- Pancreas secretes the hormone ***insulin*** to stimulate the body cells to use glucose and the liver cells to store it as ***glycogen .***
- When the blood glucose returns to its normal level ***it causes negative feed back mechanism on pancreas*** causing secretion of ***insulin to be switched off***.

B- When glucose level decreases :

- Pancreas secretes the hormone ***glucagon*** which stimulates the conversion of glycogen to glucose to be added to the blood stream .
- When the blood glucose returns to the normal level ***it causes negative feed back mechanism on pancreas*** causing secretion of ***glucagon to be switched off***.

Tropism

It is a slow growth movement ***of plants*** towards or away from a particular ***stimulus***.

Types of Tropism

1-Phototropism	**2-Geotropism**
A slow growth movement of plants towards or away from ***light***	A slow growth movement of plants towards or away from ***gravity***

Types of response

1-Positive	**2-Negative**
If the response ***towards*** a stimulus	If the response is ***away*** from the stimulus

Response of shoot and root

	Phototropism	**Geotropism**
Shoot	Positive	Negative
Root	negative	positive

What causes tropism ?

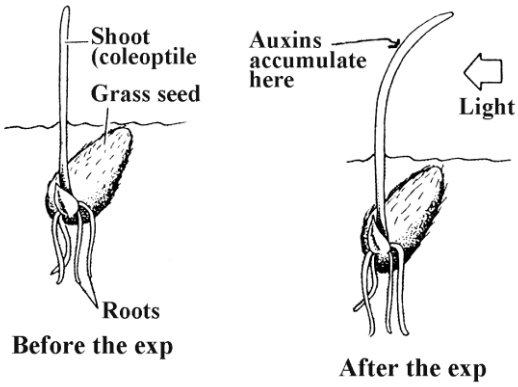
Unequal distribution of the plant growth hormones ***(which are known as auxins***) leading to unequal growth of the plant sides, so the plant bends.
Auxins are produced at the tip of the shoot and diffuse downwards.

What causes positive phototropism

Auxins accumulate in the side of darkness of shoot leading to ***rapid growth*** in this side, this causes the shoot to grow in the ***direction of light*** .

What causes negative phototropism

Auxins accumulate in the side of darkness but the high conc. of auxins ***inhibits*** growth in this side , therefore the root grows ***away from light***.



Notice

The sensitive region in ***the tip of the shoot*** is considered ***the receptor***.
The ***part just below*** the tip is the ***effector.***

Etiolation

If a plant is placed in darkness

It grows rapidly in an attempt to reach light but :

- It becomes weak.
- No flowers or branches are produced .
- The leaves become pale .
- Then the plant dies

Coleoptile :

It is a protective sheath which covers the plumule (young shoot) of plants, such as grasses .

Experiments to prove that auxins are produced at the tip.

Experiment (1)

1- Get two coleoptiles A and B.
2- Remove the tip of the coleoptile A.
3- Expose them to a side source of light .

Observation :

- The coleoptile B grows in the direction of light
- The coleoptile A shows no response .

Conclusion :

- No auxins produced in coleoptile A , and this indicates that auxins are produced in tips of plants .

Experiment (2)

1- Replace the tip of the coloptile A (of the experiment 1) using agar jelly .
2- Expose it to a side source of light .

Observation :

- The coleoptile grows towards light .

Conclusion :

Auxins diffused from the tip through the agar jelly to affect the growth below the tip.

Experiment (3)

In the above experiment insert a piece of **mica, glass or metal** in the agar layer .

Observation and conclusion :

No response to light because mica, glass or metal are impermeable , so auxins can not diffuse.

Experiment to prove that auxins causes bending of the shoot

Get two ***similar*** young potted plants, paint one of them with ***auxins*** at one side and keep the other ***untreated***, leave them in a ***dark room*** for about three days such that they are supplied daily with water. The shoot treated will bend towards the untreated side while the other grows vertically.

Normal seedling and etiolated seedling

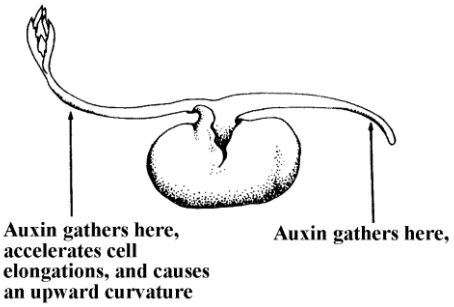
1- Leaves are larger and broader	- leaves are smaller in size.
2- Leave have stalk or petiole.	- No stalk or petiole is observed.
3- Stem is wider (thicker)	- Stem is thinner.
4- Stem is shorter.	- Stem is longer.
5- Root is more branched	- less branches.

Geotropism or gravitropism

Positive geotropism	Negative geotropism
➢ It is the slow growth movement of a plant ***in the direction*** of gravity.	➢ It is the slow growth movement of a plant ***away*** from gravity
➢ e.g. root is positive geotropic as it grows in the direction of gravity .	➢ e.g. shoot is negative geotropic as it grows opposite to gravity .

What causes negative geotropism ?

- If a plant is placed horizontally, auxins accumulate in the ***lower*** side of the shoot.
  (Auxins accumulate towards gravity)
- As a result of this accumulation the lower side ***grows rapidly*** leading to growth against gravity.



What causes positive geotropism ?

-If a plant is placed horizontally auxins accumulate in the ***lower*** side of the root , this ***inhibits*** growth at this side causing the plant to grow in the direction of gravity.

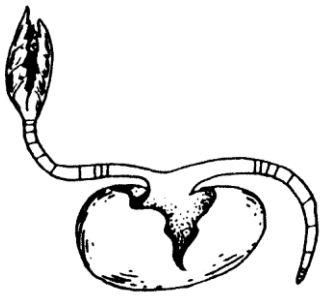
Importance of phototropism

- Positive phototropism keeps the plant well exposed to light to carry out photosynthesis .
- Negative phototropism keeps the root away from light therefore it grows in the soil to find enough water and minerals.

Importance of geotropism

- Positive geotropism helps the root to grow in the soil to obtain water and minerals.
- Negative geotropism keeps the shoot in a direction opposite to gravity so it grows towards light for photosynthesis.

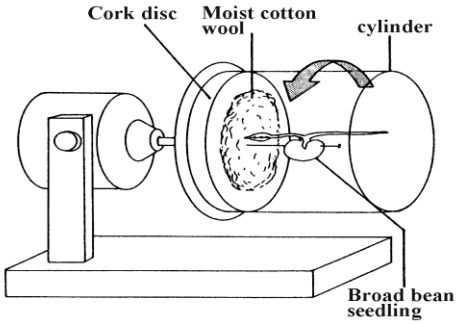
How to determine the regions of elongation or growth



- Put regular ink marks on the root and shoot as in fig.
- Expose it to gravity.
- The regions where the marks are spaced out are the region of elongation.

The clinostat

-It is a slowly rotating disc used to demonstrate geotropism.



How to use it

-Place a seedling horizontally .

-If its disc is left without being rotated the shoot grows against gravity while the root grows towards it .

-If its drum is rotated, the radical(young root) and the plumule (young shoot) grow horizontally due to the ***equal distribution*** of auxins .

(Place a light-proof case during using the clinostat to avoid the effect of light. Also to reduce the effect of air current on the rate of evaporation of water from the moist cotton)

COMPARISON

PHOTOTROPISM	GEOTROPISM
- It is the response of plant to light.	- It is the response of plant to gravity .
-In phototropism ***auxins*** accumulate in the side ***away*** from light .	- In geotropism ***auxins*** accumulate ***in the side*** of gravity .
- ***Plumule and shoot*** are positive phototropic.	-***Plumule and shoot*** are negative geotropic .
- ***Radicle and root*** are negative phototropic .	- ***Radicle and root*** are positive geotropic .

Using Plant Hormones as weed-killers

When artificial plant hormones ***(auxins)*** are sprayed onto cereal crops, it is taken by the weeds which have broad leaves but not by the crop , therefore the auxins cause excessive growth in the weeds consuming their food leading to their ***etiolation*** and then to death.

Importance of killing weeds

- To provide more space and nutrients for crops.
- Avoid consumption of minerals in soil by weeds.

How weedkillers spread in plants

Weed killers are absorbed and reach ***phloem*** where they are ***translocated*** in phloem upwards and outwards to ***diffuse*** through cell membranes to enter the different plant cells.

Coordination

Definitions related to coordination

Sense organs

Group of receptor cells respond to specific stimuli.

Example

- Eye has light receptors.
- Skin has temperature and pressure receptors.
- Nose and tongue have chemical receptors.

Effector

A part of the body that ***goes into action*** when receives impulses.

Examples

- Muscles
- Glands.

Coordination or communication

The way in which receptors ***pick up stimuli*** and then ***pass information*** to effectors.

Systems needed for coordination

- **Nervous system.**
- **Endocrine system**

HUMAN
NERVOUS SYSTEM

It consists of :

1- Central nervous system (CNS)

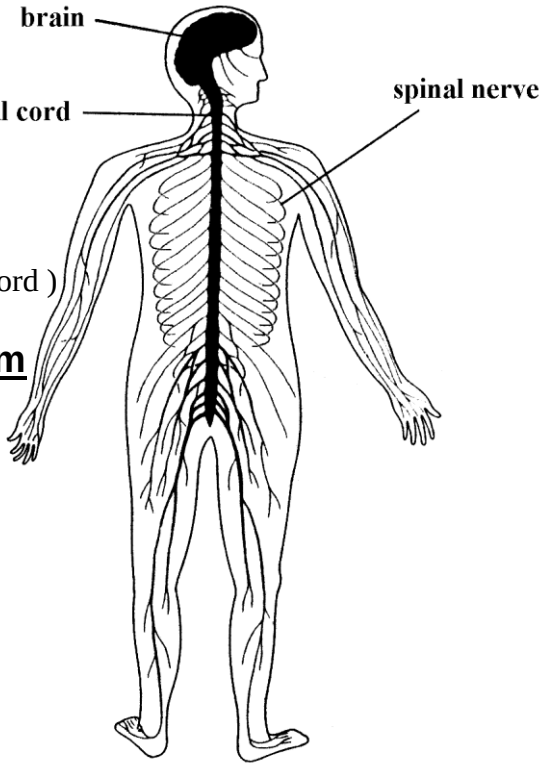
Composed of brain and spinal cord .

2- Peripheral nervous system (PNS)

Composed of

a- Cranial nerves (nerves branched from brain.)

b- Spinal nerves (nerves branched from spinal cord)



Functions of the central nervous system

- ***Receive impulses*** from different receptors
- ***Integrates the received messages*** or impulses.
- ***Produce nerve impulses*** to the proper effector.

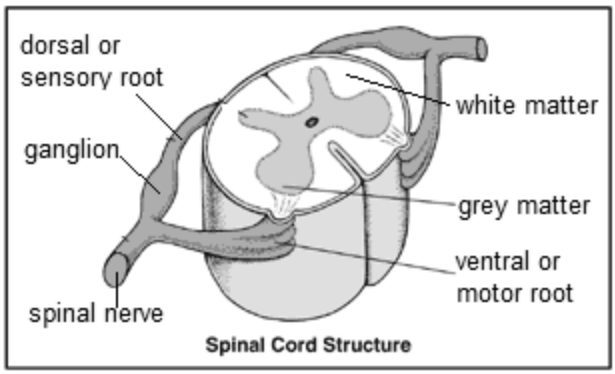
The spinal cord

Protected by :

- Vertebral column

Its regions :

- White matter to the outside
- Gray matter to the inside .



Its functions :

1. ***Controls reflex actions*** in the parts below the neck .
2. ***Conducts impulses*** from the sense organs ***below the neck*** to the brain.
3. **Conducts impulses** form the brain to ***the effectors*** (muscles or glands below the neck).

Building units of nervous system

Are the nerve cells(neurones.)

Types of neurones

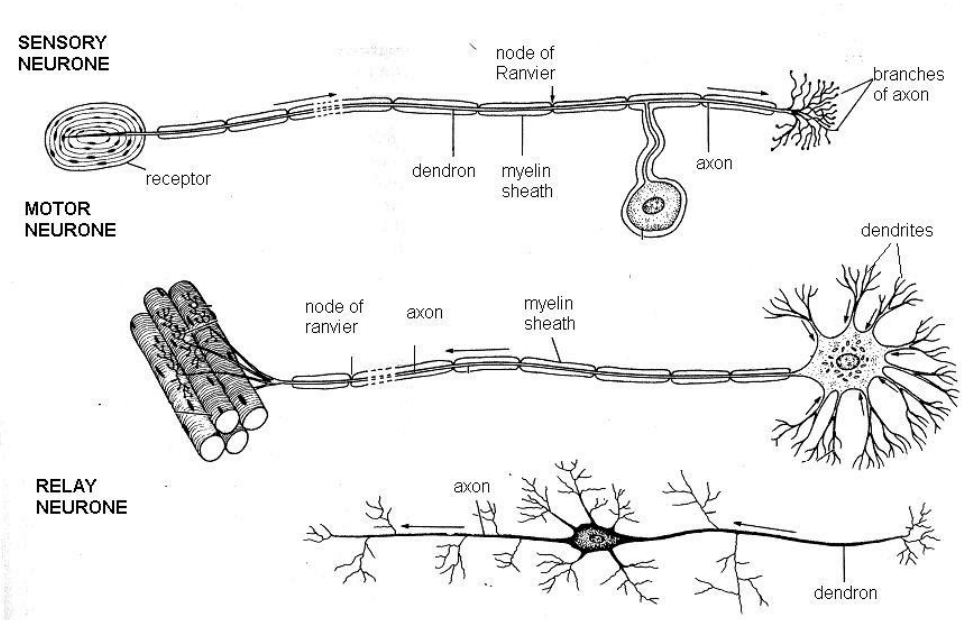
Sensory neurone

- Its function is to carry impulses from a sensory organ or receptor to CNS
- It has a long dendron and a short axon.

Motor or effector neurone

- Its function is to carry impulses from CNS to an effector .
- It has many dendrites and a long axon

Connector or relay neurone
Connects neurons in the CNS



Myelin sheath

- Made of cells ***rich in fat and protein.***
- Contains narrow gaps called ***node of Ranvier***

Functions of myelin sheath

- ***Protection, insulation*** and increases ***speed of transmission*** of nerve impulses.
- Speed in myelinated nerve cell 100 metres per second while in non myelinated nerve cell is only 5 metres per second.

Nerve impulses :

Series of electro-chemical signals travel down nerve fibres

Ganglion :

Swelling in the sensory nerve contains the cell bodies of sensory neurons .

Nerve cell is adapted to its function

- Has ***long axon or dendron*** to transmit nerve impulses.
- Has ***nerve ending*** to transmit impulses to another nerve cell or effector.
- Has ***dendrites*** to receive nerve impulses from other cells.
- May have ***myelin sheath*** for protection, insulation and to speed transmission of nerve impulses.

Reflex action and reflex arc.

Reflex action

It is a ***rapid involuntary*** response to stimulus.
Example : withdrawal of a hand when it touches a hot object .

Its importance

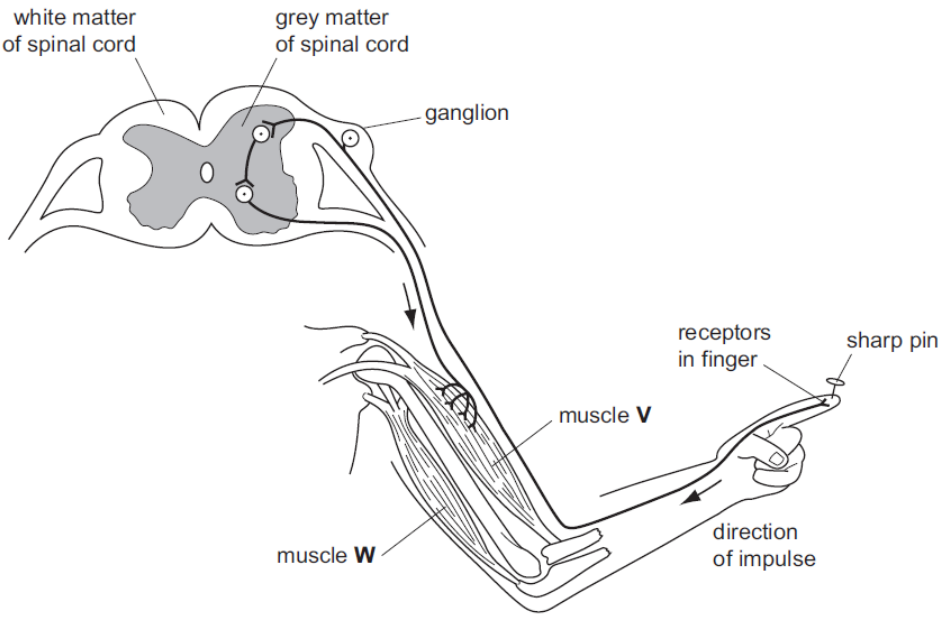
- Has a ***survival value***, as it is rapid and does not consume time in thinking as it does not involve the higher centres in the brain.
- Reflex action has a role in learning skills such as walking and driving.

Reflex arc

It is the ***pathway*** of impulses in a reflex action .

Stages of a reflex action

1- ***Receptor cells*** send sensory impulses along a sensory neuron to CNS (spinal cord) through the ***dorsal root*** .
2- ***Sensory neuron*** forms a synapse with the connector neuron.
3- Impulses are transmitted through the ***connector*** to the motor neuron also through a synapse.
4- ***Motor neuron*** carries impulses through ***ventral root*** to the muscle to contract to move the hand away .



Notice

Cell body of a ***sensory neurone*** is found in the ***ganglion*** of the dorsal root.
Cell bodies of ***motor and relay neurones*** are found in ***grey matter*** of brain or spinal cord.

Synapse

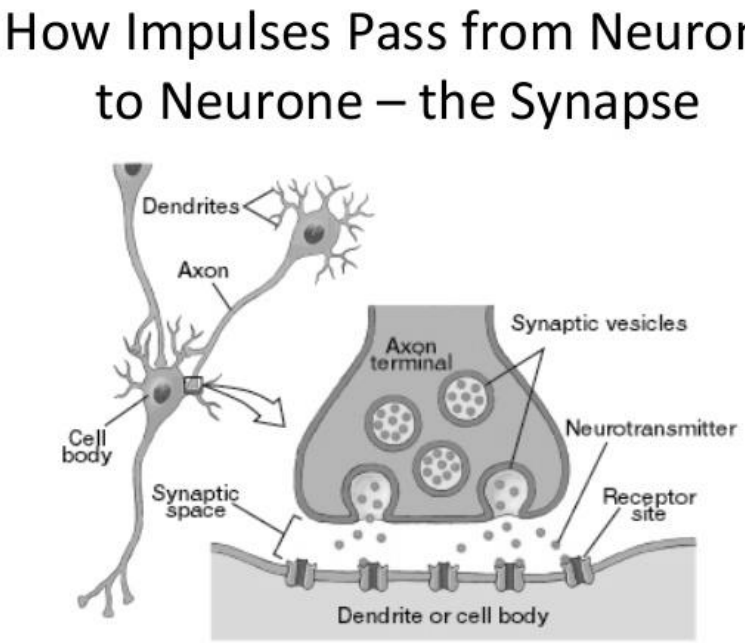
A ***junction*** between nerve cells consisting of a ***minute gap*** across which impulses pass by diffusion of a ***neurotransmitter substance***.

Structure of synapse

- The gap is known as ***synaptic cleft***.
- The end of a nerve cell is called ***synaptic knob.***
- In synaptic knob ***vesicles containing neurotransmitter*** substance are made.

Transmission of impulse along a synapse

1- Impulse arrives at end of ***synaptic knob***.
2- ***Transmitter substance secreted*** into synaptic gap or cleft to reach the adjacent neurone where it binds to ***special receptors*** (neurotransmitter substance and receptors act as lock and its key).
3- ***New impulse*** is generated in the adjacent neurone.



Importance of synapse

- Ensures ***one way transmission*** of nerve as neurotransmitter are only produced in synaptic bulb (knob) while receptors for neurotransmitter substance are found in the post synaptic membrane.
- ***Slower transmission*** as time is needed for release of neurotransmitter to diffuse across synaptic cleft and also time is needed for neurotransmitter molecules to bind with the receptors.

Effect of heroin on synapse

In brain heroin is metabolized to ***morphine***
Morphine binds to ***endorphins receptors*** in synapse.
Endorphins is a group of neurotransmitters which affect ***mood and reduce sensation of pain***, this makes people feel good.
Heroin ***reduces the ability*** to produce natural endorphins and other neurotransmitters.

Nervous control	Hormonal control
- The message is electro- chemical. - The message travels very quickly. - The impulse is transmitted in nerves. - Localised (means that the impulse is sent directly to target organ.) - Short term effect.	- The message is chemical. - Message travels more slowly. - Hormones are transmitted via blood. - Widespread (means that hormones are dispersed through out the body) - Long term effect

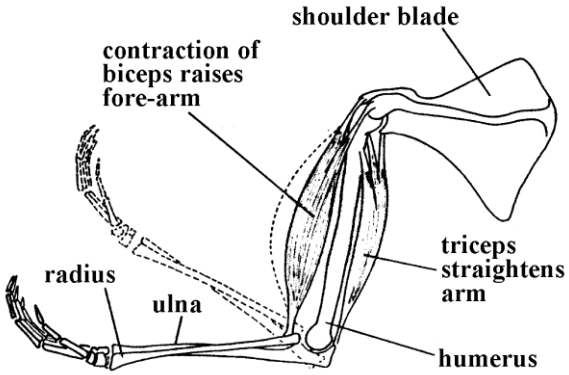
Voluntary actions	Involuntary actions
- The action which you can decide whether or not you carry out the action. - It starts in the cerebrum. - It is a learned action. - Usually slower ***Example*** : Picking up a book.	- Actions which happen automatically, you ***can not*** decide whether or not you carry out the action. - It starts in medulla oblongata, or spinal cord in case of reflex action. - Unlearned action. - Usually faster. ***Example*** : peristalsis

Antagonistic muscles

Two sets of muscles work against each other to move the body parts in opposite directions.

The sets of antagonistic muscles

- **One is called flexor** : which bends the joint due to its contraction.
- **One is called extensor** : which straightened out a joint due to its contraction .



Example

Biceps is a flexor : when contracts it pulls ***ulna*** towards shoulder blade(scapula)

Triceps is an extensor : when contracts it pulls end of ***radius*** bone causing arm to be straight.

Notice :

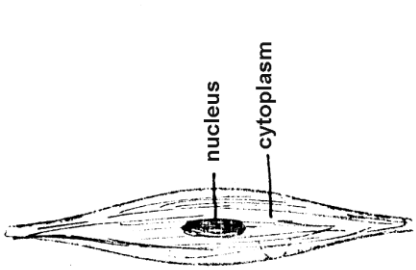
Each bone and muscle are joined by a bundle of strong non stretchy fibers called ***tendons***.

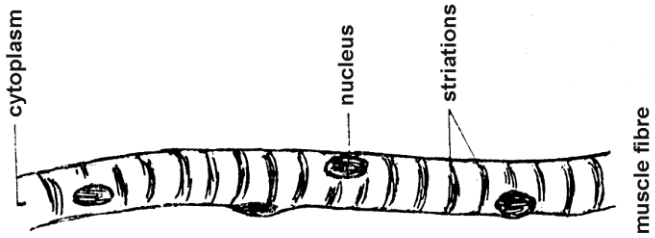
Triceps : joined to the shoulder by means of ***three*** tendons.

Biceps : joined to the shoulder by ***two*** tendons.

Muscle cells

Are modified to carry out contraction for movement.





Adaptation of muscles for their function

1- Have a lot of ***mitochondria*** to produce enough ***energy*** for their action.
2- Can respire ***anaerobically*** in addition to ***aerobic respiration*** for production of enough energy for their action.
3- Store carbohydrates in the form of ***glycogen*** to be used as a source of energy.
4- Part of its cytoplasm is modified into ***contractile filaments***.

HUMAN EYE

- Found in a groove in the skull called ***orbit or socket***.
- It moves in its orbit by three pairs of muscles called ***eye muscles***.

It is protected by :

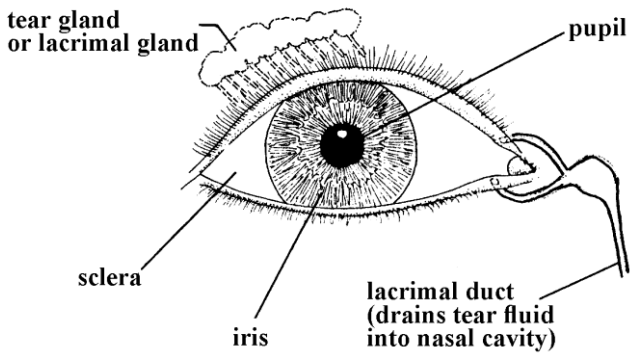
Skull, eye lids, lashes and tears.

Components of tears

Water ,sodium bicarbonate, sodium chloride and enzyme called ***lysozyme.***

Functions of tears

- Reduces friction between lids and eye .
- Lysozyme kills microbes.
- Washe the eye.



Functions of the different structures of the eye

Sclera (sclerotic coat)

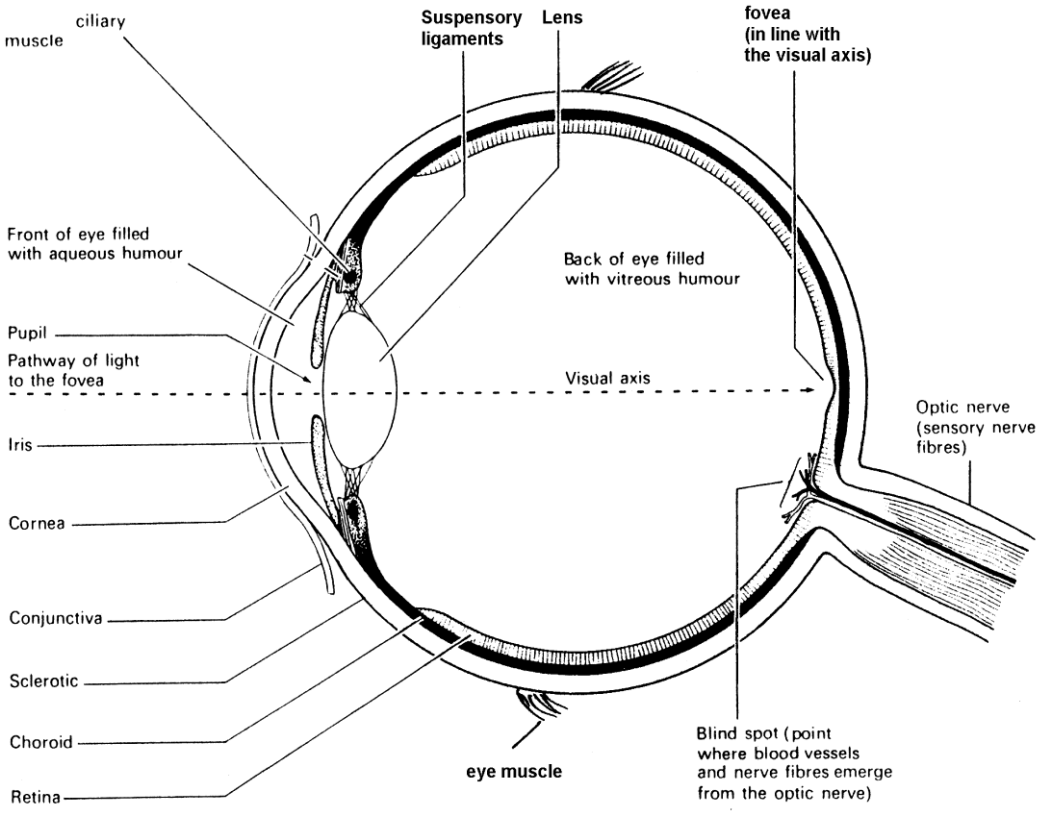
- Protects the eye.
- Attached to the ***eye muscles*** which move the eye in its orbit.
- Does not envelop all the eye because it is ***opaque***, therefore its front part is transparent and is called ***cornea***.

Cornea

Has a curved surface where most refraction (bending or converging) of light happens, so that light rays are collected to enter the eye.

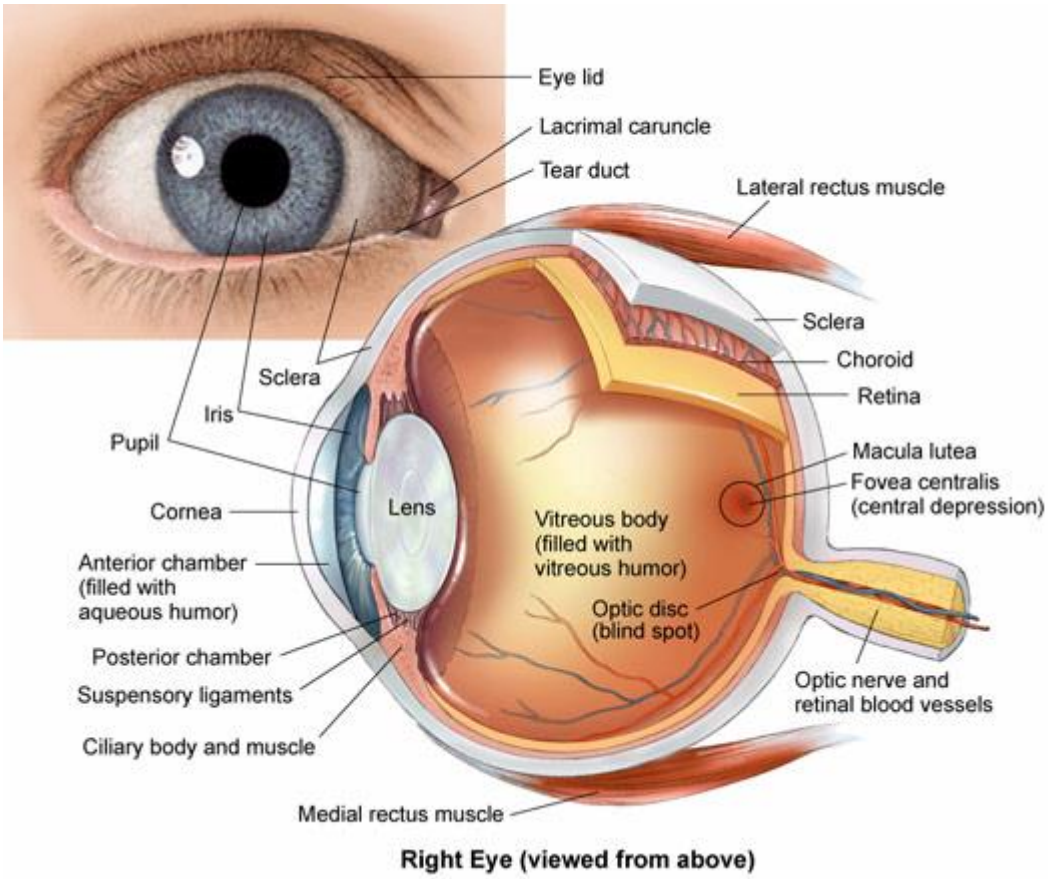
Choroid

- Contains ***dark pigments*** to prevent reflection of light inside the eye for formation of clear sharp image.
- Contains ***blood vessels*** to supply the eye with food and oxygen and to carry away wastes of metabolism of the eye.



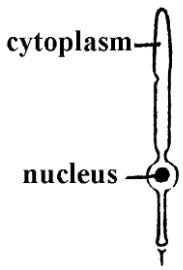
Retina

- It contains the ***light receptors*** (cells that can detect light.).
- There are two types of light receptors ***cones and rods***.



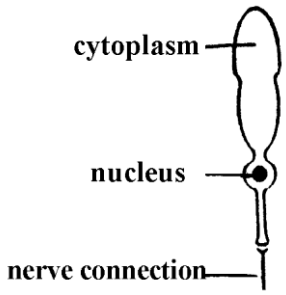
Right Eye (viewed from above)

Rods



- ***Larger*** in number .
- Spread in ***all retina*** but much less in fovea and absent in blind spot.
- Sensitive to ***low light*** intensity therefore can detect dim light.
- ***Cannot detect colours***
- Each group share one nerve connection " therefore it is less accurate in vision

cones



- ***Smaller*** in number .
- Concentrated in ***fovea***.
- Sensitive to ***bright light*** .
- ***Detect colours***.
- Each has its own nerve connection therefore it is more accurate.
- There are ***three types of cones*** each type absorbs light of ***certain wave length.***

Two important regions are found in the retina , ***fovea or yellow spot and blind spot***.

Fovea or Yellow spot

The point of ***accurate vision*** because it contains most cones .

Blind spot

- The point where optic nerve and blood vessels leave the eye.
- It is so called because it contains ***no light receptors*** therefore it cannot detect images.

How to determine blind spot ?

Hold the book about 50 cm away.
Close the left eye and concentrate on the cross with the right
Eye. Slowly bring the book closer to the face. When the image
Of the dot falls on the blind spot it will seem to disappear.

Notice

If you look straight at an object in dim light you cannot see it clear as it falls on fovea that contain cones which cannot detect dim light but you can see it clear if you look at one side as the image falls on rods.

Optic nerve

Carries impulses from the eye to the centre of vision in the brain.

Vitreous humour

- Jelly- like fluid .
- Keeps shape of eye .
- Supports retina to be attached to the choroid .
- Helps refraction (bending) of light to be focused on the retina .

Aqueous humor

- Saline solution (contains salts) .
- Supply food to the lens and cornea.
- Helps refraction (bending) of light

Conjunctiva

Protects cornea

Iris

- Controls the amount of light that enters the eye.

Pupil

- An opening in the iris.
-It is the pathway of light into the eye.

Lens

- Adjust (focus) the light rays on the retina.

Ciliary body

- It is the edge of the choroid .
- Secretes eye fluids.

.Ciliary muscles

- Alter the shape of the lens to focus the image on the retina.

Suspensory ligaments

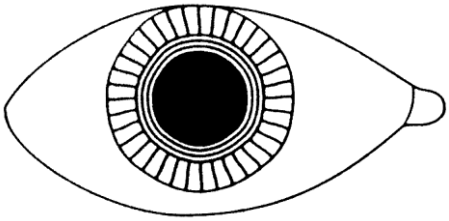
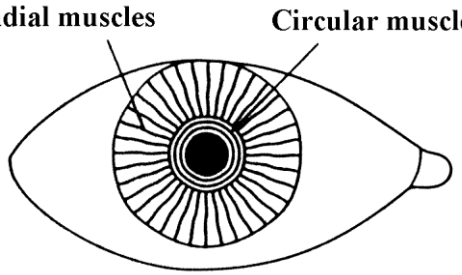
- Attach the lens to the ciliary muscles .

Controlling amount of light by Iris " pupil reflex or light reflex .

It importance

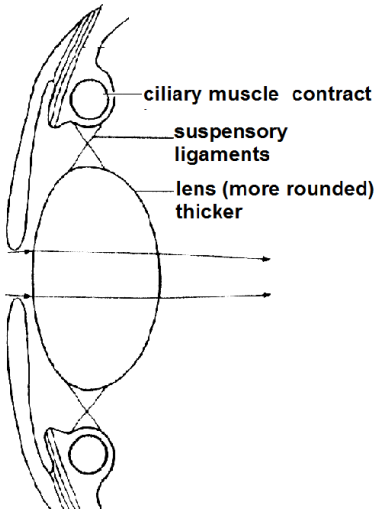
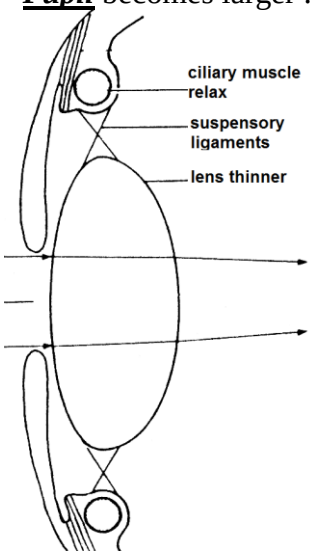
- In ***bright light*** it reduces the amount of light that enters the eye so it protects the light receptors against bright light that may harm them.
- In ***dim light*** it allows enough light to enter the eye for clear vision.

How iris controls the amount of light that enters the eye

In dim light	in bright light
	
- ***Radial muscles*** of the iris contract . - ***Circular muscles*** relax . - ***Pupil*** becomes larger so that enough light can enter the eye .	- ***Radial muscles*** of the iris relax . - ***Circular muscles*** contract . - ***Pupil*** becomes smaller to reduce the amount of light that enters the eye to protect the light receptors.

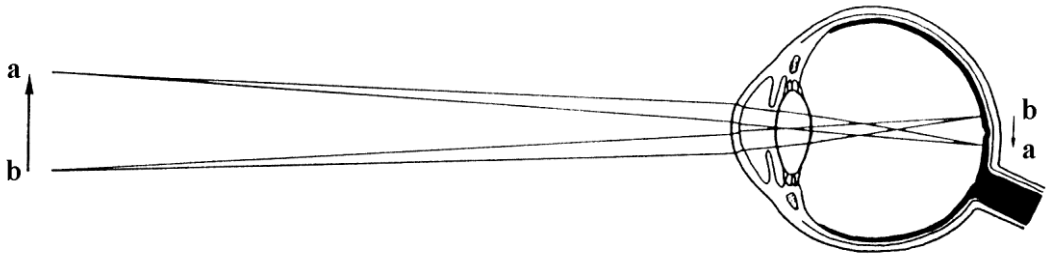
Focusing light (accommodation of the eye)

Means adjustment of shape of the eye lens to focus light on retina to be able to see far objects and near objects.

Near object	Far object
- ***Ciliary muscles*** contract . - ***Suspensory ligaments*** slacken . - The eye ***lens*** becomes thicker . - ***Pupil*** becomes small .	- ***Ciliary muscles*** relax . - ***Suspensory ligaments*** become stretched . - The eye ***lens*** becomes thinner . - ***Pupil*** becomes larger .
	

Mechanism of vision or pathway of light

- Light rays come to the eye from an object .
- Light rays become ***converged*** by ***cornea ,*** and then pass through pupil to the lens .
- The lens ***focus*** the image on ***fovea*** (the formed image is ***small and inverted***).
- Light receptors convert ***light energy to nerve impulses*** to be carried by the ***optic nerve*** to the ***center of vision*** in the brain .
- In the brain the image is detected .



Asexual reproduction

Definition A type of producing new genetically identical offspring from ***one parent*** only without producing ***gametes***.

Gametes Cells produced from a male and a female to fuse together producing one cell called ***zygote*** that divide producing a new organism .

Gametes in animals

-Sperm in males .

-Ovum in females .

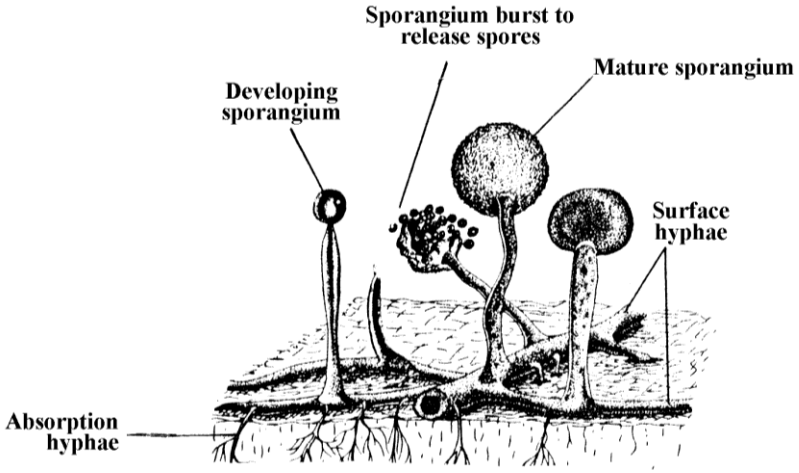
Asexual reproduction in bacteria
(simple division or binary fission)

(a) Bacterial cell (b) Chromosome replicates (c) Cell divides

Stages of binary fission

- Bacterial cell increases in size and nuclear material replicates .
- The nuclear material becomes constricted in the middle and divides into two.
- A cell wall is formed separating it into two cells.
- The new cells may remain together and divide repeatedly forming a ***colony or clone.***

ASEXUAL REPRODUCTION IN FUNGI
(Spore formation in fungi)



Stages of spore formation in fungi

1-Under favorable conditions the tip of the aerial hypha becomes filled with cytoplasm, nuclei and nutritive substances.
2- The tip swells forming a ***sporangium*** .
3- The sporangium forms a large number of cells called ***spores***.
4- When the sporangium becomes mature, it ruptures, and the spores are carried away usually by wind .
5- If the spores fall on a suitable medium , they germinate producing new hyphae that grow forming a new fungus .
6-If the spores fall on unsuitable medium , they ***remain dormant*** (of a very low rate of activity)until the conditions become favorable .

How a fungus spreads to a new source of food

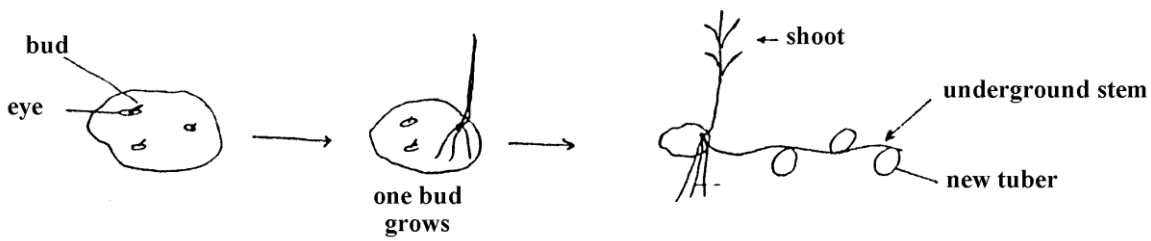
Fungus produces ***spores in sporangium*** or spore case which bursts releasing spores that can spread by wind, when spores fall on food in ***suitable conditions*** such as temperature and humidity, they ***germinate*** leading to formation of new fungi.

Asexual reproduction in potatoes
(Tuber formation in potatoes)

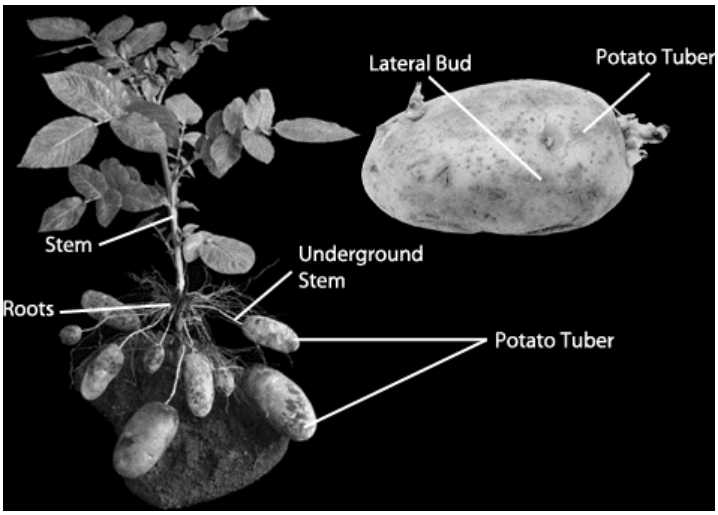
What is tuber ?

A short fleshy underground stem or root , usually much enlarged, and has a storage function.

Steps of tuber formation



1- In the potato tubers there are grooves called ***eyes***.
(Each eye contains a bud with scale leaf.)
2- In favorable conditions buds grow using the ***stored food*** in the tuber producing new shoot, and root .
3- Roots grow down and the shoot forms leaves.
4- ***Underground side stems*** grow out from the base of the main stem.
5- Food is stored in the underground stems forming ***new tubers***.
6- The leaves, stems and old tuber die, but the new tubers remain ***dormant*** until the conditions become favorable .



Advantages and disadvantages of asexual reproduction

Advantages	Disadvantages
➢ Often rapid because there is no need to find a mating partner. ➢ Produces identical strains, therefore it is useful if parents are of good strains. ➢ Can withstand unfavorable condition using stored foot. ➢ Maintains a good strain exactly with no variation	➢ Because it is a rapid process therefore it is harmful in case of organisms that produce diseases ➢ No variety in offspring therefore , if there is a change in the environment they may all die if unable to be adapted to the environment .. ➢ Harmful genes in parents will be transferred to the offspring. ➢ Overcrowding may take place causing competition for food

Sexual reproduction

Definition :

A process involving the fusion of ***haploid nuclei*** to form a ***diploid zygote*** and the production of genetically ***different*** offspring.

Advantages and disadvantages of sexual reproduction .

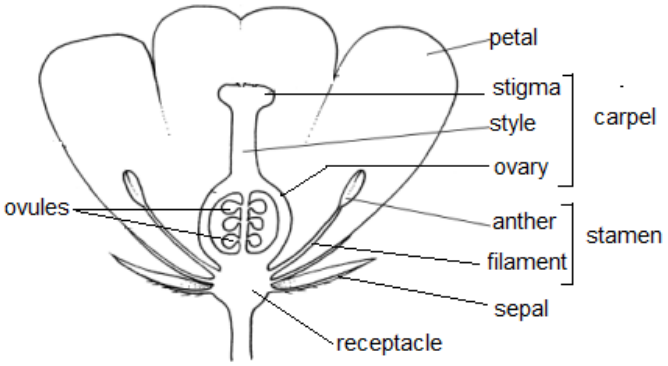
Advantages	Disadvantages
➢ Produces new varieties therefore many can be adapted to the changes in the environment. ➢ Allows evolution of species . ➢ Harmful genes in the parents will not necessarily be handed on to the off springs. ➢ Slower that asexual therefore it does not lead often to overcrowding.	➢ Excellent individuals can not give identical offspring. ➢ It is a slow process leads to the production of few offspring and this a disadvantage in organisms useful to humans such as the food producing organisms ..

Comparison

between sexual and asexual reproduction

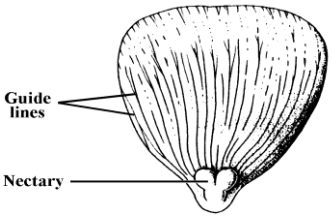
SEXUAL	ASEXUAL
➢ Two parents are involved ➢ Gametes are formed ➢ Gametes are produced by a type of division known as ***meiosis***. ➢ Diploid cells called ***zygotes*** are formed from haploid gametes. ➢ Leads to variation ➢ Slower than asexual . ➢ In most living organisms	➢ One parent only is involved. ➢ No gametes are formed . ➢ Binary fission, buds and spores are produced by a type of division known as ***mitosis.*** ➢ No zygotes are formed. ➢ Individuals of the offspring are identical . ➢ Rapid, as no time is consumed to find a partner . ➢ Mainly in simple organisms.

Sexual Reproduction
in flowering plants.



Consists of .

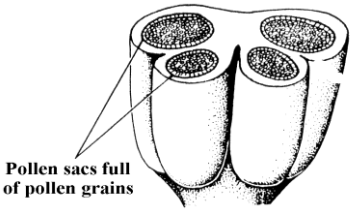
1-Receptacle : - carries modified leaves which are sepals ,petals,stamens and carpels.

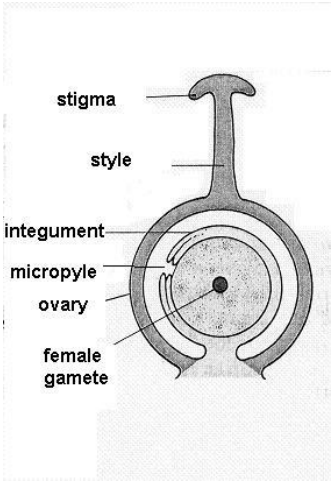


2-Sepals : - consists of green leaves

3- Petals : - colored leaves.

4- Stamens : - are the male reproductive organs of the flower .





5- Carpels - are the female reproductive organs .

6-Nectary gland : - secretes nectar.

Function of the different parts of the flower

Structure	Properties	Functions
1-Receptacle	➢ Enlarged, extended part of stem	➢ Carriers the flower.
2-Sepals	➢ Usually small and green	➢ Protect the flower while it is closed
3-Petals	➢ Usually large, colored and sometimes scented (have smell)	➢ Attract insects for pollination . ➢ Some have ***guide lines*** to guide the insect to the nectary gland. ➢ Used for landing of insects. ➢ Surround and protect the reproductive organs of the flower.
4-Stamens	➢ Each consists of an ***anther*** and a ***filament***	➢ ***Anther*** contains pollen sacs to produce pollen grains(that contain male gametes in flowering plants) ➢ ***Filament*** carries the anther and hold it to be exposed to agents of pollination.
5-Carpels	➢ Are the female organs ➢ Each consists of ***stigma, style and ovary***	➢ ***Stigma*** : receives the pollen grains and produce nutritive materials to the pollen to germinate ➢ ***Style*** : holds the stigma to be exposed to agents of pollination ➢ ***Ovary*** : produces ovules (that contain the female gametes in flowering plants) .
6- Nectary gland		➢ Makes sugary liquid called nectar to be used by insects as food.

Stages of reproduction in flowering plants

1- Pollination

It is the transfer of pollen grains from an anther to a stigma

2-Fertilization

It is the fusion of the male gamete and the female gamete producing a cell called ***zygote.***

Types of pollination

1-Self pollination

2-Cross pollination

It is the transfer of pollen from an ***anther*** to the ***stigma*** of the same flower or another flower on the same plant.

It is the transfer of pollen from an ***anther*** of a flower to a ***stigma*** of another flower on another plant of the same species.

Characteristics of self and cross pollinated flowers

1-Self pollinated flowers	*2-Cross pollinated flowers*
➢ ***Hermaphrodite*** (bisexual means carries both male and female organs) ➢ Male and female organs become mature at the same time ➢ Stamens are longer than carpels . ➢ Male and female organs ripen before opening of the flower.	➢ ***Unisexual or bisexual***(means if it carries male or female organ only or both) ➢ Male and female organs become mature at different times. ➢ Stamens are shorter than carpels . ➢ Male and female organs ripen after opening of the flower ➢ Stigma secretes chemicals to kill the pollen grains of the same flower.

Implication of self pollination

Produces ***less variation*** than cross pollination, therefore, plants with good strains are more likely to produce offspring of good strains , but this is considered as a ***disadvantage*** if there is a change in the environment, as there is no enough variation, therefore most of such strains may be unable to live in the new conditions, or if a ***mutation*** developed in pests , such plants may be unable to resist it.

Implications of cross pollination

Produces ***more variation***, which is necessary for natural selection and evolution, for example if there is a change in the environment or development of new strains of pests, many of such variations can live but the ***disadvantage*** of cross pollination is that good strains are not necessary to produce good strains.

Agents or means of pollination

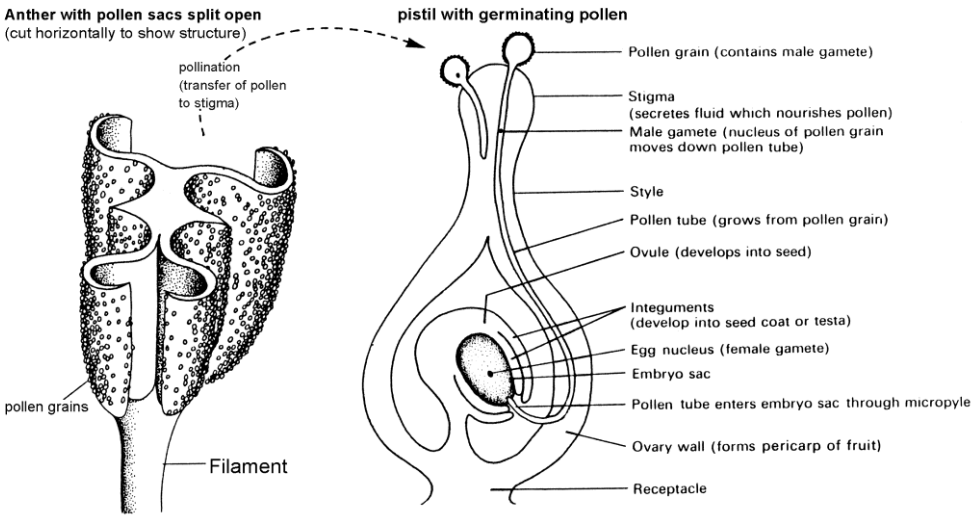
1-Wind 2-Insects 3-Water 4-Animals 5-Humans.

Characteristics of wind and insect pollinated flowers

1-Insect pollinated flowers e.g. apple	*2-Wind pollinated flowers e.g. grass*
➢ Usually large . ➢ Appear in warm times *(the times when insects are active*) ➢ Scented to attract insects ➢ Have nectary glands to secrete nectar	➢ Usually small. ➢ Appear in cold times (when more wind is available) ➢ Not scented . ➢ No nectar

➢ Reproductive organs are enclosed within the flower, so that the insect has to brush it to reach the nectar gland. ➢ **Pollen grains are** : a-Sticky to cling to insects. b-Small in number. c-Larger than those carried by wind. ➢ Stigma is not Feathery	➢ Reproductive organs are projected outside the flower. ➢ **Pollen grains are** : a-Small , light and dry to be carried by wind . b-Larger in number as most of them are lost. ➢ Stigma is feathery to trap pollen grains from air.

Fertilization



Steps of fertilization

1- When a pollen grain falls on the stigma, the stigma produces a sticky nutritive fluid.
2- The pollen grain absorbs this fluid producing ***a pollen tube***, and the nucleus of the pollen grain(which is the male gamete) passes through the tube .
3- The pollen tube grows towards the ovule till it reaches the ***micropyle.***
1- The tip of the pollen tube ruptures, and the nucleus of the pollen grain fuses with the egg nucleus (which is the female gamete) producing a ***zygote.***

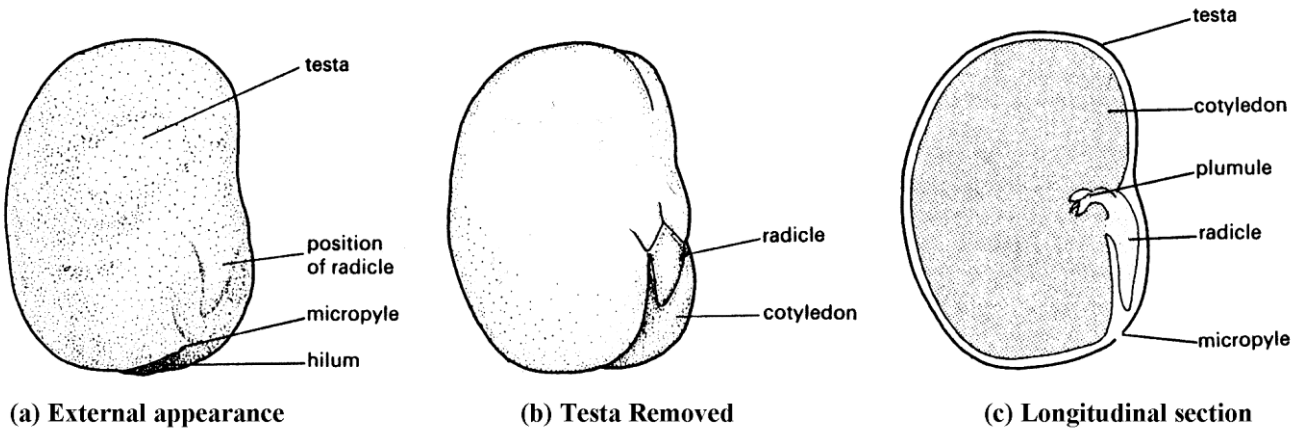
What happens after fertilization

1- Sepals , petals, stamens , stigma and style ***dry up and fall.***
2- The ***ovule*** develops into a ***seed.***
3- The ***integument*** becomes the ***testa*** of the seed.
4- The ***ovary*** enlarges and becomes the ***fruit***.
5- The ***wall*** of the ovary becomes the ***pericarp***.

Functions of the fruit to the plant :

1- Protects the seed.
2- Helps in dispersal .
3- Stores food.

The structure of a non endospermic seed



(a) External appearance (b) Testa Removed (c) Longitudinal section

1- Testa : - non permeable
- becomes soft and rupture during germination.

2- Cotyledons : - store food .

3- Radicle : - grow producing young root .

4- Plumule : - grows producing young shoot.

5- Hilum :- is a scar indicates the place of attachment of the seed to fruit .

6- Micropyle :- during germination, water enters the seed through the micropyle.

Dispersal of seeds and fruits.

Definition :

Dispersal is the ***spreading out*** of seeds and fruits.

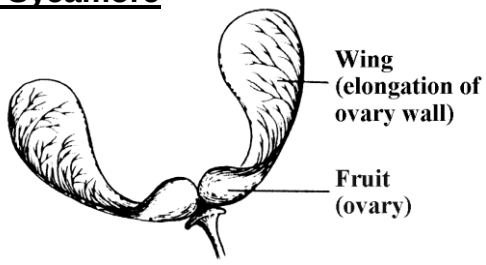
TYPES OF DISPERSAL:

1- Wind dispersal .

2- Animal dispersal .

Example of wind dispersal .

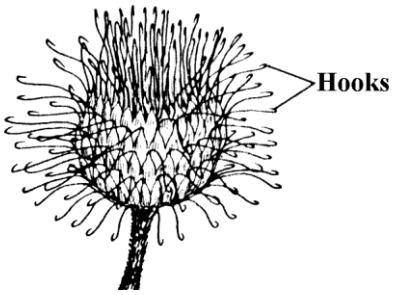
1- Sycamore



-It has wing-like structure to allow it to be carried by wind for a long distance by increasing its surface area.

Examples of animal dispersal

2- Burdock



- It has hooks to cling to the fur of animals or feathers of birds to be carried from one place to another

Advantages and disadvantages of dispersal

Advantages	Disadvantages
➢ Avoid over-crowding which increases the chance of spread of disease. ➢ Avoid competition between plants for water and minerals. ➢ Allow the species to spread in different areas allowing increase in population.	➢ Allow the spreading of plants which carry undesirable properties. ➢ Seeds and fruits may fall on soil with unsuitable conditions. ➢ Allow undesirable plants to grow between crops.

Germination

The beginning of growth of an embryo or a spore, this growth takes place by using the stored food in the spore or the seed.

Stages of Germination

1. The seed takes up water through the ***micropyle*** .
2. The cotyledons swell, causing the ***testa*** to burst.
3. The enzymes in the seed become active by the effect of water.
4. Enzymes are used to digest the stored food in the seed.
5. The digested food diffuses through the embryo and used in growth .
6. ***Radicle*** emerges from the testa.
7. Testa falls off.
8. Plumule opens out and grows into ***shoot.***

Conditions necessary for germination

Water	*Oxygen*	*Suitable temperature*
• Activates the enzymes in the seeds • Transports salts from the soil to the shoot • Expand the vacuoles of the newly formed cells causing the root and the shoot to grow . • Transport sugars from the cotyledons to the growing regions.	• Used in aerobic respiration to provide the embryo with the energy required for the different metabolic reactions	• The best temperature is about 35-40^{o} C as it makes the enzymes in seeds active.

Development

Development is the *increase in complexity* of the organism by cell *differentiation* and *specialization* leading to formation of different tissues and organs that can perform different functions.

Specialization of cell

-Means that the cell becomes ***adapted for a particular function*** within an organism.
- Growth is followed by development.

REPRODUCTION IN HUMANS

Humans are characterized by :

1- Internal fertilization : means that gametes fuse inside the body of the female .

2-Internal development: means that the embryo grows inside the body of the female .

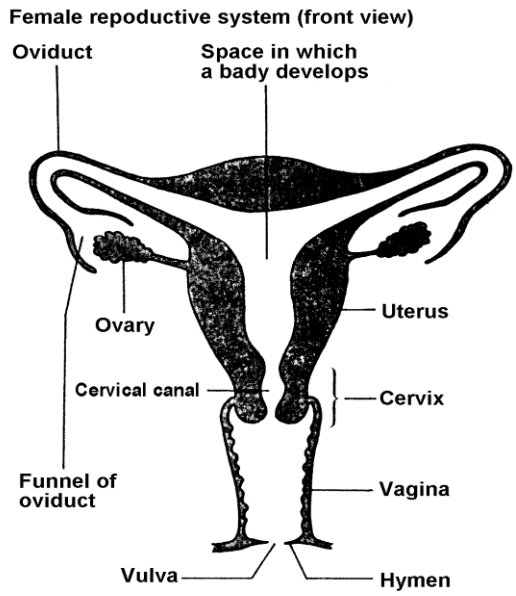
Gonads :

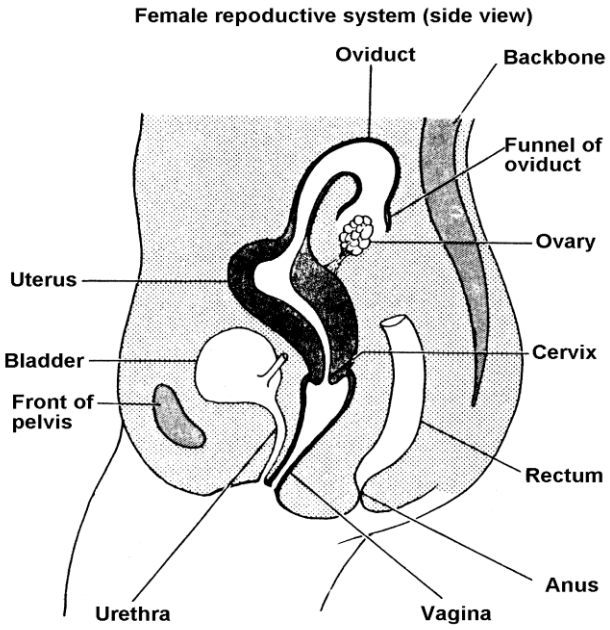
Are the organs responsible for producing gametes .

In humans :

- The male gonads are the ***testes***.
- The female gonads are the ***ovaries .***

The female reproductive system

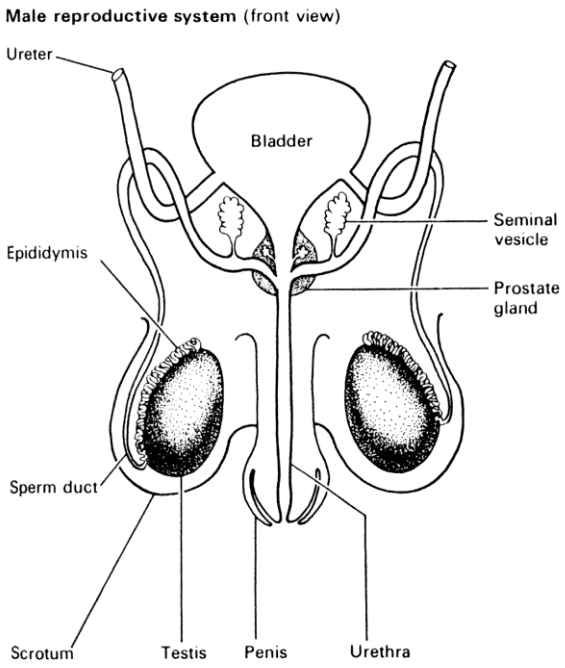


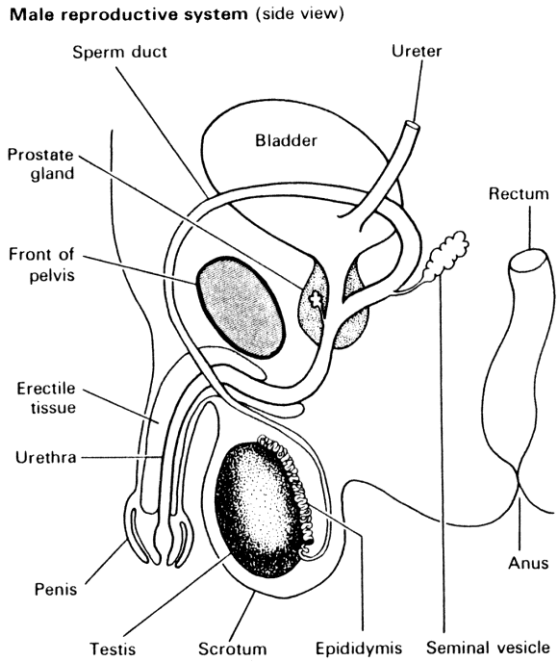


Properties and functions of the different parts

Structure	properties and functions
1-Ovaries	• Are two, right one and left one . ***Functions :*** a-Production of ova *(singular : ovum*) b-Production of the female hormones (*which are known as oestrogen*) c-Each ovary produces an ovum each 2 months (56 days) *(Therefore there is only one ovum produced every 28 days by one of the two ovaries).*
2-Oviduct " Fallopian tubes "	• Its front part is a funnel-shaped structure to receive ova. *(this part is called funnel of the oviduct)* • Funnel of the oviduct and the oviduct contains cilia to push the ova into the uterus • It is the site of fertilization *(because the ovum dies before leaving it)*
3-Uterus or womb	• A muscular organ. • It is the site where the embryo is developed if the ovum is fertilized. • It consists of a muscular wall and a lining . -The lining is soft, spongy with many blood vessels to supply the embryo with food and oxygen . - In the lining ***implantation*** of the embryo takes place . *(Implantation means that the embryo fixes itself to the lining of uterus*) • If there is no fertilization the lining is broken down releasing blood, this is called ***menstruation***. • Every month new lining is formed , except during pregnancy the lining is not broken down and remain to support the embryo .. • During birth it contracts to push the fetus out.
4-Cervix	• It is a muscular ring that separates the uterus and vagina. • It secretes mucus to help sperm to swim.
5-Vagina	• It is the organ of copulation . • Its exterior is called vulva . • It is folded to expand during birth . • It secretes mucus to facilitate the movement of the male organ during copulation . • Secretes acid to kill bacteria and other microorganisms.

The male reproductive system .





Properties and functions of the different structures

Structure	Properties and functions
1-Testes	a- Production of sperm. b- Production of the male sex hormone which is known as ***testosterone.***
2-Scrotum or scrotal sac.	• A sac of skin • Used to hold the testes outside the body at a lower temperature ***because*** increase in temperature affects production of sperm.
3-Epididymis	• A coiled tube **Its functions** a- Stores sperms b- Contracts to help in ejaculation of sperms .
4-Sperm duct	• Conducts sperm from the epididymis to the urethra . • Contracts by a process like peristalsis to help in ***ejaculation.***
5-Urethra	• A common passage for both ***urine and semen*** . *(semen is the sperm plus the fluid produced by prostate gland and seminal vesicles.)* • Has a muscular wall to contract to help in ejaculation . • Urination cannot take place during ejaculation because the sphincter muscle of the bladder contracts during ejaculation.

6-Seminal vesicles and prostate gland	***Secrete fluid known as seminal fluid to mix with sperm ,this fluid consists of :*** • Mucus (produced by prostate gland) to facilitate copulation and swimming of sperm. • Sugars (fructose) to provide energy for sperm. • Alkaline material to neutralize the acidity of the urethra and vagina. *(urethra is acidic due to the remains of acidic urine).*
7-Penis	• It is the organ of copulation . • Contains erectile tissue which has blood cavities, when penis is stimulated blood fills the cavities making the penis long and strong enough for copulation ,this is known as ***erection.*** • Covered with a piece of skin called fore skin which is removed during the process of ***circumcision***.

Sperm

It adaptive features

Head : Contains nucleus carries the ***inherited*** information .
Can produce ***enzymes*** from an organelle in the Head known as ***acrosome*** to penetrate wall of the The ovum.

Neck : Contains ***mitochondria*** to produce the energy required for its movement .

Tail or (flagellum) Used for its movement.

Ovum

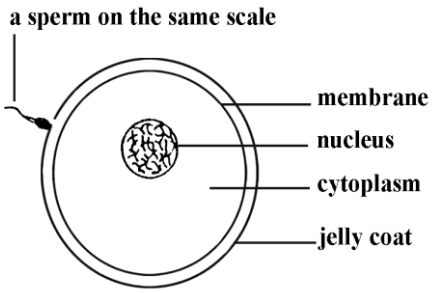
Adaptive features

- Contains ***stored food*** to be used in its growth and division.
- Surrounded by ***jelly coat*** which becomes ***hard*** after fertilization to prevent any other sperm to enter.

Comparison

	Male gamete	Female gamete
Size	smaller	larger
Structure	Has ***flagellum and acrosome*** Has ***no jelly coat.***	Has ***no*** flagellum and acrosome Has ***jelly coat.***
Mortality Or mobility	motile	***Not*** motile
number	***Larger*** in number	***Smaller*** in number

Intercourse



- Due to stimulation , the blood pressure increases in the penis, so it becomes stiff and erect.
- The penis is then inserted into the vagina and moves rhythmically, this stimulates it, and so the muscles of the epididymis, sperm ducts and urethra contract in a wave motion to push the sperms,
- During this, a fluid from seminal vesicles, and prostate gland is secreted to be mixed with sperm that ejaculate inside vagina .

Fertilization

1- The semen is deposited at the top of vagina below the cervix.
2- Sperms swim using their tails through the cervix and the film of moisture lining the uterus.
3- Sperms are attracted towards the ovum due to the chemicals it produces.
4- Many sperms reach the egg, each sperm produces enzymes from its head to digest a way into the egg.
5-The sperm leaves its tail outside, then the nucleus of the sperm and that of the ovum fuse together forming a zygote.
6- Once one sperm has succeeded in penetrating the egg, a ***fertilization membrane*** is formed quickly to prevent any other sperm to enter the ovum .

Zygote

A cell formed due to the ***fusion*** of a male gamete and a female gamete.

Embryo

A ***ball of cells*** formed due to the ***division*** of the zygote by mitosis.

Foetus (or fetus)

A mammalian embryo in fairly ***advanced stage of development*** .

What happens if there is no fertilization

Menstruation takes place.

Menstruation

- It is the break down of the lining of uterus in case if there is no fertiliztion .
- It takes place due to a drop in the level of a hormone called progesterone .
  (Function of progesterone is to maintain the lining of uterus).

Menstrual cycle

It is the changes in uterus and ovaries that take place between one menstruation and the other.

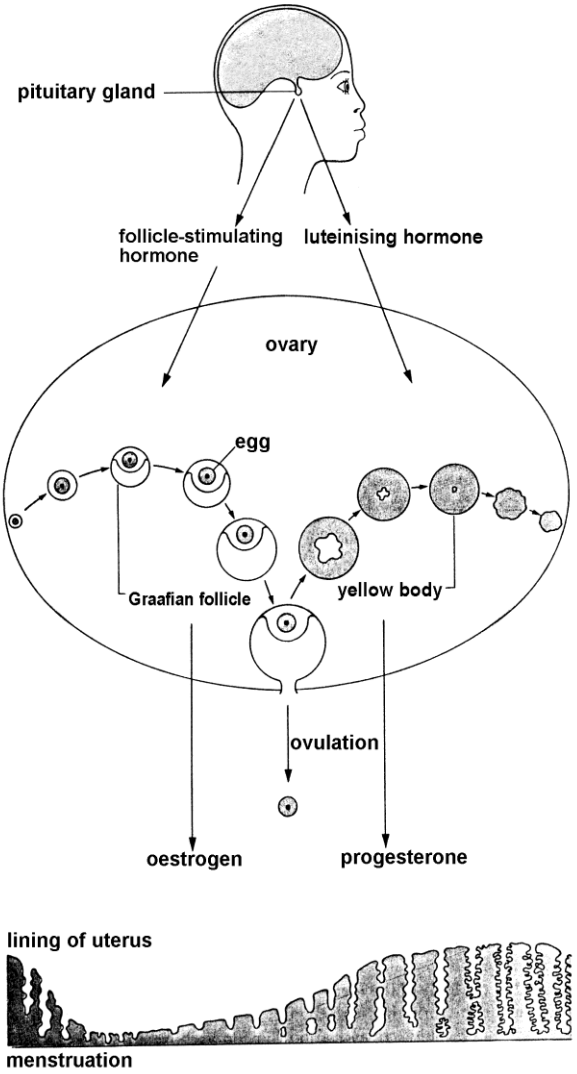
Stages of the menstrual cycle

1- The ***pituitary gland*** secretes the hormone ***(FSH) follicle stimulating hormone*** which stimulates an ovum to develop into a larger structure called ***Graafian follicle***.

2- Graafian follicle secretes the hormone ***oestrogen*** which :

A-Inhibits the production of FSH to avoid development of other ova during this period .

B-Stimulates building up of uterine lining.



3- The pituitary gland produces a hormone called ***LH (Lutenising hormone***) to the Graafian follicle to pop out an ovum into the oviduct and to develop the remaining of the follicle into a structure called ***corpus luteum*** or yellow body.

4- The yellow body produces a hormone known as ***progesterone*** which causes the lining of the uterus to become thicker and to maintain it.

2- About two weeks after ovulation, the yellow body withers away, therefore the level of progesterone in the blood drops , as a result the lining breaks down and menstruation occurs.

Role of oestrogen in the menstrual cycle

Oestrogen stimulates ***repair of the lining of uterus(lining of uterus is known as endometrium)*** so that it becomes ready for ***implantation*** , also by ***negative feedback mechanism*** it inhibits production of ***FSH*** so that no more ova can be released and stimulate production of ***LH*** for ovulation.

Role of progesterone

Role of progesterone during the menstrual cycle

- Maintains the lining of uterus (endometrium) to be prepared for implantation.
- Inhibits production of FSH and LH by negative feedback mechanism.

Role of progesterone during pregnancy

- Stops menstrual cycle.
- Maintains the lining which is needed for supporting the embryo.
- Stimulates development of mammary glands.

Ovulation

- Means the release of an ovum into the oviduct.
- It takes place at ***day 14*** of the menstrual cycle (first day in the menstrual cycle is the day at which breakdown of lining of uterus and release of blood or menstruation takes place)

What happens if there is fertilization ?

1- Formation of ***embryo*** due to the successive division of the zygote by a method of division called ***mitosis***.

2- The ***menstrual cycle stops***, until after the baby has been born, this is because production of progesterone continues to maintain the lining of uterus .
(Maintenance of the lining is necessary to support the embryo .)

3- ***Implantation takes place***
Implantation means the process by which the embryo attach to the lining of uterus.

4- ***Formation of amnion and placenta.***

Amnion (amniotic sac or a water sac)

- Secretes amniotic fluid.
- Protects fetus against pathogens

Functions of amniotic fluid

- Acts as shock absorber.
- Protects the embryo against adhesion of organs.
- Facilitates the movement of the fetus.
- Provides a suitable temperature for the fetus.
- During pregnancy it sterilizes the pathway of the fetus.
- Collects wastes of the foetus.

Placenta .

Formation of placenta **:**

- Some of the cells of the embryo grow into projections called villi that fix into the uterus.
- The uterus also grows projections .
- The maternal (mother's) villi, and the fetal villi grow closely together forming the placenta.

The blood in placenta includes **:**

- Maternal blood from the uterine artery.
- Fetal (or foetal) blood from the umbilical artery and the umbilical vein in the umbilical cord.

Importance of placenta

1- Exchange of gases

a- Oxygen from the mother's blood diffuses into the fetal blood .

b- CO_2 from the fetal blood diffuses into the mother's blood .

2- Nutrition

Food materials such as glucose and amino acids diffuse or taken by active uptake into the fetal blood .

3- Excretion

Waste products such as urea diffuse from the fetal blood to mother's blood .

4- Secretion of hormones

Secretes oestrogen and progesterone to :

a-Keep the uterine lining to support the embryo.

b-Stimulate the growth of milk- producing tissues in the woman's breast.

c- Prevent any more ova to be released during pregnancy .

5-Makes fetal blood and maternal blood never mix in placenta therefore :

(a) It protects the fetus ***against high blood pressure***.

(b) It protects the fetus ***against bacteria*** (If found in mother's blood), but viruses like ***HIVand rubella*** can pass through placenta because they are very small.

*(rubella is a virus that causes **German measles**.)*

(c) It protects the fetus and mother against blood ***agglutination*** if mother's blood group and that of the fetus are not matched.

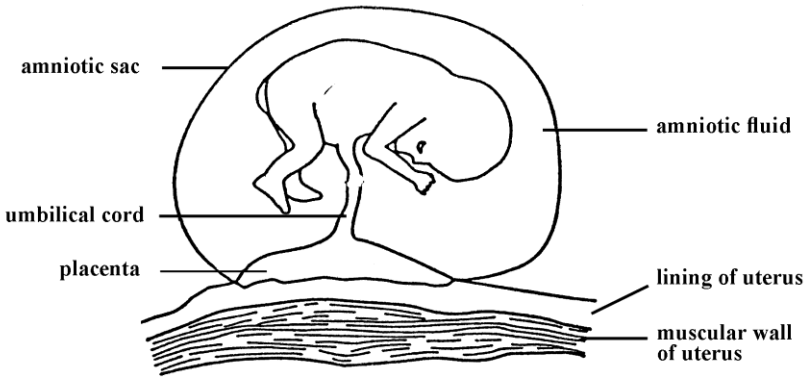
C- Umbilical Cord

- It connects placenta and fetus.

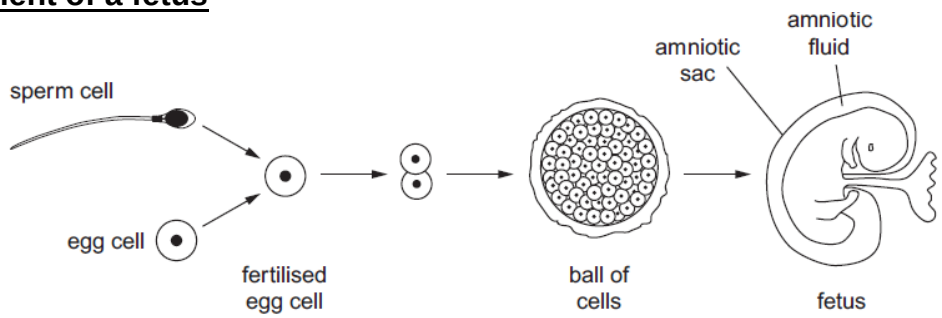
-**It contains:**

1- ***Umbilical artery*** carries CO_2 and other waste products of the fetus to placenta.

2-***Umbilical vein*** carries O_2 and food materials from placenta to fetus.



Development of a fetus



Ante - natal care.

Means care of fetus before birth to help the fetus to develop into healthy baby and to make birth easier.

Ante- natal care includes the following :

1-Diet

Must include :

- More proteins for building cells.
- More carbohydrates and fats for more energy.
- More minerals such as calcium to build bones and iron to form haemoglobin.

2- Drugs

- Must be avoided because they can pass through the placenta to fetal blood and harm the fetus, especially during the first weeks leading to mutations (abnormalities).

3- Smoking

Must be avoided, it can result in small and less healthy baby because :

- CO of smoking can reduce the oxygen supply as it combines with hemoglobin forming stable carboxyhemoglobin .
- Nicotine makes the fetal heart beats more quickly .

4- Alcohol

Should be avoided because they :

- May form abnormalities in the fetus.
- May result in premature baby .
- May lead to miscarriage.

5- Diseases

- Viral diseases may cause damaging effect e.g German measles which may cause deafness of baby .

6- Exercise

- Helps mother to keep fit, and this helps in birth .
- Helps to keep her circulatory system working efficiently.

BIRTH

- It is the process by which the fetus leaves the uterus.
- Takes place about nine months after fertilization

Stages of birth (or labour)

1- First stage :

a- ***Oxytocin hormone*** is secreted by the pituitary gland to stimulate contraction of uterus.
b- The cervix becomes soft and dilates.
c-Rupture of the amniotic sac and the amniotic fluid .

2- Second Stage :

- The head of the baby is pushed out by the effect of the uterine contractions, and so the rest of its body slides quickly .

3- Third stage

a- The umbilical cord is then tied and cut ,
(This does not hurt neither the mother or the baby because it contains no nerves.)
b- The uterus contracts to expel the placenta.
c- Cold air stimulates the lungs of the baby, so breathing through lung starts.

Breast milk and bottle feeding

Breast milk	Bottle feeding
1- Contains nearly all the types of food except for iron in the right proportion. also, it increases according to the demand of the baby.	- Contains more protein , sodium and phosphorus , but less sugar, vitamin A and D than the human milk but it can be modified .
.2- Free from bacteria 3-Provides emotional and psychological benefits to both mother and baby. 4- Its temperature is suitable to the baby . 5- Costs nothing . 3- Ready. **Disadvantages** ➢ Some drugs such as nicotine can pass from mother to the baby. ➢ Mother ***may be*** unable to produce enough milk. ➢ Suckling ***may be*** painful if nipples are inflamed.	.- May contain bacteria - Its temperature may be higher or lower than the temperature of the baby. - May be expensive. - Needs time to be prepared. **Its advantages :** ➢ Can be used to measure the amount needed by the baby . ➢ People other than mother can feed the baby.

Methods of birth control
contraceptive methods or family planning .

Types of methods of birth control:

1- Natural methods
2- Chemical methods
3- Mechanical methods
4- Surgical methods

1-Natural methods

Method	Advantages	Disadvantages
1-Abstinence (***No intercourse at all***). 2- ***Rhythm method or safe period*** • Means to avoid intercourse in the time where an ovum in the oviduct . • This period can be recognized as follows : a- Slight rise in temperature b-The mucus of vagina becomes more viscous.	-100% successful -Acceptable to all religions and cultures - Has no side effects	- Not suitable for most couples. -The signs of this period may not be clear -The menstrual cycle may be irregular as a result the time of ovulation can not be determined accurately.

2-Chemical methods

Method	Advantages	Disadvantages
1- ***Contraceptive pills*** : - Contain oestrogen and progesterone to prevent ovulation by their negative feedback effect . - It is taken daily for three weeks, during this period the lining of the uterus is formed normally - Then taking pills stops for a week therefore the lining breaks down leading to menstruation. ***(Instead of pills the female can be given injection of long lasting contraceptive hormones)***	- 100% successful . - The female can be pregnant after leaving it.	- Long term use may cause side effects such as headaches and allergies. - Can not be used by diabetics and those who have liver diseases.
2- ***Morning after pills*** : - Contains hormones - Taken after intercourse - Prevent implantation	-Works several days after intercourse . - The female can be pregnant after leaving it.	- May cause side effects like the contraceptive pills.
3- ***Spermicides***: - A creamy substance that kills sperm. - It is put into the vagina before intercourse.	- Easy to be used .	- sperm can pass without being killed, therefore it must be used beside condom.

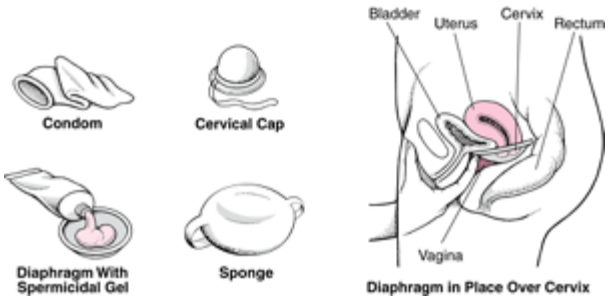
4- <u>Intrauterine system (IUS)</u> -A device placed in the uterus -It releases hormones to prevent implantation and interfere with ability of the sperm to find and ferrtilise an ovum.		

3- Mechanical Methods

Methods	Advantages	Disadvantages
<u>1- Intra - uterine device IUD or loop</u> - it prevents implantation as it is put on the lining of uterus 2- ***<u>Diaphragm or cap</u>*** - It is a dom-shaped piece of rubber with a metal spring around it . - It is placed in vagina before intercourse.	- Effective . - The female can be pregnant after removing it . - Female can place and remove it by herself.	- May cause bleeding and infection if not fitted well. - Pregnancy may take place if not fitted well. - Sperm can enter uterus if cap is not fitted well .
<u>3- Condom</u> - It is a sheath of rubber placed over the male organ during intercourse to prevent sperms to reach vagina . ***<u>4- femidom (female condom)</u>*** *Placed in vagina to prevent release of sperm through cervix*	- Can also provide protection against sexually transmitted diseases.	- Any defect in its manufacture may allow sperm to pass through vagina .

4- Surgical methods

Method	Advantages	Disadvantages
<u>1- Tubal ligation(or female sterilization)</u> - Cut and tie the oviducts to close the way through which sperm reach ova	- 100% effective . - Does not affect the female characteristics as they are controlled by the hormones secreted by ovaries into the blood stream	- Irreversible. - stress of surgical operation. - Expensive
<u>2- Vasectomy in males</u> : - Cut and tie the sperm ducts to prevent ejaculation of sperm.	- 100% effective. - does not affect the male characteristics as they are controlled by testosterone which is secreted by testes into the blood stream . - The male ejaculates semen but without sperms .	- Irreversible. - stress of surgical operation. - Expensive.



Sexually transmitted infections (STIs)

Definition

Diseases which are transmitted from an infected person to a healthy one during sexual intercourse .

AIDS (Acquired immune deficiency syndrome)

- Caused by a virus known as ***human immune deficiency virus*** or HIV .

-***This virus***

a- lives in blood or body fluids.

b- lives in the lymphocytes damaging T- lymphocytes decreasing immunity .

c- It may live many years without any symptoms.

Methods of trnsimission

- Intercourse with infected person.
- Blood transfusion form an infected person.
- Organ transplant form an infected person.
- Sharing needles with infected people.

How to avoid it ?

- Avoid intercourse with many partners.
- Use a condom .
- Never inject drugs.
- Never share razors or tooth brushes.

FERTILITY DRUGS

Definition

- Are drugs used to stimulate the development and production of ova by ovaries.
- They increase LH and FSH conc. in blood.

Social aspects of fertility drugs.

1- Both ovaries are stimulated at the same time, also the rate of stimulation may be higher than normal ,therefore many ova may be produced at the same time leading to multiple pregnancies.

2- Multiple pregnancies lead to many problems such as :

a- Badies may be very weak , and cannot live, this causes emotional problems.

b- If the babies live they will need over care which costs more money and effort.

c- Babies may be defective (deformed) and this has its social and emotional problems.

d-To get rid from some fertilized ova from the uterus to reduce the number of babies has its religious problems.

ARTIFICIAL INSEMINATION

Definition :

fertilization outside the body of the female (or a way of fertilization different from the normal way.) for example ***Semen*** is collected from a male and then inserted into vagina or allowed to pass through cervix of a female ***during time of ovulation*** so that ***fertilization*** can take place.

Social aspects of artificial insemination

- In case of using sperms from a donor , the male has to accept that the child in not his.
- When a child grows up he has to know who his or her father.

In artificial insemination, fertilised eggs are left for time before being implanted

- To ensure that the process succeeded and the embryo is growing.
- To allow it to be large enough to be easily implanted.

Method	Advantages	Disadvantages
Test tube babies: ➢ Ripen ova are taken from a female and placed with the male's sperms in certain apparatus. ➢ Sperms fertilize ova, forming zygotes. ➢ Zygotes are left to divide forming young embryos (just ball of cells) ➢ .The embryo is implanted into the females uterus.	➢ Helps women who have blockage in their oviducts to be pregnant. ➢ If the male is unable to produce healthy sperms , sperms from a donor can be used.	➢ Put the male and female under stress of surgical methods ➢ Expensive. ➢ usually many embryos are implanted , one is used while others are killed or used in researches.

Sex hormones .

Male sex hormones (Androgens)	Female sex hormone (estrogen)
Example : testosterone **Produce primary sexual characteristics such as** • Development of sex organs . • Erection in case of stimulation . • Production of sperm. **Produce secondary sexual characteristics :** • Rough voice (deep voice). • growth of facial and pubic hair. • Muscle development. • Broad shoulders .	**Produce Primary sexual characteristics such as** • Ovulation • Menstruation. **Produce secondary sexual characteristics such as** • Hips widen • Breast increases in size. • High pitched voice.

Twins

1- Identical twins	2- Non identical twins
Caused when a sperm fertilizes an ovum forming a zygote ,which divides forming a ball of cells , and then for ***unknown reasons*** the ball of cells divides forming two embryos, each grows separately forming two individuals . **The identical twins :** - share the same placenta . - have similar features and have the same sex.	Caused when two sperm fertilize two separate ova forming two separate zygotes , each grows forming an individual **The non identical twins :** - each has a placenta. - have different features. - may be of different sexes.

Hormones

Are organic substances (many are proteins such as insulin) secreted in small amounts by ***endocrine*** glands into the ***blood stream*** directly to reach and affect certain organs or tissues ***(known as target organs or tissues)*** its function is to alter the activity of the target organs and then destroyed in liver.

Notice

Hormones are also called ***chemical messengers*** because they can carry the messages from one part of the body to another to respond in a particular way.

Examples of hormones

1- Insulin . 2- Adrenaline . 3- glucagon.

Insulin

- A hormone secreted by certain cells in the ***pancreas*** called ***Islets of langerhans*** .
- It is a ***protein***.
- Its function is to lower the blood glucose level.

How insulin can lower blood glucose level when its level becomes higher than the normal :

(a) Stimulates the **liver** cells to store excess glucose in the form of ***glycogen***.
(b) Stimulates the ***muscle*** cells to store excess glucose in the form of ***glycogen***.

(c) Stimulates the conversion of excess ***carbohydrates to fats.***
(d) Stimulates the ***body cells*** to use glucose.

Adrenaline

- It is a hormone secreted by the ***adrenal glands*** (supra - renal glands) which are found above the kidneys .

- It is known as fight, and flight hormone as it prepares the body for action in the following ways :

(a) Increases the rate of ***heat beats***.
(b) Increases the ***blood pressure***.
(c) Increases the rate of ***breathing.***
(d) Causes ***constriction*** of the blood vessels in skin and digestive system to increase flow of blood to muscles.
(e) Converts ***glycogen*** stored in liver to ***glucose*** , and fats to fatty acids .
(The above actions to provide the muscles with enough food and oxygen to produce the energy required for rapid and efficient response and also to allow blood to carry away the waste products of this metabolism.)

Glucagon hormone

- It is also secreted by ***Islets of Langerhans in pancreas***.
- It is secreted when blood glucose level drops ***below normal***.
- It stimulates liver to break down amount of stored ***glycogen into glucose***, until glucose level becomes normal.

Notice

- Insulin ***can not*** be taken through mouth but as an injection because insulin being ***protein*** it will be digested by the effect of ***proteases*** if taken through mouth.
- ***Diabetes*** is a disease caused due to lack of insulin, it is dangerous as it damages tissues especially in brain and heart as it decreases water potential in blood as a result of this water moves from body cells to blood causing the cells to shrink and die.

How hormones improve sporting performance

Anabolic steroids

Steroid hormones include the reproductive hormones such as ***oestogen, progesterone and testosterone.***
Are known as anabolic as they ***stimulate building of large molecules from smaller ones***, such as building of proteins from amino acids.

Testosterone

Causes more proteins to be made in muscles causing ***muscles to be larger and stronger***.

The use of anabolic steroids in sport is banned because

- It gives someone an unfair advantage.
- Can lead to health risk such as decreasing efficiency of the immune system and liver damage.

DRUGS

A drug

-Is any substance taken into the body that modifies or affects chemical reactions in the body.
-***By medicine*** drug is a substance used to help our bodies to fight diseases.

Medicinal drugs such as antibiotics

1- Inhibit synthesis of cell walls of bacteria so reduce their reproduction.
2- Inhibits formation of protein in bacteria.
3- Disturb cell membrane function.
4- Affect enzyme action in bacteria**.**

Why antibiotics kill bacteria but not viruses

Viruses have no cell wall , no cell membrane for action of antibiotics.

Reasons for taking drugs such as heroin and alcohol

1- Social pressure .
2- Being daring.
3- Escape as some drugs help to forget problems temporarily.
4- Creativity : Some poets and writers did their best work under the influence of drugs but there are thousands of failures who are drug takers.

The personal and social problems abuse of heroin

1- Depression of the central nervous system, decreasing the feel of pain .
2- ***Respiratory depression*** ,as it decreases the sensitivity of the respiratory centre in the brain to carbon dioxide , and so the respiratory centre can not send impulse to the intercostal muscles to contract,. This leads to death.
3- Transmission of ***hepatitis and AIDS*** due to sharing needles in injecting drugs.
4- Death due to accidental ***overdose***.
5- Loss of weight as the addict does not eat well.
6- The person may become ***dependent*** on the drug, **i.e**. he becomes unable to live without it,because stop taking heroin causes many symptoms known as ***withdrawal symptoms*** such as ,stomach cramps, diarrhoea, fever, headache , runny nose and eyes, nausea and weakness.
7- May harm the body especially liver and brain cells.
8- Causes ***tolerance*** , means the dose has to keep increasing in order to have the same effect.
9- Addicts lose interest in their persons , jobs and families.
10- Addicts may become ***criminals*** to get enough money for drugs.

Harmful effects due to the misuse of alcohol

A- Short term effects:

1- ***Delays response*** (it increases the time of response as it has a depressant effect) this may lead to accidents if driving or working on a machine .
2- ***Disturbance in talking*** .
3- ***Double vision*** .

1- Large doses may lead to ***loss of consciousness***, coma and even death .
(Death is caused when a person vomiting when unconscious due to the effect of alcohol and then his airways become blocked by vomit.)
2- It can ***increase aggression*** in some people, so they are more likely to be violent or commit other crimes.

B- Long term effects :

1- ***Liver damage***. (cirrhosis or fibrosis of liver) as the liver is the organ responsible for breakdown of alcohol.
(Alcohol kills the liver cells which are then replaced then by fibres)
2- ***Weakens the heart muscles*** and may lead to heart attack .
3- ***Damages brain and nerves*** leading to loss of sensation .
(This is because alcohol in the tissue fluid surrounding the brain cells makes the tissue fluid able to absorb water by osmosis from brain cells causing the cells to shrink.)
4- Increases the risk of cancer .
5- May cause ***miscarriage of pregnant*** .
6- Cause ***stomach ulcer***.
(because alcohol increases the gastric juice)
7- ***Tolerance***
(means that the body becomes in need for a greater amounts of alcohol to gain the same effect)
- ***Dependence***
(means that the person cannot feel well without the drug)
9- Excessive loss of water through urine

Social problems

- Leads to ***violence and antisocial*** behavior.
- Loss of friends and family relationships.
- ***Poor work performance***, and may result in loss of job.
- Spending money on alcohol causes a shortage in the spending on family requirements and may lead to ***crimes*** to get money.

Disease and immunity

Microorganism
A tiny organism that can only be seen with a microscope.

Disease
Disorder or malfunction in the body.

Infectious disease (transmissible disease)
Diseases which are ***caused by pathogens*** and can be ***transmitted*** from one organism to another

Pathogen
A microorganism that causes disease.

Antigen
Any molecule that the body recognizes as foreign.

Types of pathogens
- **Viruses** such as the virus that causes ***AIDS.***
- **Bacteria** such as that causes ***cholera and tetanus***.
- **Protoctists** such as ***plasmodium*** that causes ***malaria.***
- **Fungi** such as that causes ***athlete's foot.***

How a pathogen harms the body
- May damage cells by reproducing in cells and using up their materials.
- By production of ***toxic waste*** materials that can spread around the body causing many ***symptoms such as*** high temperature, cough and feel of pain.

Infection
The entry of the pathogen into the body.

Ways of transmission of pathogen

Direct contact Through blood or body fluids
Examples
- Virus of AIDS which is known as HIV is transmitted when direct contact through ***intercourse*** takes place.
- The fungus that causes ***athlete's foot*** is transmitted by sharing a towel with an infected person.
  *(Diseases which are transmitted by direct contact are known as **contagious** diseases.)*

Indirect transmission
- ***Contaminated*** surfaces or animals.
- ***By air through the respiratory passage***
  When an infected person coughs or sneezes the pathogen is carried in droplets which can be inspired by another one.
  Example influenza.

- ***Through food*** containing the parasite.
  Example salmonella and cholera.

- ***Through water*** containing the parasite
  Examples
  Virus that causes polio.
  Bacteria that causes cholera.

- ***By vector***
  (vector is an organism that carries a pathogen from one host to another.)
  Examples
  Infected dogs and bats transmit ***rabies virus*** through their saliva when bite a person.
  Female Anopheles mosquitoes transmit the parasite of ***malaria*** through their saliva.

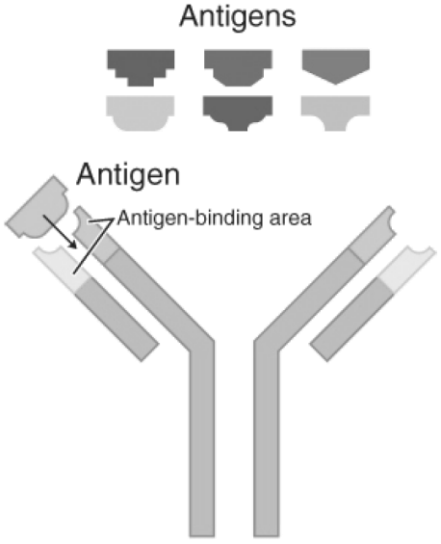
Notice

Pathogen is considered as a ***parasite***, while the infected person is considered as a ***host.***

Body defences

- **Mechanical barriers** such as skin and hair in the nose.
  (skin has a thick outer layer of dead cells containing a protein called Keratin which makes it difficult to be penetrated by pathogens)
- **Chemical barriers** such as mucus and hydrochloric acid in the stomach.
- **Phagocytosis and antibody production** by white blood cells.

Structure of antibodies



Effect of antibodies

- Each type of lymphocytes is able to produce ***only one type of antibodies***.
- Each type of antibodies is ***specific for attacking certain antigen*** as it acts as a lock and the antigen acts as a key.
- When an antigen enters the body, the ***proper type of lymphocytes*** recognise it and start to divide to increase in number forming a ***clone*** that produce their antibodies to destroy the antigen.

Notice

Different ***sequences*** and number of different ***types*** of amino acids are responsible for giving protein a ***certain shape***, for example it gives the ***shape of binding site of the antibody***.

Clone

Identical cells or molecules.

Memory cells

When lymphocytes are cloned, ***not all of them produce antibodies*** but many remain in the body waiting if this antigen attacks the body once more to destroy it, these cells are known as memory cells.

Measles only once in life but repeated infection by influenza may take place

Because there is only ***one strain of common measles virus***, therefore after infection memory cells remain in the body to attack this virus, but there are ***many strains of influenza virus*** with different antigens therefore immune response is needed every time as the formed memory cells become with no effect ***against the new strain***.

Vaccination

Means giving ***dead or weakened pathogen*** stimulating body to produce clones of lymphocytes, many produce ***antibodies*** against this pathogens while others remain as ***memory cells.***

Active and passive immunity

Active immunity

- Defence against a pathogen ***by antibody production*** .
- It is gained ***after infection*** by pathogen or by ***vaccination*** as this stimulate the body to produce ***memory cells***.

Passive immunity

Short term defence against a pathogen by ***antibodies acquired from another individual***.

Examples

- From a mother to the fetus ***through placenta*** and breast milk.
- By giving a ***strong animal*** the pathogen and then obtain its antibodies to be given to the infected person.

Advantage of passive immunity

Immediate effect with no need to wait the production of the person's antibodies.

Disadvantage of passive immunity

Short term effect as no memory cells are produced and the given ***antibodies can be destroyed*** in the body after short period.

Advantage of active immunity

Long lasting due to production of memory cells.

Disadvantage of active immunity

Time is needed for formation of clones of antibodies and memory cells.

Auto-immune disease

When the immune system destroy body cells.

Example Type 1 diabetes

- It develops in children.
- In this type the immune system attacks ***beta cells of pancreas*** that produce insulin hormone.

Ways to avoid infectious disease

Hygienic food preparation

- ***Good cooking*** o kill bacteria.
- Keep food ***away from insects*** that can transmit bacteria and viruses.
- Keep ***your hair away*** from food.
- ***Never cough or sneeze*** over food.
- Keep food ***in fridge*** to slow down growth of bacteria.

Good personal hygiene

- Keep your ***body clean***.
- Use ***soap and shampoo*** to remove oil secreted by skin.
- ***Brush your teeth*** and use mouth wash to kill harmful bacteria.

Waste disposable

- Can be ***compacted*** (pressed down) to occupy small space.
- Can be ***collected in landfill site***, where is decomposed ***producing methane gas*** that can be used as a fuel.
- The landfill site can be covered with ***soil, grass and trees***.

Sewage treatment

Sewage is the liquid waste that has come from houses and industry, it contains water, urine , faeces, toilet paper and detergents, it contains bacteria and other microorganisms.

Cholera

A disease caused by ***bacteria.***

How it is transmitted

- Through ***water and food*** contaminated by faeces of an infected person.
- ***Contaminated hands*** of food handlers.
- ***By insects*** which can transmit the parasite from sewage or faeces of an infected person to food or water.

Effect of cholera

- Lives in the ***small intestine.***

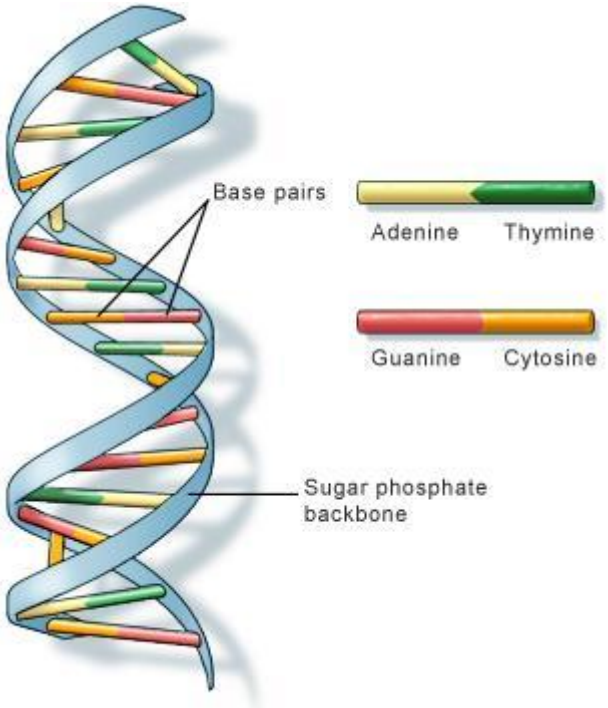
- Produce ***toxins that stimulate wall of intestine to secrete chloride ions*** which causes lumen of intestine to be of lower water potential than the blood.
- Water moves by osmosis from blood to the lumen of intestine leading to ***diarrohea***.

Deoxyribonucleic acid
DNA

It carries the inherited information

Its structure

- Formed of two ***strands that twist together*** forming a spiral known as ***double helix***.



- Each strand is formed of ***sequence of bases***.
- Bases of one strand form ***hydrogen bonds*** with bases of the other strand.

DNA bases

- There are ***four types*** represented by ***A,T,C and G***.
- ***A and T*** are joined together by ***two hydrogen bonds***.
- ***C and G*** are joined together by ***three hydrogen bonds***.

Importance of DNA bases

- The sequence of bases ***provides codes for the types of proteins*** that have to be made in the cells.
- The ***different types of proteins*** lead to development of characteristics, ***for example*** black hair is a protein while yellow hair is other protein.
- The ***different types of proteins*** may be enzymes or hormones that affect activity of the body or maybe antibodies for immunity.

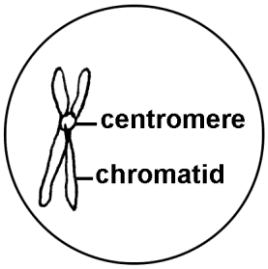
How a protein is made

– the ***gene coding for the protein*** remains in the nucleus.
– ***mRNA molecules*** carry a copy of the gene to the cytoplasm.
– the mRNA ***passes through ribosomes***
– the ***ribosome assembles amino acids*** into protein molecules.
– the specific ***order of amino acids*** is determined by the ***sequence of bases*** in the mRNA

INHERITANCE

It is the transmission of ***genetic information*** from generation to generation .

Chromosome



- A coiled thread of ***DNA and protein*** found in the nucleus of cells, it is made up of string of genes.
- Every species is characterized by having a certain number of chromosomes.

Example : humans have **46** chromosomes in every cell of the body except for gametes (gamete has only **23** chromosomes.)

- Chromosomes ***can be seen clearly*** in the cell by the light microscope ***only when*** the cell is dividing because at this stage they become ***shorter and fatter***.
- Chromosomes carry ***genes***.

Gene

-A specific length of DNA occupying a position called ***locus*** in a chromosome which codes for making a particular protein.

Allele

- Allele is one of two or more different forms of a gene.

Example :
The gene which codes for fur colour in an animal may have two forms (alleles), a form (an allele) codes for white colour and a form (an allele) codes for black colour.

Notice

All body cells in an organism contain the ***same genes***, but in each cell ***only the genes needed by the cell are expressed.***

Example
Cell in ***salivary gland and cell of stomach*** each contain all the genes on 46 chromosomes but in salivary gland the ***gene coding for production of amylase*** is expressed while in stomach the ***gene coding for production of pepsin*** is expressed

Types of nuclei

Diploid	Haploid

- A nucleus which has ***two sets*** of chromosomes - In all body cells except gametes. 	- A nucleus which has ***one set*** of unpaired chromosomes. - In gametes. 

Homologous chromosomes

- Chromosomes which carry genes for the same characteristics in the same position.
- Have the same position of ***centromere***.
- One comes from the father ***(paternal)*** while the other comes from the mother ***(maternal).***

Types of chromosomes

Autosomes	Sex chromosomes
- Are the chromosomes responsible for different characteristics except sex .	- Are the chromosomes responsible for sex determination. - Are represented by X and Y . (Y is ***shorter*** than X). - ***In males X and Y*** chromosomes are present. - ***In females two X*** chromosomes re present.

The chromosomal structure in humans and sex determination

Chromosomes in male
44+XY

Chromosomes in female
44+XX

Probability of Sex

Parents	male		female	
genotype	44+XY		44+XX	
gametes	22+X	22+Y	22+X	22+X
genotype	44+XX	44+XX	44+XY	44+XY
phenotype	female	female	male	male
Probability	50% female		50% male	

Who determines sex ?

Males because they produce gametes that contain the ***chromosome Y***.

Monohybrid inheritance

Means that cross between organisms which show ***contrasting variations*** of ***only one*** characteristic.

Example

Black animal crossed with a white one.

If all their offspring is ***black***, the ***allele for black*** is said to be ***dominant*** and is represented by a ***capital*** letter (B) while the ***allele for white*** is ***ressisive*** and is represented by the same letter but ***small*** (b)

Each individual receives two alleles for each characteristic

- One from the father and one from the mother.
- If the two alleles are ***identical*** for example BB or bb the individual is called ***homozygous***.
- If the two alleles are ***different*** for example Bb the individual is called ***heterozygous***

Dominant allele

An allele that is expressed on the phenotype of an organism if it is present whether the organism is ***homozygous or heterozygous***.

Recessive allele

- An allele that is only expressed when there is no dominant allele of the gene present.
- The organism which has the recessive phenotype is ***always homozygous***

Genotype

It is the ***genetic makeup*** of an organism in terms of the alleles present.
The genotype of the organism is ***homozygous*** or ***heterozygous.***

Phenotype

It is the physical or other features of an organism due to both its genotype and its environment.

Example

An animal its fur colour is black, therefore:

- Its phenotype is back
- Its genotype may be :
  - *Homozygous black (BB).*
  - *Heterozygous black (Bb.)*

Homozygous

Means having two identical alleles of a particular gene.

Heterozygous

Means having two different alleles of a particular gene.

Results of simple cross

1- If two homozygous individuals with different phenotypes are crossed

The result is 100% heterozygous dominant.

Example

Parental phenotype	Red		white	
genotype	RR		rr	
gamete	(R)	(R)	(r)	(r)
F1 genotype	Rr	Rr	Rr	Rr
Phenotype	red	red	red	red

Phenotype ratio 100 % red

Genotype ratio 100 % heterozygous red

2- If two heterozygous individuals with the same phenotype

Example

Parental phenotype	Red		red	
genotype	Rr		Rr	
gametes	(R)	(r)	(R)	(r)
F1 genotype	RR	Rr	Rr	rr
Phenotype	red	red	red	white

The phenotype ratio is : 3 dominant : 1 recessive **or** 75 % dominant : 25 % recessive.

The genotype ratio is : 1 homozygous dominant : 2 heterozygous : 1 homozygous recessive

OR 25% homozygous dominant : 50% heterozygous : 25% homozygous recessive

3- If a heterozygous dominant and homozygous recessive are crossed

Example

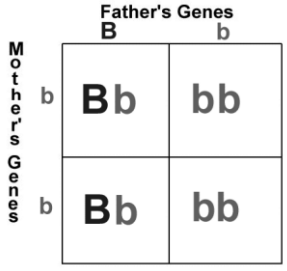
Parental phenotype	Red		white	
genotype	Rr		rr	
gametes	(R)	(r)	(r)	(r)
F1 genotype	Rr	Rr	rr	rr
Phenotype	red	red	white	white

The phenotype ratio is : 1 dominant : 1 recessive **or** 50 % dominant : 50 % recessive.

The genotype ratio is : 1 heterozygous dominant : 1 homozygous recessive

In any of the above examples you can use (punnett) squares as shown below

	R	r
R	RR	Rr
r	Rr	rr



Blood groups

There are four blood groups

A , B , A B and O

Blood groups are controlled by 3 alleles

I^A , I^B and I^O

- Both I^A and I^B are dominant while I^O is recessive

Blood group	Its genotype
A	Homozygous ($I^A I^A$)or heterozygous ($I^A I^O$)
B	Homozygous ($I^B I^B$)or heterozygous ($I^B I^O$)
AB	Heterozygous ($I^A I^B$) only
O	homozygous ($I^O I^O$)only

Co- dominance

- It is the existence of two alleles for a characteristic where ***neither is dominant*** over the other but both are ***equally dominant*** and influence of both alleles is shown in the phenotype.
- In case of Co-dominance both alleles are represented by ***capital letters***.

Example

If a plant with red flowers and a plant with white flower re crossed together and the produced offspring has pink flowers

Parental phenotype	Red		white	
genotype	RR		WW	
gamete	(R)	(R)	(W)	(W)
F1 genotype	RW	RW	RW	RW
Phenotype	pink	pink	pink	pink
Phenotype ratio	100 % pink			
Genotype ratio	100 % heterozygous pink			

Result of crossing F1

Parental phenotype	Pink		Pink	
genotype	RW		RW	
gamete	(R)	(W)	(R)	(W)
F1 genotype	RR	RW	RW	WW
Phenotype	Red	pink	pink	white
Phenotype ratio	1 red	: 2 pink	: 1 white	

Genotype ratio 1 homozygous red : 2 heterozygous pink : 1 homozygous white

NOTICE

- ***Breeding true or pure breading*** means homozygous individual .

Test cross or back cross

Means crossing an individual that has the ***dominant phenotype*** with other individual that has the ***recessive phenotype*** to know if it is ***homozygous or heterozygous*** .

- If the result is ***100%*** with dominant phenotype , we conclude that this individual is ***homozygous*** .
- If the result is ***50%*** with dominant phenotype , we conclude that this individual is ***heterozygous*** .

SEX LINKAGE

- It is the inheritance of genes carried on the ***sex chromosomes*** .
- The sex linked alleles are ***carried on X*** chromosome but not on the Y chromosome because ***X is longer*** than Y therefore it can carry more alleles .

Examples

1- Haemophilia

- It is a disease in which the blood of the affected person has a ***reduced ability to clot*** .
- This gene therefore has two alleles :
  1-***The normal allele*** , it is ***dominant***.
  2- ***The allele for haemophilia*** , it is a ***recessive*** allele.

If the allele codes for normal is represented by (N) while the allele codes for haemophilia is represented by (n)

A male his genotype X^N Y is normal
A male his genotype X^n Y is affected and not a carrier as one recessive allele is enough to show the recessive characteristic .
A female her genotype $X^N X^N$ is normal.
A female her genotype $X^N X^n$ is carrier.

Therefore the haemophelian males are more than the females as one recessive allele is enough to develop the disease .

2-Red - green colour blindness

- It is a disease caused due to a ***recessive*** allele of a sex linked gene .
- In this disease the person cannot distinguish the ***green, yellow , orange and red*** colours .
- This disease can be detected by using a card contains the above colours in a certain pattern and so the infected person cannot detect this pattern .
- It is due to a defect in one of the ***three groups*** of colour sensitive cones .

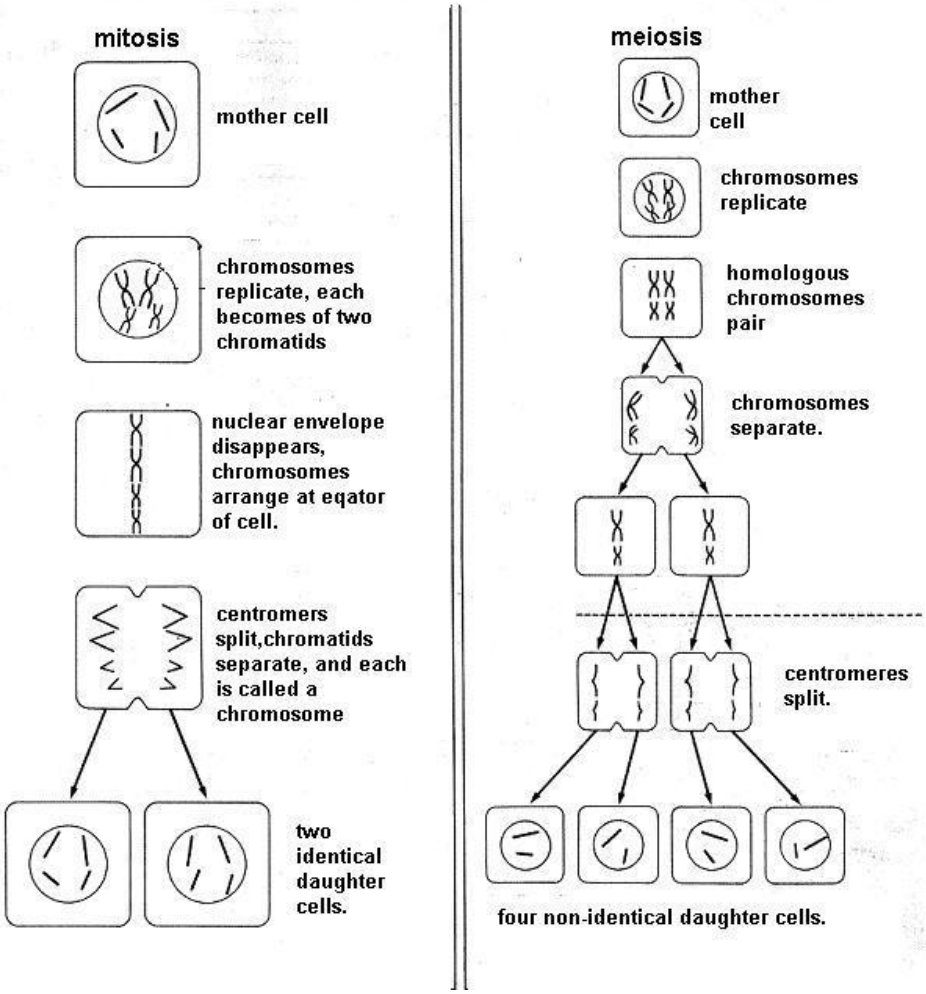
If the allele for normal is (B or any other capital letter) so the possible genotypes of males are:

normal male : X^B Y
affected male : X^b Y

The possible genotypes of females are:

normal female : $X^B X^B$
carrier female : $X^B X^b$
affected female: $X^b X^b$

Types of nuclear division



Mitosis	Meiosis(or reduction division)
- A type of ***nuclear division*** resulting in ***genetically identical*** cells in which the chromosome number is maintained by the exact duplication of chromosomes.	- A type of ***nuclear division*** that results in cells with ***half*** the number of chromosomes found in the parent cell.
- ***Takes place in*** growth , tissue repair , and asexual reproduction.	- ***Takes place*** in formation of gametes in sexual reproduction
- ***Two*** daughter cells are produced from one mother cell.	- **Four** daughter cells are produced from one mother cell
- The produced cells are ***identical*** to each other and to the mother cell***.(no variation).***	- The produced cells are ***not identical*** to each other and to the mother cell***.(Leads to variation).***
- Does not lead to ***selection and evolution***.	- Leads to ***selection and evolution***

Importace of meiosis in formation of gametes

To ***reduce*** the number of chromosomes to its half producing ***haploid gametes*** and this is necessary to ***restore the normal diploid*** number of chromosomes ***after fertilization***.
It leads to ***variation*** during formation of gametes , this variation is necessary for ***natural selection*** and ***evolution***.

How meiosis leads to variation

By forming ***new combinations of alleles*** from maternal and paternal chromosomes

Stem cells

Are ***unspecialised cells*** that divide by mitosis to produce daughter cells that can become ***specialised for specific functions.***

Example

Stem cells in embryo may be modified into red blood cells, liver cells..etc.

VARIATION

What is variation ?

Variation means that living organisms of the same species differ form each other in some of their characteristics.

Types of variation

1- Discontinuous variation	2-Continuous variation
Definition : Are the variations which is caused by genes alone and results in a limited number of distinct phenotypes with no intermediate forms. It is influenced by genes only.	***Definition*** Are the changes which occur when the characteristic is determined by many pairs of alleles leading to a gradual transition between two extremes of a characteristic . It is influenced by genes and environment.
Factors affecting it - A single pair or few pairs of alleles. -Is not effected by environment .	**Factors affecting it** - Many pairs of alleles. - Affected by environment.
Examples : 1. Blood groups 2. Tongue rolling	**Examples** 1. Height in humans 2. Intelligence 3. Weight 4. Finger prints.

What causes genetic variation ?

Meiosis

- During meiosis a ***half of the chromosomes*** go into one gamete and a half into the other gamete.
- Each set of chromosomes carries alleles with particular characteristics and this causes variation.

2- Fertilization :

Fertilization leads to ***random combination of alleles*** for example :

One sperm from millions of sperms fuses with one ovum leading to the production of certain characteristics which may be varied if another sperm fuses with that ovum.

3- Mutation .

It's a sudden change in gene or genes, chromosome or chromosomes.

Factors lead to mutation

Chemicals

Such as mustard gas, tobacco and some food preservatives.

Many chemicals alter structure of DNA when react with it .

Radiation

Such as X –ray, gamma ray and cosmic radiation.

It may cause break in DNA .

Notice

Factors that cause mutation are known as ***mutagens***

Types of mutation

1-Chromosome mutation	2-Gene mutation
May be caused due to : • A change in one or more chromosomes. • Increase or decrease in number of chromosomes • A part of a chromosome get snapped and lost. ***Example*** Down's syndrome	• Caused due to a change in the individual's gene. ***Example*** Sickle cell anaemia.

Down's Syndrome

What causes it ?

- A chromosome mutation in which the ovum carries extra chromosome ***i.e*** 24 instead of 23.
- This takes place due to unequal division during formation of the ova leading to presence of an extra chromosome (chromosome number 21 becomes two instead of one).
- After fertilization the produced individual carries 47 chromosomes in his somatic cells instead of 46.

Characteristics of individuals

- Physical and mental retardation
  e.g : heart defects
- liability to infectious diseases .

Diagram 1 (Down Syndrome)

Diagram 2 (Unaffected)

The reproductive organs do not develop properly therefore this disease *can not* **be inherited.**

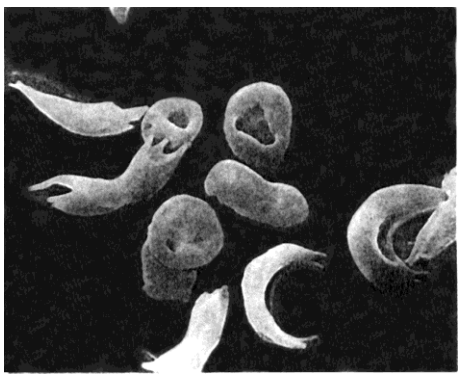
Notice

- Older mothers have a high chance of producing down's syndrome babies.
- Cells from amniotic cavity can be taken and stained to know if there is disorder in the number of chromosomes.

Sickle cell anaemia

What is sickle cell anaemia?

A ***mutation*** leads to change in the ***base sequence*** of the gene coding for haemoglobin leading to a disorder in the ***sequence of amino acids*** in the haemoglobin molecule .
The defective haemoglobin molecule causes the red blood cells to ***distort when subjected to a low conc. of O_2.***



Harms of sickle cell anaemia

The distortion of RBC's leads to :

- *Their rapid destruction.*
- *Damage of the inner walls of blood vessels causing pain and resist blood flow.*
- *Decrease in ability to carry oxygen .*
- *Decrease in their flexibility, as a result blood pressure increases to push them in fine capillaries .*

People according to sickle cell

Homozygous normal people $Hb^A Hb^A$	Trait , heterozygous or carrier $Hb^A Hb^S$	Homozygous sickle $Hb^S Hb^S$
• Have normal haemoglabin	• Some blood is normal and some is abnormal • Also called ***milder*** from. • Not all red blood cells distort in shortage of oxygen .	• All the blood carries abnormal haemoglobin. • Die due to inability to carry enough oxygen .

Malaria

Is a disease caused by a parasite called ***plasmodium*** which is transmitted by mosquitoes, this parasite lives in RBC's

Sickle cell anaemia and malaria.

In tropical regions sickle cell is widely spread because, mosquitoes which transmit malaria live there, therefore :

(a) The normal people $Hb^A Hb^A$ die by the effect of malaria.

(b) The homozygous sickle $Hb^S Hb^S$ die by the effect of anaemia, and do not reach the age of marriage.

(c) The trait $Hb^A Hb^S$ are resistant to malaria and also can live as some blood cells contain normal haemoglobin, therefore they reproduce producing individuals who have sickle cell haemoglobin .

Advantages of sickle cell anaemia :

Resistance to malaria because sickle cells have shorter life span so the parasite ***can not complete*** the part of its life cycle that must take place in the red blood cells.

Sickle cell anaemia is a form of discontinuous variation because

first it is a genetic condition ,***not affected by environment*** ,second it is ***controlled by one gene*** with small number of alleles (two $H^N H^S$), third it has ***only three distinct categories*** which are $H^N H^N$, $H^N H^S$ and $H^S H^S$ with no intermediate forms.

SELECTION

It is the process of choosing the best varieties which are well adapted to the environment and allow them to grow and reproduce.

Types of selection

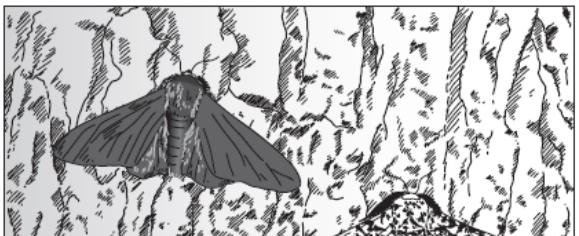
1- Artificial selection

- It is a process carried out by humans to choose and breed the best varieties of domestic animals and plants in order to improve their strain
- Artificial selection results in new varieties within a ***particular species*** but does not form new species in most cases.

2- Natural selection

- It is the process by which the best organisms adapted to their environment tend to have an increased chance of survival.

Examples of natural selection



1-Dark moths can live in industrial polluted areas better than those moths which have pale colours because they can hide from their enemies by camouflage as the surrounding in the polluted area is dark .

2- In lack off water, desert plants which have long roots have a chance for survival better than those with short roots .

Development of antibiotic resistant bacteria

as a result of ***mutation*** in bacteria ***new strains*** are developed which are resistant to certain antibiotic. By using this antibiotic by human , the non-resistant bacteria die while resistant bacteria can live and reproduce (this known as ***natural selection*** and ***survival for the fittest***) one of the factors that increases development of antibiotic resistant bacteria is that , many users of antibiotics do ***not complete the course.***

When using antibiotics

You should complete the course even if you feel better, ***because*** many bacteria may remain in your body and develop resistance to this antibiotic and so if you reuse this antibiotic it will not be effective or even if you infect a person with this type of bacteria , he can not be treated with this antibiotic.

Why some antibiotics are used less than others

Because many types of bacteria are ***resistant*** to certain types of antibiotics which makes their use non effective, other types of antibiotics are less frequently used because of their ***side effects*** or because they ***cannot be used by children*** or only used for certain types of ***rare diseases***.

Evolution

The change in ***adaptive features*** of a population over time as the ***result of natural selection***

Theory of natural selection , and how natural selection is considered as a mechanism that leads to evolution .

1- Variation

Individuals within a species are all ***slightly different*** from each other, these differences are called variation, some of these varieties may be able to survive better than others .

2- Overproduction

Most organisms produce more young than will survive to adulthood.

3- Struggle for existence and survival for the fittest

If there is a change in the surrounding environment, such as climate or food supply, some of the varieties may be able to survive better than others.

4- Advantageous characteristics passed on to offspring

The variety which is best adapted to the new conditions can live longer and reproduce more than the other varieties, so passing on their advantageous characteristic to their offspring.

5- Gradual change

By time the variety which is best adapted will be of largest number and then begins to replace the other varieties leading to evolution .

Artificial selection in plants

Used to

1- Increase crop yield.
2- Developing plants resistant to pests.
3- Increase rate of reproduction in plants.
4- Developing identical plants with good characteristic by cloning.
5- Developing plants that can grow with less fertilizer.

Ways of artificial selection in plants

1- By cross- breeding of strains with desirable characteristics.

Example : cross breeding plants of good colour and other with attractive smell , to obtain plants with both characteristics

- *Before maturation of one variety (e.g. that with attractive colour) remove its stamens to avoid self pollination, then cover it with a plastic bag to avoid cross pollination.*
- *When flowers of the other variety become mature , collect its pollen grains , and dust it on the stigma of the other one.*
- *Use the produced seeds to produce new plants , choose those with the required characteristics and allow self pollination several times until all the produced offspring has the required characteristics.*

2- By increasing the rate of mutation by using radioactive materials , and choose the best produced varieties and allow them to grow and reproduce

3- Production of new strains by vegetative propagation .e.g. grafting .

Example of using artificial selection to improve food production

By allowing cross pollination between strains of rice of high resistant to pests and strains of rice with high yield and then the produced seeds are allowed to germinate ,and from the produced offspring the individuals with both resistance and high yield are allowed to be self pollinated and the process is repeated until 100%of offspring are produced with both desired characteristics

Adaptive features

Adaptive feature

the inherited ***functional features*** of an organism that ***increase its fitness.***

Fitness

The probability of an organism ***surviving and reproducing*** in the environment in which it is found.

Adaptation

Process, resulting from ***natural selection***, by which populations become ***more suited*** to their environment ***over many generations.***

Adaptation of desert plants (xerophytes)

Example : cactus

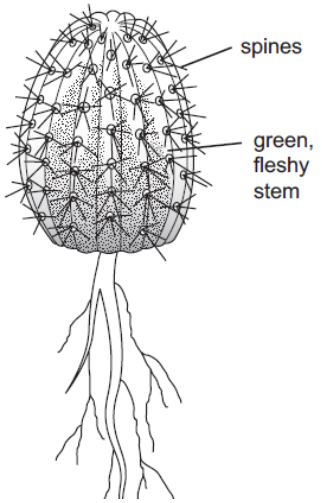
leaves

-Very small in the form of spines .

*To decrease the water loss .

*In order not to be ruptuered by wind

*To protect the plant against being eaten.



Root

- Very long and branched :

*To increase the area of absorption .

*To fix the plant firmly in the loose sandy soil .

Stem

-Short in order not to be affected by wind .

-Covered with cuticle to decrease the water loss.

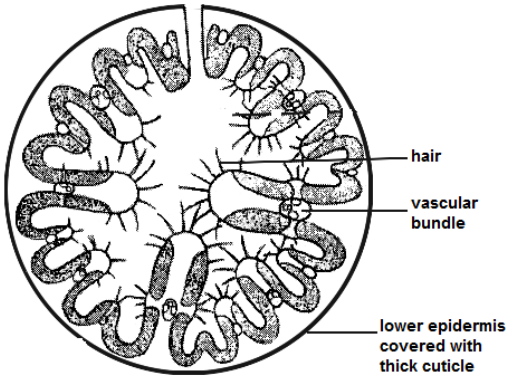
- Juicy to store water and food .

-Contain chlorophyll for photosynthesis .

Other xerophyte

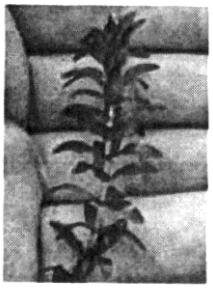
arram grass

- Has ***rolled leaves*** and ***stomata in grooves*** to reduce the direct effect of air currents on the rate of transpiration.
- ***Thick cuticle*** to reduce water loss.
- Stomata are surrounded ***by hair*** to trap water vapour therefore humidity around stomatal pores increases leading to a decrease in rate of transpiration



Adaptation Of water or pond plants (hydrophytes)

First : Submerged plants e.g elodea or Canadian pondweed



Root

- Very weak or absent

Because it is not needed for absorption or fixation

Leaf

- Large in number to provide a ***large surface area*** for photosynthesis, and for the gaseous exchange needed for respiration.
- Epidermal cells of leaves contain ***chloroplasts*** to increase rate of photosynthesis as the light intensity in water is low.
- Contain ***air spaces*** to keep the plant suspended near the water surface for photosynthesis .
- Thin, ribbon-like in order not to be pulled off by water currents.
- ***No stomata*** as it is not needed for transpiration or gaseous exchange

Stem

- Elastic free form any supporting tissues.
  In order not to be broken down by the effect of
- Contain ***air spaces*** to keep the plant suspended near the water surface for photosynthesis .
- Contain ***chlorophyll*** for photosynthesis to help the small leaves in making the plant's food.

Second : Floating Plants e.g. Nymphea (water lily)

Roots

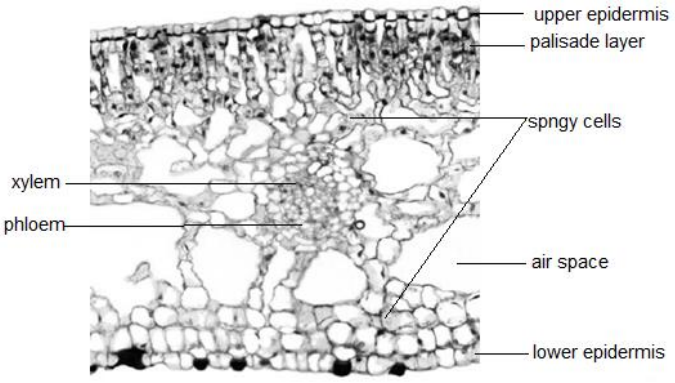
Are present to fix the plant in soil of ***shallow water***

Stem

Short

Leaves

- ***Broad*** to get rid of the water that enter the plant.
- Contain stomata on the ***upper surface only*** because the lower surface touches water.
- Has ***long neckor stalk*** to expose the leaf to light on the surface of water to carry out photosynthesis.
- There are ***air spaces*** running from leaves to roots which allow diffusion of oxygen as there is no enough oxygen in the mud that surrounds roots.



Genetic engineering

Taking a gene from one species and putting it into another species so that this gene can be expressed in the phenotype.

Example production of the human insulin

Why it is produced

People have the disease ***diabetes mellitus*** need injection of insulin every day as they can not produce insulin.

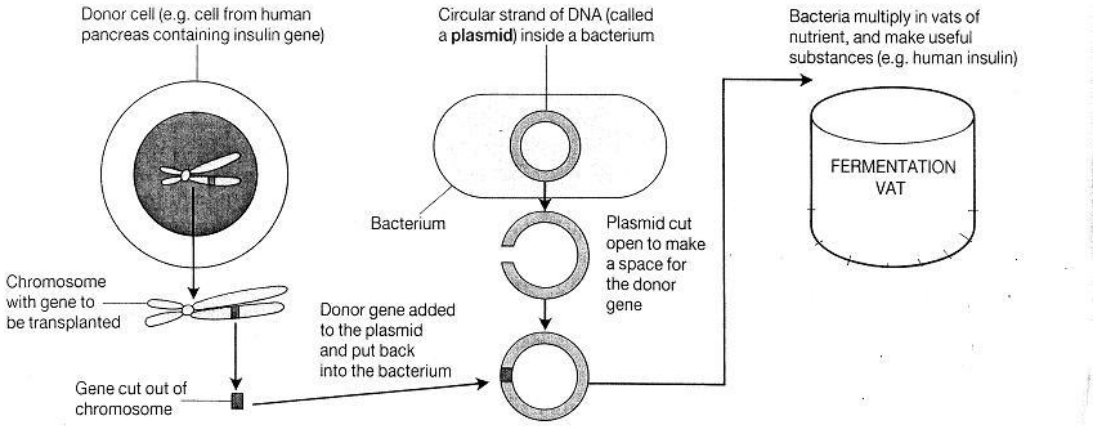
How insulin was obtained before genetic engineering

From the animals killed for food.

Stages of production of human insulin by genetic engineering

1- Using certain enzyme known as ***restriction endonuclease***, DNA in a human cell is cut into short lengths forming ***sticky ends***.
2- The particular length of DNA which codes for making insulin is identified and isolated.
3- ***A plasmid*** (which is a ring of DNA found in bacteria) is separated by centrifugation.
4- The ***same restriction endonuclease*** is used to cut the plasmid forming ***complementary sticky ends.***
5- A specific enzyme known as ***ligase*** is used to stick the gene which codes for insulin and the plasmid of the bacteria.
6- The genetically engineered plasmids (the plasmid joined to the gene coding for insulin) are added to a culture of bacteria.
7- Many bacteria will take up one or more of the plasmids into their cells, these bacteria can

produce insulin .
The genetically engineered bacteria are allowed to reproduce in ***fermenter*** to produce identical cells that have the ability to produce insulin.



Plasmid is used as a vector

(vector is a structure or organism used to transfer something from one organism to another)

Advantages of using plasmid as a vector

- Can be extracted easily from bacteria.
- Can be easily returned back into bacteria.
- The gene introduced to the plasmid can be

Why bacteria is useful in genetic engineering

- Because bacteria has ***plasmids*** that can be isolated , modified and then introduced into bacteria once more , also bacteria ***reproduce at a very high rate*** producing ***genetically identical*** offspring.
- Lack of ***ethical concerns*** over their use.
- ***Have genetic code*** shared with all other organisms

Advantages of using insulin produced by genetically engineered bacteria rather than obtaining insulin from animals

- Insulin produced by genetic engineering is ***identical*** to that of the human therefore it will not lead to ***rejection*** or ***allergies*** while that obtained from animal is slightly different than that of the human.
- ***Rate of production*** of insulin by bacteria is very high compared with obtained from animal.
- Insulin obtained from animal may lead to ***transmission of diseases***Insulin produced by genetic engineering is ***identical*** to that of the human therefore it will not lead to ***rejection*** or ***allergies*** while that obtained from animal is slightly different than that of the human.
- ***Rate of production*** of insulin by bacteria is very high compared with obtained from animal.

- Insulin obtained from animal may lead to ***transmission of diseases***

Other examples of genetic engineering

– the insertion of genes into crop plants to be resistant to herbicides.
– the insertion of genes into crop plants to be resistant to insect pests.
– the insertion of genes into crop plants to provide additional vitamins.

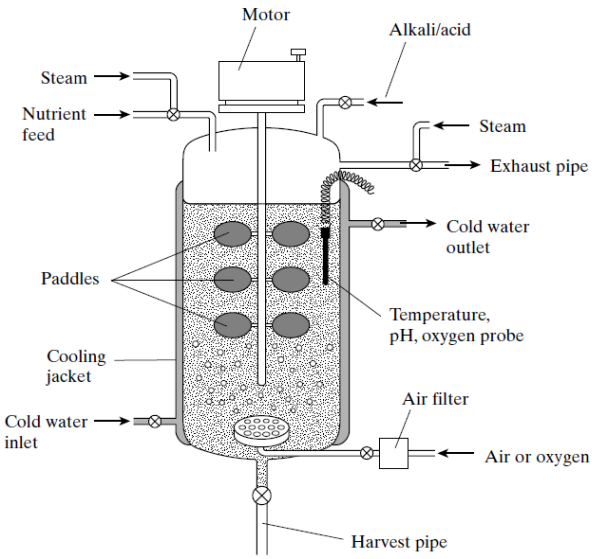
Advantages of genetically modified crops

- Can develop crops resistant to pesticides and herbicides, so that pesticides and herbicides can be used without harming the crop.
- Can develop crops with much more vitamins such as golden rice.
- Can high yielding
- Can develop disease resistant crops.
- Can develop crops with vigorous growth in normal conditions.
- Can develop plants all grow to a similar height (making harvesting easier)
- Can develop crops ripen at the same time so that they are all ready to harvest at the same time

Disdvantages of genetically modified crops(GM crops)

- ***Gene can pass*** from herbicide resistant crops to herbs or weeds leding to development of ***resistant weed populations*** in the field.
- Herbicide and insecticide crops may affect ***human health***.
- May enable the farmer to ***increase doses*** of herbicide and insecticide this increases ***pollution***.
- Affects ***biodiversity***.

Using fermenters



Sterilizing a fermenter

- This takes place by introducing **very hot stem under high pressure.**

Why sterilization using steam is better than using other chemicals or detergents?

If chemicals or detergents are used, **their remains** may harm the useful organisms

which are required to be grown in the fermenter but steam when cooled it forms water which will not harm the microorganisms when added to the fermenter.

Importance of strilisation

To avoid the presence of any foreign microorganisms that **can compete** with the organisms in the culture (medium) reducing the yield of the product, and cause the product **to be contaminated** with waste products or cells of the foreign organisms

Paddles in fermenters

- For **agitation or stirring**, to mix up the contents so that microorganisms can be more exposed to the nutrients.
- To keep the temperature even throughout the vessel.
- Some fermenter use **jets of air** to mix the contents instead of paddles.

How to adjust temperature in the fermenter

- Temperature may increase as a result of metabolic activities of microorganisms in the fermenter, this increase can be detected by temperature probe.
- To reduce temperature to its suitable value, cold water is forced into the water jacket until reaching the required temperature.

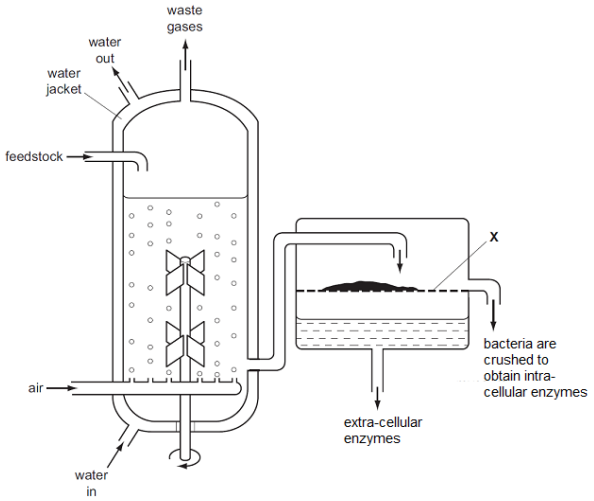
Notice

Stainless steel or special alloys are used in making fermenters **because** many microorganisms produce acidic substances that have **corrosive action** on the walls of the fermenter.

Using fermenters to manufacture enzymes

The organisms used

Yeast , fungi or bacteria



Method

1. ***Feedstock*** such as starch is sterilised and is forced into the fermenter to be used by microorganisms which are allowed to grow producing their enzymes.
2. If the enzymes are ***extracellular***, they are extracted directly from the filtrate.
3. If the enzymes are ***intracellular*** , the microorganisms are filtered out of the feedstock to be crushed and then the enzymes are extracted with water or other solvents.

Manufacture of antibiotic penicillin.

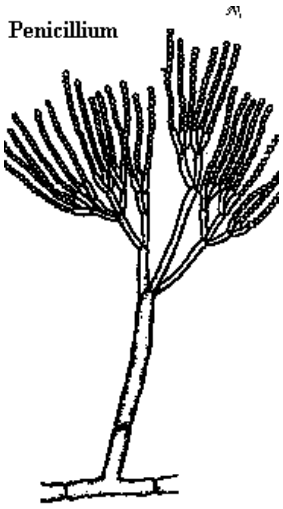
It is made by a fungus known as ***penicillium***

steps

- In a ***sterilized*** fermenter, ***spores of a the mould Penicillium*** are placed (the spores are known as ***starter culture*** as they are used to start the process)

- ***Culture solution*** is forced into the fermenter, this solution which is usually contains waste products of starch industry (called corn steep liquor), it contains the sugar lactose, amino acids and mineral ions.
- ***Oxygen*** is forced for respiration of the mould Penicillium.

- Temperature is kept at 24^{o} C this provides suitable temperature for spores to be developed into filaments of cells which multiply rapidly , doubling their mass every six hours.
- ***After about 40 hours*** the cells begin to produce penicillin, and continue to produce it for several days.
- ***After this period*** of time the fermenter contains fungus , unused nutrients and penicillin solution.
- The products are ***filtered*** to remove the fungus, then penicillin is extracted from the watery solution using organic solvents.
- Penicillin is dissolved in water and allowed to form ***crystals of pure penicillin***



ECOLOGY

Sun

- Is the main source of ***energy .***

Ecosystem

- It is the community of independent organisms and the environment in which they live.

Examples of ecosystems :

Forests, rivers, deserts and a decomposing log or lake.

Habitat

Is a place where n organism lives.

Types of organisms in ecosystems

1-Producers (autotrophs)	**2-Consumers (Heterotrophs)**	**3-Decomposers (saprtrophs)**
Living organisms that can make their organic food usually using Energy from sunlight, through photosynthesis. **e.g.** green plants, phytoplnktons, algae and photosynthetic bacteria.	Organisms which obtain their energy by feeding on other organisms . **e.g**. humans and animals	Organisms which get their energy from dead bodies and organic remains **e.g** saprotrophic bacteria ,and fungi .

Types of consumers

1-Herbivores	**2-Carnivores**	**3-Omnivores**
Organisms obtain energy by feeding on plants only. **e.g** rabbit	Organisms obtain energy by eating other animals. **e.g** lion	Feed on plants and flesh **e.g** humans.

Parasites

Living organisms which obtain their food from other organisms causing harm to them .
e.g bacteria that cause diseases such as cholera .

Host

The living organism which is harmed by parasite **e.g** . a human infected by cholera .

Importance of decomposers :

1-Reduce accumulation of organic remains and deed bodies .
2-Help in recycling of nutrients.
(during decomposition dead bodies and remains are converted to inorganic materials to be used by producers once more .)

Food chain

It is a chart showing the flow of energy in the form of food from one organism to the next beginning with a producer.

Example :

grass → **insect** → **frog** → **snake**

(producer) *(primary consumer)* *(secondary consumer)* *(tertiary consumer)*

Notice

- The arrow represents the flow of energy .
- Primary consumer is a herbivorous organism or omnivorous .

Energy flow

- During photosynthesis light energy is stored in the form of a chemical energy inside the producers.
- This chemical energy flows from one organism to another in the form of food but during this an amount of energy is lost:
  - *In the form of heat to the surrounding medium.*
  - *In the form of kinetic energy during movement .*
  - *In the form of undigested food which is expelled without making use of its stored energy.*
  - *In the form of expired hot air or excretion of warm urine .*

The non-cyclic nature of energy flow

Means that amount of energy lost during its transfer from one trophic level to another and not cycled like nutrients e.g. water, nitrogen and carbon.

Trophic level or feeding level

Is the organism's position in a food chain, food web or pyramid. e.g producer , primary consumer ... etc.

What limits the length of a food chain

Shortage of energy due to the loss of energy among trophic levels.

Importance of short food chains

- Reduces the loss of energy.
- Reduces the loss in biomass.

Importance of feeding on plants (to be a primary consumer)

Reduces loss of ***energy*** and ***biomass***, and this helps to feed ***greater number*** of humans.

Disadvantages of feeding on plants only

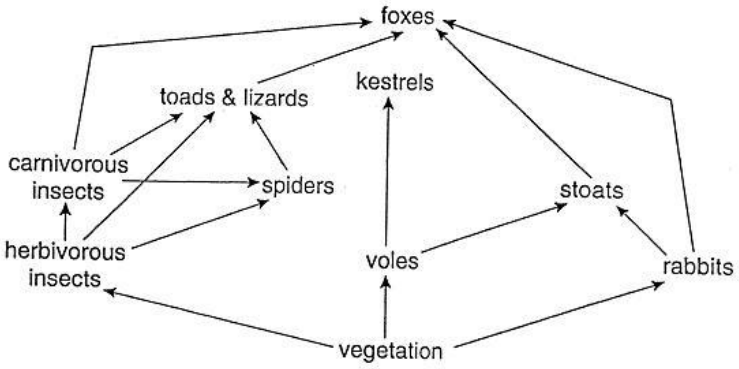
Shortage in ***certain amino acids*** which are found in animal proteins and not in plant proteins.

Advantage of feeding crop plants to animals.

- Supports animal life
- Provides animal protein for humans in the form of meat , milk and eggs

Food Web

- A food web is a network of ***interconnected*** food chains showing the energy flow through part of an ecosystem.



Food webs are better than food chains

Food chains provide ***one possibility*** for each trophic level , but the food web provides ***different possibilities*** of food relationships therefore it gives a clearer image .

Why it is difficult to determine trophic level of an organism in a food web

When it occupies more than one trophic level because it shares different food chains in this food web.

When there is a plague(high increase) in an organism

it causes a decrease in number of the organism which it uses as food and an increase in number of organisms that use it as food.

Food cycles

A food chain or food web with decomposers added .

Food pyramids

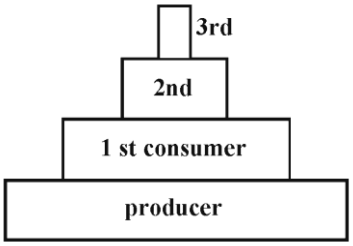
It is a diagram of boxes above each other , the size of each box represents certain data about organisms in a food chain .

Types of food pyramids

1- Pramid of number **2- Pramid of biomass** **3- Pramid of energy.**

1-Pyramid of number

A diagram of boxes above each other, the ***size*** of each box represents ***the number*** of each kind of organisms in a food chain.



Advantages

- ***Easy to be constructed*** as it does not kill organisms to prepare dry mass like that of pyramid of biomass or to determine their energy content like pyramid of energy.
- Its construction ***is not a time consuming*** or expensive process.

Disadvantge

A pyramid of number may be misleading (upside down).

2-Pyramid of biomass

A diagram of boxes above each other, the size of each box represents the ***mass*** of each kind of organisms in a food chain.

Advantage

Provides better image for the flow of energy in the ecosystem better than that of the pyramid of number.

Disadvantges

- Time consuming, expensive , and samples of organisms needed to be killed for preparation of dry mass.
- It does not provide a clear image about the flow of energy in the ecosystem as the amount of energy in equal masses of materials such as carbohydrates and fats are not equal.

3-Pyramid of energy

A diagram of boxes above each other, the size of each box represents the ***energy content*** of this kind of organisms in a food chain.

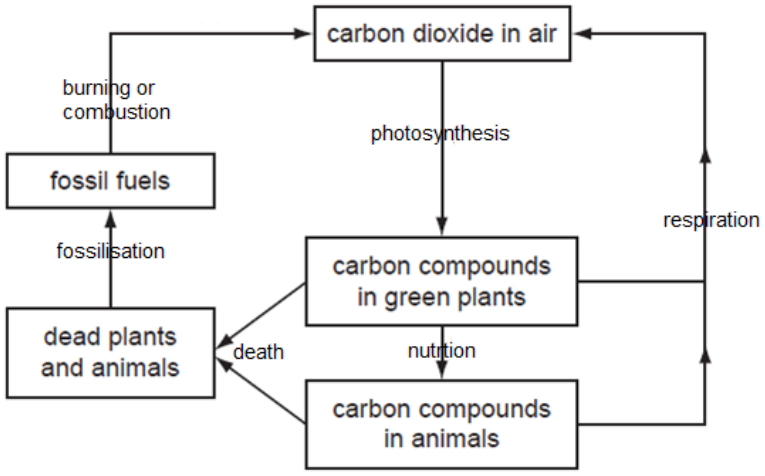
Advantage

It is the best type because it gives a clear image of how the amount of energy in each tropic level gets less and less.

Disadvantages

Time consuming , expensive and samples of organisms needed to be killed by being burnt in a ***calorimeter***.

Carbon cycle

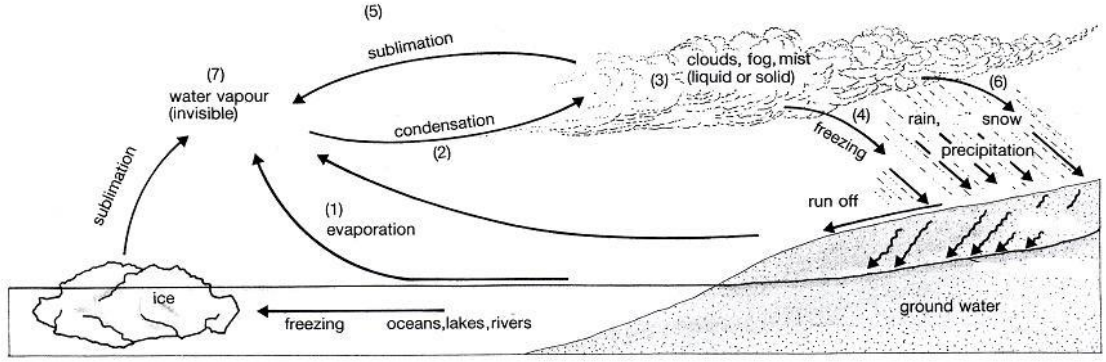


- Carbon is found mainly in air in the form of carbon dioxide, found in living organisms in carbohydrates, fats and proteins.

Flow of CO_2

- Carbon is absorbed by plants during the process of photosynthesis in the form of CO_2 to from glucose
- Carbon compounds in plants are used in synthesis of polysaccharides, proteins and fats.
- Carbon flows from plants to other organisms in the form of food.
- Other organisms break down food during respiration producing CO_2 , or die and decompose releasing CO_2
- Dead organisms under certain conditions of pressure and temperature form fuels .
- Burning of fuels releases CO_2 in air.

Water cycle



- Some of the water in seas, lakes and oceans evaporate .
- Vapour rises forming clouds, their particles may condense and fall as rain, or snow and this is known as ***precipitation*** .
- Some water is taken by plants, and then lost by transpiration, and after death and decay.
- Some water is taken by humans and animals, and returns by respiration, excretion, defecation or after death and decay.
- Some of the rain water forms the underground water or reach water streams , where it evaporate and so on.

Nitrogen cycle

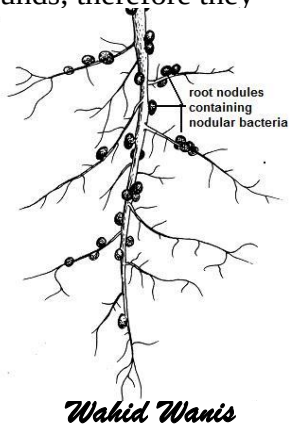
Microorganisms take part in nitrogen cycle

1-Nitrogen fixing bacteria

- Bacteria live in soil that can convert nitrogen gas into nitrogenous compounds such as nitrates.
- Are ***aerobic bacteria*** therefore ***ploughing soil*** is important for activating it because ploughing help soil to be well aerated.
- It is ***useful bacteria*** because plant need nitrogen ions for formation of proteins and can not use nitrogen as a gas, but can obtain it in the form of nitrogen compounds, therefore they increase fertility of soil .

2-Nodular bacteria

- A type of nitrogen fixing bacteria live in root nodules in leguminous plants.
- Live in ***symbiotic*** relationship (exchange of benefit)with ***leguminous*** plants such as beans and peas.



- Inside nodules *nitrogen fixation* takes place leading to
  Formation of nitrogen compound such as ammonia that
  can be absorbed by the plant and used in formation of amino acids

Therefore:

- Leguminous plants do not need many fertilizer..s.
- Leguminous plants rich in proteins
- Leguminous plants have role in crop rotation as they increase the soil fertility.

3-Nitrifying bacteria :

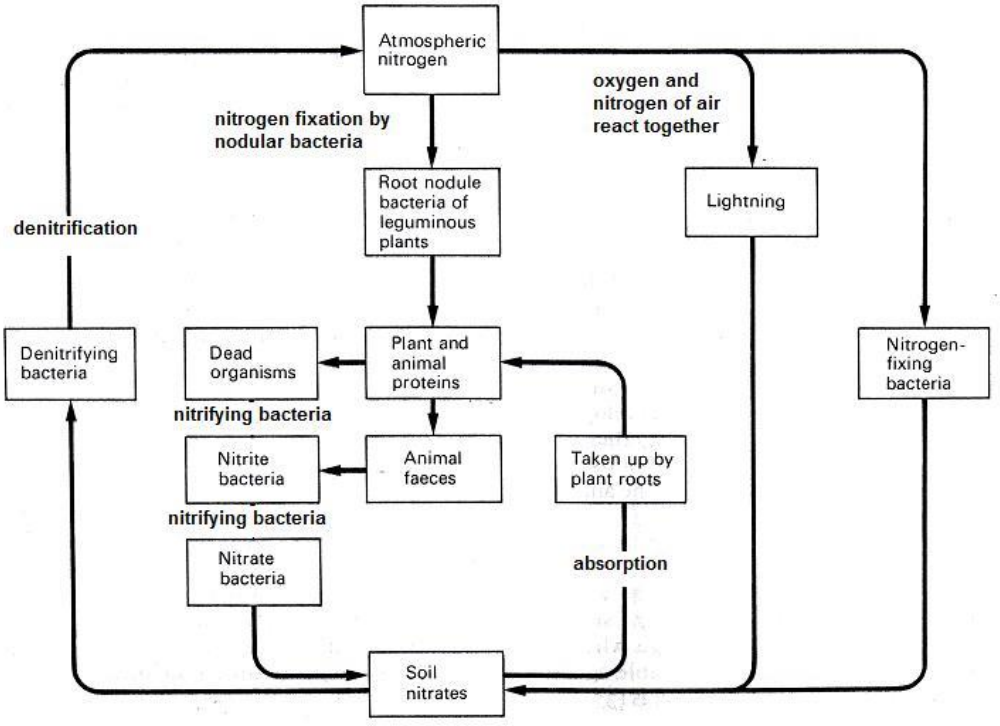
Can oxidise ***ammonia*** into ***nitrites*** and also can oxidise ***nitrites*** into nitrates ***nitrates***, to be absorbed by plants

4-Denitrifying bacteria

- Decompose nitrogenous compounds into nitrogen gas.
- ***Aerobic***, therefore they do not breakdown nitrates in soil if there is enough oxygen in soil, but only break it down to obtain oxygen for aerobic respiration when there is no enough oxygen.
- Decrease the fertility of soil as it decreases the nitrogenous compounds in soil .
- Necessary to complete nitrogen cycle.

Importance of nitrogen ions

Needed for formation of protein need for formation of enzymes, hormones , antibodies and for growth and tissue repair, DNA and RNA



How nitrogen compounds in dead bodies can be available to plants

Protein in their bodies can be digested *by* ***decomposers*** such as saprotrophic bacteria and fungi forming ***amino acids*** which can be ***deaminated*** leading to formation of ***ammonia*** which can be oxidized by *nitrifying bacteria* into nitrites and nitrates in soil which is then can be absorbed by plants.

Other way is that they can be eaten by ***scavengers*** and proteins of their bodies can be

digested and excess amino acids are ***deaminated*** forming ***urea*** that can be excreted with urine to be available for plants as nitrogen containing compound, or the ***undigested proteins*** *are* ***egested*** to be decomposed by saprotrophic organisms.

Population

A group of organisms of ***one species*** living in the same area at the same time and ***can interbreed*** with one another.

Factors effecting population

1-Food supply

Food keeps organisms stronger and able to resist diseases therefore they can live longer and reproduce more.

2-Predation

In presence of predators the number of the preys decreases.

3-Diseases

Spread of diseases decreases population.

4-Emigration

Departure of individuals from a population , decreases number of population.

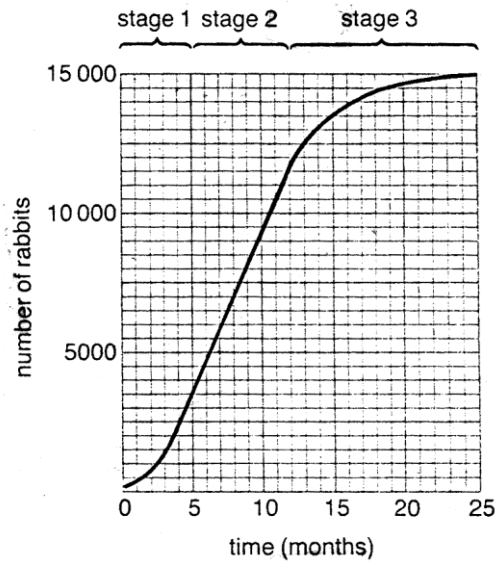
5-Immigration

Means entry of individuals into population , this increases the number of population .

6-Overcrowding

Causes a decrease in population due to :

* *Pollution by wastes.*
* *Spread of diseases.*
* *Competition for food.*
* *Fighting for resources.*



Curves of population growth

Sigmoid curve (S. shaped curve)

Phases of sigmoid curve

1- Primitive stage or lag stage (A)

Birth rate is slightly higher than death rate .

2-Transitional (exponential) stage or log stage (B)

Birth rate is higher than death rate, increase in population is high.

3- Stage of stabilization (stationary)

Birth rate is equal to the death rate, this is due to increase in death rate due to lack of food pollution by wastes ….. etc.

4-Death phase.

During this phase death rate is higher than birth rate.

Causes of increasing birth rate

1-Development of medicine

2-Developing food resources.

3- Hygienic education which helps people to avoid diseases.

Social implication of current human survival rate.

1-Increase of pollution , due to increase in wastes.
2-Deforestation to :
* *Build new roads and cities .*
* *To use wood in making buildings and furniture.*
* *To make paper from wood pulp.*

3- Loss of habitats for other species as a result of damaging forests and using more land causes extinction of many species.
4- Soil erosion .
5- Increase in population leads to severe food shortage
Increase in population leads to a decrease in the land available to grow crops as it is used in buildings . Increase in population also leads to deforestation for building new cities and roads and this decreases number of animals and plants available to be used as food.
6-Lack of job opportunities.
7-Low standard services such as health and education

Community

Is group of different populations live in a particular area and interact with each other.

How to observe yeast cells and how to determine their total population in a medium

stir using a glass rod for equal distribution of the yeast cells, using a syringe take a volume of 1mm and put it on a glass slide and ***stain the cells*** , using the high power lens of the microscope observe the cells, count the cells in this volume , ***repeat*** with equal volumes , take the average number of cells per mm , calculate the number of cells in the total volume of the flask.

The problem of world food supplies

Modern technology and increasing food production

- Production of ***modern machines*** for ploughing and irrigating soil.
- Production of chemical ***fertilizers*** to increase fertility of soil leading to an increase in food production.
- Production of ***pesticides*** to kill pests that harm crops.
- Production of ***herbicides*** to kill herbs.
- Applying ***artificial selection*** for production of good crops such as those of high yield and resistant to pests.

Problems which contribute to famine

1-Unequal distribution of food

The world countries together have more than enough to feed everyone including the millions Which are added every year but food supplies are not shared equally .
(Americans for example represent only 6 % of the world's population but consume 35% of the world's food)

2-Drought

(means lack of rain water which makes agriculture impossible)

Can lead to death of plants , soil erosion(removal of the top fertile soil) and desertification.

3-Flooding

Damage agriculture and wash away the top fertile soil, and this affects animal life.

4-Increasing population

5-Long term climatic changes

may cause agriculture impossible in some parts

6-Effect of pests

such as locust which damage crops.

Some possible solutions

1- When ***famine*** strikes ,rich countries can respond with food and money, ***but this***:
   - may cause poor countries to depend on food aid.
   - respond with money may goes into cash crops, weapon industries or city developments instead of food production.

2- The most successful aid is to **improve health, crops and irrigation.**

3- Researches can be done to reduce the costs of agriculture.

4- Reduction of soil erosion by cultivating belts of trees around agricultural land.

5- **New sources of food** can be found, for example:
   - using single cell proteins .
   - convert cheap plant foods such as Soya into imitation meat.

Negative impacts to an ecosystem of large-scale monocultures of crop plants

(Monoculture means to cultivate large area of the same plant.)

- ***Less variation***, so artificial selection and evolution cannot take place.
- ***Cannot support*** variety of animals.
- Can lead to an ***increase in population of pests*** of this crop leading to reduction in this crop.
- Farmers use ***large quantities of pesticides*** that can harm useful organisms.

Negative impacts to an ecosystem of intensive crop production

- ***Chemical fertilizers*** are used leading to eutophication.
- Excessive ***herbicides and pesticides*** are used leading to death of many useful organisms and can accumulate along food chain.
- Rapid decrease in ***nutrients of soil***.

Negative impacts to an ecosystem of intensive livestock production

- Suffer in the ***crowded conditions*** in which they live.
- ***Spread of disease*** easily.
- Increasing use of antibiotics to treat them leading to development of ***antibiotic resistant bacteria***.
- ***Their wastes*** can pollute land and waterways.

Deforestation

Means cutting down of trees of forests.
Mainly takes place by logging companies.

Reasons for deforestation

1- To build new roads , and new cities.
2- To cultivate new crops for food production.
3- To use wood for making furniture , buildings and for making paper .

Harms of deforestation

1- ***Increase*** in conc. Of carbon dioxide in air , and this may lead to green house effect .
2- ***Decrease*** in conc. Of oxygen .
3- ***Soil erosion***
- erosion means removal of top fertile soil .
- cutting down of trees leads to erosion as the presence of trees
  a- decreases the effect of wind
  b- decreases the effect of water currents in removing top soil.
  c- their roots bind the soil particles together .

4- ***Desertification***
- Means changes in properties of top soil from agricultural soil to desert soil .
- Cutting down of trees makes soil exposed to the effect of wind that carries sand .

5- ***Kills many organisms***
- by removing their shelters
- by removing the source of food

(this also decreases fertility of soil as the presence of animals increases fertility by their wastes , and by their decay in soil)

Measures to reduce the effect of deforestation

- In Europe a system of woodland management known as ***coppicing*** is used in which trees are cut down to just above the ground level , and then left to re-grow.
- Forests are divided into areas and each year an area is coppiced , and then left to about 10 years before repeating the process.
- Using ***selective felling*** not clear felling
- ***Clear felling*** if all the trees in one area are cut down , but selective felling if certain trees are cut leaving others to grow around them.
  (Felling trees affects animal life as large machines with loud sounds are used.)
- Recycling paper
- Using other materials such as aluminum and iron in buildings.

Notice
Wetland such as swamps are destroyed by being drained so that it can be easily farmed or to build new roads or villages and this destroys organisms that live in wetland

Pollution

Definition :
The presence of any substance or a from of energy in the wrong place , with the wrong quantity at the wrong time causing harm.

Pollution by female contraceptive hormones

- If reach water they can affect the ***efficiency of male hormones*** of animals so they produce ***less sperm***.
- Can make male ***fish to change sex*** and become female.
- If reaches drinking water it ***reduces ability of males*** to produce sperm.
- ***Other chemicals*** such as those used in making plastics have similar effect like those of the female hormones.

Water pollution by sewage

- Sewage contains human urine and faeces which may be contaminated with viruses and bacteria which lead to spread of many diseases such as cholera and typhoid
- Leads to ***eutrophication*** like fertilizers .

Dangers of overuse of nitrogen fertilizers.

1-Eutrophication

Means rapid increase in ***water plants and algae*** to block out light, so the plants in water die and this increases population of bacteria which ***consume oxygen*** dissolved in water leading to death of aquatic organisms.

2- Other harms of overuse of nitrogen fertilizers

Some of the nitrates may be carried deep into the soil reaching the underground water which may be used as ***aquifers*** (sources of drinking water) making them unfit for drinking.

Main causes of eutophication

1- Using fertilizers.
2- Sewage drained in water
3- Using detergents containing phosphates.
4- Factory farming
means drainage of remains of animals in water streams which increase phosphates and nitrates.

Leaching

Means washing away different materials by rain water into water streams.

Algal bloom

A thick layer of algae on the surface of water

Pollution of water by inorganic wastes

Inorganic wastes

Are the substances that have not been made by living things, they tend ***not*** to contain carbon in their molecules

Examples

a- Ammonium nitrate which is used as fertilizers.
b- Mercury as a waste product form factories, it is a toxic substance, it causes :
* *Problems in muscles and nervous systems*
* *Death of water animals*
c- Lead : may damage the brain of children.
d- Heavy metals such as lead and mercury act as enzyme inhibitors , and so can kill organisms.

Pollution of air by sulphur dioxide

Sources

1. Coal burning industries
2. Volcanic activities .
3. Sulphuric acid industries.
4. Tires industries

Harms :

1. Dissolve in rain water causing acid rain.
2. Dissolves in mucus of respiratory system .(causing irritation , asthma and bronchitis)
3. Go through stomata damaging plant leaves.

Pollution by acid rain

Factors which contribute to acid rain

1- Normal rain is slightly acidic because of the dissolution of atmospheric CO_2 in rain water forming carbonic acid of pH about 5.7 .

2- Production of SO_2 due to the burning of coal and petroleum in different purposes.

3- Production of Nitrogen oxides during lightning and in factories. Nitrogen oxides may dissolve in rain
water forming nitrous and nitric acid.

Measures to reduce to acid rain

1. Removal of proportions of sulphur compounds from coal and petroleum before burning .
2. Removing proportions of SO_2 form the exhaust gases of factories before being discharged into the atmosphere, this can be done by using certain filters.
3. Designing furnaces in which the fuels can be burned at a lower temperature, this produces less acidic gases .
4. Vehicles can have catalytic converters fitted to their exhaust systems to remove acidic gases but this requires
   a- More money .
   b- Using free lead petrol .

Harms of acid rain

1- Has a corrosive action on the buildings which are made of lime stone (calcium carbonate $Ca\ CO_3$)

2- Reduces the growth of plants and damages their leaves.

3- Causes lakes to be acidic and this has its harmful effects on marine life as increase in acidity may ***damage shells, exoskeletons and skin*** of many animals, ***enzymes*** of animals may be unable to work well in ***low pH*** and this disturbs their metabolism.

4. Dissolves the aluminum salts in the soil which reach water streams and lakes causing it to be toxic **as they cause fish to produce more mucus that blocks their gills**.

Pollution by herbicides and pesticides

Pesticides : Are chemicals used to kill pests , such as insects .

Herbicides : Are chemicals used to kill weeds.

Importance of their use :

1- Reduces crop loss.

2- Controls spread of diseases e.g.malaria .

Harms of their over use :

1-***Persistent*** pesticides such as DDT (pesticides which do not break down but remain in the environment). pass and ***accumulate along food chain*** and become more and more concentrated until reaches humans food as pesticide residues, causing harm .

2- ***Non persistent*** pesticides (which - break down into harmless materials after time). *Therefore there must be enough time between spraying pesticide and harvest the plant , if not people could be poisoned* .

3- Insects - and weeds may develop ***resistance*** to pesticides *therefore pesticides have to be changed from time to time* .

4- Insecticides may kill ***harmful and useful*** organisms together.

Why many countries banned the use of some pesticides

- Because they are ***non specific*** therefore they can kill useful organisms such as bees.
- Many pesticides are ***non-biodegradable*** therefore they remain in the environment and accumulate along the food chain causing the top consumers such as human to receive high harmful doses.

Pollution by nuclear fall out

It means that after explosion, radioactive materials get into atmosphere and ***come down*** to the earth as ***fall out*** .

Its sources

1- Radioactive materials in the ***earth's crust*** .
2- Defects in ***nuclear power stations*** , that may lead to leakage of radiation or explosion .
3- ***Nuclear tests*** .
4- ***X-ray*** machines .
5- ***Cosmic radiation*** from sun and outer space .

Its harms

1- Affect ***dividing cells*** .
2- Damaging ***genes*** .
3- Cause ***cancer*** such as leukaemia .
4- Increase the rate of ***mutation*** in the sex cells causing deformation of babies .

How to reduce their effects

1- Radio - active materials have to be stored or transported in containers which do not allow radiation to escape.
2- ***Precautions*** have to be taken in nuclear power stations to avoid pollution by radio activity .
3- Reducing ***nuclear tests***.
4- To ***find alternative*** sources of energy .

Pollution by non-biodegradable plastics.

Biodegradable materials

- Are the materials that can be digested by bacteria .
- Cause short term pollution problems.

Non biodegradable materials

Are the materials which ***cannot*** be digested by bacteria e.g plastics

Advantages of using plastics

- Cheap.
- Light weight.
- Can be made in any shape and any colour.

The problem of non biodegradable materials

1-If thrown in ***sewage pipes*** leads to their blockage .
2-Some non-biodegradable materials ***can be recycled*** such as paper and metals but the majority such as plastics and polythene ***cannot be recycled*** because they cause pollution during burning or melting .
3-They can harm marine environment because they ***cannot be eaten*** by marine animals therefore they can ***accumulate*** and may remain floating on the surface of water ***blocking out light*** which is needed for photosynthetic organisms
4-Plastics can ***trap or surround*** marine animals causing them to ***suffocate***.
5-***May be eaten*** by animals such as turtles causing their death.
6-Causes ***visual pollution***.

How to avoid pollution by non biodegradable materials

1-New types of ***biodegradable plastics*** have now been developed and their use is gradually increasing .
2- **Some rubbish is now burnt in large furnaces instead of being buried , this helps us to**

- ***get rid*** of non biodegradable materials.
- the ***heat obtained*** from combustion can be used in different useful purposes.
- ***reduces the use of fossil fuel*** as plastic is obtained from fossil fuel.

CONSERVATION

Conservation means ***protection and looking after species*** , ***habitat, resources or even ecosystems*** to be maintained in a good state for future generations.

What is meant by biodiversity?

- It is the total number of different species living in a defined area, ecosystem or biome.
- It also involves the genetic variation that exist within each species.
- It is the result of evolution.

Sustainable resource (renewable resources)

A resource which is ***produced as rapidly as it is removed*** from the environment so that it ***does not run out***.

Examples

Solar energy, tidal energy, wind energy.

Non sustainable resource (non- renewable resources)

A resource which is ***not produced as rapidly as it is removed*** from the environment so that it ***may run out***.

Example

Fossil fuels

Sustainable development

Development providing for the needs of an ***increasing human population without harming*** the environment.

Sustainable development requirements

- Management of ***conflicting demands***.
- Planning to be able to ***spend less*** and make ***more profit***.
- ***Regulations*** to make sure that new developments are ***planned with the environment in mind.***
- ***Co-operation*** at local, national and international levels.

How to maintain fish stocks

Education

- Avoid fishing in breeding seasons.
- Avoid catching small fish to allow them to grow and breed

Legal quota

- Allow countries, regions or fishermen to catch only a certain quantity of fish .
- Quota system specify different amounts for different species.
- It is controlled by inspectors.
- Disadvantages of this system is that it is difficult to catch certain species

Re-stocking

Means to make large number of certain species of fish breed in fish hatcheries and then release them.

Why organisms become endangered or extinct

- Climate changes
- Habitat destruction
- Hunting
- Pollution
- Introduced species.

Reasons for conservation programs

- Reducing extinction.
- Protecting vulnerable environments.
- Maintaining ecosystem functions.
- Balanced nutrient cycles.
- Resources provision such as food, drugs, fuels and genes.

Ways of conserving species

- Captive breeding programs such as breeding in zoo and then allow the produced organisms to live in wild.
- Prevent destruction of the grassland in which they live and to ensure good supply of food.
- Their predators can be controlled or provide them with alternative food
- Education
- Seed banks where seeds are kept to be used when needed.

The need for conservation of habitats and natural resources

Takes place by :

1. Reducing pollution
2. Reducing deforestation
3. Avoid overhunting of certain species .
4. Avoid overgrazing that lead to desertification .

Damaging of a species will affect the balance of the environment as each species has its role in the food web , therefore its absence leads to increase in the number of organisms which this organism use it as food and a decrease in the number of organisms which use this organism as food .

Natural disasters can affect organisms

Examples of natural disasters

global warming, desertification or soil erosion, volcanoes and earthquakes.

Recycling

Means to reuse waste materials after being treated to be in a proper form.

Examples

Recycling paper, glass , plastic and metals

Importance of recycling

1- Reduces accumulation of wastes.

1- Conserve natural resources.

Recycling glass

Glass is made of non-sustainable resources which are pure sand (silicon oxide), other chemicals such as lime (calcium oxide) and soda (sodium oxide).

Making glass requires very high temperature and leads to release of a lot of carbon dioxide.

Method of recycling glass

Glass is crushed , melted and used in making new glass.

Advantages

Less heat is needed

Less carbon dioxide is released.

Maintaining resources.

Reduces pollution due to accumulation of waste glass.

Recycling metals

- Reduces expense of mining.
- Reduces energy consumption

Recycling paper

Properties of recycled paper.

1-Not pure which as the first time prepared paper.
2-Not fine in texture therefore it can be used in making paper towels and paper bags.

Importance of recycling paper

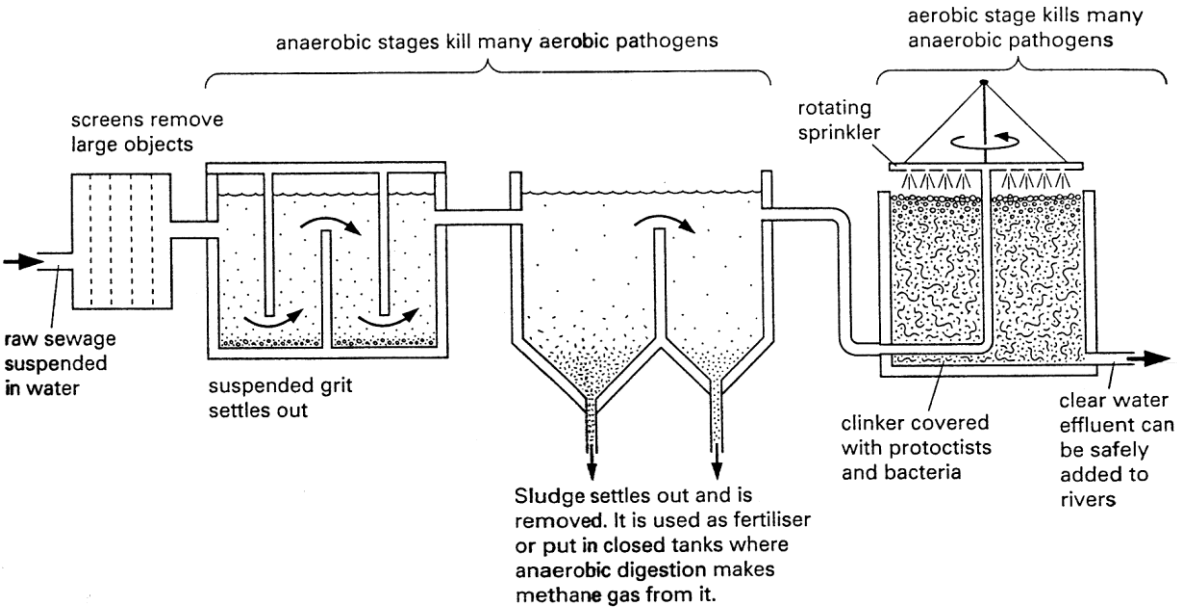
1- Reduces accumulation of wastes and visual pollution.
2- Reduces the rate of cutting trees which are used in making paper .
3-less consumption of water and energy.
4-Avoid burning of waste paper which leads to production of toxic gases.

Disadvantage (There is difficulty in collecting and transport waste paper)

Method of recycling paper

1- Waste paper is collected and washed by water to remove dust, glue and part of ink .
2- Paper is then placed in containers of hot water and chemicals to form paste(pulp).
3- Bleaching substance is added to keep it white but this is an expensive method , therefore usually colour is added to mask the remains of the original colour .
(In some cases no colour is added and no bleaching is done ,and the produced paper is used in making bags and towels)
4- The paste is then inserted between hot cylinders ,the distance between them determine the thickness of the produced paper .

Sewage treatment



Method of sewage treatment

Raw sewage is passed through screens to trap large objects such as grit.
The screened sewage is transferred to settlement tanks where insoluble parts drift to the bottom.

The liquid sewage is treated in one of two ways

First trickling filters

Trickling filters are made of small stones and clinker.
Many aerobic microorganisms such as bacteria and fungi live on the surface of the stone to feed on nutrients found in sewage, also on the stones unicellular organisms that feed on bacteria.
The liquid sewage is trickled onto the surface of the stones through holes in a rotating pipe to be drained out of the bottom of the bed clear with no smell or pathogens and allowed to run into a river or sea.

Second activated sludge

The liquid sewage is passed through aeration tank in which oxygen is forced to activate aerobic microorganisms to feed on organic remains

Importance of sewage treatment

1- Avoid the effect of harmful microorganisms when sewage is drained in water streams.
2- Avoid the eutrophication if sewage is discharged in water streams.
3- If sewage is treated , water from sewage can be used, and remains can be used as fertilizers.

Disadvantages of treating sewage

1- Not nice to know that the water you drink was a sewage.
2- Many dissolved materials such as phosphates obtained from detergents can not be removed and may lead to eutrophication.

2- Expensive.

Classification

Classification: living organisms can be ***sorted*** into groups on the bases of ***shared features in morphology and anatomy***.

- Organisms are classified into groups , the largest group is known as ***kingdom,*** for example plant kingdom and animal kingdom .
- Each kingdom is divided into smaller groups each is known as ***phylum*** such as phylum ***arthropods*** which is divided into smaller groups each is known as ***class*** for example class insects and class arachnids.
- Each class is divided into smaller groups each is known as ***order*** which in turn divided into smaller groups each is known as ***family*** which is divided into smaller groups, each is known as ***genus*** and each genus is divided into smaller groups each is known as ***species.***

Classification from largest group to smallest

Kingdom, phylum, class, order, family, genus and species

Species

It is a group of organisms which have a lot of features in common and can breed with each other producing young fertile offspring.

Examples of species *humans ,cats ,and dogs*.

Importance of classification

- To facilitate the study of living organisms.
- To facilitate the identification of living organisms.
- Classification systems ***aim to reflect evolutionary*** relationships

The binomial system of naming species

Means giving each organism a name of two words :

-The first represents ***genus***, it begins with a ***capital letter*.**

- The second represents ***species*** , it begins with a ***small letter*.**
- The name is written LATIN in italics, or underlined.

Example: the scientific name of humans is *Homo sapiens*

Homo : represents genus

sapiens : represents species

Notice

- The above system is the traditionally system it depends on ***morphology*** *(means shape of their bodies such as having wings, legs and hairy skin)* and ***anatomy*** *(means details of body structure).*

- There are more accurate classification systems such as ***cladistics*** which is based on sequences of ***bases in DNA*** and sequence of ***amino acids in proteins*** .

- ***Closely related*** organisms have ***base sequences in DNA that are more similar*** than those that share only a distant ancestor.

The five kingdoms

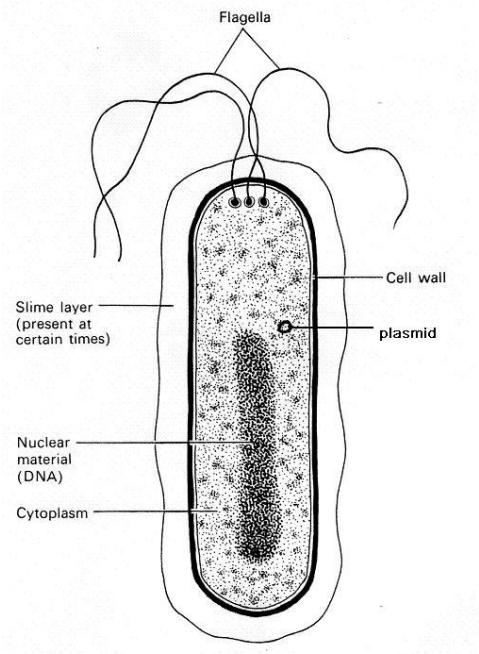
1. **Kingdom prokaryotae (Monera or prokaryotes)**
2. **Kingdom protoctista (protoctists).**
3. **Kingdom fungi**
4. **Kingdom plantae**
5. **Kingdom animalia**

Kingdom prokaryotae (Monera or prokaryotes)

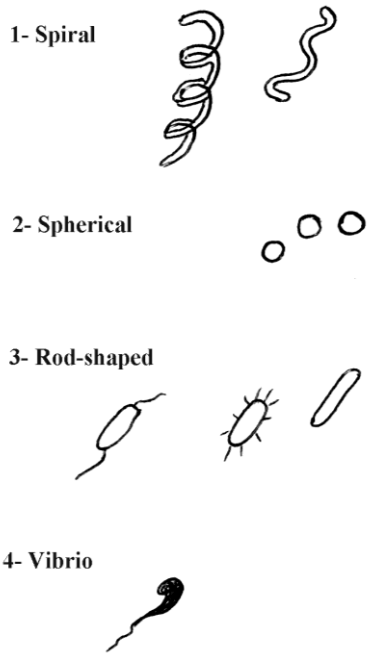
(prokaryotes are organisms with no nucleus while organisms with nucleus are known as eukaryotic organisms).

Example bacteria

Structure of bacteria



shapes of bacteria



The main characteristics

- Have no nucleus and ***no organelles except ribosomes***.
- The ribosomes are ***smaller*** than the other kingdoms.
- Have circular DNA **not** associated with protein.
- Many types may contain circular rings of DNA called ***plasmids***.
- Many types are covered with a ***slime capsule*** for protection.
- The bacterial cell is surrounded by a cell wall made of proteins and carbohydrates forming a substance called ***murein.***
- Its cytoplasm contains stored food in the form of ***glycogen and lipids***.
- May have flagella ***(singular :flagellum)*** used in movement.
- May contain ***chlorophyll*** to carry out photosynthesis.

Effect of temperature :

A - In high temperature many types ***can secrete thick coat*** around themselves forming ***spores*** to withstand the high temperature.

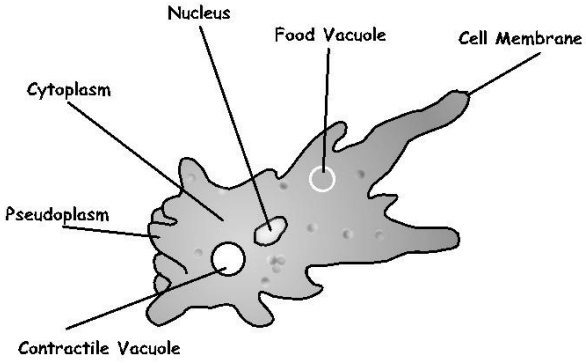
B - In very low temperatures activities of bacteria ***slow down*** ,but are ***not killed***.

Disinfecting or sterilization

- kills bacteria and other microorganisms.
- Alcohol is an example of disinfectants.

Kingdom protoctista (protoctists).

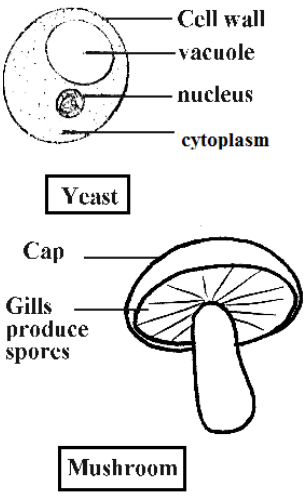
- Involve unicellular animals ***(known as protozoa)*** and multi-cellular organisms such as ***seaweeds***.
- Cells contain nucleus.
- Some have ***cell wall*** and ***chloroplasts*** known as ***algae***.

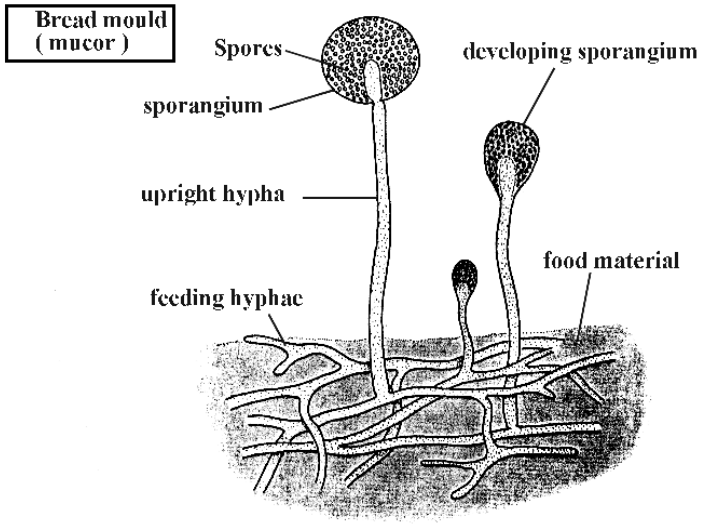


Examples

Amoeba, paramecium and chlamydomonas

Kingdom fungi





- Organisms with ***eukaryotic*** cells.
- Have cell walls made of ***chitin and somtimes chitin and cellulose***.
- Most of them are multicellular but ***few are unicellular such as yeast.***
- ***Never motile*** (self – propelled or can move by itself) as they have no cilia or flagella.
- Body usually made of ***hyphae*** (singular :hypha) which are ***aseptate*** (means not divided into cells but contains many nuclei).
- The whole body of a fungus is called ***mycelium***
- Reproduce by ***spores*** (but yeast reproduce by ***budding***)
- ***Heterotrophic*** organisms as they contain no chlorophyll for formation of its food by

photosynthesis.

Examples : yeast, mushroom and bread mould (mucor)

How a fungus is adapted is adapted to obtain its food

It has ***feeding hyphae*** branched in food substances such as bread in case of bread mould, feeding hyphae provide ***large surface area*** for production of extracellular enzymes that digest the surrounding food into small soluble molecules that can be absorbed by simple ***diffusion and active uptake***.

Comparison

Bacteria	Fungi
- Have a unicellular form .	- Formed of thread -like structures each is known as hypha and collectively are called ***mycelium.*** *(but yeast is a unicellular fungus)*
- Have a cell wall made of ***murein***.	- The cell wall made of ***chitin*** or ***chitin and cellulose.***
- Have ***no real nucleus*** (nuclear material without a nuclear envelope)	- Hypha contains ***many nuclei*** in the cytoplasm .
- There are types of bacteria contain ***bacterio-chlorophyll*** and can carry out photosynthesis	- Contain ***no chlorophyll*** and so cannot carry out photosynthesis.
- Reproduce by simple ***binary fission*** .	- Reproduce by ***spore formation*** (but yeast reproduces by ***budding***.

Comparison

Yeast	Other types of fungi
- Unicellular.	- Formed of hyphae.
- Reproduce by ***budding*** in favorable conditions but reproduce by ***spore formation*** in unfavorable conditions .	- Reproduce by ***spore formation*** .
- Is not a parasitic organism .	- May be parasitic or saprotrophic .

Kingdom plants

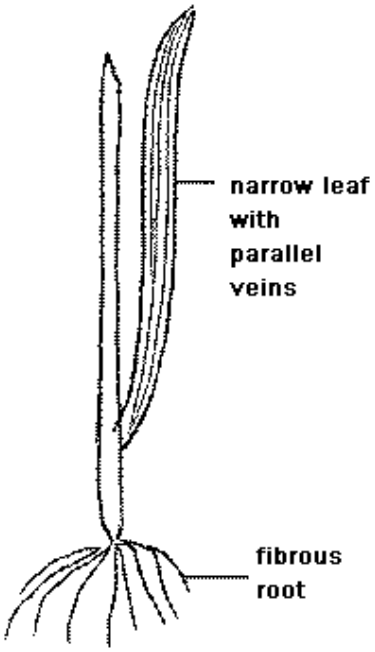
- Organisms with ***eukaryotic*** cells.
- Have cell walls containing mainly cellulose .
- ***Autotrophic*** organisms as they can carry out photosynthesis.

Examples

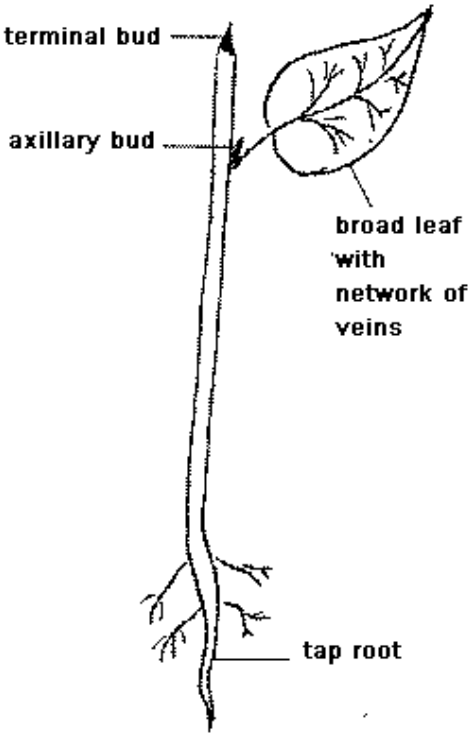
Ferns and flowering plants.

FLOWERING PLANTS

Monocotyledon .



Dicotyledon (eudicotyledon).



The main characteristics of flowering plants

1-Contain ***chlorophyll*** and make their food by ***photosynthesis***.
2-Produce ***flowers*** for reproduction.
3-Produce ***fruits*** enclosing seeds.
4-Seeds ***germinate*** in suitable conditions producing new plants.

Types of flowering plants

Monocotyledons	Dicotyledons
1- Have ***narrow*** leaves(strap- shaped) with ***parallel*** veins	have ***broad*** leaves with ***network*** of branched veins
2- The seed contains ***one*** cotyledon	the seed contains ***two*** cotyledons
3- Have ***fibrous*** roots	have main ***tap root*** with lateral roots

4- The number of ***stomata is equally.*** distributed in the upper and lower surfaces of the leaves	stomata are usually found in the ***lower*** surface
5- Floral parts such as petals are ***three*** or their multiples	floral parts are ***four*** or ***five*** or their multiples.

Ferns

- Plants with roots, stems and leaves (the leaves of fern are called ***fronds***).
- Do ***not produce*** flowers.
- Reproduce by spores produced on the underside of the fronds.

Kingdom animal

- Organisms with ***eukaryotic*** cells.
- ***Multicellular*** organisms , differentiated into tissues.
- Often ***motile***.
- Have ***no*** cell wall.
- ***Heterotrophic*** organisms.

Phylum vertebrates

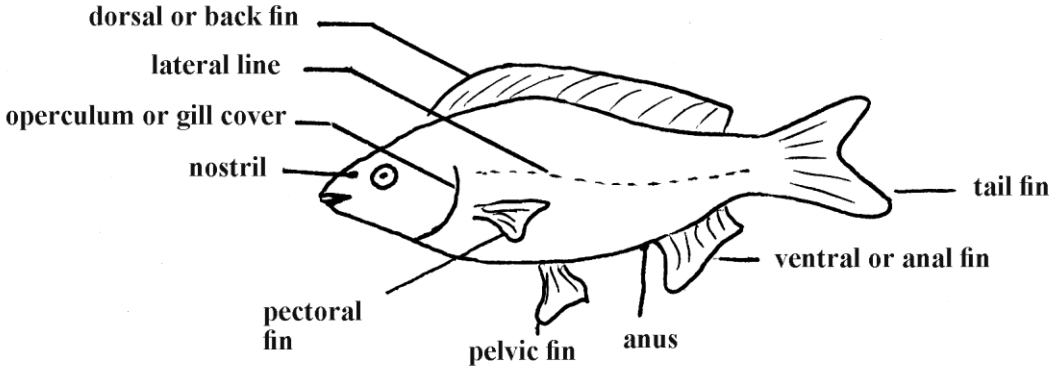
Definition: Vertebrates are the living organisms which have a ***vertebral*** column (a backbone).

The main classes of vertebrates:

1- Fish **2- Amphibians** **3-Reptiles**
4- Birds **5- Mammals**

Fish

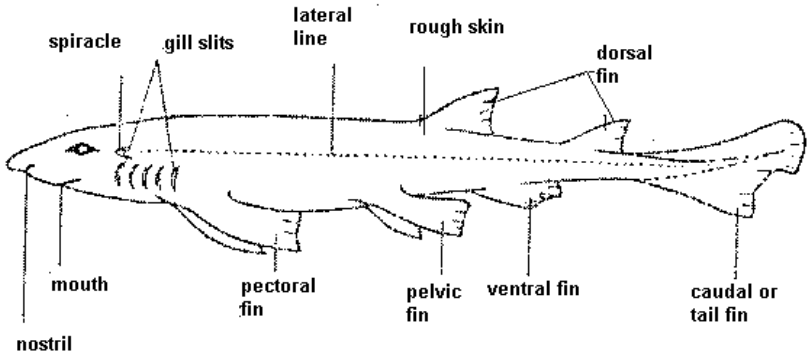
Bony fish (skeleton is made of bones)



Characteristics and adaptation of fish

1. Have a stream-lined (fusi-form) shape to decrease resistance of water.
2. Covered with scales for protection.
3. Have lateral line for sensation.
4. Have gills for breathing.
5. Have different colors according to their environment to hide from their enemies by camouflage.

Cartilaginous fish (skeleton is made of cartilages)



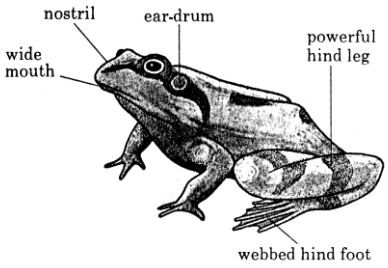
Shapes of fins

Forked fin

Non forked fin

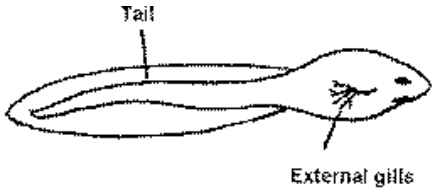
Amphibians

Example :Frog



Tadpole

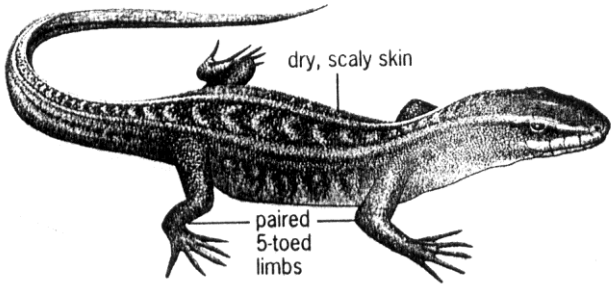
(The early stage of frog)



The main characteristics

1-Have four limbs.
2-Have ***moist skin*** with fine capillaries for gaseous exchange (to help their small lungs).
3-Have external ***ear drum*** for hearing.
4-Their eyes are ***protruded*** to be able to see while the body is submerged in water.
5-Their ***nostrils*** (nasal openings) are found at the top of the head to be able to breathe while swimming in water.
6- They lay soft eggs in a jelly-like coat that hatch into ***tadpoles***.
(The jelly is used to absorb water and swell to act as shock absorber)
7- The male has a dark region below the lower jaw, it is the site of the ***vocal sac***.
8- Their early stages(tadpoles) are adapted to life in water as follows:
- Have ***external gills*** for breathing.
- Have ***tails*** for swimming in water.
- Have ***stream- lined*** shape to decrease resistance of water.

Reptiles

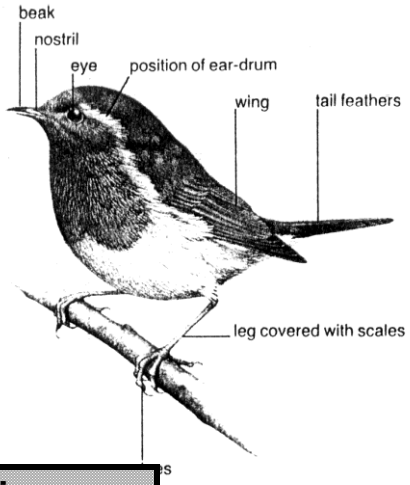


The main characteristics

1-Have ***dry scaly skin*** to reduce water loss, therefore they are able to live in dry places.
2- Some of them such as crocodiles spend a lot of time in water.
3-Lay eggs with water-proof shells.
4-Their ear drums are deep inside their heads.
5- Most of them have four ***short weak limbs*** (snakes have no limbs) therefore they slide along the ground.
6-The body is divided into ***head, neck ,trunk and tail***.

Examples : lizards, snakes and crocodiles.

Birds



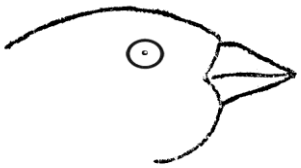
The main characteristics

1- Are covered with ***feathers*** which:
- act as an insulating layer
- decrease the density of the bird to help in flying.
- is covered with a waterproof oil in order not to absorb water.

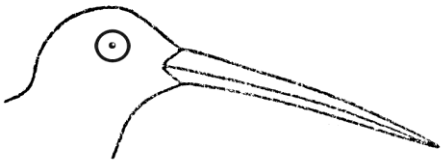
2- Have ***beaks*** modified according to the type of food.

a- Beak for eating small soft seeds

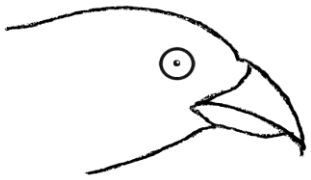
b- Beak for eating hard seeds



c- Beak for eating worms and seeds found deep in mud



d- Beak used for tearing flesh



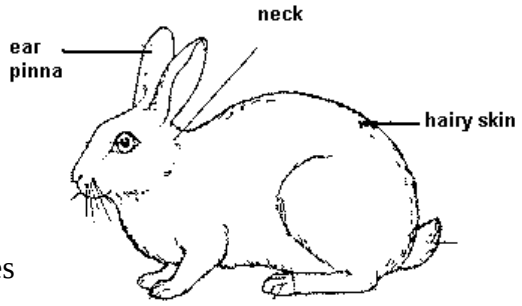
3- Their ***fore limbs*** are modified into wings.
4- Have ***tails*** to control their direction during flying.
5- Their ***ear drums*** are found deep in their heads.
5- Their females lay eggs with hard shells.

e- flat beak for eating fish

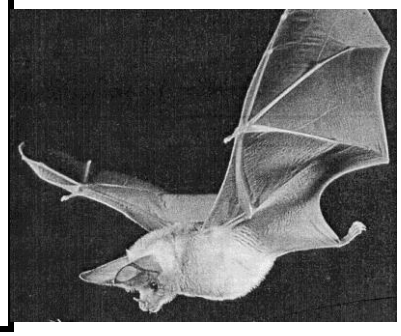
Mammals

1- Have ***hairy skin*** or fur.
2- Have external ***ear pinnae*** or flap.
3- Have wiskers.
4- The females have ***mammary glands*** that secrete milk.
5- Have four limbs
6- Have ***teeth with different types*** (other vertebrates have one type only)

Examples : humans ,cats, dogs and bats:



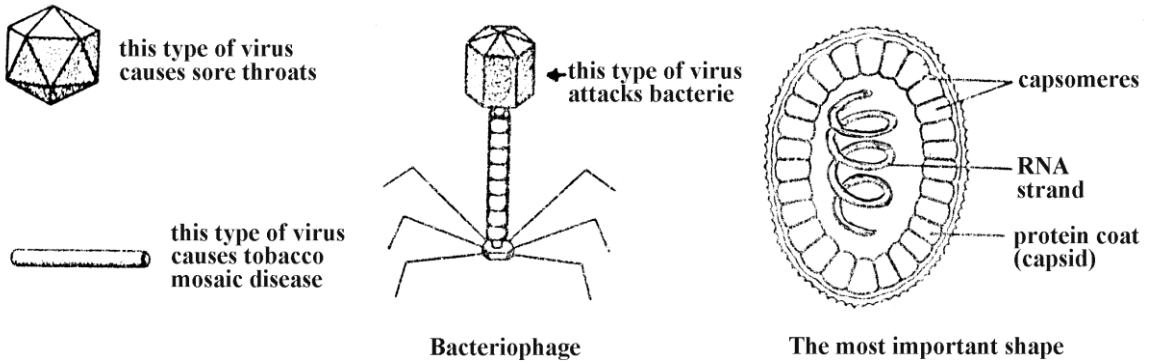
Notice : **bats are not considered as birds because:**
~ they have no feathers
~ they do not lay eggs.
~ they have no beaks
but considered as mammals because:
~ they have hairy skin.
~ they have ear pinnae.
~ they give birth.



Only birds and mammals
are (homeothermic) warm blooded (means that they have a constant body temperature which does not change when the surrounding temperature changes)
Example the normal temperature of humans is 37°C.

Viruses

Viruses differ in shape



Bacteriophage

The most important shape

The main characteristics

Viruses have many characteristics of livings and also have many characteristics of non livings , therefore:

- Viruses are considered as ***link*** or intermediate stage between livings and non livings.
- It is ***difficult to classify viruses*** among living organisms as they have many characteristic

of living organisms and others of non living organisms.

A- Characteristics like living organisms:

~ have a core of DNA or RNA
~ have proteins
~ can reproduce

B - characteristics like non- living things :

~ have no cytoplasm ,or cell organelles.
~ do not carry out any function of life ***except*** reproduction ***inside*** living cells.

C- Other characteristics :

~ Very much smaller than bacteria.
~ Are parasites.

Diseases caused by viruses:

measles, polio, AIDS.

Comparison

Viruses	Bacteria
- Smaller than bacteria - A virus has a protein coat ***(capsid)***consists of units called ***capsomers*** . - Has no cell membrane. - Contains no cytoplasm. - Contains no cell organelle. - Can not carry out any function of life ***except*** **reproduction**. - Can not be found except as a ***parasite*** in living cells .	- Larger than virus. - Has a cell wall made of (murein) . - Has a cell membrane. - Contains cytoplasm. - Contains few cell organelles such as ribosomes. - Can carry out all the functions of living organisms . - Can live free or as a parasite.

Phylum Arthropods

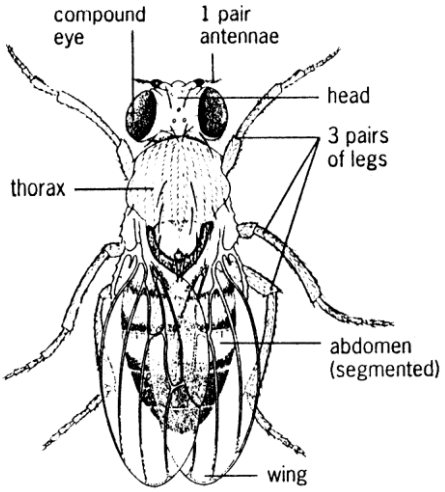
The main characteristics

1- ***Invertebrates***, have ***segmented*** body.
(between segments there are flexible joints which permit movement)
2- Have ***exoskeleton*** made of ***chitin*** for protection and support.
3- Have pairs of ***jointed legs*** to facilitate their movement.
4- In most arthropods the segments are grouped together to form distinct regions e.g. head, thorax and abdomen.

The main classes of arthropods

1-Insects 2- Arachnids 3-Crustaceans. 4- Myriapods

1-Insects



~The body is divided into ***head ,thorax ,and abdomen***.
~ Have ***three pairs*** of jointed legs.
~ Have ***one pair*** of antenna.
~ Have ***compound eyes*** (few types have simple eyes).
~ Most of them have ***wings***.

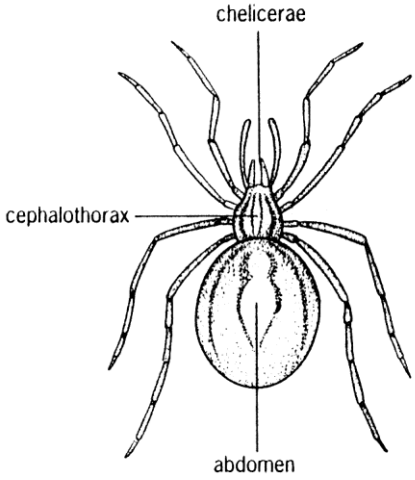
Adaptation of insects

- Have compound eyes for ***wide vision*** .
  (a compound eye is an eye composed of many units and lenses.)
- Have antenna ***for sensation***.
- Are small to ***hide*** from enemies.
- Have different colours for ***camouflage***.
- Have jointed legs for ***rapid*** movement.
- Have segmented bodies to facilitate their movement.
- Have exoskeleton for ***protection and support***.

2- Arachnids

The main characteristics

- The body is divided into ***two parts*** only which are ***Cephalothorax*** (head and thorax fused together) and ***abdomen***.
- Have ***four pairs*** of jointed legs originated from cephalothorax.
- Usually the legs end with ***claws*** for catching preys.
- Have ***no wings***.
- Have ***simple eyes***.
- Have ***no antenna*** but a pair of ***chelicerae or pedipalps***. which are used to hold the prey.



Adaptation of arachnids

~ Have ***jointed legs*** for rapid movement .
~ Have ***segmented body*** to facilitate their movement.
~ Have ***exoskeleton*** for protection.

Examples:

spiders and scorpions

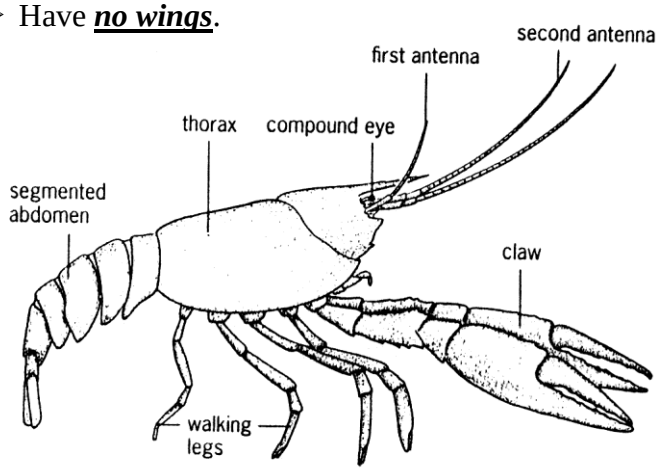
Notice that arachnids have mouth parts seen as antennae , but their function is to catch the prey , they are not known as antennae as they are not used in sensation.

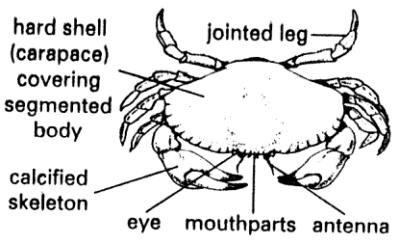
Insects	Arachnids
1- Body is divided into ***three regions***, head, thorax and abdomen.	- Body is divided into ***two regions*** only (cephalothorax and abdomen)
2- ***One pair*** of antenna is attached to head	- Have ***no antenna*** but a pair of *chelicerae*. which are used to hold prey
3- ***Three pairs*** of jointed legs originated from thorax .	- ***Four pairs*** of jointed legs originated from cephalothorax .
4- One pair of ***compound eyes*** (but few have simple eyes).	- Usually have several pairs of simple eyes
5- May have ***wings***.	- ***No wings***

3-Crustaceans

The main characteristics:

- The body is divided into ***two parts*** only (cephalothorax and abdomen).
- Have ***two pairs*** of antenna.
- Have one pair of ***stalked compound eyes***.
- Most of them are aquatic, respire by gills.
- Usually have ***more than four pairs*** of legs(or appendages).
- Have ***no wings***.





Adaptation of crustaceans:

- Have ***antenna*** for sensation.
- Have stalked ***compound eyes*** for wide field of vision.
- May have ***gills*** for breathing in water.

Examples:

crabs, lobsters, and shrimps.

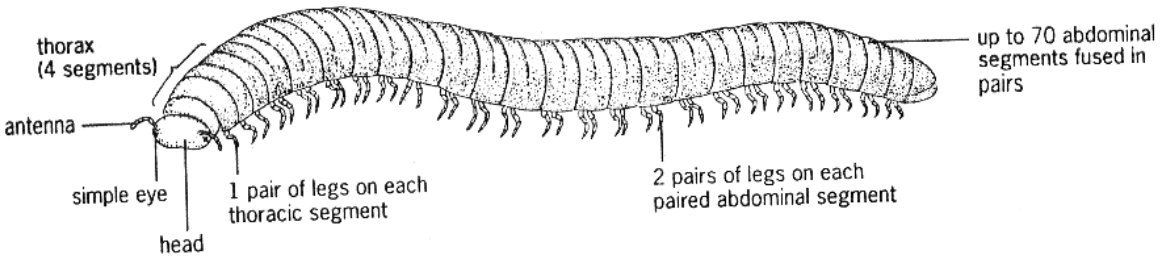
4-Myriapods

Examples

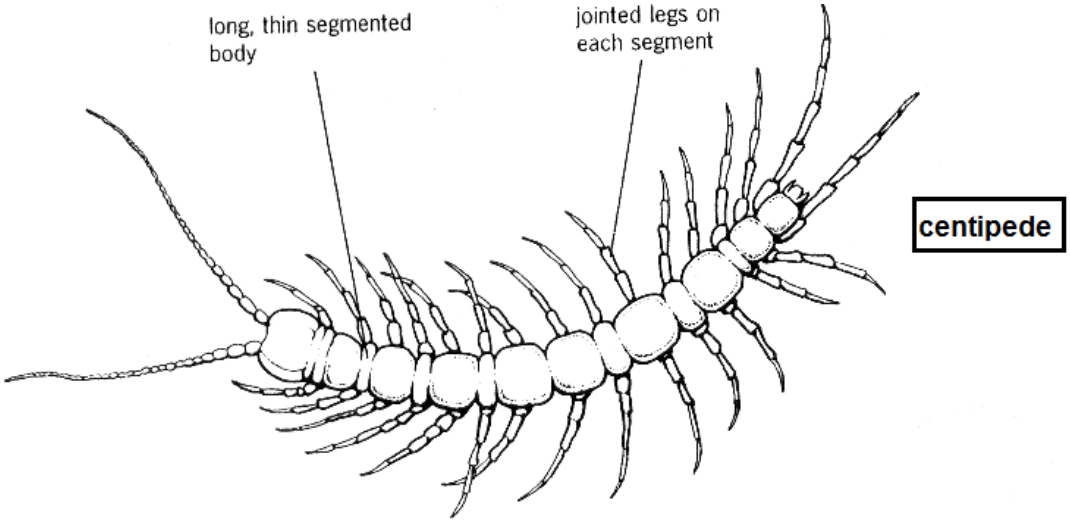
Millipedes (are herbivores) and centipedes (are carnivores).

The main characteristics

1. Are arthropods (have exoskeleton, segmented body and pairs of jointed legs).
2. Have head, but the body cannot be obviously divided into thorax and abdomen.
3. Have a pair of legs at each body segment.
4. As a myriapod grows additional segments are formed.



Millipede



centipede

My best wishes and good luck.