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[COMBINED SCIENCE REVISION GUIDE]

This book consist of three sections namely Biology, Chemistry and Physics. The mandate is to make each and every student understand science and be able to seat for exams.

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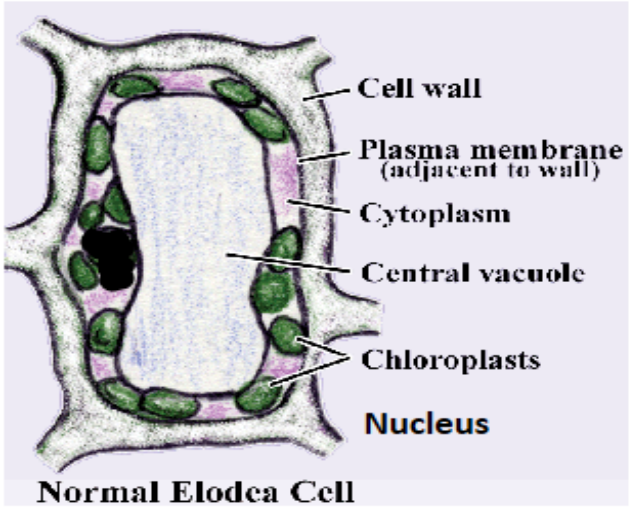
Cell and cell specialization

A cell is a basic unit of all living organisms. Cells are divided into plant and animal cells.

Plant cell

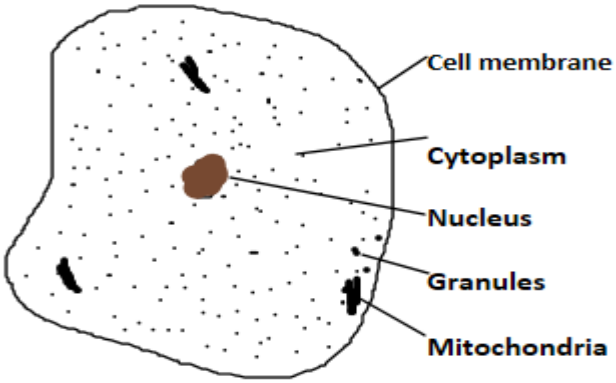


Cytoplasm
It is a thick liquid which contain food reserves such as oil droplets, starch granules. Many chemical metabolic processes occurs in the cytoplasm. These chemical reactions help in keeping the cell alive. The thick liquid is 90% water with molecules of salt and sugars.

Cell membrane
This is a thin layer of cytoplasm around the outside of the cell. It is selective in that it allows certain substances to enter and leave.in general, oxygen, food and water are allowed to enter. Waste products are allowed to leave and harmful substances are kept out. In this way the cell membrane maintains the structure and chemical reactions of the cytoplasm.

Nucleus
It control all the activities of the cell. For example, it controls the type and quantity of enzymes, it regulates the chemical changes, it determines what the cell will be. e.g. a blood cell a liver cell. The nucleus also controls cell division.

Animal cell



Cell wall
A tough, non-living layer made of cellulose surrounding the cell membrane. Prevents plant cell from bursting. Allows water and salts to pass through. i.e. it is freely permeable.

Vacuole
A fluid filled space surrounded by the cell membrane which is inside the cytoplasm. It contains salts and sugars to keep the cell alive and firm.

Chloroplasts
An organelle that contains chlorophyll and which is found In the cytoplasm of some plant cells. Its function is to trap sunlight for photosynthesis.

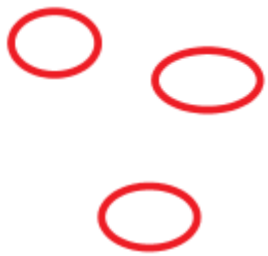
Mitochondria
These are tiny organelles responsible for producing energy from aerobic respiration.

Cell specialization

This is when a cell is adapted for a specific role. When cells are specialized

- They do one particular job which they are best at.
- They develop a distinct shape which helps them adapt to the role
- They start to undertake special kinds of chemical changes

Specialized cells in animals

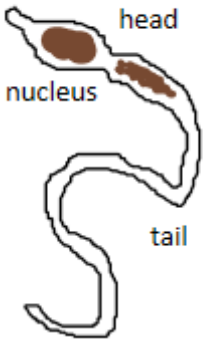


Have no nucleus when Mature. They are tiny disk like cells which contain a red pigment called hemoglobin. Their function is to transport oxygen.

Muscle cell

Forms a sheet of muscle tissue. They contract and relax to carry out specific task. e.g. circular muscles of esophagus relax and contract to push food down to the stomach.

Sperm cell



Their special function is of producing sperms which is a male sex cell.

Specialized cells in plants

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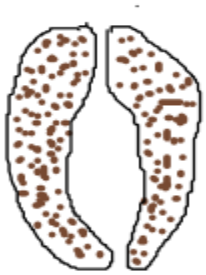
Palisade mesophyll cells

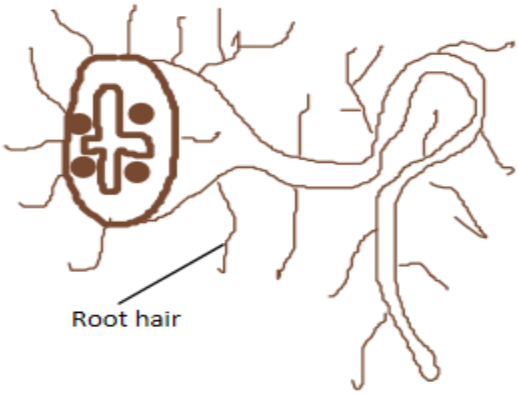
Have chloroplasts which contain chlorophyll to trap sunlight for photosynthesis

Guard cell



Specials kidney which opens and closes the stomata. They have light sensitive cells to enable them to adapt to changes in light intensity.

Root hair cell



They are numerous to increase absorption of water and nutrients.

Levels of Organization

Organelle: a specialized part of a cell that has its own function, e.g. the nucleus

Cell: the smallest part of a living structure that can operate as an independent unit e.g. red blood cell

Tissue: a group of cells with similar structures, working together to perform a shared function e.g. muscle tissue

Organ: a structure made up of a group of tissues, working together to perform specific functions e.g. the heart

Organ system: group of organs with related functions, working together to perform body functions e.g. respiratory system

Organism: an individual made of organ systems which work to keep that organism alive e.g. a human

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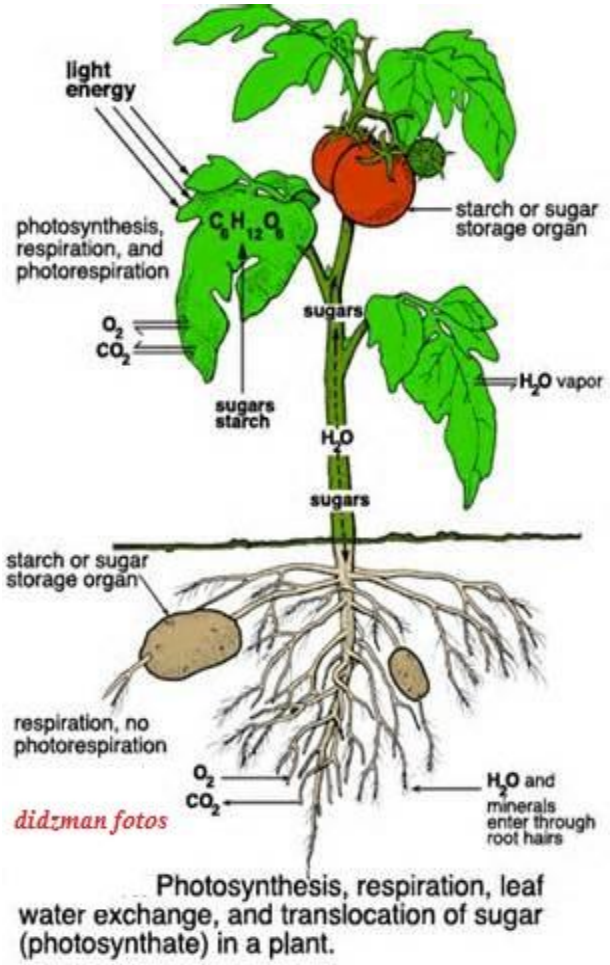
Photosynthesis

Photosynthesis is a process whereby green plants manufacture carbohydrates using carbon dioxide and water in the presence of sunlight; chlorophyll and oxygen is given out as a buy product.



Photosynthesis, respiration, leaf water exchange, and translocation of sugar (photosynthate) in a plant.

NB it is only green plants which photosynthesise.

What happens to end products of photosynthesis?

The main products of photosynthesis are:

- Carbohydrates and oxygen.

i. CARBOHYDRATES

- Carbohydrates are produced in form of sugars (glucose), fructose, maltose, sucrose and all these may be used immediately by the plant during respiration and excess of sugars are converted into starch for storage.

Why starch and not glucose?

- Because starch is insoluble, it does not dissolve in water but glucose is soluble.

ii. OXYGEN

- It diffuses into the atmosphere and used by animals during respiration.

Word Equation for Photosynthesis

$$Carbondioxide + water \frac{sunlight}{chlorophyll} = Carbohydrates + oxygen$$

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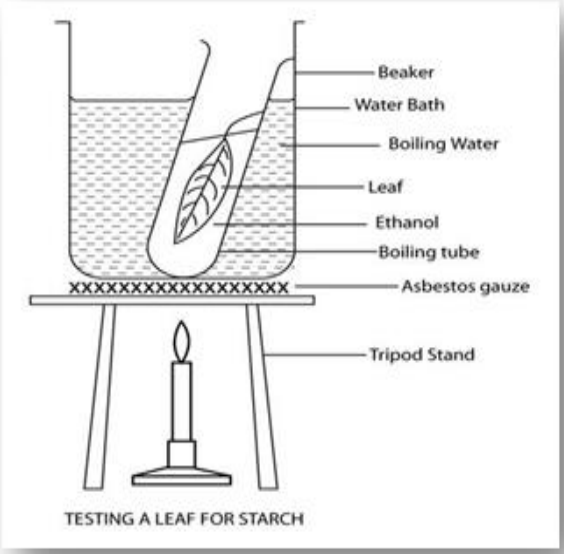
Testing a leaf for Starch



Aim: testing a leaf for starch

Procedure:

- Boil a leaf to stop all chemical reactions
- Remove chlorophyll by boiling the leaf in alcohol or methylated spirit. Take caution because alcohol catches fire easily. Boil it indirectly in a water bath.
- Put the leaf in warm water to make it soft
- Then spread it over a white tile so that its easy to see colors clearly
- Observe the color changes.

Observations

- In the presence of starch iodine solution changes color from brown to blue black

Conclusion

- Green plants photosynthesize shown by the presents of starch

Factors That Are Necessary For Photosynthesis

i. ***Carbon dioxide***- combines with hydrogen from water to form carbohydrates.

$$\boldsymbol{Carbon\ dioxide + hydrogen = carbohydrates}$$

ii. ***Chlorophyll***-to trap sunlight
iii. ***Sunlight***- electrolysis of water (separate water molecules into oxygen and hydrogen)
iv. ***Water*-to** provides hydrogen. Facilitates transportation of materials

NB No photosynthesis takes place in absence of any of above factors.

Testing the Importance of the Factors of Photosynthesis

i. carbon dioxide

AIM: Investigating the importance of carbon dioxide for photosynthesis

Procedure:

- DE starch a potted plant by placing it in a dark room until all the starch has been removed

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LEAF B

- Put potassium hydroxide in one leaf and water another leaf. Label them A and B
- Take the plant back on sunlight and wait for some ours
- Take leaf A and leaf B and test them for starch

Observations

- Leaf A iodine solution turns blue black
- Leaf B iodine solution remained brown

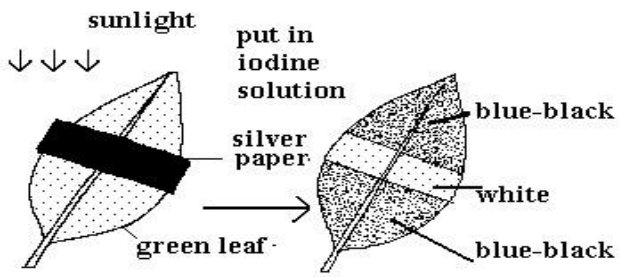
Explanations

- Potassium hydroxide solution removed carbon dioxide from leaf A. so no carbon dioxide no photosynthesis

Conclusion

- Carbon dioxide is necessary for photosynthesis.

ii. SUNLIGHT



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AIM: to show that sunlight is necessary for photosynthesis

APPARATUS: A potted plant, black cover [aluminum foil], iodine solution

PROCEDURE

- De starch the plant by putting the plant in a dark room until all the starch is removed
- Make sure that there is no more starch
- Cover one part of a leaf with silver paper and place the plant on sunlight.
- Observe the plant for some hours

OBSERVATION

- Covered part - Iodine solution remains brown.
- Uncovered part - Iodine solution turns blue black indicating that there was photosynthesis

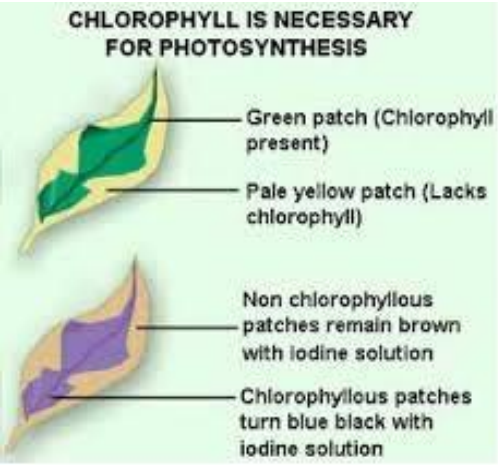
EXPLANATION

- The aluminum foil is an opaque which prevents light from reaching that part of a leaf
- No Sunlight – no photosynthesis – no starch.

CONCLUSION

- Sunlight is necessary for photosynthesis.

CHLOROPHYLL:



AIM: to show that chlorophyll is necessary for photosynthesis.
APPARATUS: variegated leaf, (a leaf with pale yellow and green part) plus all apparatus to test for starch.
OBSERVATION:

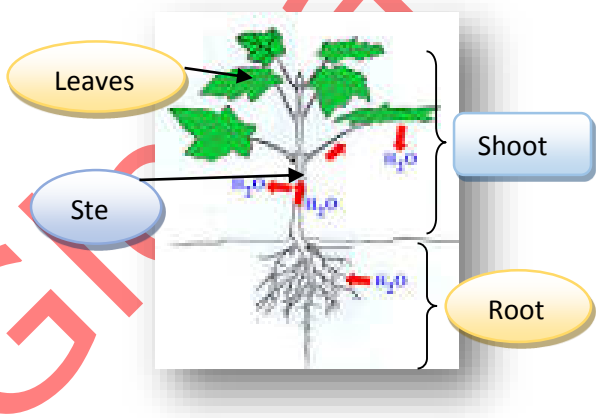
The green part – iodine solution turns blue black.
The pale yellow part – iodine solution remains brown.

EXPLANATION:
The white part has no chlorophyll so no photosynthesis.

CONLUSION:
Chlorophyll is necessary for photosynthesis.
NB The green plant is the control.

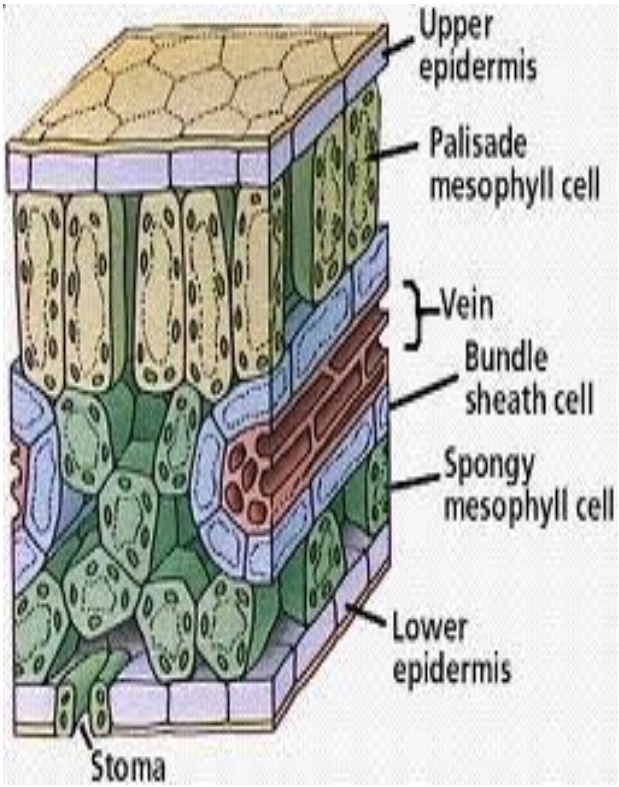
Control experiment is the experiment which enables us to make conclusion.
The uncovered part is the control.

Structure of the Flowering Plant



Internal Structure of the leaf

Parts And Functions.



A— ***cuticle layer.*** – acts as the water proof.
B – ***Upper epidemic.*** – it contains stomata pores to allow in and out of gases (carbon dioxide and oxygen)
C – ***Palisade layer***.—this is whereby photosynthesis takes place because it contains chloroplasts.
D – ***Spongy layer***. – allow exchange of gases.
E – ***Vascular bundle***. – contains xylem and phloem vessels.
F – ***Xylem.*** – Carries the water.
G – ***Phloem***. – Transport mineral salts and sugars.
H – ***Air spaces***. – This is where carbon dioxide and oxygen are stored.
I – ***Guard cells***. – closes and open to control amount of water loss.
J—***stomata pore***. – allow entry and exit of carbon dioxide and oxygen.
K – ***Lower epidemic***. – contains stomata pores and guard cells.

The Adaptation Of A Leaf For Photosynthesis:

How is the Leaf Structured to Perform Its Functions?

1. Large surface area. To increase maximum absorption of sunlight.
2. It is thin to allow sunlight to reach all parts of the plant.
3. It has more stomata pores at the lower epidemic than the upper epidemic to reduce water loss.
4. Contains chloroplasts to increase photosynthesis.
5. Millions of veins for easy transportation of substances.

Structure of a Root

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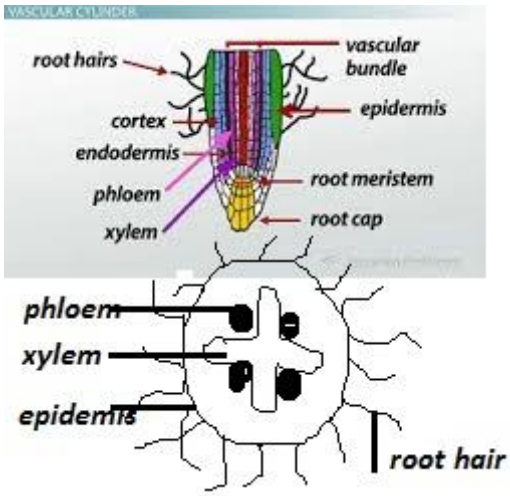
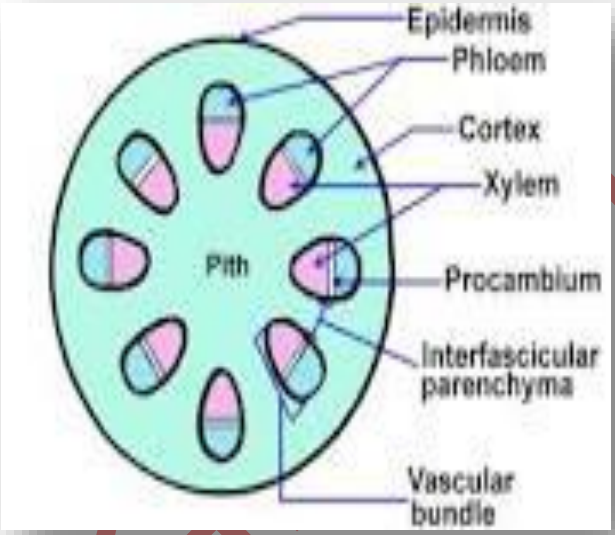


1. ***Xylem vessels***: To transport water from the roots to the leaves.
2. ***Phloem vessels***: Transportation of mineral salts from the root to the leaves.
3. ***Pilferous layer***: It allows diffusion of water from the soil to the plant as well as the absorption of mineral salts.

Adaptation Of A Root For Photosynthesis

i. Millions of root hairs for absorption of water and carbon-dioxide and mineral salts.
ii. Pilferers layer has got large surface area for maximum absorption.

Structure of a Stem



1. ***Cambium layer***: It separates phloem vessels from xylem vessels.
2. ***Pith***: It supports the plant.
3. ***Cortex***: Contains cells which enable the stem to grow outwards as the plant grows bigger.
4. ***Epidemic layer***: It protects the stem from damage from animal activities.
5. ***Chlorophyll body***: It helps the absorption of sunlight for photosynthesis.

Plant Nutrition

- In order to source maximum growth and development plants require certain nutrients.

- These nutrients include the following: 1) Phosphorus; Potassium; Nitrogen; Calcium

Nutrient	Use	Deficiency
Nitrogen	Plant growth. Development of leaves and stem.	Stunted growth. Leaf Chlorosis
Potassium	Formation of flowers/fruits. Improve disease resistance.	Poor flowering and fruit setting. Yellow/brownish leaf colour margins. Premature death.
Phosphorous	Improves root growth. Improve root uptake of mineral salts and water(producing energy carrier molecules) i.e.: ATP	Poor root growth. Purplish leaf colouration. Plant tall and thin.

Plant Pests and Diseases

A pest in an organism that is harmful to plants and animals. There are two types of pests namely 1) *Tissue eating pests*.

2) *Sap sucking pests*.

a) TISSUE EATING PESTS.

They have chewing mouth parts eg: locusts, grasshopper, snails, millipedes, caterpillar and cutworms.

b) SAP SUCKING PESTS.

These have piercing mouth parts that they pluck their mouth into the stem or leave and they suck the plant's water and nutrients. Such pests include aphids, red spiders mites.

Plant Diseases

- These plant diseases include bacterial wilt and fungal rust.

Summary of plant pests and diseases

Sign of damage	Pest	Example of plant affected
Chewed leaves	Caterpillar/locust	Maize
Leaves distorted, many small black or green insects on sample	Aphids	Orange trees
Leaves with discolorations or damaged by small organisms	Red spider mites/ sucking organisms	Tomato plants
Leaves coated with a light powder	Powdered mildew caused by fungus	Covo

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Rusty red sports on leaves	Rust fungus	Potato plants
Blackened veins or vascular bundles. Small wilted/collapsed plant on wet soil	Bacteria (which causes bacterial wilt	Rape

Pest Control

- There are two methods of controlling pests namely 1) Chemical control.

  2) Cultural control.

i. ***Chemical control***: This is a method of controlling pests using pestcides.ie chemicals.
ii. ***Cultural control***: This is a method of controlling pests using natural methods such as uprooting of the infected plants, crop rotation as well as applying cultured products for control.

CONTROL METHOD	ADVANTAGES	DISADVANTAGES
Chemicals method: Involves the use of pesticides and fungicides.	1) Efficient. 2) Specific. 3) Controllable if applied correctly.	1) Expensive. Can kill or damage other plants or animals. 2)Can remain in the soil for a long time and will be harmful to other plants and will also disturb the aquatic life of the ecosystem.(food chain) 3) As time goes on pests will end up being resistant to pesticides.
Cultural method: Early planting. Removal of weeds. Crop rotation. Seeds fumigated.	1)Low costs(cheap) Availability of cultural materials like tobacco leaves of ashes to control aphids. 2) They are safe and do not have any negative effects to future plants.	1) Slow. 2) Need to be repeated timely. 3) Need research.

Pesticide warning colour codes

Colour	***Meaning***
Purple	Extremely Dangerous
Red	Very Dangerous
Amber	It is Dangerous
Green	Less Toxic(May be used in homes)

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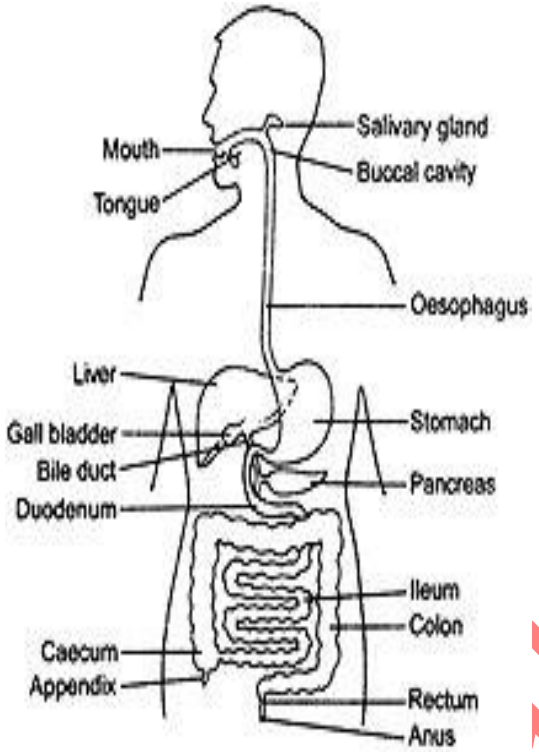
Animal Nutrition

The Human Alimentary Canal.

- This is the food passage or canal that begins from the mouth and stretches down to anus. This canal has got various stages and parts that perform different functions as the food moves down through it to the anus. The alimentary canal has got many parts with different functions.

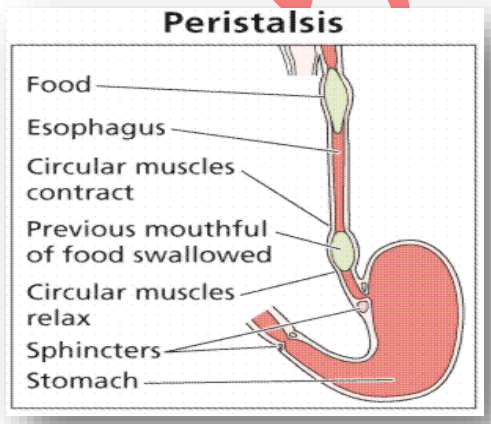


***Mouth*:** This is the first part of the alimentary canal.

- This is where food is digested by teeth through chewing (mechanical) digestion into smaller pieces. Food is mixed with saliva. Saliva is secreted from the salivary glands under the tongue which contains enzyme amylase which digest starch into soluble substance called maltose. Food is then swallowed down into the esophagus through a process called *Peristalsis.*

Peristalsis

- Is a force that is produced by the esophagus that forces food to move down the canal to the stomach? This is the contraction and expansion of the circular muscles of the esophagus that forces food to move down the canal.



Esophagus

- This is the tube that connects the mouth and the stomach and it produces the peristalsis force as it takes food down the canal.

Stomach

- This is a chamber that holds the food for a time before it proceeds down with the canal. Here the environment is acidic. That's where gastric juices with enzymes are secreted to facilitate the digestion of protein and starch (carbon-hydrate). That's where protein digestion starts. Enzyme pepsin is produced to digest protein to peptides and peptones. Maltose digests starch to glucose. Gastric juices also contain acids to kill bacterial infections which might have been swallowed from the mouth.

Small intestines.(Duodenum and ileum)

- Acid from the stomach on reaching the duodenum stimulates the pancreas to release pancreatic juice to finalize digestion

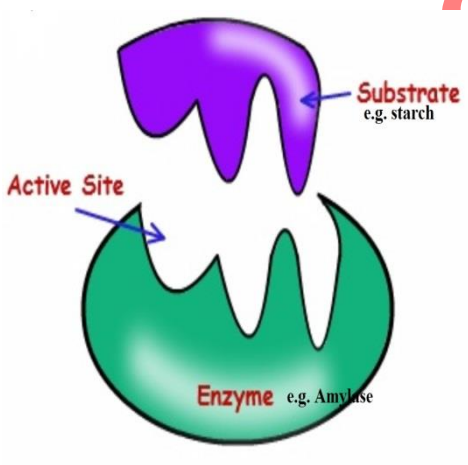
Duodenum

- This is where bile is secreted from the gal-bladder to neutralize all the acids from the stomach. The bile also emulsifies fats. That's also where pancreatic juice is produced to end the digestion of proteins.

Enzymes include.

1. ***peptidase*** which breaks into amino acid
2. ***maltose*** which digest glucose into
3. ***trypsin*** which digest proteins to peptides
4. ***amylase*** for starch digestion into maltose
5. ***renin*** in adults to digest fats
6. ***lipase*** in children to digest fats

How enzymes help in digestion



Factors affecting enzyme action on food

Temperature-high temperature denatures (kills) enzymes. Low temperatures inactivate enzymes. Optimum temperature is 37°C.

pH – this is a measure of hydrogen. Enzymes are specific to pH. Pepsin work best in the stomach where the environment is acidic.

Surface area- Rate of digestion increases when the particle size is small. Mechanical digestion by teeth help in reducing the particle size of food.

Time – some enzymes needs time to digest food. Protein digestion needs more time.

Ilium

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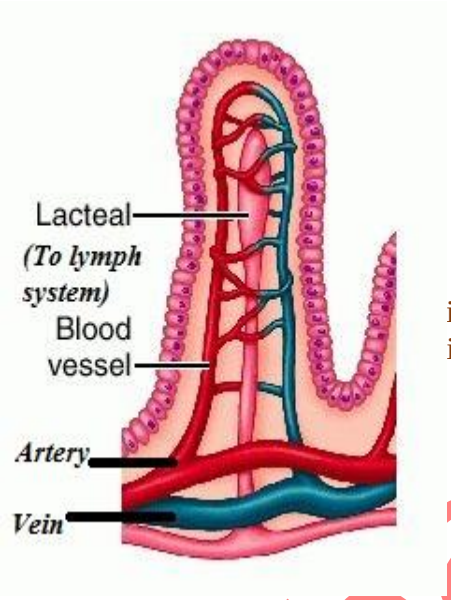
- This is where digestion of food ends.
- Absorption of food into the blood stream begins here because ileum has millions of villi which have large surface area for absorption. It is well adapted for this function
- The micro villi which are numerous have a network of blood capillaries.

Large Intestines (colon and rectum)

a. ***Colon***- synthesis of vitamin c by bacteria. This is where water is reabsorbed into the body and the now solid faeces is taken to the rectum
b. ***Rectum*** –temporary storage of faeces before they pass out (egested) through the anus.

Structure of the villi



Villus (plural villi)- a finger like projection of the lining of the small intestines, typically increasing its surface area for the absorption of substances.

Adaptation of the Villi for Maximum Absorption

i. They are numerous and folded to increase absorption
ii. Thin epithelium layer for fast absorption
ii. Network of blood capillaries so that absorbed food is quickly transported

Digestion

- This is the breaking down of large insoluble food molecules into small soluble food molecules

They are two types of digestion.

a) Chemical digestion.

- This is the chemical breaking down of insoluble food molecules into small soluble food molecules i.e. is where enzymes breakdown the food. The digested food is assimilated for use in the body.

b) Mechanical/ physical digestion

- Breakdown of food by action of teeth and muscles of the esophagus

What Is Assimilation?

- IS the process by which absorbed food is used by the body e.g.?

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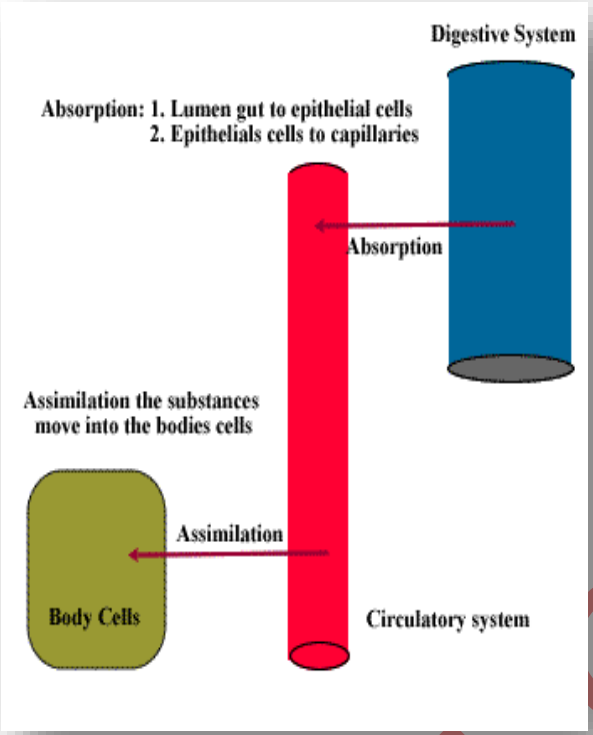
- Glucose used in respiration, Protein repair of worn out of tissues and build new tissues; fats for warmth.



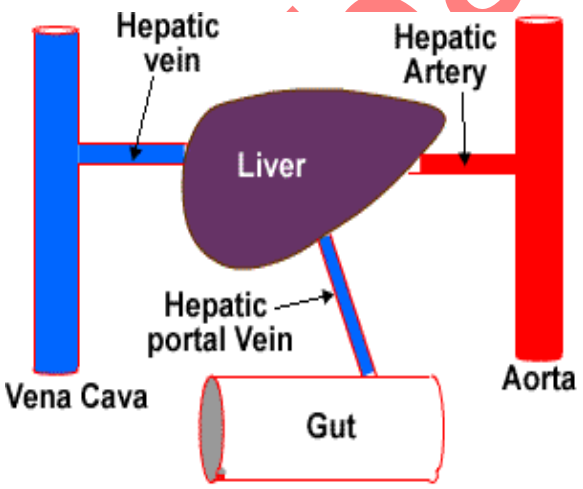
End Products of Digestion

1. Carbohydrates- glucose
2. Proteins- Amino Acids
3. Fats and Oils- fatty acids and glycerol

What Happens To The End Products Of Digestion?

1. ***Glucose***- for respiration.
2. ***Amino acids***-repair won out tissues and new tissues. Excess amino acids are converted into urea and are stored in the kidneys for excretion
3. ***Fatty Acid*** is stored under the skin for warmth .fats can be converted into glucose to provide energy.

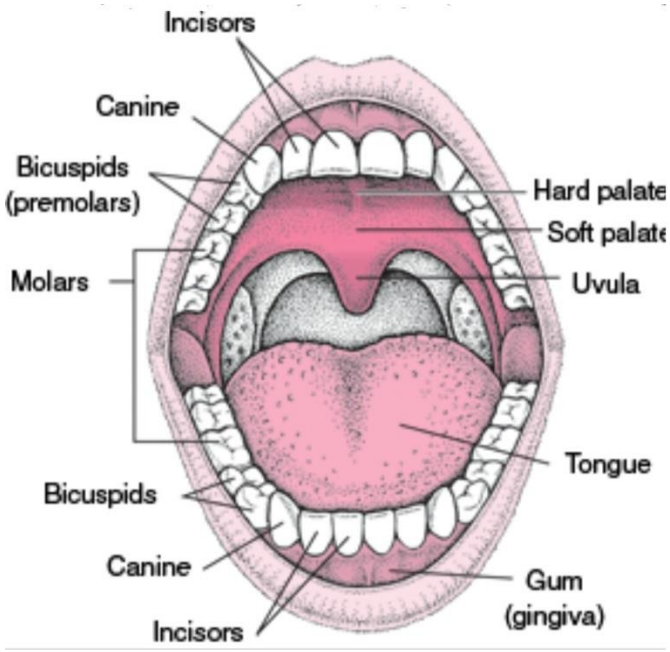
Liver



Function of the Liver

1. Storage of excess food. Excess glucose is converted to an insoluble substance called glycogen which is then stored in the liver.
2. Deamination of excess amino acids. excess amino acids are broken down into urea which is taken to the kidney for excretion.
3. Breakdown of all toxic substances.

Teeth and teeth decay



Incisor- cutting soft food like bread (for biting)

Canine - cutting hard food like meat

Molars - for grinding food (chewing)

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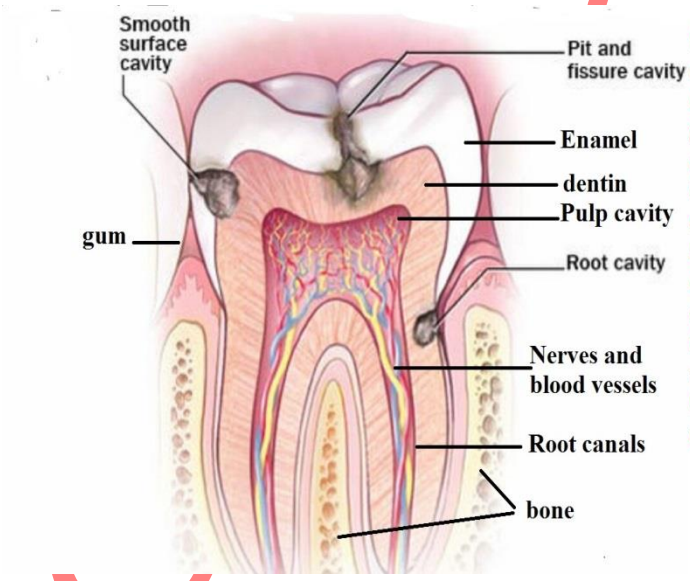
Teeth decay



Teeth decay is caused by reaction between enamel (made of calcium, a metal) and the acid poduced by bacterias after feeding on plaque. The mouth provides a good atmosphere for bacteria reproduction because there is warmth and moisture. After eating, food remains (plaque) is eaten and decomposed by bacterias thereby producing an acid which will then reacts with enamel. continuous reaction eventually creates a hole which leads to the pulp cavity. Since pulp vavity contains nerves and blood vessels a hole may expose them to outside temperatures and air which will be painful

Care of Teeth

1. Clean teeth especially before going to be.
2. Use toothpaste or safer alternatives such as salt or bicarbonate of soda.
3. a balanced diet essential to keep the teeth

Diet

- This refers to the different kinds of food and the amount of each kind of food eaten by a person or a group of people in a community.

BALANCED DIET

- It is a diet which include all the essential nutrients in their correct proportions

The essential components of a balanced diet are:

1. CARBOHYDRATES
2. PROTEINS
3. FATS
4. MINERAL SALTS
5. VITAMINS
6. FIBRE / ROUGHAGE
7. WATER

DIET COMPONENT	FUNCTION(S)
Carbohydrates	Energy source
Proteins	Growth and repair of worn out tissues
Fats	Energy source , Making of cell membrane insulator , Protection of internal organs
iMineral Salts	For vital processes in the body (metabolism) For protection against diseases
Vitamins	For vital processes in the body For protection against diseases in the body
Fibre / Roughage	For normal bowel. Prevent constipation
Water	Assist in removal of waste from the body. To enable chemical reactions to occur in the body It is a major component of body fluids.

Food tests

NUTRIENT	REAGENT (s)	RESULTS WHEN NUTRIENT IS PRESENT	WHEN NUTRIENT IS ABSENT
Starch	Iodine solution	Brown to blue black	Brown
Simple / reducing sugar	Benedict solution Clinistix	Blue to Orange or brick red Pink to purple	Blue
Protein	Biuret solution , Copper sulphate solution and hydroxide solution Albustic	Blue to purple / violet Green to dark green	Blue Green
Fats	Ethanol	White emulsion	Clear

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Food Requirement for Different People

Pregnant woman

- More proteins for building new tissues for the baby.
- Carbohydrates for energy for the mother.
- Calcium for bone formation
- Ion for blood.

Builder

- More carbohydrates for energy

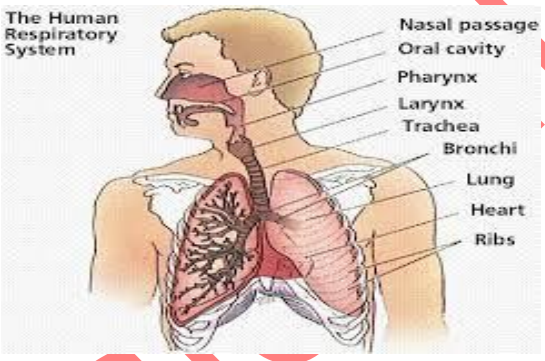
Sedentary Workers

- These are people who tend to spend much time seated; somewhat inactive. They need less carbohydrate.

Human Respiration

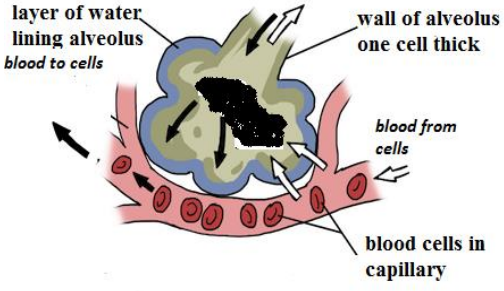
Respiratory System and Gaseous Exchange

The respiratory system is a system which allows oxygen in and carbon dioxide out during respiration. It is responsible for gaseous exchange.



1. ***Nostrils***- It contains hairs to trap dust. It is an opening to allow breathing. It also contains mucus to trap dust and bacteria.
2. ***Voice Box***-Produce voice
3. ***Trachea***-passage which leads to the bronchus. It contains mucus to trap bacteria
4. ***Bronchus***-Receive the oxygen from the trachea to the lungs
5. ***The Air sacs***-this is where gaseous exchange takes places and for storage of gasses.

Gaseous exchange in the Air sac



Adaptations of the Air Sacs/Alveolus for Gaseous Exchange

i. Moist surface because the gases should be absorbed in liquid.
ii. Network of blood vessels to transport gases quickly
ii. They are numerous to increase absorption
v. Thin epithelium layer to increase absorption

Difference between inhaled and exhaled air

To inhale is to breathe in and to exhale is to breathe out

Gas	Inhaled air	Exhaled air
1. Oxygen	20 %	16 %
2. Carbon dioxide	0.03%	4%
3. Nitrogen	78%	79%
4. Water vapour	Saturated	saturated

Experiment

RESPIRATIUON

- It is the breakdown of glucose to release energy. There is ***aerobic*** and ***anaerobic*** respiration in both plants and animals.
- ***Aerobic*** respiration is the breaking down of glucose in the presents of air to release energy.

Word equation (in both plants and animals)

$$\boldsymbol{Glucose + oxygen = energy + carbon\ dioxide + water\ vapour}$$

- ***Anaerobic*** -respiration it is the breaking down of glucose with limited or no amount of oxygen

Anaerobic respiration in animals

$$\boldsymbol{Glucose + limited\ oxygen = lactic\ acid + carbon\ dioxide}$$

- The lactic acid causes muscle cramp or stiffness of muscles
- *An athlete was running 100 meters race and before completing the race he fell down and died. EXPLAIN WHY?*

Anaerobic Respiration in Plants

$$\boldsymbol{Glucose + limited\ oxygen = alcohol + carbon\ dioxide}$$

- The products of respiration are the raw material for photosynthesis and vice versa

Differences between Respiration and Photosynthesises

RESPIRATION	PHOTOSYNTHESIS
Break down process (breaks glucose)	It is a building up process (it build carbohydrates)
In plants takes place during the night	In plants, it takes place during the day
Raw materials of respiration are the products of photosynthesis	Raw materials of photosynthesis are the product of respiration
It occurs in plants and animals	It occurs in plants only

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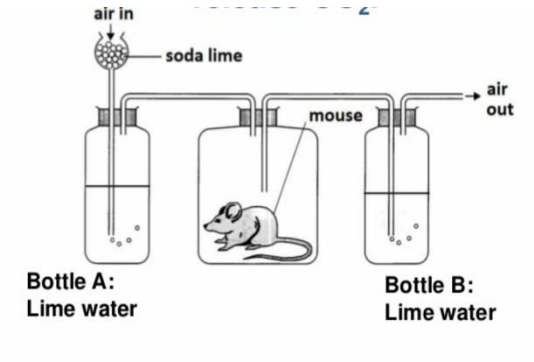
An Experiment 1:

To Show that Animals can respire



Observation

At *A* lime water remains clear because carbon dioxide from air has been removed by soda lime

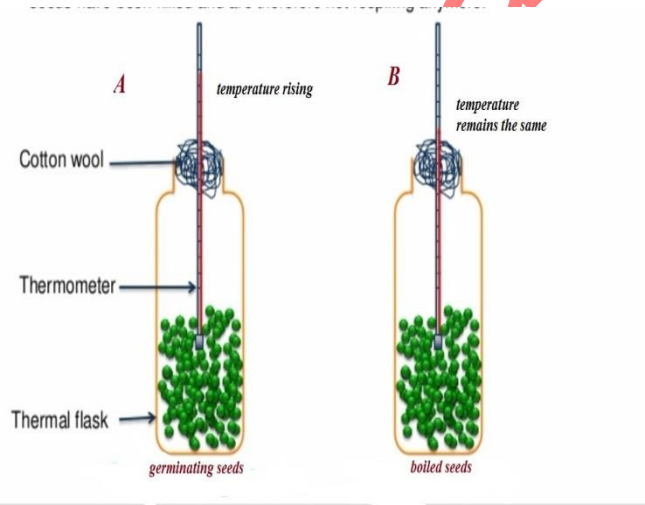
At *B* lime water changes to milk. The mouse produces carbon dioxide which goes to bottle B

The tubes are dipped in lime water to increase reaction

EXPERIMENT 2:

To show that germinating seeds respire

- Germination is the beginning of growth in plants. ***Respiration*** is the biological term which describes seeds germination. When seeds are germinating heat energy and carbon dioxide are released.
- Factors that are necessary for germination includes
    1. Water (moisture)
    2. Suitable temperature
    3. oxygen



At A temperature is rising because germinating seeds produces heat

At B seeds are boiled which means they cannot germinate to produce heat

Cotton wool prevents heat from escaping through the mouth of the flask

Thermal flask prevents heat from escaping through the sides.

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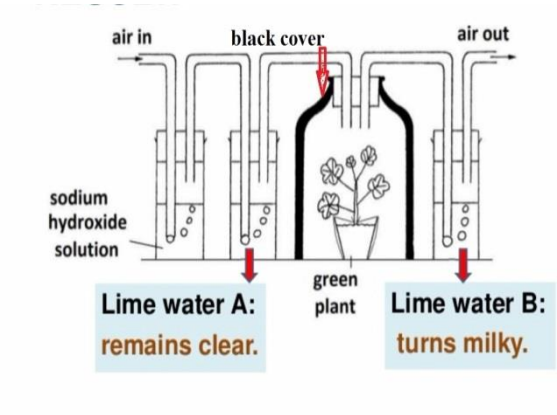
Experiment 3:

To show that green plants respire



At A lime water remained clear because carbon dioxide from atmospheric air was removed by the sodium hydroxide solution

At B lime water turned milky because the plant respire and give out carbon dioxide

The black cover maintains darkness in the flask so that the plant can respire

(in the dark plants can only respire)

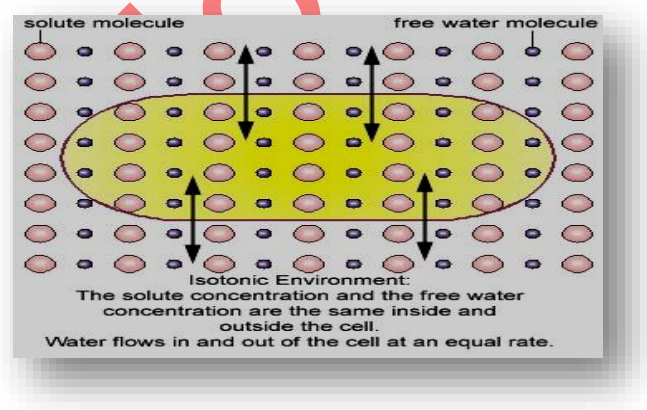
Transport system in plants

Osmosis – It is the ***net*** movement of ***water*** molecules from the region of their high concentration to the region of their low concentration through a semi-permeable membrane

Diffusion – It is the movement of ***water*** and ***gaseous*** molecules from the region of their high concentration to the region of their low concentration through the concentration gradient (diffusion gradient)

Active Uptake –It is the movement of ***mineral salts*** or ***ions*** from the region of lower concentration to the region of higher concentration with the use of ATP energy (Adenosine Tri-Phosphate) which is produced by the mitochondria

Osmosis in Liquids (Equal Concentration)



There is no movement of water molecules because there is equal concentration of water molecules

Osmosis (unequal concentration)

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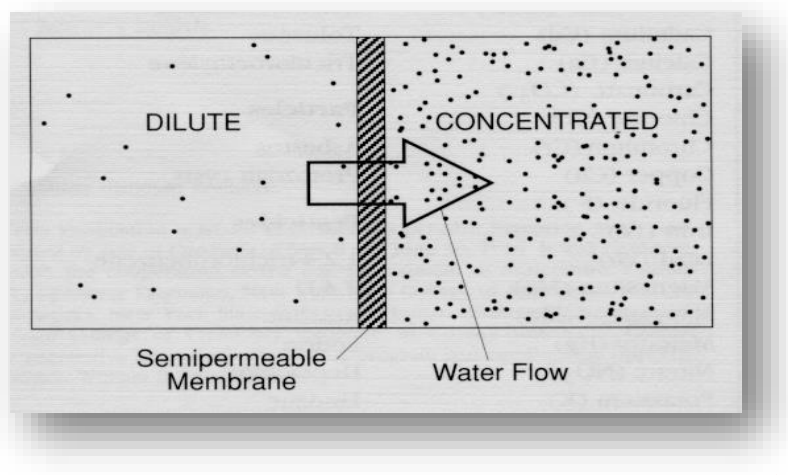
We use salt or sugar to reduce the concentration of water molecules



Water is highly concentrated in A than in B so it moves by the process of osmosis moving from where there is high concentration of water to the low

Concentration Gradient

It is the difference between higher regions tend lower region

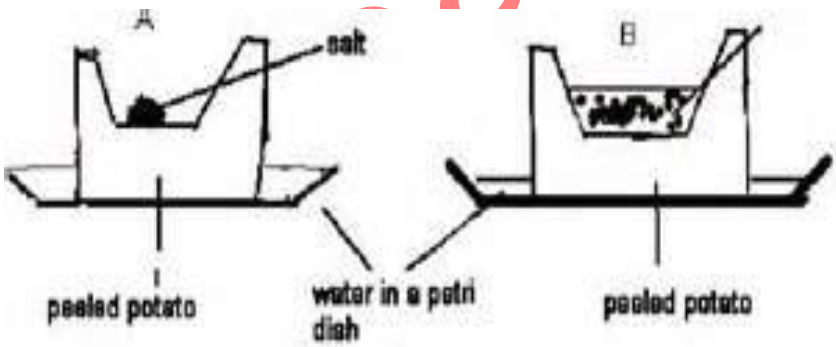
Question

- *Describe and explain how water moves from the soil to the plant leaf?*

Answer

- Water moves by the transpiration pull
- The water that is lost in the atmosphere by the proses of transpiration creates a lower gradient in the cells of the leaf than the cells of a stem and in turn cells of the roots.
- Water is highly concentrated in the soil than in the plant

The Process of Osmosis in a Potato



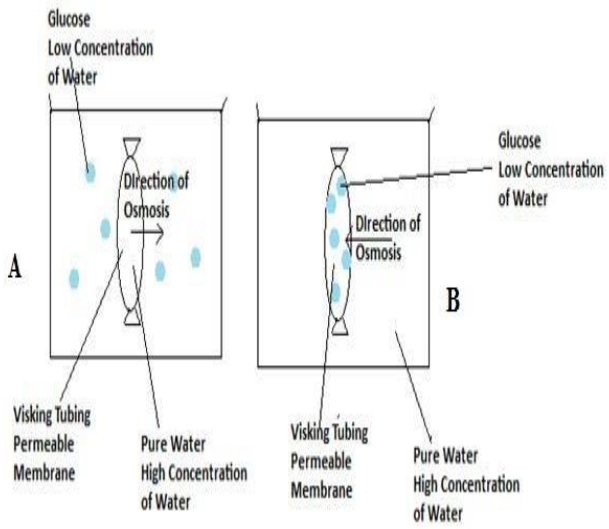
Question

- Describe and explain what happens to the level of water in the beaker?
- Describe and explain what happens to the salt solution in the potato?

Answer

- The salt in the potato creates a low concentration of water so water moves from the potato into the whole creating a low concentration of water in the potato than in the beaker. Since there is a lower concentration of water in the potato than in the beaker, water moves reducing the amount of water in the beaker
- At the end of the experiment the level of water in the beaker decreases and the salt solution increases

The same experiment can be demonstrated using visking tubing. Visking tubing is semi-permeable.

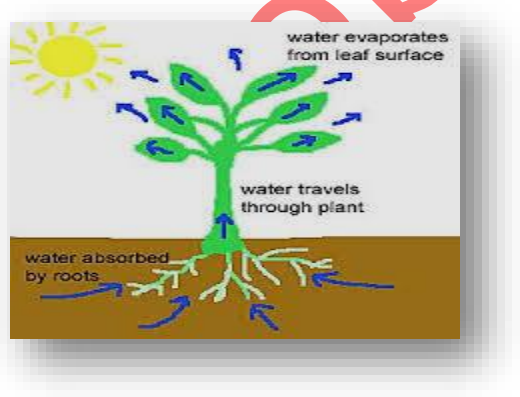


In A water is highly concentrated in the visking tubing than in beaker. The arrow shows the direction of movement of water. Eventually the visking tubing decreases in size and the level of water in the beaker increases

In B water is highly concentrated in the beaker than in the visking tubing, water moves in the direction shown by the arrow. Eventually the visking tubing increases in size and the level of water in the beaker decreases

TRANSPIRATION

It is the loss of water through the leaves of a plant into the atmosphere



Importance of Transpiration

i. ***Cooling the Plant***

ii. ***Transportation Effect***-Transportation of material from the soil to the leaves

Factors Affecting The Rate Of Transpiration

i. ***Temperature*** = when the temperature is high the rate of transpiration increases

ii. ***Wind*** = on a windy day transpiration is high

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iii. ***Light intensity*** = when light intensity is high the rate of transpiration increases

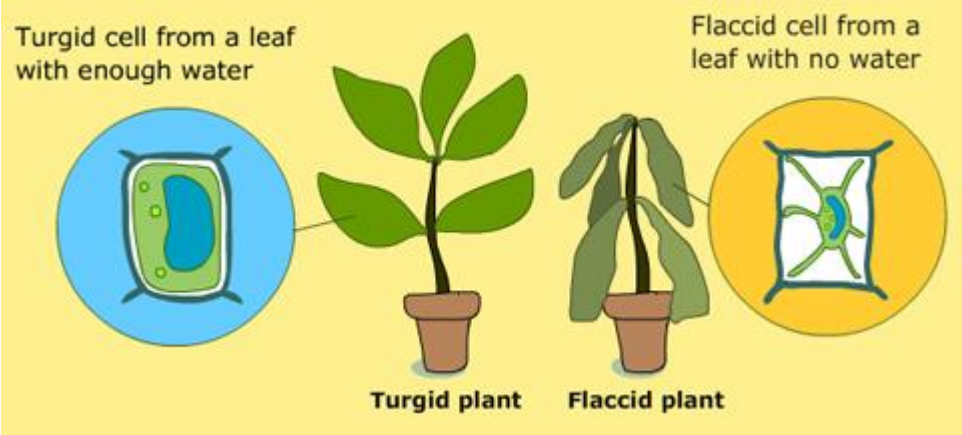
iv. ***Humidity*** =when the is high humidity the rate of transpiration of transpiration

Turgidity

- A turgid cell is one which is gaining water
- The cell will increase in size

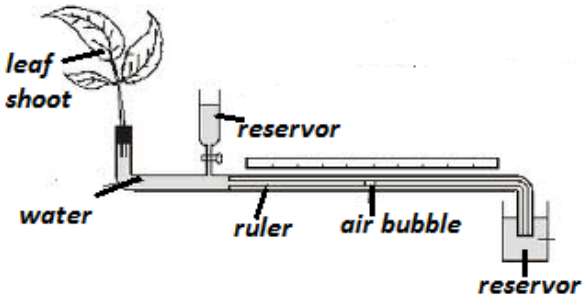
Flaccidity

- This is when a cell loses water
- When a cell is losing water the conditions is called ***Plasmolysis***



Potometer

Is an instrument used to demonstrate rate of transpiration



the shoot is cut with a sharp knife and immediately put in tube with water .

sharp knife- so that cells are not disturbed

put in water immediately - to prevent air lock .

reservor - removes all bubbles of oxygen

ruler - to measure rate of transpiration.

when the leaf starts to loose water the air bubble is seen moving towards the plant. The rate of movement is depended on humidity, light intensity, temperature and surface area of the leaf.

Transport in Humans

The Heart

- The heart is a double circulatory system. that is, it pumps blood to the rest of the body and to the lungs

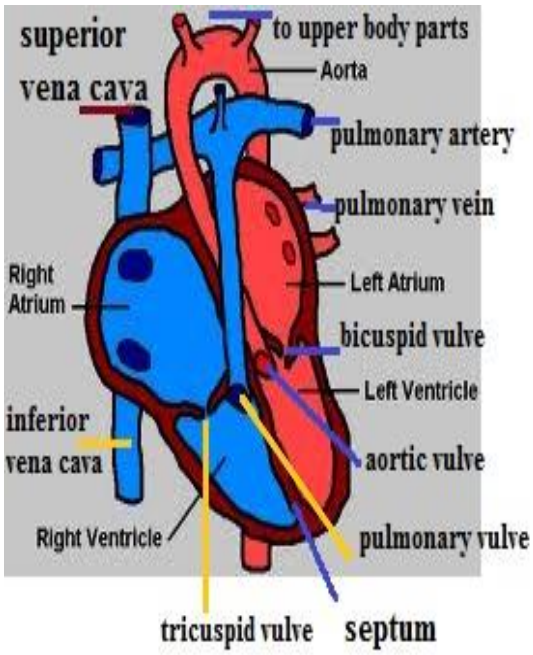
Function of the Heart

i. ***Transportation of material around the body***
   a. PLASMA = a fluid which contains food substances EG glucose, amino acids
ii. ***Homeostasis function***-Distribution of heat across the body
iii. ***Defense system***- transport white blood cells.

The heart is made up of veins and arteries

Veins- carry blood to the heart

Arteries- carry blood from the heart



Pulmonary Artery- carries deoxygenated blood from the heart to the lungs
Pulmonary vein- carries oxygenated blood from the lungs to the heart
Aorta- carries oxygenated blood from the heart to the rest of the body
Vena Cava- carries deoxygenated blood from the rest of the body to the heart
Left Ventricle - receives blood from the lungs and pump it to the left atrium
Left Atrium -Receives blood from the left ventricle and pumps blood to the aorta.
Right Atrium- Receives blood from the right ventricle and pumps blood to the pulmonary artery
Right Ventricle- Receives blood from vena cava and pumps blood to the right atrium.
Septum- Separate the right side from the left side of the heart, that is it separate the deoxygenated blood from the oxygenated blood.
Semi Lunar Valves- Prevent backflow of blood

Deoxygenated bloods from the rest of the body passes through vena cava were semi lunar valves prevent backflow of blood. The blood is at low pressure. The blood is carried to the right atrium of the heart and moves to the right ventricle. The right ventricle pumps blood to the lungs through the pulmonary artery. Gaseous exchange takes place in the lungs were carbon dioxide is taken out and oxygen is taken in. The oxygenated blood flows to the heart from the lungs through the pulmonary vein to the left ventricle. The left ventricle pumps blood at high pressure to the left atrium and the high pressurized blood is pumped to the rest of the body through the aorta. The aorta has no valves since blood is at high pressure.

Question

- *Explain the difference in pressure of the blood pumped to the rest of the body and that which is pumped to the lungs?*

Answer

- *Blood to the rest of the body has to be at high pressure since it has to reach distant organs like the toes while the lungs are just nearby so blood should be at low pressure*

Question

- *Explain what happens when the septum has a hole*

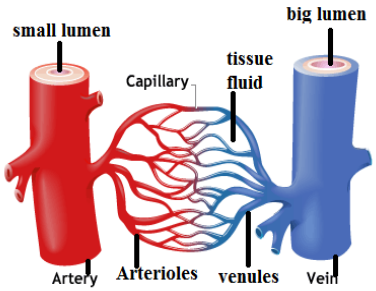
Answer

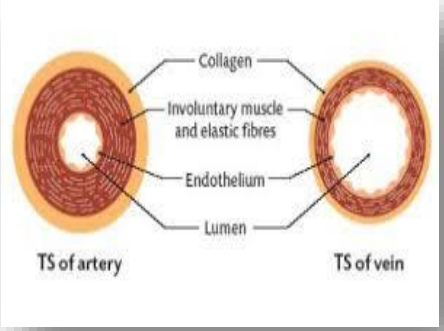
Deoxygenated blood from the right will mix with the oxygenated blood from the left which may lead to heart failure resulting in death of a person. The septum is a part which separates de-oxygenated blood from oxygenated blood.

Blood Composition

1. Plasma-is a substance which contains glucose, proteins etc.
2. Platelets-help in blood clotting when there is there is a wound.
3. Red blood cells-contains hemoglobin, a red pigment which transport oxygen and carbon dioxide.
4. White blood cells-help in defending the body against body infections by engulfing the pathogens.
5. Water-constitutes two third of the blood. It is used to make fluids in the body.

Difference between Arteries, Veins and the Capillaries





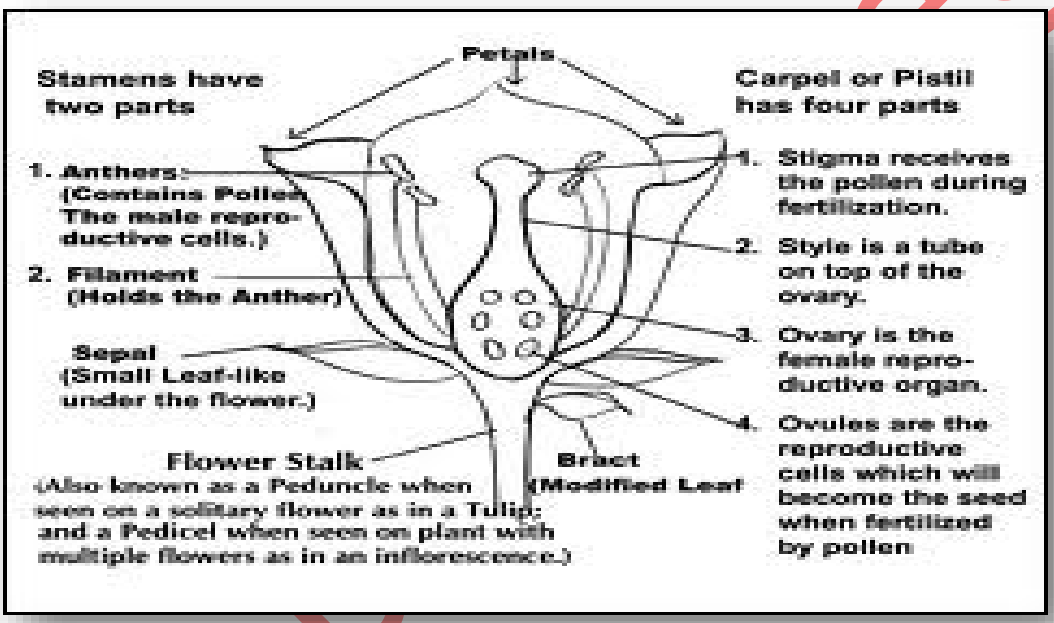
Reproduction systems in plants

- Plants can produce sexually or asexually

Sexual Reproduction In Plants

- This is done by the fusion of male and female sex cell. The ovules are the female sex cells while the pollen grains are the male sex cells.
- ***Flowers*** =Produce seeds which will grow into new plants
- ***The Stigma and the Style***=Are female parts. The female parts are called ***carpel***
- ***The Anther and the filament***=Produces pollen grains which are the male sex cells and they are called **Sepals**

The Sexual Reproduction Organ of the Plant



There are two types of plant flowers

1. The insect pollinated flower
2. Wind pollinated flower

Difference between Wind and Insect Pollinated Flower

Insect	Wind
Flower produce scent	There is no scent
Anther and stigma are enclosed inside	Stigma and anther are exposed
Nectary	Not nectar
Bright petals	Dull petals
The agent is the insect e.g. bees	The agent is the wind

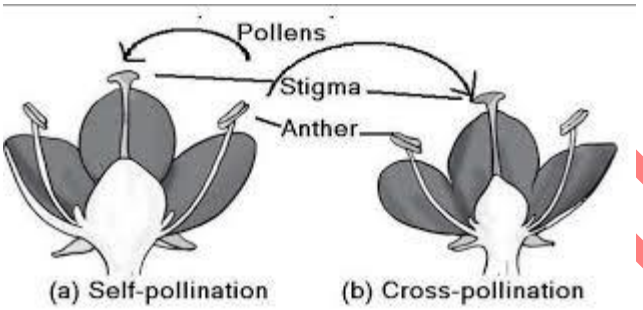
Pollination

It is the transfer of the pollen grains from the anther to the stigma. This enables the male sex cells (pollen grains) to reach the female sex cells (ovules) for fertilization to occur. Pollination is the beginning of growth and development of flowers.

It can be ***cross pollination*** or ***self-pollination***

Cross Pollination is the transfer of pollen grains from the anther of one plant to the stigma of another plant

Self-pollination is the transfer of pollen grain from the anther to the stigma to the same plant



Events from Pollination to Fertilisation

When the pollen grains lands on the stigma they **germinate** thereby producing a pollen tube which will grow down the style. This allows pollen grains to move down and fuse with the ovules. This is called **fertilization.**

Events after Fertilisation

- Ovary- develops into fruit
- Ovule- develops into seed
- SEPAL, PETALS and the STYLE wither and fall down

Seed Dispersal

This is where by the seeds from plants are spread all over the places away from themselves to stop overcrowding and to create new colonies. There are agents of seed dispersal, namely:

I. **Wind-** especially for seeds that are loose from the plant are scattered easily during a windy day. Seeds that fall in this category are feathery in order to allow them to float in air. Examples include dandelions.
II. **Gravity-** this method suits all the seeds that are heavy. When these seeds are ripe they fall to the ground. Examples include, mango, apples, coconuts e.t.c
III. **Water-**seeds can travel long distances depending on specific mode of water.
IV. **Animals-** small hooks on the surface of the seed enable attachment to animal fur for dispersal.

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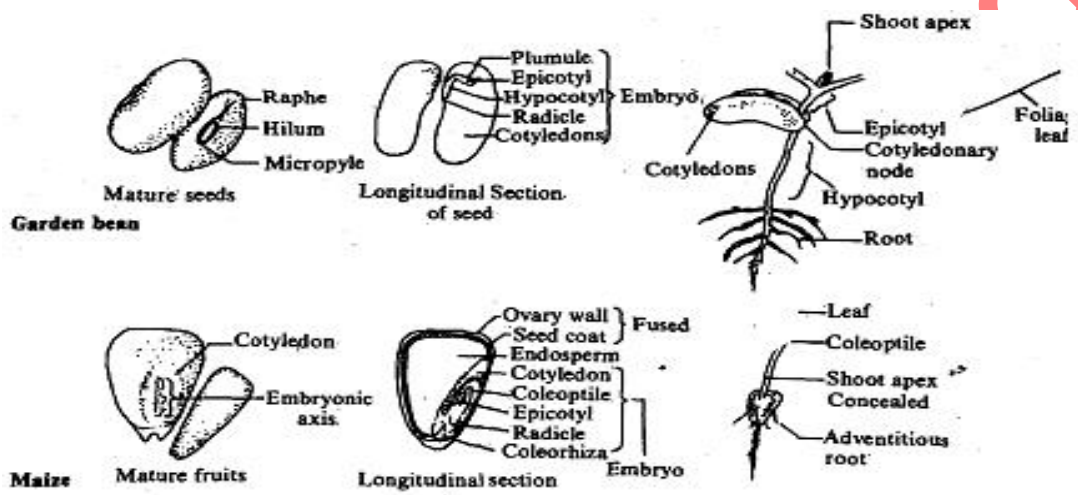
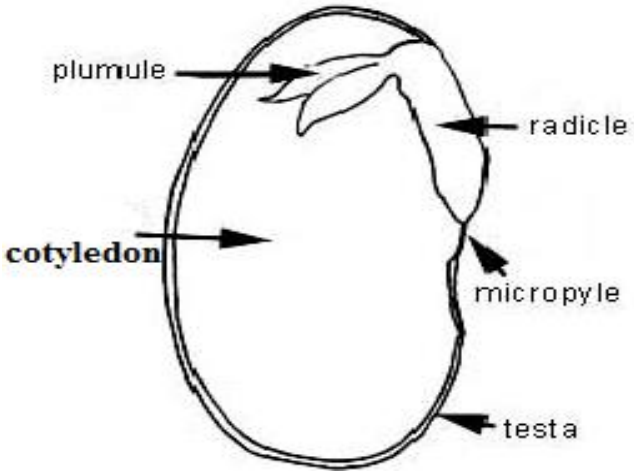
V. **Humans-** it depends on technical means of human mode of transport. Some seeds may stick on human clothes other, like fruit trees are carried in order to be planted elsewhere.

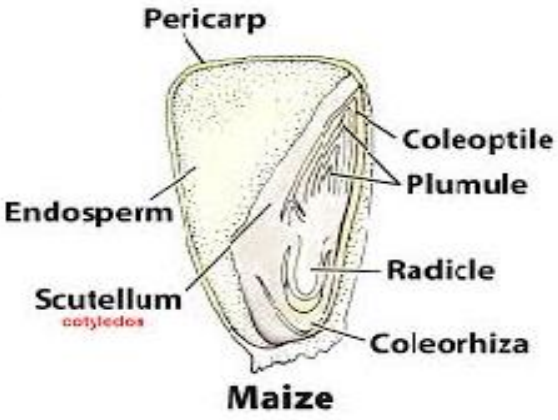
Germination of seeds

Monocotyledonous and Dicotyledonous seeds

Monocots are seeds with one food storage source called the endosperm. Examples include all cereals like maize. Dicots are seeds with two food storage called the cotyledons. Examples includes been seeds.

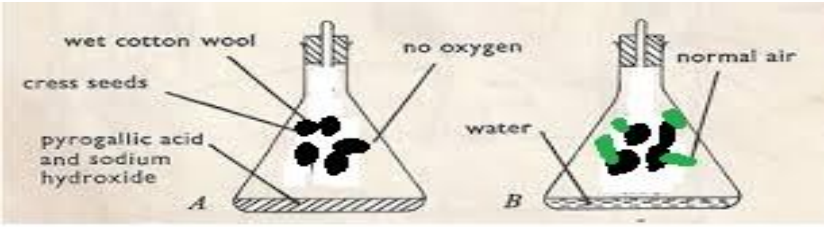






Functions

1. Endosperm-where starch is stored
2. Radicle – develops into the root after germination.
3. Plumule- develops into the shoot after germination.
4. Micropyle – where water is absorbed during germination
5. Hilum – The eye of a seed. Point of its attachment to its base for support.



no germination here because of pyrogalic acid which absorb oxygen away from seeds

germination occurs here because of presents of oxygen

Percentage Germination

- It is determined by dividing the number of seeds germinated by number of seed soaked*100

Question

- A farmer planted 20 seeds 6 germinated. Calculate the % germination

6/20*100 = 30%

Asexual Reproduction (Vegetative Reproductive)

- It is the production of new individual plants from germinated structures by other means other than seeds. E.g. Tubes = Potato, Rhizomes = Grass, Cuttings = Sugar Cane or Sweet Potato

ADVANTAGES

I. Desirable characteristics are maintained
II. Many field plants are obtained
III. Enough food is readily available for the new plants to survive

DISADVANTAGES

I. Too many plants may lead to overcrowding which may increase competition for light ,water ,and nutrients
II. Offspring may be affected by the same adverse environmental conditions and diseases

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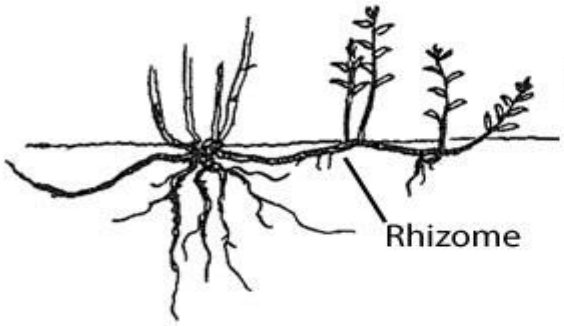


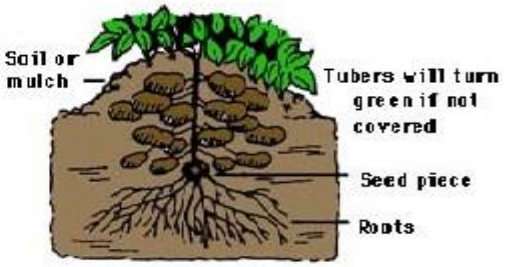
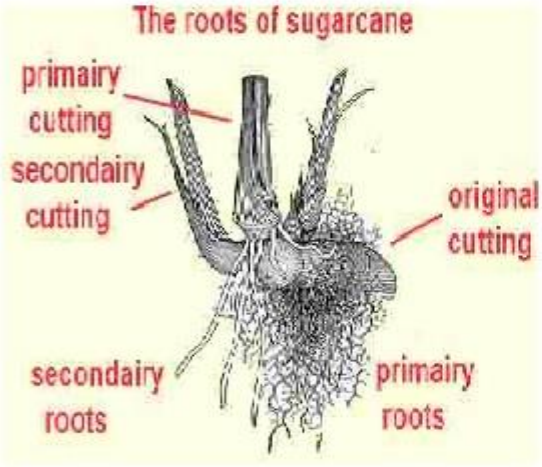


Figure 6



Ecosystem

- It is a self-contained system of independent organism and their physical environment
- It is driven by energy from the sun which enters the system via green plants and later on passed on to animals.

An ecosystem has biological and physical components

1. **PYSICAL COMPONENTS OF THE SOIL**
- They are also called non-living abiotic factors e.g. water, air in the soil, light rock particles
2. **BIOLOGICAL COMPONENTS OF THE SOIL**
- They are called living organism e.g. Plants, humans, animals, fungi, bacteria,

The Soil

The Properties of Clay, Sand, and Loam Soil

Properties	Clay	Loam	Sand
Size of particles	*Very small*	*Medium*	*Large*
Air content	*Low*	*Medium*	*High*

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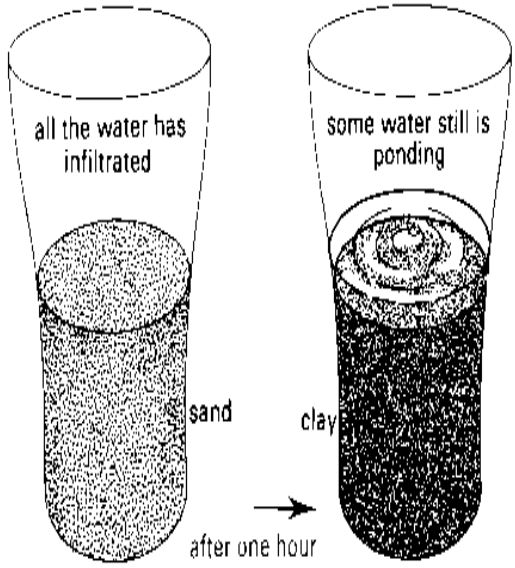
Water holding capacity	*High*	*Medium*	*Low*
Drainage	*Low*	*Medium*	*High*
Leaching	*Low*	*Reduced*	*Very high*
Infiltration	*Low*	*Medium*	*High*
Ph: Acidity/Alkalinity	*Generally alkaline*	*Less acidic than sand*	*More acidic than clay*

EXPERIMENT 1

Comparing the water holding capacity and the drainage of the clay and sand soils

Water holding capacity is the ability of soil to hold water. Sand soil has good drainage and good aeration compared to clay soil. Because of this sand soil has a low water holding capacity than clay soil. This is shown in the diagrams below. After an hour water in the sand soil has completely infiltrated into the soil unlike in the clay soil in which some water still remains on top of the soil.

METHOD



Put the same amount of water in both sand and clay soil at the same time

After some time record the amount of water in clay and sand soil

OBSERVATION

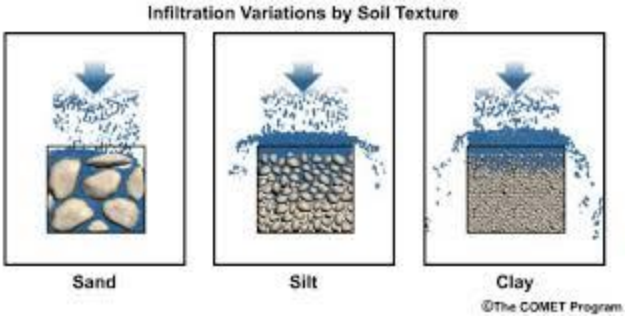
In sand soil all the water has infiltrated.

In clay soil some of the water remains in the soil.

CONCLUSION

Clay soil holds more water than sand soil, good drainage

Clay soil has poor drainage as compared to sand soil



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Percentage Air Content of the Soil

1. Take the same size of measuring cylinders (250ml) and label them ***A*** and ***B***
2. Add 100ml of the soil sample in the cylinder ***A***
3. Add 100ml of water in the soil sample In beaker ***B***
4. Actual volume of water + soil
5. Expected total volume of soil + water

Percentage air content

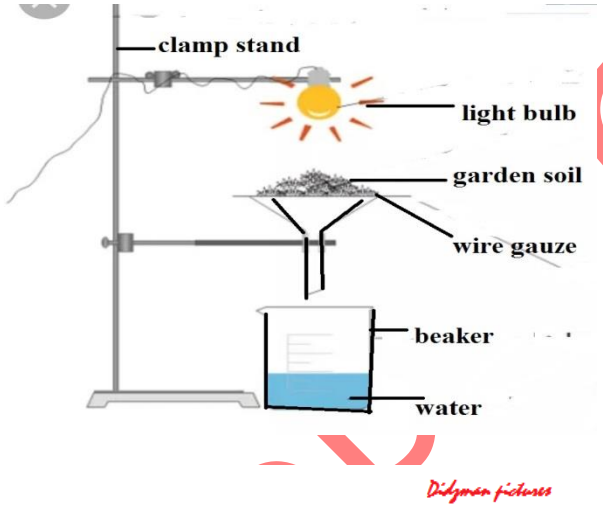
1. $Expected\ volume\ of\ soil\ +\ water - Actual\ volume\ of\ water\ +\ soil$
2. Divide the result in '1' above by volume of soil only (100) and multiply by 100%

For example: If Actual volume of soil plus water is 80 ml

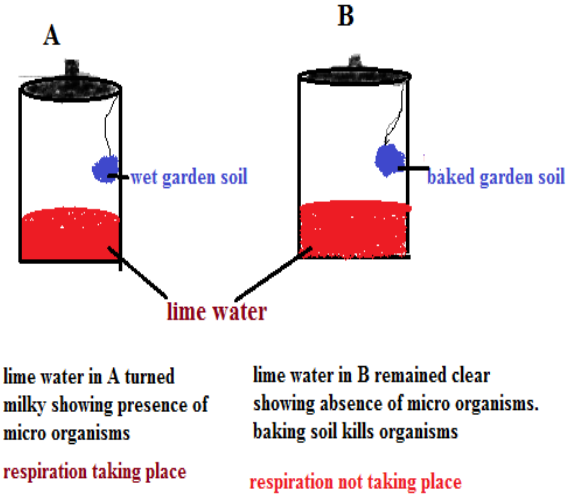
>200ml-180ml=20ml

. : ***Percentage air content*** = 20ml/100ml * 100% = 20%

Showing The Presents Of Micro Organism In The Soil



Microorganisms in the garden soil run away from light. They will fall into the beaker with water. The wire gauze prevents soil particles from falling into the beaker. Water preserves the organisms



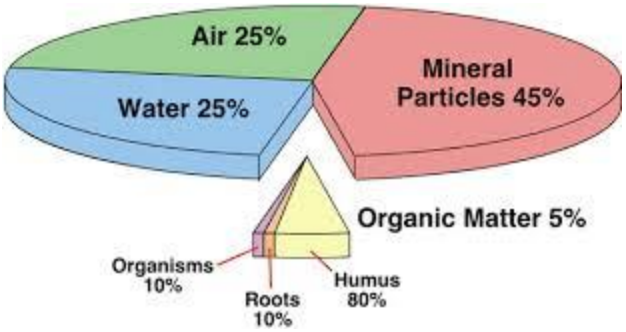
METHOD

200g of fertile garden soil was collected and divided into two equal halves

N.B the soil should be taken from the same place for comparison

half was baked thoroughly and left to cool
Each sample was placed in separate pieces of cloth and suspended in jam jars with equal amount of lime water or bicarbonate indicator
Both jars had tight leads and left in a warm place for a few days

Detemining The Water Contend Of The Soil



METHOD

1. An empty jar was weighed
2. Fresh garden soil was added to the jar and mass of the soil was obtained
3. The soil was dried over water bath as above. This was done to preserve microorganisms otherwise microorganisms would be killed.
4. The soil was left to cool weighed and reweighed until a constant mass is contained.
5. The amount of water in the soil and its percentage was obtained

The following results from the above experiment was obtained

i. Mass of container =60g
ii. Mass of container + fresh soil was= 100g
iii. Mass of container + soil after heated over a water both was =96,5g

The soil was then heated directly over the burner

iv. Mass of container + soil after direct heat was =83,5g

Air Content

» mass of container + fresh soil (100) – Its mass after heating over a water bath (96.5) =3.5

.: Percentage water content

*» Air content (as above) * 100%*

Mass of soil only (100-60)

» 3.5/40 *100% = 8.375

Humus Content

» Mass after heating over water bath (96.5) – mass after direct heating (83.5) = 3g

.: Percentage Humus content

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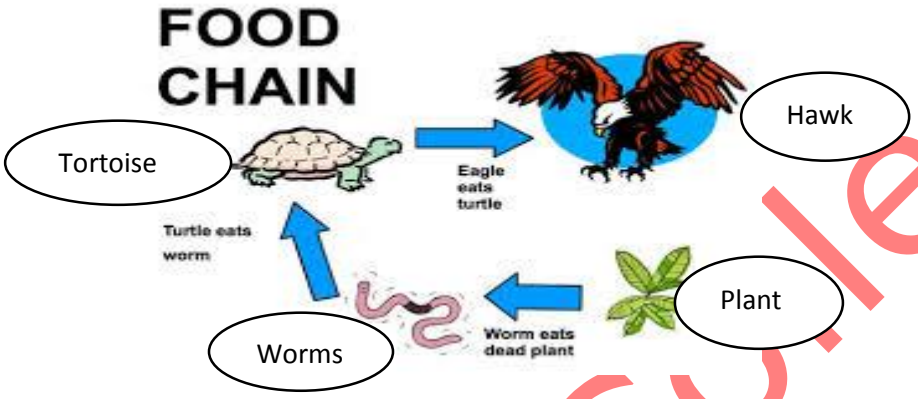
» *Humus content (as above) * 100%*

Mass of soil only(100-60)

» 3/40 * 100 = 3.75

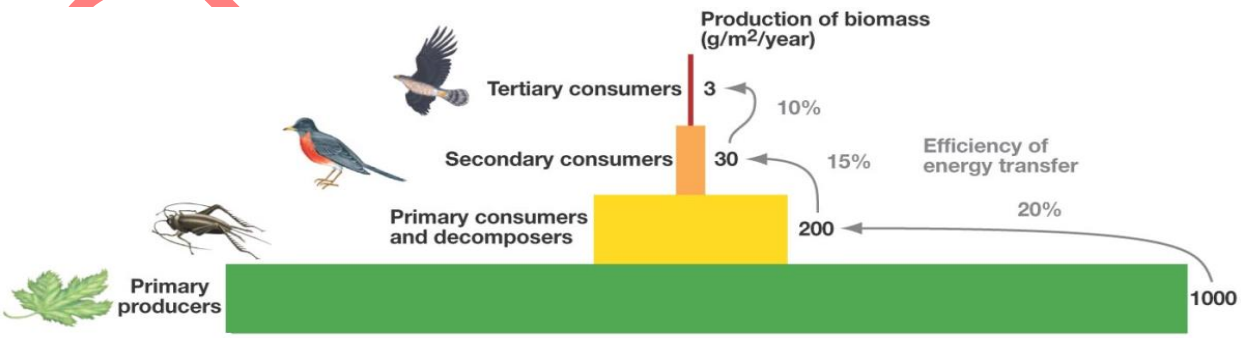
Natural Ecosystem



- *Is a linear feeding relationship*
- *Plant is the producer*
- *Worm is the primary consumer (herbivore)*
- *Tortoise is the secondary consumer (omnivore)*
- *Hawk is the tertiary consumer (carnivore)*
- *Soil organisms are decomposers which feed on dead plants and animals.*
- *Sun (ultimate source of energy)*

If an organism is completely removed the ecosystem is disturbed. Let's say worm is removed, lizard will die because they no longer have food. On the other hand plant will increase in number because there is nothing to feed on it.

Pyramid of Number



The number will be decreasing as you go upwards because energy is lost at each trophic level

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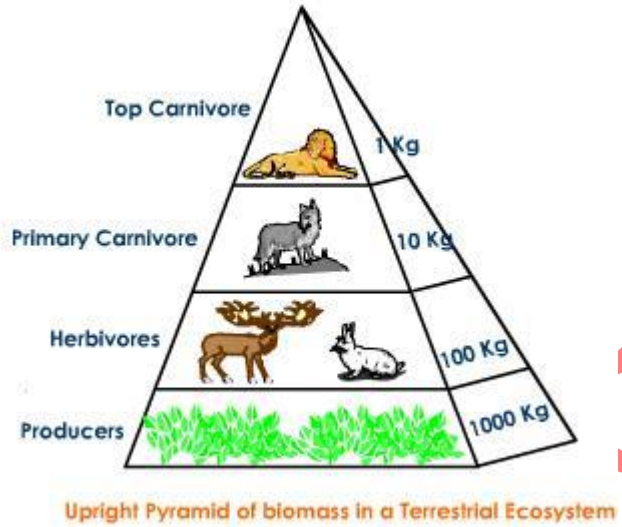
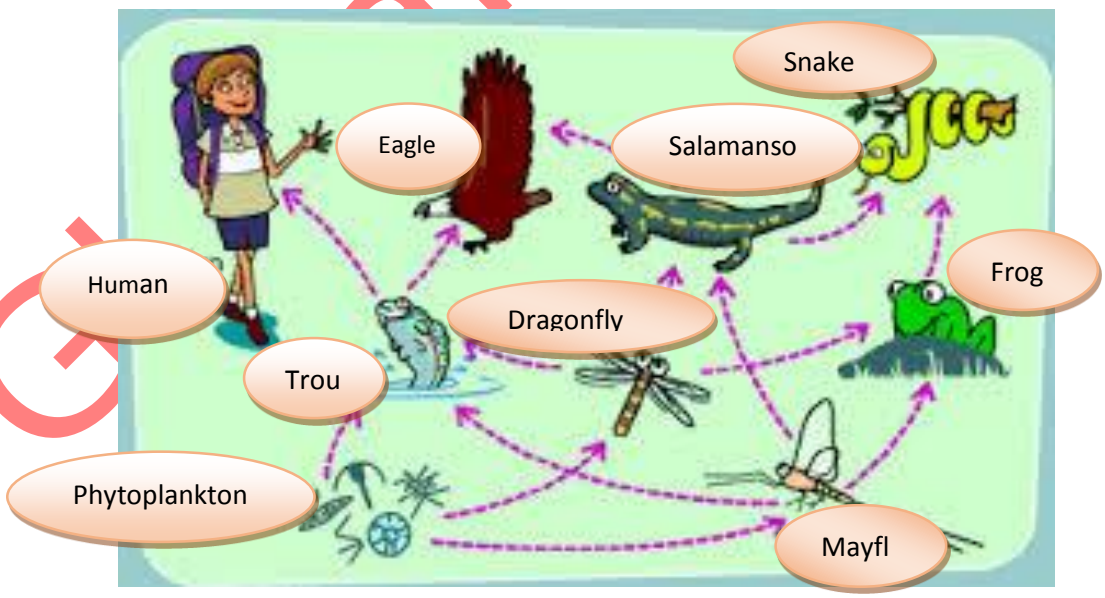
Pyramid of Biomass



- Biomass is the weight of the organism in a given area
- The different level are called trophical level
- The energy from the sun is lost by (***respiration, movement, excretion***)

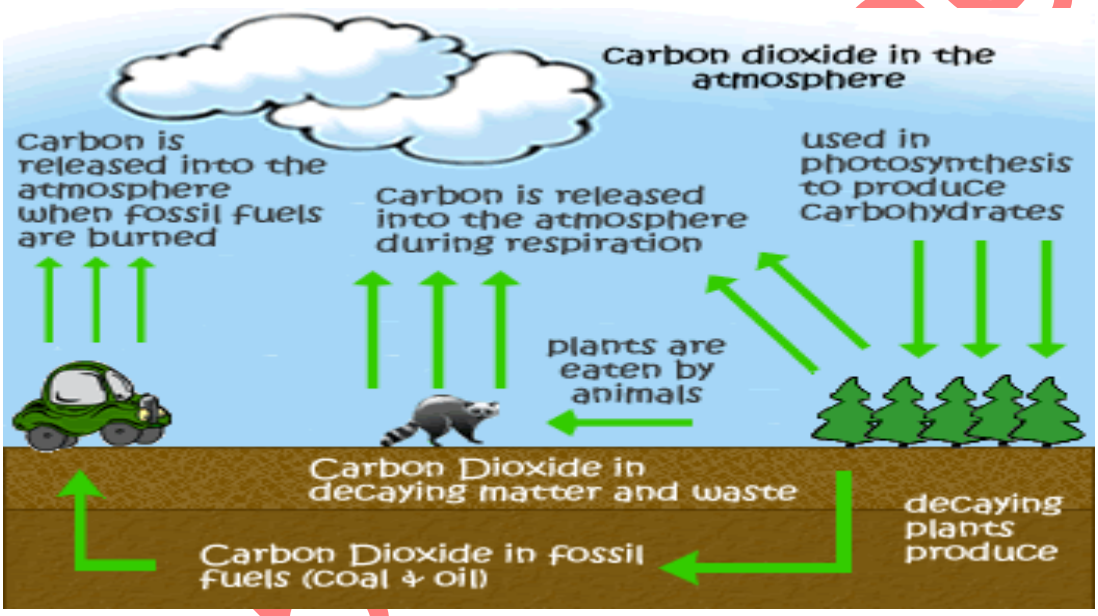
Food Web

- It is a combination of more than one food chain
- It shows feeding interrelationship between plants and animals in an ecosystem.
- An organism feed on several animals and itself be food for more than one organism



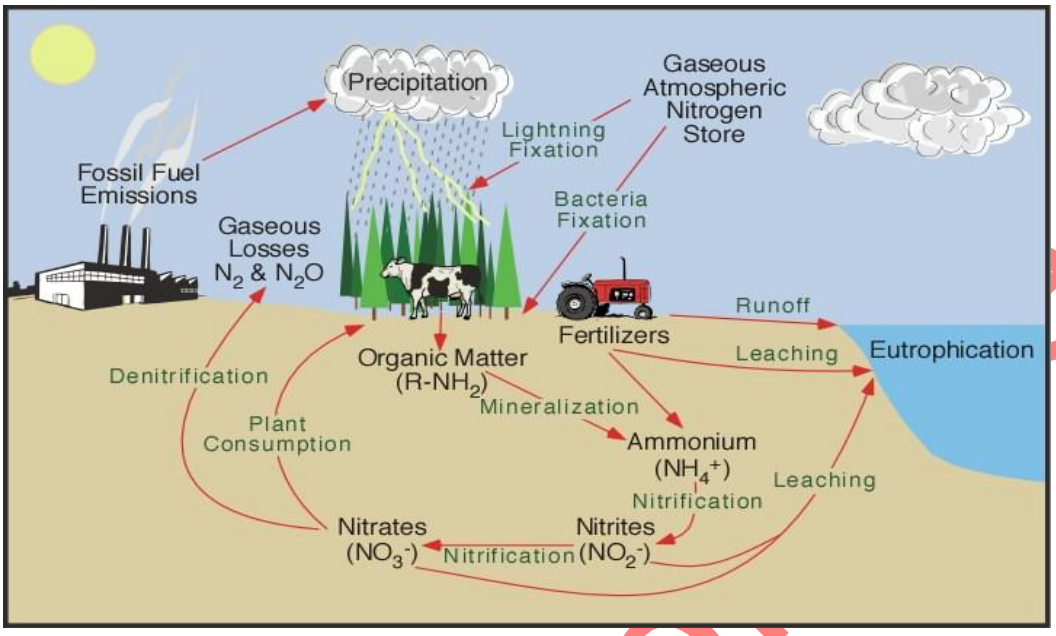
Carbon Cycle

- During photosynthesis green plants take in carbon and combine with water to form carbohydrate(glucose)
- The carbohydrate are used to make fats and proteins in plants
- Animal eat plants
- Protein are used for growth of new tissues and repairing of worn-out tissues
- Carbohydrates and fats are used for energy during respiration realising carbon dioxide and water into the atmosphere
- Carbon dioxide is also released into the atmosphere when animals and plants die and decay
- Fossil fuels like oil , coal , and gas are formed from plants over a million of years
- When these burns e.g. release carbon dioxide into the atmosphere



Nitrogen Cycle

- Nitrogen from the atmosphere is added to the soil as nitrate during thunderstorm
- DE nitrification bacteria in the soil reduce nitrate into nitrogen which passes from the soil into the atmosphere especially in water logging soil
- Improving soil drainage can reduce these
- Nitrogen fixing bacteria, found in the soil and roots nodules of leguminous plants convert soil nitrogen to atmospheric nitrogen to photosynthesis nitrogen compound hence enrich the nitrogen content of the soil.
- Protein from animals remains are broken down by the decomposers into ammonium compounds and finally nitrate in the soil



Artificial Ecosystems

- These are man-made ecosystems. It can be as a result of cultivation of the same type of plant; or having the same type of animal species in an area. An example is a vegetable garden at home or maize field. They result in reduced /limited species diversity

Problems Caused By Reduced Species Diversity

Species diversity is when there are different kinds of organisms in a given area. When it is reduced it means there are a few different kinds of organisms in an area.

i. Soil infertility (since the same type of crop takes up the same nutrients from the soil)
ii. Pest problem (resulting in disease causing organisms spreading rapidly).
iii. Production meant for human consumption only

Management of Ecosystems

The ecosystem is managed by carrying out the following

I. Crop rotation,
II. avoiding stream bank cultivation
III. par docking
IV. destocking
V. forestation and re forestation

Due to the above measures the following will result.

1. Surface run off: it is reduced because more water penetrates the soil and is retained
2. Erosion: ground cover reduces erosion resulting in top soil being preserved.
3. Evaporation: this is reduced by ground cover, which provides mulching.

Effects of Human Activities on Ecosystems

- Human activities, which disturb the ecosystems, can be classified into industrial, agricultural and social.
- These activities result in soil erosion, desertification, reduced bio-diversity and pollution. Pollution can also result in acid rain and global warming or greenhouse effect.

Acid Rain

- It is a result of release of sulphur dioxide into the atmosphere, from industrial and social activities.
- Sulphur dioxide dissolves in water (rain) to form a weak acid, which kills plants on land and in water.
- Acid rain has resulted in destruction of large areas of forests in some countries.

Eutrophication

- Sewage and fertilizer are deposited in water bodies
- This causes excessive growth of water plants.
- The balance of nature of nature is disturbed.

Carrying capacity

- It is the maximum number of organisms an area can support without deterioration,
- The limiting factors are oxygen, food, water, space and shelter.

Effects of Exceeding the Carrying Capacity

- It results in overstocking which in turn causes overgrazing and deterioration of veld.
- It causes soil erosion.
- It disturb the ecosystem

Ways of Controlling the Carrying Capacity of a Habitat.

1. Culling – killing of animals to maintain carrying capacity
2. Destocking – reducing numbers to sustainable levels
3. Pad docking – keeping animals in paddocks and rotating them accordingly.

Reproduction in Humans

Humans reproduce sexually. This is the fusion of male and female sex cells to produce a zygote. The zygote, in the womb will develop into an embryo, then a foetus and then a baby. This takes 9 months.

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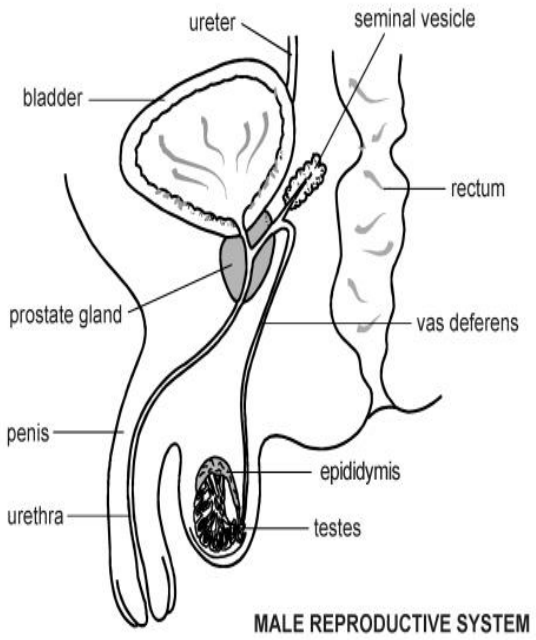
The male Reproductive Organ



Function of Parts

Testes – an organ that produces spermatozoa (male reproductive cells). They are enclosed in a bag called ***scrotum***. It consist of erectile tissue responsible for erection. It serves also for the elimination of urine.

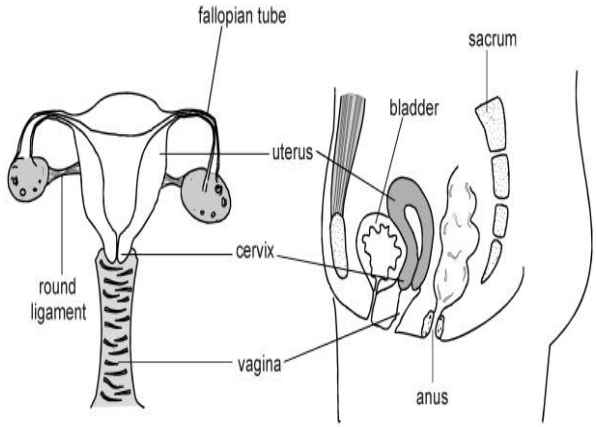
Scrotum – a pouch/bag of skin containing the testicles.

Urethra – the duct by which urine is conveyed out of the body from the bladder and also conveys semen.

Seminal vesicle – produces seminal fluids that nourishes and lubricate sperms. Together plus sperms are called semen.

Prostate gland - Secretes nutrients and enzymes which activate sperms to move on their own or become active

The Female Reproductive Organ



FEMALE REPRODUCTIVE SYSTEM

Ovary – organ which ova or eggs are produced, present as a pair

Ova – female sex cells

Oviduct/Fallopian Tube – passage through which an ovum passes from an ovary.

Uterus/Womb – this is where offspring are conceived and in which they gestate before birth.

Vagina – the muscular tube leading from the external genitals to the cervix of the uterus in women. It receives the penis during copulation.

Cervix –controls the opening to the uterus. It prevents germs from entering into the uterus.

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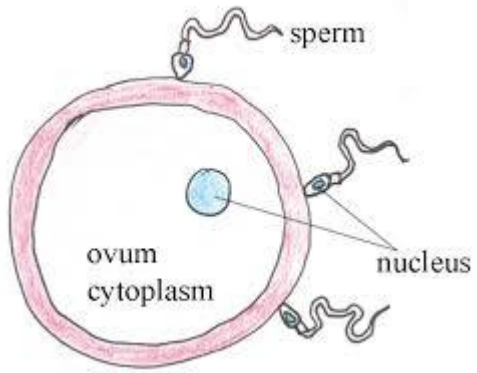
Fertilisation

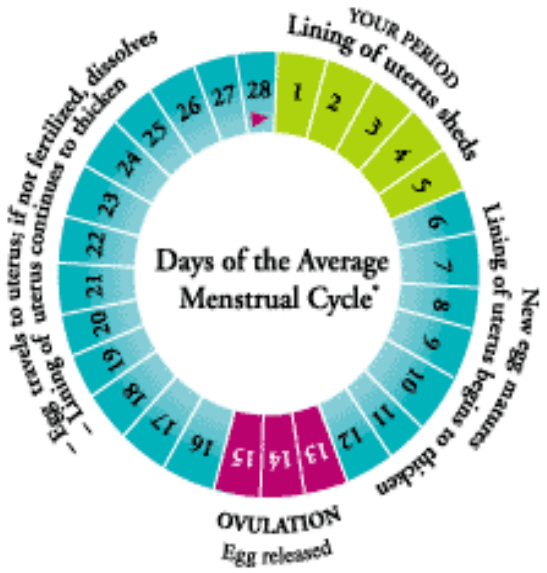
- It is the fusion of male and female sex cells to produce a zygote. It takes place in the oviduct.

Structure of the Ovum and Sperm



The Menstrual Cycle

- When fertilization did not occur the uterus lining breaks as well as the ova and they pass out. This occurs periodically once every month.



* Note: This diagram shows a 28-day cycle. Some women's cycles may be longer or shorter.

The reproductive cycle in females is called the menstrual or estrus cycle.
It has an average of 28 days and it varies with individuals but follows a certain pattern.
The ovary produces hormones: estrogen and progesterone, which regulates the menstrual cycle.
Estrogen influences build-up of the uterus lining in preparation for fertilization. Progesterone maintains the thickness of the uterus. At day 14, ovulation occurs and if the egg released is not fertilized the egg breaks. The ovary then stops producing progesterone. The decrease in release of the hormone will cause the uterus lining to break. The fluid will pass out and it may take an average of 5 days.
The cycle is simplified in the diagram above.

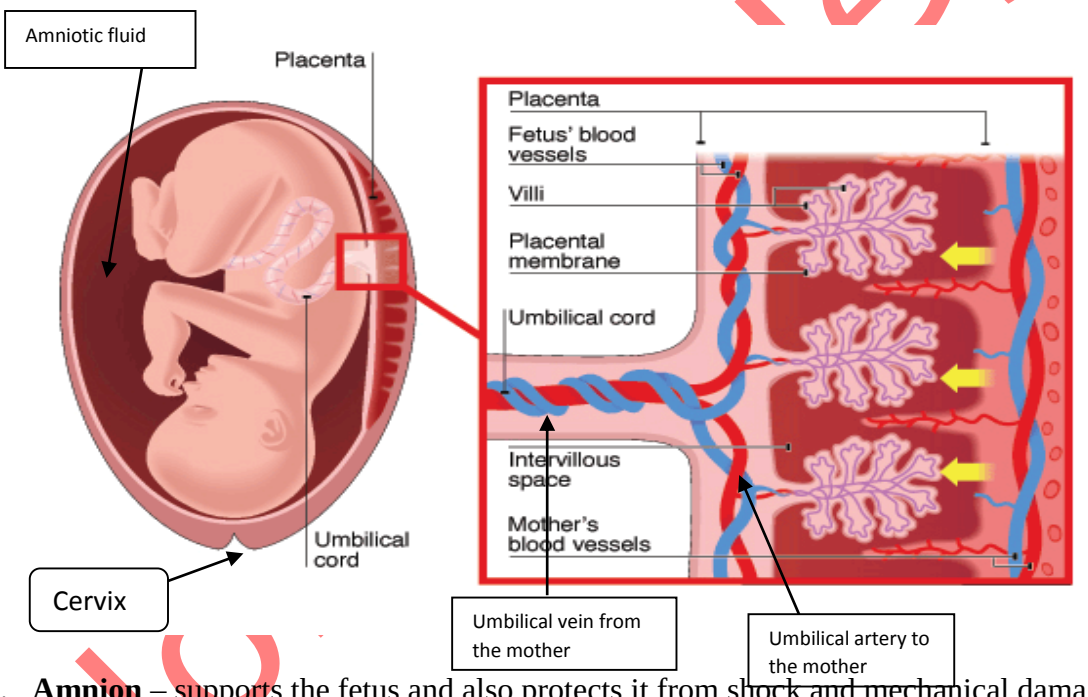
Causes of Infertility in Humans

1. Low sperm count
2. Poor quality of sperms
3. Physical condition – failure of the penis to erect

4. Cancer
5. Damage by sexually transmitted diseases.
6. Blockage of the oviducts or sperm ducts.

Growth of the Embryo /Fetus (from fertilization to birth)

- After fertilization, the zygote is formed. A form of cell division called mitosis takes place- forming ball of cells, then the embryo, which moves down into the uterus lining and attaches to it. This is called implantation. The implanted embryo obtains some food supplication from the mother through the umbilical cord. The umbilical cord connects to the placenta, which contains a network of blood capillaries which supply food.
- It takes 9 month for the baby to grow inside the womb. Development of the heart, head, and limbs changes the embryo to fetus.
- The fetus develops whilst contained in a fluid sac called the amniotic sac filled with amniotic fluid or amnion.



1. **Amnion** – supports the fetus and also protects it from shock and mechanical damage
2. **Umbilical cord –** it attaches the fetus to the placenta and contains the umbilical artery and vein which carry deoxygenated and oxygenated blood , with oxygen , glucose , amino acids , salt and antibodies moving from the maternal blood to the fetal blood , carbon dioxide and urea moving from the fetal blood to the maternal blood .The placenta is selective permeable . Alcohol, nicotine and other harmful substances are kept away from the fetus by the placenta but may force their way across when present in high concentration over a period of time and can affect the development of the fetus negatively

Health and diseases

Diseases

- A disorder of structure or function in a human, animal, or plant, especially one that produces specific signs or symptoms or that affects a specific location and is not simply a direct result of physical injury.

CAUSES OF DISEASE

- Diseases are caused by Bacteria , Viruses , Fungi , Protozoa and Worms causes diseases
- Disease causing organisms are called ***pathogens***

HOW PATHOGENS ARE TRANSMITTED

1. By vectors (e.g.) malaria and cholera
2. By contact (e.g.) ring worm and gonorrhea
3. By droplets (e.g.) tuberculosis (TB)
4. By eating contaminated food and drink contaminated water (e.g.) cholera , Typhoid , Bilharzia and Dysentery

Cholera

- Acute diarrhea , fever ,vomiting

TREATMENT

- Oral rehydration and Antibiotics

CONTROL OF CHOLERA

- Good sanitation
- Protection of water sources
- Vaccination as a preventive measure
- Isolation of the infected person

ROLE OF HYGIENE IN DISEASE CONTROL

Personal Hygiene

- This is hygiene of the individual. It involves care of food , clothing , exercise , personal .cleaning and general good habits which include having meals regularly , having enough sleep and stress prevention
- Personal hygiene helps to prevent the onset of and spreading of diseases

Domestic Hygiene

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- This is hygiene within the household to prevent contamination of food and water
- It involves proper handling , storage and preparation of food to prevent contamination and general cleanliness of the home to prevent breading of vectors

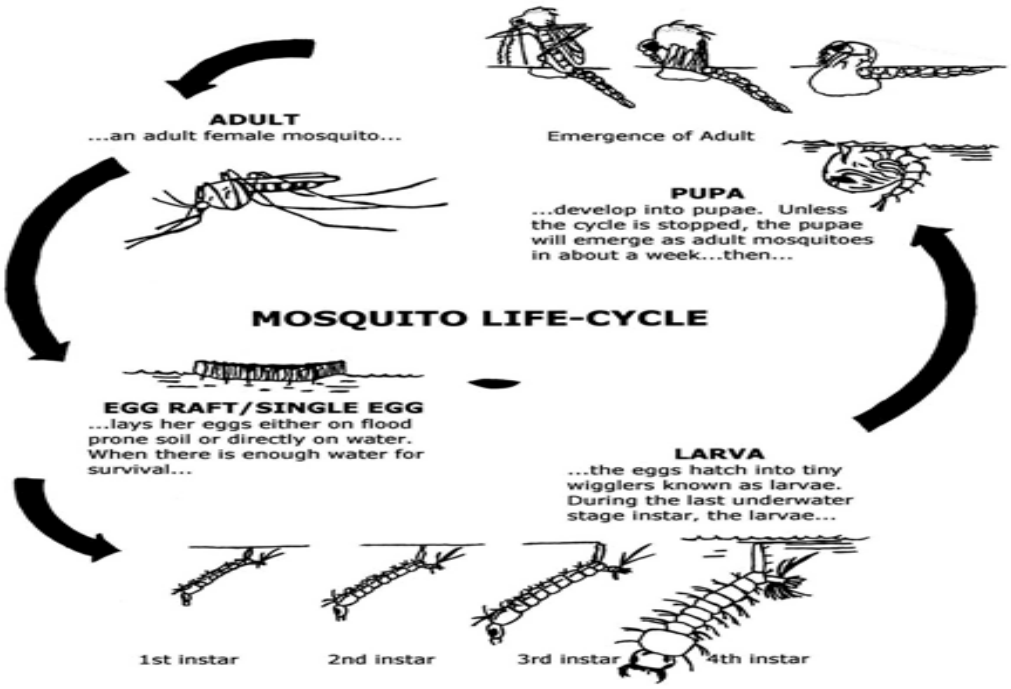
Community Hygiene

- This is essential to prevent epidemics. it involves
- Proper water treatment
- Proper sewage disposal and treatment
- Proper immunization of children
- Proper control of vectors
- Sufficient health facilities including regulatory mechanism and by laws about food safety in shops and food outlets

Malaria

- The vector is the female Anopheles mosquito
- The causative Agent is Plasmodium , which is a protozoa

THE LIFE CYCLE OF THE FEMALE MOSQUITO ANOPHELES



The Life Cycle of the Plasmodium (Malaria Parasite)

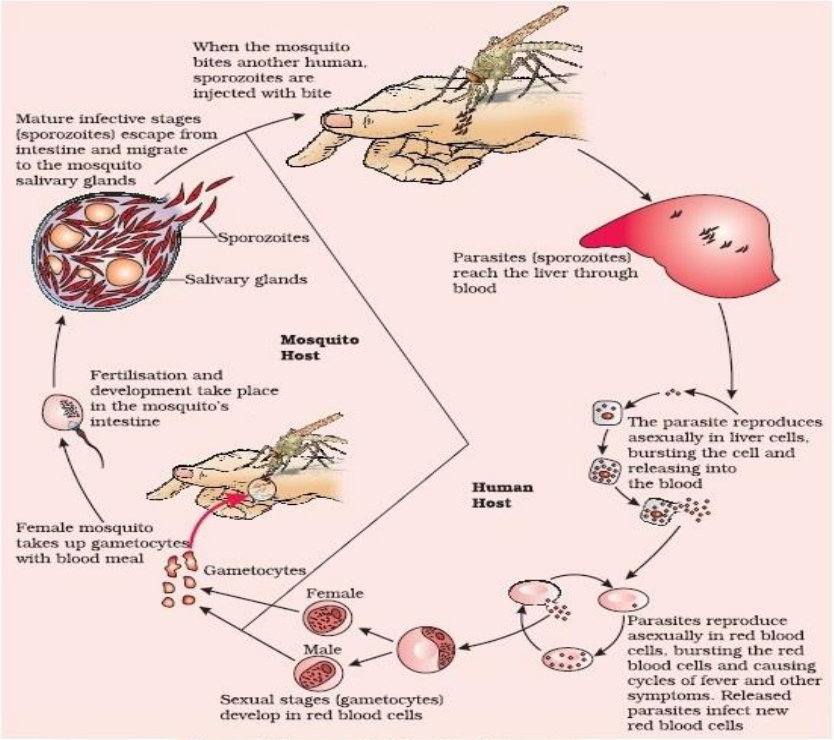


Figure 1 . Stages in the life cycle of *Plasmodium*

METHOD OF CONTROLLING MALARIA

1. Prevent the Breading of Mosquitoes

- This can be done by identifying places in which mosquitoes bread then removal of conditions favorable for breading and use of appropriate insecticides for killing mosquitoes at different stages of the life cycle
- Bury empty containers or drain stagnant water or spray oily insecticide on to stagnant water bodies to kill larvae and pupae

2. Inactivating Adult Mosquitoes

- By spraying residual insecticide on walls and roofs of houses (indoors). This will kill adult mosquitoes because the residual insecticide remains active long after spraying. DDT is the most commonly used insecticide for mosquitoes in Zimbabwe.

3. Preventing Mosquitoes from Biting People

- Use of mosquito nets (treated or untreated) especially by infected people. Having wire mesh screens on windows and doors to prevent entry of mosquitoes into the homes. Wearing thick long sleeved shirts/tops and trousers . Use of mosquito repellent jelly

4. The Use Of Anti Malaria Drugs To Kill Malaria Parasites

I. QUININE : effective on parasite in red blood cells , but ineffective on parasites in the live

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II. CHLOROQUINE : effective against parasites in red blood cells and for acute attacks of malaria
III. PRIMAQUINE PHOSPHATE : is the least dangerous
IV. FANCIDE :Is the most recent drug used for chloroquine resistant cases

V. THE USES OF PROPHYLACTIC DRUGS

- These are drugs taken by a healthy person as precaution, so that when parasite enters the body, they are prevented from developing and causing malaria. The drugs include DAPSONE and PYRIMETHAMINE available in Zimbabwe as DELTAPRIM , MALASONE or MALOPRIM

NOTE

- The malaria parasite has developed resistance towards certain drug , so scientists have to work hard to come up with new effective drugs

Defence Systems

The Body 'S Defense Mechanisms and Barriers

1.**THE SKIN** : it is a physical barrier against bacteria and other pathogens
2.**WAX AND HAIRS** : Found in the ears , prevent invasion by micro organisms
3.**MUCUS AND HAIRS** : Found in the nose , it trap the dust and invading bacteria and spores
4.**STOMACH ACID** : They kill bacteria which enters in with food in the stomach
5.**WHITE BLOOD CELLS** : Some engulf and digest bacteria , others produce antibodies to destroy bacteria or neutralize toxins or poisons produced by bacteria
6.**TEARS** : have a mild antiseptic to kill bacteria in the eyes
7.**BLOOD CLOTTING**: it is caused by the platelets in blood at damaged part of the skin .The mechanism involves blood proteins in plasma forming a network of fibres and eventually a clot. Clots prevent loss of blood and entry of bacteria
8.**SALIVA** : It has a cleansing action

Ebola

Ebola virus disease (EVD), also known as Ebola hemorrhagic fever (EHF) or simply Ebola is a viral hemorrhagic fever of humans and other primates caused by Ebola viruses. Signs and symptoms typically start between two days and three weeks after contracting the virus with a fever, sore throat, muscular pain, and headaches. Vomiting, diarrhea and rash usually follow, along with decreased function of the liver and kidneys. At this time, some people begin to bleed both internally and externally. The disease has a high risk of death, killing between 25 and 90 percent of those infected, with an average of about 50 percent.

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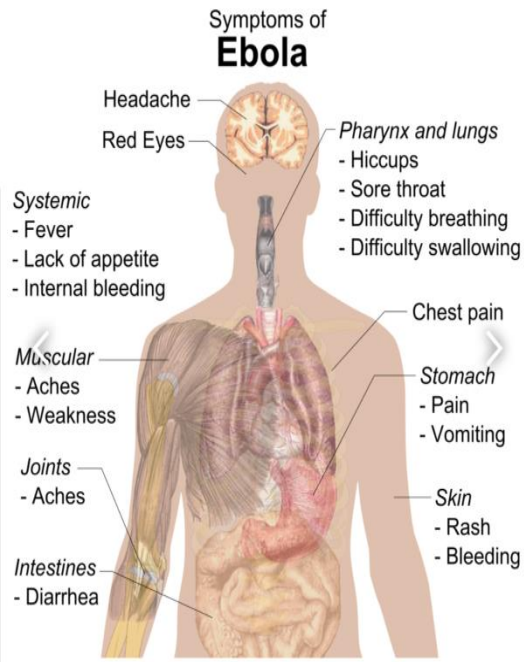
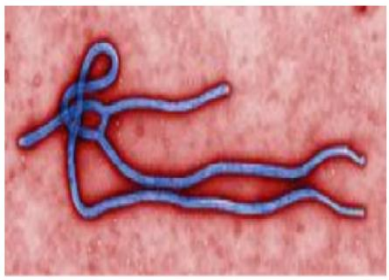


Ebola virus



The virus spreads through direct contact with body fluids, such as blood from infected humans or other animals!' Spread may also occur from contact with items recently contaminated with bodily fluids. Spread of the disease through air between primates, including humans, has been documented in either laboratory or natural condltlons.Pl Semen or breast milk of a person after recovery from EVDmay carry the virus for several weeks to months. Fruit bats are believed to be the normal carrier in nature, able to spread the virus without being affected by it. Other diseases such as malaria, cholera, typhoid fever, meningitis and other viral hemorrhagic fevers may resemble EVD. Blood samples are tested for viral RNA,viral antibodies or for the virus itself to confirm the diagnosis. Control of outbreaks requires coordinated medical services and community engagement. This includes rapid detection, contact tracing of those who have been exposed, quick access to laboratory services, care for those infected, and proper disposal of the dead through cremation or burial. Samples of body fluids and tissues from people with the disease should be handled with care.

Recovery and death

Recovery may begin between 7 and 14 days after first symptoms. Death, if it occurs, follows typically 6 to 16 days from first symptoms and is often due to low blood pressure from fluid loss. In general, bleeding often indicates a worse outcome, and blood loss may result in death. People are often in a coma near the end of life. Those who survive often have ongoing muscular and joint pain, liver inflammation, decreased hearing, and may have continued tiredness, continued weakness, decreased appetite, and difficulty returning to pre-illness weight. Problems with vision may develop. Survivors develop antibodies against Ebola

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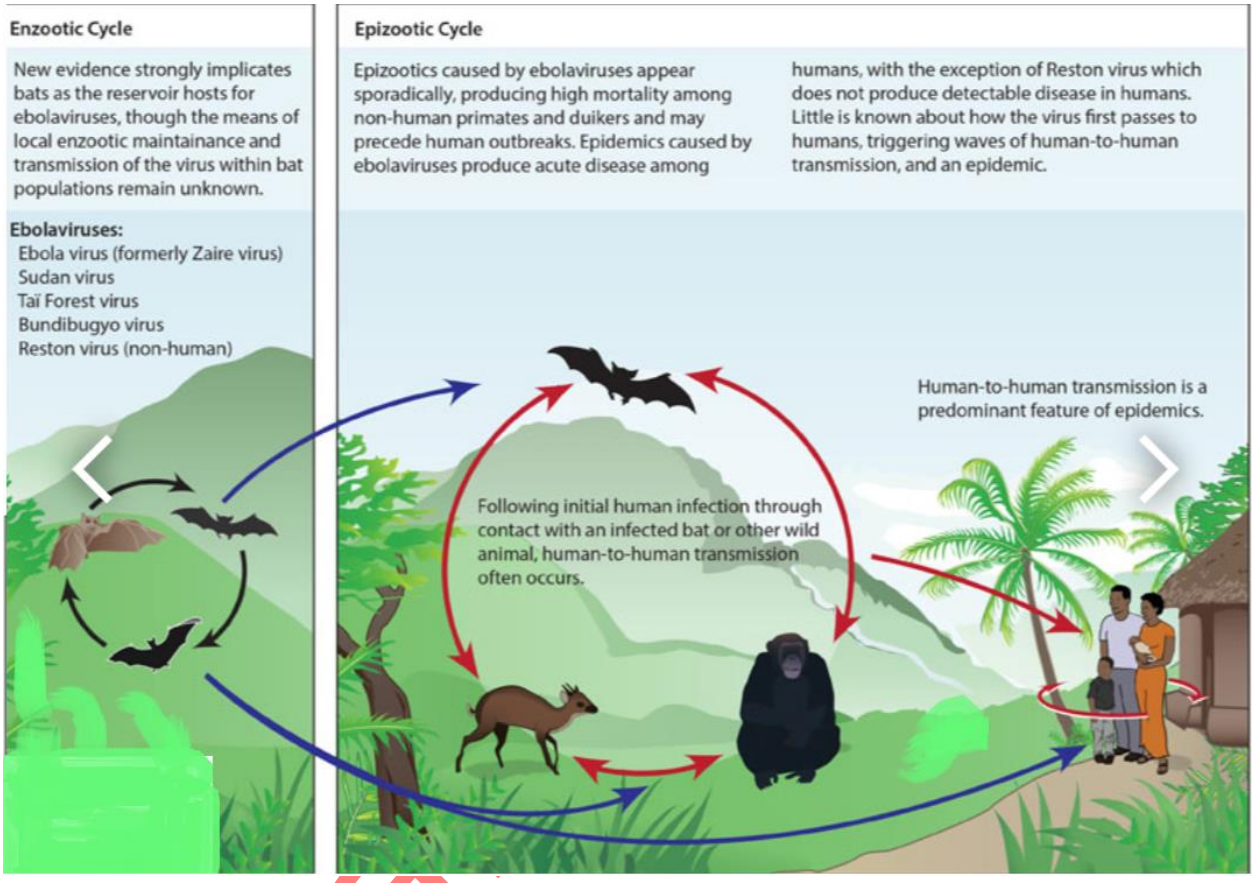
that last at least 10 years, but it is unclear whether they are immune to additional infections.



Typhoid

Typhoid fever, also known simply as typhoid, is a bacterial infection due to Salmonella typhi that causes syrnptorns. It spreads through contaminated food, water or close contact. Partly preventable by vaccine treatable by medical professional. Requires a medical diagnosis. Lab tests or imaging often required. Short-term: resolves within days to weeks however it requires a medical diagnosis

Symptoms include high fever, headache, stomach pain and either constipation or diarrhea.

People may experience:

Pain areas: in the abdomen or muscles.

Gastrointestinal: bloating, constipation, diarrhea, nausea, or vomiting

Whole body: fatigue, fever, chills, loss of appetite, or malaise

Also common: headache, muscle weakness, rash with small red dots, skin rash, or weight loss

Treatment

Treatment includes antibiotics and fluids.

Supportive care

IV fluids and Oral rehydration therapy

Medications

Antibiotics and Penicillin

Classically, the course of untreated typhoid fever is divided into four distinct stages, each lasting about a week. Over the course of these stages, the patient becomes exhausted and emaciated.

- In the first week, the body temperature rises slowly, and fever fluctuations are seen), malaise, headache, and cough. A bloody nose (epistaxis) is seen in a quarter of cases, and abdominal pain is also possible. A decrease in the number of circulating white blood cells (leukopenia) occurs with eosinopenia and relative lymphocytosis; blood cultures are positive for Salmonella Typhi. The Widal test is usually negative in the first week.
- In the second week, the person is often too tired to get up, with high fever in plateau around 40°C and bradycardia (sphygmothermic dissociation or Faget sign), classically with a dichroitic pulse wave. Delirium is frequent, often calm, but sometimes agitated. This delirium gives to typhoid the nickname of "nervous fever". The abdomen is distended and painful in the right lower quadrant. Diarrhea can occur in this stage: six to eight stools in a day, green, and comparable to pea soup, with a characteristic smell. However, constipation is also frequent. The spleen and liver are enlarged and tender, and liver transaminases are elevated. The Widal test is strongly positive, with anti O and anti H antibodies. Blood cultures are sometimes still positive at this stage. The major symptom of this fever is that the fever usually rises in the afternoon up to the first and second week.
- In the third week of typhoid fever, a number of complications can occur:
  - Intestinal hemorrhage due to bleeding in congested
  - Peyer's patches; this can be very serious, but is

- Intestinal perforation in the distal ileum: this is a very serious complication and is frequently fatal. It may occur without alarming symptoms until septicemia or diffuse peritonitis sets in. Respiratory diseases such as pneumonia and acute bronchitis. The fever is still very high and oscillates very little over 24 hours. Dehydration ensues, and the patient is delirious (typhoid state). One-third of affected individuals develop a macular rash on the trunk. Platelet count goes down slowly and risk of bleeding rises.

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Sexually Transmitted Infections

These are diseases transmitted sexually. If an infected person has an unprotected sex with an uninfected person the disease is transmitted. Consider the table below.

Disease	Pathogen	Signs	Symptoms	Treatment/cure
HIV/AIDS	Virus	Weight loss, Diarrhea, Skin sores, Swollen glands, Persistent cough, Low white blood cell count	Pneumonia,No immunity Fatigue fevers	No cure, Life can be prolonged by use of ARVs
Syphilis	Bacterium	Sore on penis or vagina a week after infection, Spots on skin, Blindness and insanity(long term)	Mild fever	Antibiotics if attended early
gonorrhea	Bacterium	**Male:**Inflammation of penis, Yellow discharge **Female:** Pus and discharge	Pain during urination,Discharge may be unnoticed	antibiotics
chancroid	Bacterium	Sores on penis or vagina Swollen glands in groin	Pain from sores and glands	antibiotics

Immunity

- It is the body's ability to resist diseases

THE TYPES OF IMMUNITY

TYPES OF IMMUNITY	HOW IT IS ACQUIRED
Natural acquired active immunity	Antigens enter the body naturally resulting in the body being stimulated to produce antibodies against a specific antigen, leading to recovery. That information gets stored in the brain, for use if the body is exposed to the same antigen I future. This has a long term effect
ARTIFICIALLY ACQUIRED PASSIVE IMMUNITY	Receiving ready-made antibodies , as is the case with infants when the receive antibodies from their mothers through breast feeding , after birth , or across the placenta during the pregnancy
ARTIFICIALLY ACQUIRED PASSIVE IMMUNITY	Receiving read made antibodies , as is the case with infants when they receive antibodies from their mothers through breast feeding ,after birth ,or across the placenta during pregnancy
ARTIFICIALLY ACQUIRED PASSIVE IMMUNITY	Obtained by injecting serum-containing antibodies into the body It is short lived. This form of immunity is given when there is risk of infection and there would be no time for the body to produce its own antibodies before symptoms of the diseases is felt. The serum is prepared from the blood of an animal, e.g. horse , previously actively immunity , the blood plasma is called FIBRINOGEN removed , leaving serum with antibodies

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NOTE

- An antigen is any substance that causes your immunity system to produce antibodies against it .An antigen may be a foreign substance from the environment such as chemicals, bacteria, viruses, or pollen. An antigen may also be formed within the body , as with bacteria toxins or tissue cells
- An antibody or immunoglobulin is a large Y shaped protein used by the immune system to identify and neutralize foreign objects like bacteria and viruses

INFANT ACQUISITION OF IMMUNITY

- Infants have naturally acquired passive immunity , via the placenta before birth , through breast feeding
- After birth , infants get artificial acquired active immunity through vaccination

IMMUNIZATION SCHEDULE

AGE	IMMUNISATION
BIRTH	BCG (against tuberculosis /TB)
3 MONTHS	DPT 1 POLIO 1
4 MONTHS	DPT 2 POLIO 2
5 MONTHS	DPT 3 POLIO 3
9 MONTHS	MEASLES
18 MONTHS	DPT AND POLIO
5 DAYS	BCG , DT, POLIO
GIRL10 = 14 YEARS	RUBELLA (GERMANY MEASLES)
GIRLS AND BOYS =13 YEARS	TUBACULOSIS (TB)

Effects of Smoking on Health

SMOKING COUSE:

1. Emphysema ,
2. Bronchitis ,
3. Lung cancer ,
4. Low birth weight for babies born to smoking mothers.
5. Non-smokers can also equally affect due to ***passive smoking.***

EFFECTS OF EXCESSIVE CONSUMPTION OF ALCOHOL

1. Alcohol is a depressant
2. It results in reduced self-control , reduces the reaction time and damages the liver causing liver cirrhosis
3. It has social implications , for example, family neglected financially , emotionally and socially , immorality resulting in unacceptable behavior , crime and prostitution

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EFFECTS OF USE OF MANDRAX AND MBANJE

1. Alteration of personality.
2. Loss of self-control.
3. Criminal tendencies like violence or murder.
4. Increase chances of HIV infections.
5. Addictive
6. Can cause blood poisoning.

Effect of Inhaling Solvents (Glue Sniffing).

1. Causes damage to the nasal passage.
2. Reduced self-control.
3. Damage to the muscles and the heart.
4. Hallucination (seeing, hearing, imagining things that are not there).

Methods of Contraception

1. Rhythm / Natural Family Planning

How It Works

- Learn to recognize fertile periods in menstrual cycle so that sex can be avoided at this stage
- Temperature method = take body temperature
- Cervical mucus = recognize changes in the appearance of cervical mucus
- Calendar method = keep records of menstrual cycle over one year
- Symptom thermal method daily temperature plus symptom of ovulation pain and premenstrual tension are recorded

Advantages

- Accepted by religious groups
- Helpful when one is ready to fall pregnant
- Both partners participate

Disadvantages

- High failure rate
- Needs motivation to take and record signs daily
- Unreliable for woman with irregular periods
- Requires training for one to learn the methods
- Imposes restriction on sexual activity

Side Effects

- Sexual frustration

2. Hormonal Methods (Pill)

How It Works

- Has two female hormones the ESTROGEN and PROGESTERONE
- Prevent the release of the ova / female sex cells

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- Causes the growth of unsuitable thin uterus lining
- Thickens cervical mucus and disturbs the movement of sperm into uterus

Advantages

- It is effective
- Easy to use
- Reversible
- Does not interfere with sexual activity
- M menstrual bleeding is lighter , shorter regular and there are fewer cramps

Disadvantages

- Must be taken daily
- Requires prescription from the doctors
- Suppresses production of breast milk
- Possibility of formation of blood clots
- Slight increase in risk of heart attack and strokes especially for those over the age of 35 years

Side Effects

- Slight weight change
- Nausea
- Breast tenderness
- Spotting in mid cycle (drops of blood appear)
- Mood changes
- Loss of sexual desire

3. Injection

How It Works

- Prevent the release of egg from the ovary
- Change lining in the uterus making it unsuitable for implantation
- Causes thickness of cervical mucus

Advantages

- It is effective
- Convenient and private
- Reversible
- Does not interfere with sex
- Improves breast feeding
- Protection against infection and pregnancy in tubes
- Not affected by medication
- Reduces pre-menstrual cramps , menopausal symptoms and some breast diseases

Disadvantages

- Requires prescription from the doctors or family planning nurse
- Some people dislike injections
- Delays in return of fertility
- Effects cannot be stopped at will
- Disturbance of the menstrual cycle

Side Effects

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- Headaches
- Weight change
- Missed / irregular periods
- Mood swings
- Loss of sexual desire
- Bloated feeling

4. Barrier

a. Male/Female Condoms

How It Works

- Male condom sheath of rubber rolled over an erect penis just before sex
- Female condom inserted into the vagina
- Both condoms prevent sperms from entering the vagina

Advantages

- No need for prescription
- Provides protection against HIV and other STIs
- Maybe used as extra protection with other methods
- Reversible

Disadvantages

- Must be used with every sex act.
- Must be worn before any contact between sexual organs.
- Reduces sensation
- There is a risk of slippage/bursting.

Side effects

- May cause irritation of penis and vagina.

c) Diaphragm/Dutch Cap

HOW IT WORKS

Rubber cap / dome placed into vagina to cover cervix and prevent entry of sperms into the uterus

Must be used with spermicide to kill sperms

ADVANTAGES

No health concerns

Used /inserted before sexual intercourse

May be reused for up to two years

DISADVANTAGES

Needs training for proper use

Always inserted before sexual intercourse

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Not suitable after three or more natural deliveries

SIDE EFFECTS
Possible discomfort
Possible irritation from spermicide
Possible bladder infection

SPERMICIDES
EFFECTIVENESS
60 to 95%
HOW IT WORKS
Jelly cream placed into vagina before sexual intercourse
Contains chemicals which kill sperms

ADVANTAGES
Does not require prescription
Does not need medical supervision
Few side effects
Easy to use
Improves the effectiveness of condoms and other methods

DISADVANTAGES
High failure rate
Used with every sex act
Messy
Must be applied at least 3 minutes but not more than 30 minutes before sexual intercourse

SIDE EFFECTS
Can cause irritation /allergy to penis or vagina

HOW IT WORKS
Small copper / plastic device placed inside the uterus
Prevents embryo from implanting in the uterus
Chemical reaction caused by the IUD in the uterus affects sperms
Prevents fertilization

ADVANTAGES
One decision, after that device is always in place
Does not interfere with the sex

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Chemistry

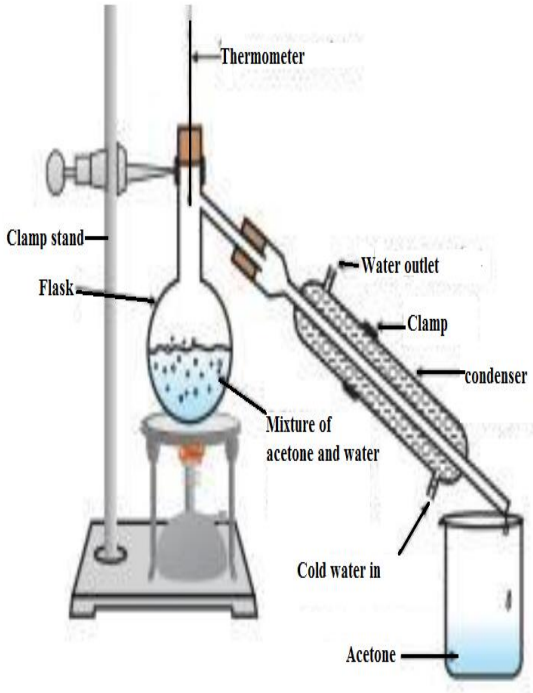
Separation

Distillation is a widely used method for separating mixtures based on differences in the conditions required to change the phase of components of the mixture. To separate mixture of liquids, the liquid can be heated to force components, which have different boiling points, into the gas phase. The gas is then condensed back into liquid form and collected. Repeating the process on the collected liquid to improve the purity of the product is called double distillation. Although the term is most commonly applied to liquids, the reverse process can be used to separate gases by liquefying components using changes in temperature and/or pressure. A plant that performs distillation is called a *distillery*. The apparatus used to perform distillation is called a *still.*

Types of distillation

a. Simple distillation
b. Fractional distillation

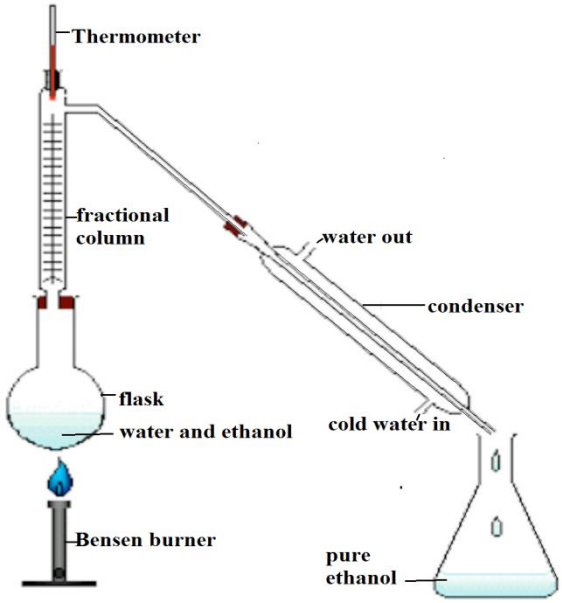
Simple distillation



Simple distillation may be used when the boiling points of two liquids are significantly different from each other or to separate liquids from solids or nonvolatile components. In simple distillation, a mixture is heated to change the most volatile component from a liquid into vapor. The vapor rises and passes into a condenser. Usually, the condenser is cooled (e.g.,by running cold water around it) to promote condensation of the vapor, which is collected. Water has a boiling point of 100 ^{o}C and acetone has a boiling point of 57 ^{O}C. As a result acetone will be collected first before water. Acetone acts as a solvent and is readily miscible with water and other solvents like ethanol

Fractional distillation

Fractional distillation is the process of separating a substance into its parts (or fractions), taking advantage of different vapor pressure properties of those substances. Fractional distillation is often used as a synonym with "distillation' because distillation always takes advantage of a difference in boiling points of component substances for separation.



Fractional distillation is used when the boiling points of the components of a mixture are close to each other, as determined using Raoul's law. A fractionating column is used to separate the components using a series of distillations called rectification.

The basic steps to distillation are:

Add heat to a liquid mixture with two or more main substances; for example} a water and ethanol mixture. As the liquid heats} **components with the lower boiling points will begin to vaporize** and rise through the column. In the water/ethanol example} ethanol will boil off first (BP 78° C) compared to water (BP l 00° C). However the vapor rising will still contain some molecules of the other substances. Vapor gets purer the higher it rises in the column as heavier molecules "fall off" and turns back to liquid. As vapor rises in the distillation column} **heavier molecules will condense back into liquid and "rain" back down.** At any given point in a fractionating column} vapor will be rising} liquid will be falling} and molecules will be mixing. Columns naturally have certain "stages": a stage is an area in the column with a similar amount of molecules of each type of substance (i.e. a general certain percentage of water and ethanol). Columns are designed to be tall enough to achieve a certain percentage separation, by finding the minimum number of required stages. **Vapor reaching the top of the column (distillate) is collected into an industrial condenser** (a big chiller), which cools the vapor back into a liquid, and piped to tank or storage. **Substances remaining in the column continue the process of distillation,** until the desired purity is reached. Some columns are a continuous process (most common), where new base solution is added continually. Others are batch systems, where the base is removed when a desired separation is achieved. In many systems, solution is recirculated several times to make sure substances are properly separated.

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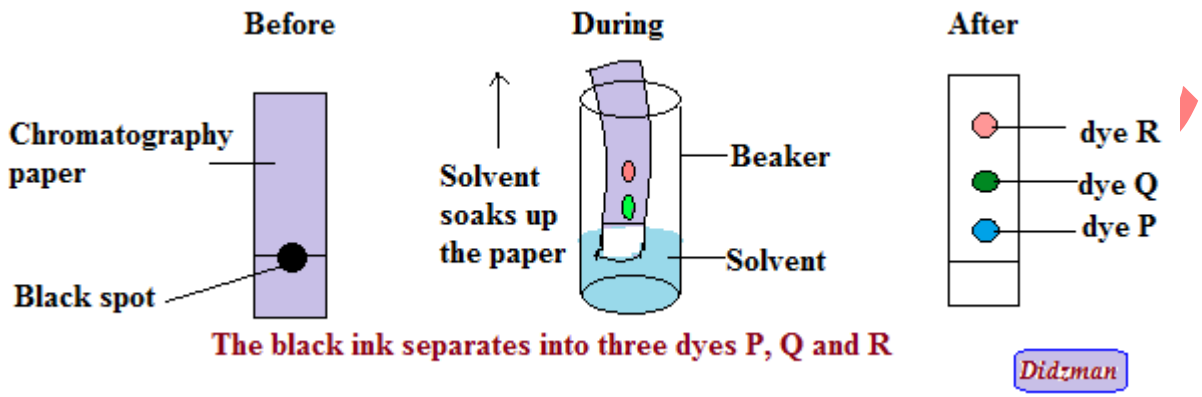
Paper chromatography

Chromatography is a technique that is widely used to separate two or more solids of different colors that can easily dissolve in water. Examples of such materials include inks and dyes. The simplest method is paper chromatography where a spot of ink or dye is put on a piece of chromatography paper



As the solvent moves up the paper, the dyes are carried with it and begin to separate. They separate because the substances have different solubilities in the solvent and are absorbed to different degrees by the chromatography paper.

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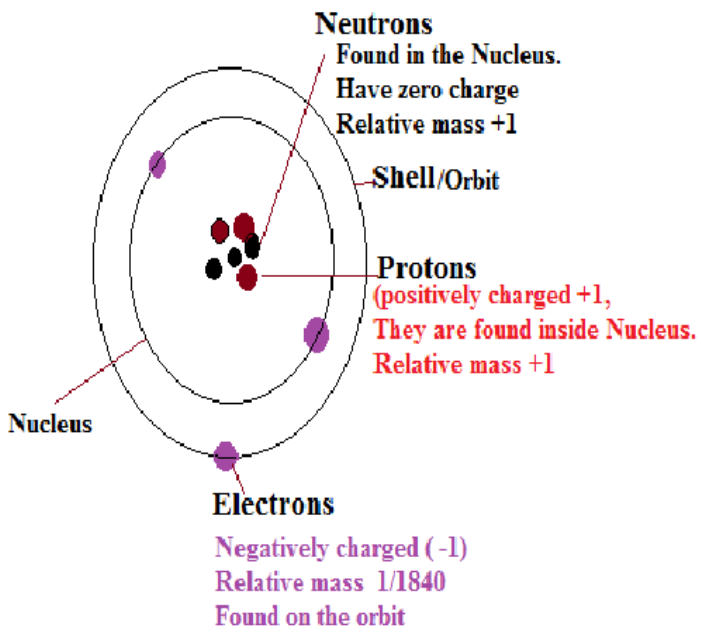
Matter

It is any substance that has mass and volume.

Structure of an Atom



An atom is the smallest particle of matter that can take part in a chemical reaction.

Atoms are made of up of three sub-atomic particles: protons, neutrons and electrons.

Protons and electrons are charged.

Neutrons are not charged.

Atoms are neutral as they contain the same number of protons and electrons. The positive and negative charges cancel out.

All electrons are the same, all neutrons are the same and all protons are the same.

Different atoms differ in the numbers of these particles.

Protons and neutrons together in nucleus are called nucleons

The total number of protons and neutrons is called nucleon number or mass number

The total numbers of protons are called proton number or atomic number.

Isotopes exist when the number of protons and neutrons are not equal e.g. chlorine 37 has 18 protons and 19neutrons. Chlorine 35 has 17 protons and 18 neutrons.

When number of protons are not equal to the number of electrons it I s called an ***ion***

Negatively charged ions exist when electrons exceeds number of protons.

Positively charged ions exist when protons exceeds the number of electrons.

Sub atomic particle	Position	Charge	Mass
Proton	Nucleus	Positive	+1
Neutron	Nucleus	Zero	+1
Electron	Shell/Orbit	Negative	$^{1}/_{1840}$

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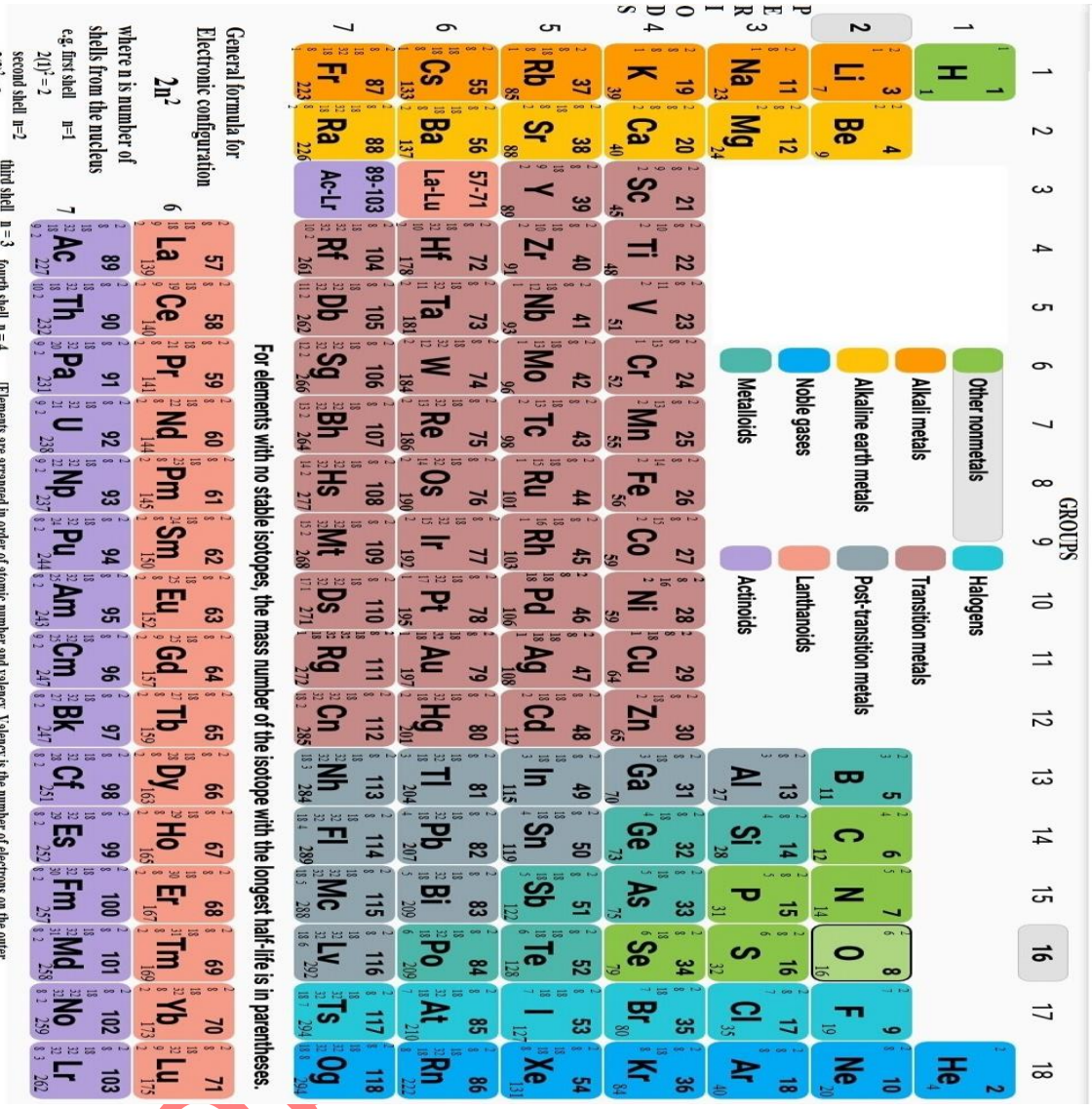
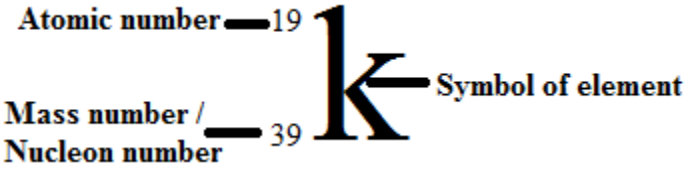
Periodic Table of elements



The table has rows and columns. The columns are called Groups and the rows are called Periods. There are 18 Groups and 7 Periods. Elements are arranged in terms of atomic number and Valency. Valency is number of electrons on the outer most shell which can be donated of shared during bonding. Group 1 to 12 consist of mostly metals, however Hydrogen is in group 1 because it has a Valency of 1. Groups 13 to 18 consist of non-metals. Most metals have a Valency of 2. Groups 13, 14 have a Valency 0f 3 and 4 respectively. This means elements in group 13 needs 3 electrons, 14 needs 4 electrons to become noble gases. In groups 15, 16 and 17, the Valency is 3, 2 and 1 respectively. Elements in group 18 are called Noble gases which mean they are non-reactive.

Nuclide Notation

It is a shorthand way of showing Atomic number, symbol and mass number of an element.



Potassium has 19 protons and 20 neutrons. Recall that:

Nucleon number	=	Proton number	+	Neutron number
39		19		20

Proton number and nucleon number

The number of protons in the nucleus of an atom is called the proton number (or atomic number) and is given the symbol **Z**. Helium atom has a proton number of 2, since it has two protons in its nucleus. Each element has its own proton number and no two different elements have the same proton number. For example, a different clement, lithium, has a proton number of 3 since it has a proton number of 3. Neutrons and protons have a similar mass. Electrons possess very little mass. So the mass of any atom depends on the number of protons and neutrons in its nucleus. The total number of protons and neutrons is called the Nucleon number which is given symbol **A**

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Element	Symbol	Proton number	Number of electrons	Number of protons	Number of neutrons	Nucleon number
Hydrogen	H	1	1	1	0	1
Helium	He	2	2	2	2	4
Carbon	C	6	6	6	6	12
Nitrogen	N	7	7	7	7	14
Oxygen	O	8	8	8	8	16
Fluorine	F	9	9	9	10	19
Neon	Ne	10	10	10	10	20
Sodium	Na	11	11	11	12	23
Magnesium	Mg	12	12	12	12	24
Sulfur	S	16	16	16	16	32
Potassium	K	19	19	19	20	39
Calcium	Ca	20	20	20	20	40
Iron	Fe	26	26	26	30	56
Zinc	Zn	30	30	30	35	65

Ions

An ion is an electrically charged particle. When an atom loses one or more electrons it becomes a positively charged ion. For example, during the chemical reactions of potassium, each atom loses an electron to form a positive ion

$$_{19}K^{+}$$

19 protons	=	19 +
18 electrons	=	18 -
overall charge	=	1+

When an atom gains one or more electrons it becomes a negatively charged ion. For example, during some of me chemical reactions of oxygen it gains two electrons to form a negative ion

$$_{8}O^{2-}$$

8 protons	=	8+
10 electrons	=	10-
Overall charge	=	2-

Some common ions

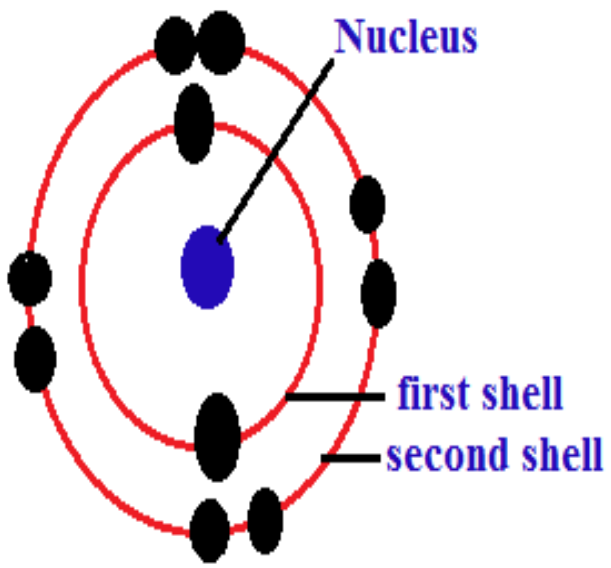
Name	Formula
Lithium ion	Li^+
Sodium ion	Na^+
Potassium ion	K^+
Magnesium ion	Mg^{2+}
Calcium ion	Ca^{2+}
Aluminium ion	Al^{3+}
Zinc ion	Zn^{2+}
Ammonium ion	NH_4^+
Fluoride ion	F^-
Chloride ion	Cl^-
Bromide ion	Br^-
Hydroxide ion	OH^-
Oxide ion	O^{2-}
Sulfide ion	S^{2-}
Carbonate ion	CO_3^{2-}
Nitrate ion	NO_3^-
Sulfate ion	SO_4^{2-}

Isotopes

Not all of the atoms in a sample of chlorine, for example, will be identical. Some atoms of the same element can contain different numbers of neutrons and so have different nucleon numbers. Atoms of the same clement which have the same proton number but different neutron numbers are called isotopes. Generally, isotopes behave ill the same way during chemical reactions because they have the same number of electrons on their outer shell. The only effect of the extra neutron is to alter the mass of the atom and properties which depend on it, such as density. There are two types of isotopes: those which arc stable and those which are unstable. The isotopes which are: unstable, as a result of the extra neutrons in their nuclei, are radioactive and are called radioisotopes. For example, uranium-235, which is used as a source of power in nuclear reactors and cobalt-60 which is used in radiotherapy

Electronic configuration

The electronic structure of an atom is a description of how the electrons are arranged. It can be shown as numbers or as a diagram. The diagram below shows the electron configuration of oxygen



The first shell – **k** shell holds 2 electrons ...then it is full

The second shell - **L shell -** holds 8 electrons until full

The third shell - **M shell -** holds 8 electrons until full

The fourth shell - **N shell -** holds 18 electrons until full

The fifth shell - **0 shell -** holds 18 electrons until full

The sixth shell - **P shell -** holds 32 electrons until full

The seventh shell - **Q shell -** holds 32 electrons until full

The importance of electronic configurations

It determines the strength and spatial distribution of electric charge around an atom or molecule, which determines all chemical reactions and chemical bonds. Equipped with atomic theory and then quantum theory, we can see how electron distribution (and changes in it during reactions) controls, energy exchanges and reaction rates, as well as explain detailed physical properties of each element and predict those of elements and compounds not yet observed.

Chemical Bonding

It is defined as the attractive forces which hold the various chemical constituent atoms, ions, etc. together in different chemical species. Bond forms to get the stability, with a release of energy. During bonding some elements donate electrons and others gain electrons. Usually metals are donors and non-metals are gainers. Metals donate electrons to become positively charged ions called **cations**. On the other hand non-metals gain electrons to become negative charged ions called anions. Metals can only lose their Valency which is the number of electrons on the outer most shell. If these electrons are lost the element becomes stable, however it will now be an ion.

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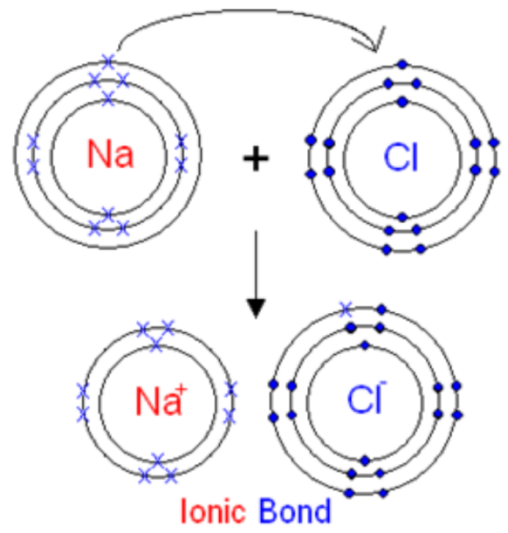
Types of Bonding

1. Ionic Bonding
2. Covalent Bonding
3. Metallic bonding

Ionic Bond
A chemical bond formed by complete transference of electrons from one atom (metal) to another (non-metal) and hence, each atom acquires the stable nearest noble gas
configuration, is called ionic bond or electrovalent bond, e.g., formation of sodium chloride:



Sodium has a Valency of 1 so it can donate 1 electron for it to be stable. On the other hand chlorine has a Valency of 7 which means it needs 1 electron to be stable.

General Characteristics of Ionic Compounds

1. Ionic compounds are usually solids in nature.
2. Ionic compounds have high melting and boiling points.
3. Ionic compounds are soluble in polar solvents like water but insoluble in non-polar solvents like benzene, C014 etc.
4. Ionic compounds are good conductor in
5. Ionic compounds have crystal structure

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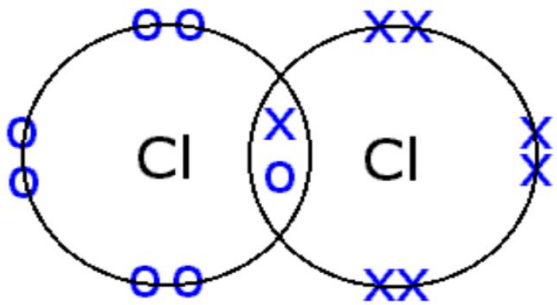
Covalent Bonding

Covalent Bond

A chemical bond formed between two atoms by mutual sharing of electrons between them to complete their octets or duplets, is known as covalent bond and the number of electrons contributed by each atom is known as covalence. e.g., formation of Chlorine II:



Properties of Covalent Compounds

1. In general, covalent compounds exist in the liquid or gaseous state at room temperature due to magnitude of intermolecular forces.
2. Covalent compounds have low melting and boiling points
3. Covalent compounds are generally poor conductors of electricity because they do not contain free electrons or ions to conduct electricity
4. They are soluble in non-polar solvents like benzene but usually insoluble in water.

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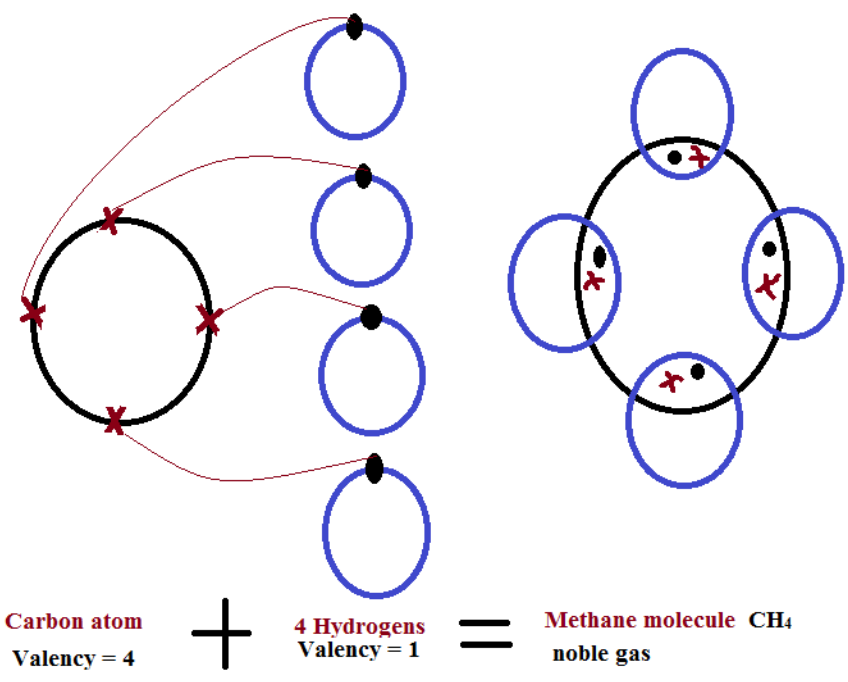
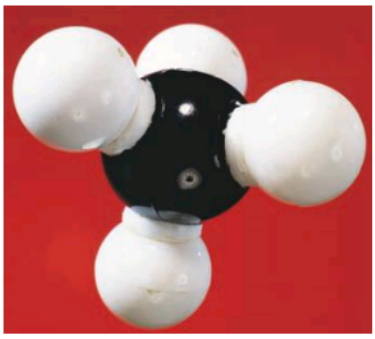
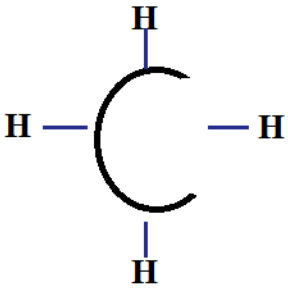
formation of Methane







Relative Atomic and Formula Mass

There are quite a number of known elements whose masses are too tiny to work with. For instance, the mass of a single atom of sulphur is 0.00000000000000000000005316g. Because of this scientists decided to use relative masses rather than actual masses. In this case an atom of carbon is given a relative atomic mass, A_r, of 12. All other atoms are given a relative atomic mass compared to that of Carbon.

Therefore, we find that the relative atomic mass (A_r) is a ratio and has no units.

$$A_r = \frac{\text{Average mass of of an element x}}{\frac{1}{12}\text{x mass of a Carbon - 12}}$$

The mass of all atoms are shown on the table of elements above.

Also, you can measure the relative mass of compounds by using the same Carbon-12 scale. For compounds the term is called Relative Formula Mass or Relative Molecular Mass (M_r). Relative molecular mass is a measure of one molecule of a substance. The mass of a molecule is the summation of all its components.

Relative Formula Mass

Find the Relative Formula Mass of the following
a) CO_2 b) H_2SO_4 c) NaCl

Answers

a) mass of 1 carbon = 12
mass os 2 oxygen atoms = 2x16
= 32
Total mass = 12+32
= 44

b) mass of 2 Hydrogen = 2x1 = 2
mass of 1 sulphur = 1x32
mass of 4 oxygen atoms = 4x16 = 64

Total mass 2+32+64
=98

c) mass of 1 sodium atom = 1x 23= 23
mass of 1 Chlorine atom = 1x 35= 35

Total mass = 23+35=58

Work out the following on your own
a) $CuSO_4$ b) MgO c) H_2O c) $CaSO_4$ d) 2NaOH + H_2

Balanced Chemical Equations

The reactions to form compounds between elements can be represented using chemical equations. Any equation contains reactants and products. The total mass of all reactants should always give the same to that of their product. Consider calculations below.

H_2 + O = H_2O

2 hydrogen atoms | 1 oxygen atom | water molecule

For a balanced chemical equation the total mass of compount is the same as total mass of reactants. See calculations below.

H_2 = 2x1 = 2 + O = 1x16 = 16 = 2x1 + 1 x16 = 2 + 16 = 18

Total = 2 + 16 = 18

The Mole concept and Avogadro's number (N_A)

As I have already stated above that atoms have very small actual masses and that scientists have devoted to using relative masses instead. Now it's time to go deeper on this concept. Sir Avogadro discovered that each atom have a total number of particles equivalent to

$6{,}023 \times 10^{23}$.

The number above is equivalent to 1 mole of a substance. A mole is a unit of measurement used by scientists. According to Avogadro a mole of a molecule or an atom is equivalent to its relative molecular mass or atomic mass respectively, measured in grams. From the calculations above 1 mole of **CO_2 is 44g and that of H_2O is 18g.**

Formula mass is also called molar mass.

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1 mole (of an atom) = total atomic mass in grams
1 mole (of a molecule = total mass of that molecule in grams.
e.g. calculate total mass in 1 mole of MgO
Answer:
Calculating total relative formula mass we get
1 x 24 + 1x 16 = 30
so, 1 mole of MgO = 30 g

With these illustrations we can as well determine the number of moles in a given mass of a substance e.g.
Calculate the number of moles in 24g of $CuSO_4$

Answer:
we use the formula

$$\text{Number of moles (n)} = \frac{\text{Total mass (m)}}{\text{mass of 1 mole}(M_r)}$$

so, 1 mole of

$CuSO_4$ = 1x64 + 1x32 + 4 x 16
= 64 + 32 + 64
= 160 g

$$\because \text{ number of moles} = \frac{24\text{ g}}{160\text{ g}}$$

= 0.15 moles

Questions

1 Calculate the number of moles in:
- a 9.8 g of sulfuric acid (H_2SO_4)
- b 40 g of sodium hydroxide (NaOH)
- c 720 g of iron(II) oxide (FeO).

2 Calculate the mass of:
- a 2 moles of zinc oxide (ZnO)
- b 0.25 mole of hydrogen sulfide (H_2S)
- c 0.35 mole of copper(II) sulfate ($CuSO_4$)

3 Calculate the number of moles at rtp in:
- a 2 dm^3 of carbon dioxide (CO_2)
- b 240 dm^3 of sulfur dioxide (SO_2)
- c 20 cm^3 of carbon monoxide (CO).

Number of atoms in a mole

Use the formula : number of atoms = number of moles x 6.023×10^{23} e.g. the total number of atoms in 24 g of $CuSO_4$ = 0.15 x 6.023×10^{23}
= 0.90345×10^{23}
= 9.0345×10^{22}

Questions

Calculate the number of atoms in?
a) 720 g of FeO b) 25 g of $MgSO_4$ c) 75 g of CuCl d) 40 g of NaOH

Metals and non-metals

Comparing the physical and chemical properties of metals and non-metals

Properties	Metals	Non-metals
Physical properties	**Metals are solid at room temperature. Except mercury and gallium**	**Non-metals generally exist as solids and and gases except Bromine**
Density	**Generally high**	**Generally low**
Malleability and Ductility	**Malleable and ductile**	**Neither malleable nor ductile**
Electrical and Thermal conductivity	**Good conductors of heat and electricity**	**Generally poor conductors of heat and electricity except graphite**
Lustre	**Poses shining lustre**	**Do not have lustre except iodine**
Sonorous sound	**Give sonorous sound when struck**	**Does not give sonorous sound**
Hardness	**Generally hard except Sodium and pottasium**	**Solid no-metals are generally soft except diamond**

Acids, Bases and Salts

- Acids, bases and salts are the groups of compound with certain characteristics properties

ACIDS

- Acids turn blue litmus red and universal indicator
- Acids react with base to form salt and water
- $Acid + Base = Salt + water$
- Acids have a sour test
- Acids causes iron to rust and dissolve

ACIDS	BASE	SALT
Hydrochloric acid	Sodium hydroxide	Sodium chloride
Sulphuric acid	Magnesium hydroxide	Magnesium sulphate
Nitric acid	Sodium hydroxide	Sodium nitrate
Nitric acid	Ammonia	Ammonium nitrate

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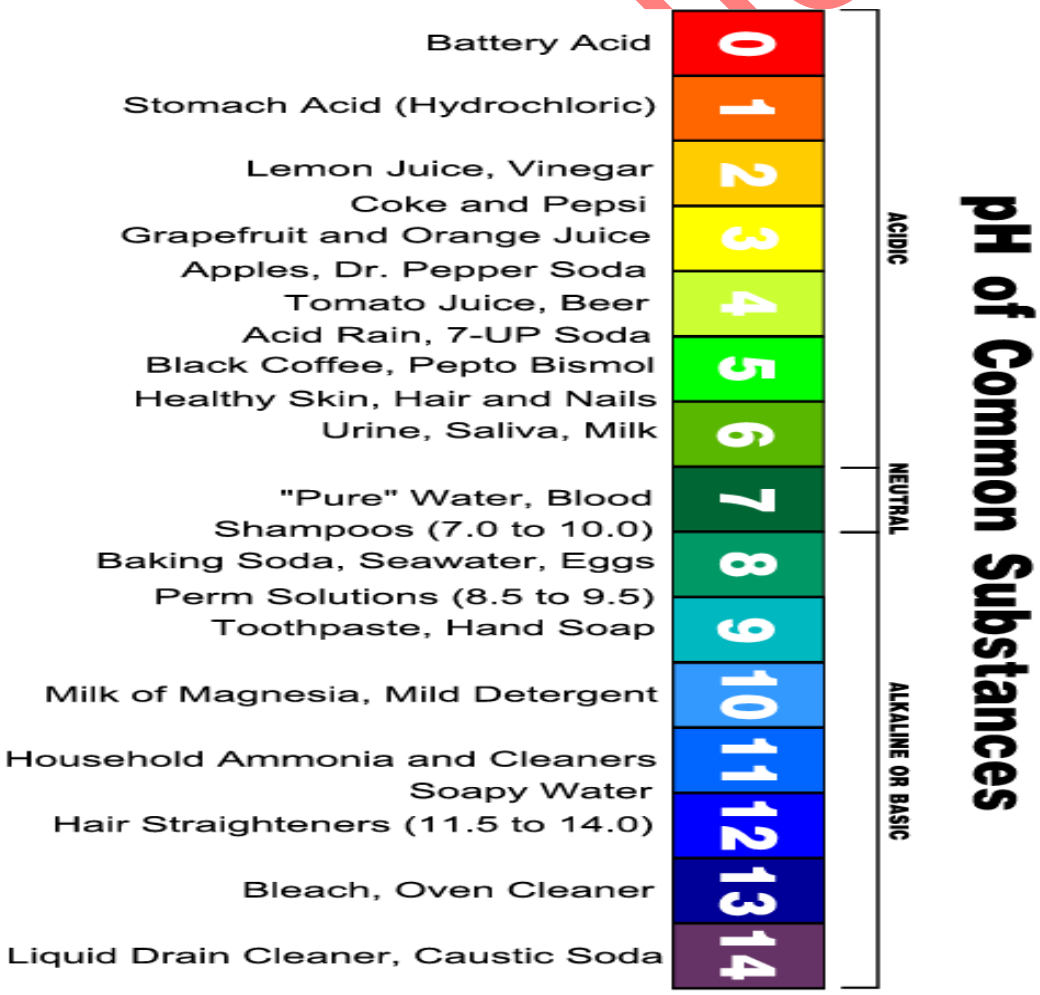
- Acid react with metal to form salt and hydrogen
- $\boldsymbol{Metal + Acid = Salt + hydrogen}$
- $\boldsymbol{Zinc + hydrochloric\ acid = Zinc\ chloride + hydrogen}$
- Acid are prepared by dissolving oxides of non-metals in water
- $\boldsymbol{Sulphuric\ acid + water = Sulphuric\ acid}$

BASE

- Base turns red litmus blue
- Base are prepared by dissolving oxides of metals in water
- Base reacts with acid to form a salt and water

NOTE: The pH scale is used to measure the strength of acid and base

The pH scale



Neutralisation is the reaction between of acid and base with the formation of salt and water

- $Acid + Base = Salt + water$

$$Sulphuric\ Acid + magnesium\ oxide = magnesium\ chloride + hydrogen$$

$$MgO + 2HCl \rightarrow MgCl_2 + H_2O$$
$$CaO + H_2SO_4 \rightarrow CaSO_4 + H_2O$$
$$Na_2O + 2HNO_3 \rightarrow 2NaNO_3 + H_2O$$

- Neutralisation results in a solution that is neither acidic nor basic. The solution will have no effect on litmus or universal indicator

Acid and Base Indicators

- Indicators are substance that gives different colours in acids and base. Litmus is blue in base and red in acids
- Indicators are used to show whether a substance is an acid or a base
- Universal indicator is another example of an indicator
- The universal indicator is also used to show how acidic or basic a substance is
- The universal indicator is red, orange in acid, blue \green in base and yellow in neutral solution.
- Red litmus turns blue and blue litmus remained blue

Acid Base Titration

Titration is a method of quantitative volumetric analysis in which a volume of one reagent (for an example an acid) is added to a known volume of another reagent (for example an alkali) slowly from a burette until an end point is reached. If an acid and alkali are used, then an indicator is used to show that the end point has been reached. A suitable indicator needs to be chosen such that the end point shows accurately that all of the solution in the flask has reacted with the solution being dripped into it – the point at which that happens is called the equivalence point. In a perfect titration the end point and equivalent point will be identical. If the indicator is not chosen well, then the end point and equivalence points differ, and the titration will not produce accurate data about the solution of interest.

Titrate – the substance to be analysed, is put in a conical flask.

Titrant – a solution of known concentration, is filled in the burette

Equivalence point – is the point where quantities of bases and acids are the same.

End point – is the point at which the indicator changes colour.

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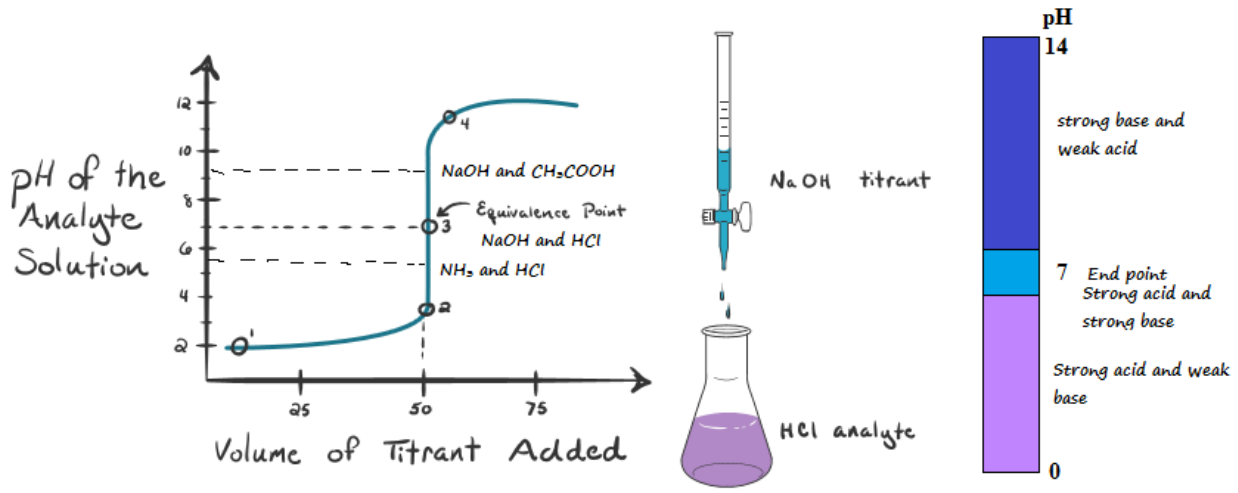


Indicators to be used includes: Universal, litmus paper, methyl

Strong acid- Hydrochloric acid(HCl)

Strong base - Sodium hydroxide (NaOH)

weak acid- acetic acid (CH_3COOH)/Ethanoic acid

weak base - Ammonia (NH_3)

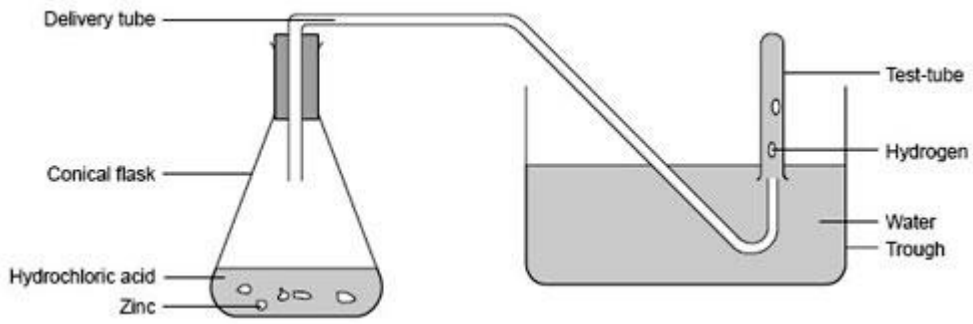
Reaction between Acids and Metals

Reaction of Metal with Acids

- Some metal react with acids to form salt and hydrogen

$$Metal + acid = salt + hydrogen$$

The Reaction of Zinc with Hydrochloric Acid



OBSERVATION

- Gas bubbles were seen in the reaction flask and a gas was collected in the gas jar on the right
- When a burning splint was put in the gas jar , a pop sound was produced

CONCLUSION

- Hydrochloric acid reacts with zinc to produce a salt , zinc chloride and a hydrogen

$$Zinc + hydrochloric\ acid = zinc\ chloride + hydrogen$$

A Table Showing the Reaction of Metal with Acids

ACID	SALT FORMED
Hydrochloric acid	Chloride
Sulphuric acid	Sulphate
Nitric acid	Nitrate
Citric acid	Citrate

Reaction between Acids and Metal hydroxide

Metal hydroxides are alkaline solutions which mean they are bases. Their reaction with bases is called Neutralisation.

$NaOH + HCI = NaCI + H_2O$

$2KOH + H_2SO_4 = K_2SO_4 + 2H_2O$

$Mg(OH)_2 + 2HNO_3 = Mg(NO_3)_2 + 2H_2O$

Reaction between Acids and Carbonates

Carbonates are also bases; they react with acids in the following way

$$Carbonate + Acid\ c = Salt + Carbon\ dioxide + water.$$

$$CaCO_3 + 2HCI = CaCL_2 + H_2O + CO_2$$
$$MgCO_3 + H_2SO_4 = MgSO_4 + H_2O + CO_2$$
$$Na_2CO_3 + 2HNO = 2NaNO + H_2O + CO_2$$

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Speeds of Reaction

1. This is the rate at which any chemical reaction occurs. This is measured by the time taken for the reaction to be complete or the amount of hydrogen produced per time interval. In a chemical reaction particles will be colliding. If the rate of collision is increased, the reaction will be speeded (will take less time).

Factors affecting speeds of reaction includes:

1. **Temperature**- increasing temperature increases the kinetic energy of particle, so, particles will start to move faster there increasing the rate of reaction. There is a negative relationship between temperature and time.
2. **Surface area (particle size)** - the larger the particle size the slower the rate of reaction and vice versa. It takes more time for coarse salt to dissolve than fine salt. The same reasoning can be applied to the reaction zinc and dilute sulphuric acid. Powdered zinc takes less time to react with the acid than crystalized (coarse) zinc
3. **Catalyst**- catalyst speeds any chemical reaction. It increases the rate of collision of particles. Copper sulphate solution is a catalyst used to speed up the reaction between metals and acid.
4. **Concentration**- the concentration of acid has an effect to the speeds of reaction. When it is too concentrated with acid, the rate is faster than when the concentration is reduced

Extraction of Metals

Iron

1. Iron occurs as haematite, a compound of oxygen and iron. Extraction is done in the blast furnace.

Raw materials and their uses

1. Iron ore/iron (iii) oxide - *source of iron.*
2. Limestone - *bind impurities.*
3. Coke (coke) - *reducing agent.*
4. Hot air - *oxidise iron and impurities.*

2. The raw materials are fed at the top and oxygen is allowed in through the tap holes. The temperature inside the furnace differs at every level (bottom, middle and top)

The process is called (**RED OX),** *Oxidation and Reduction*

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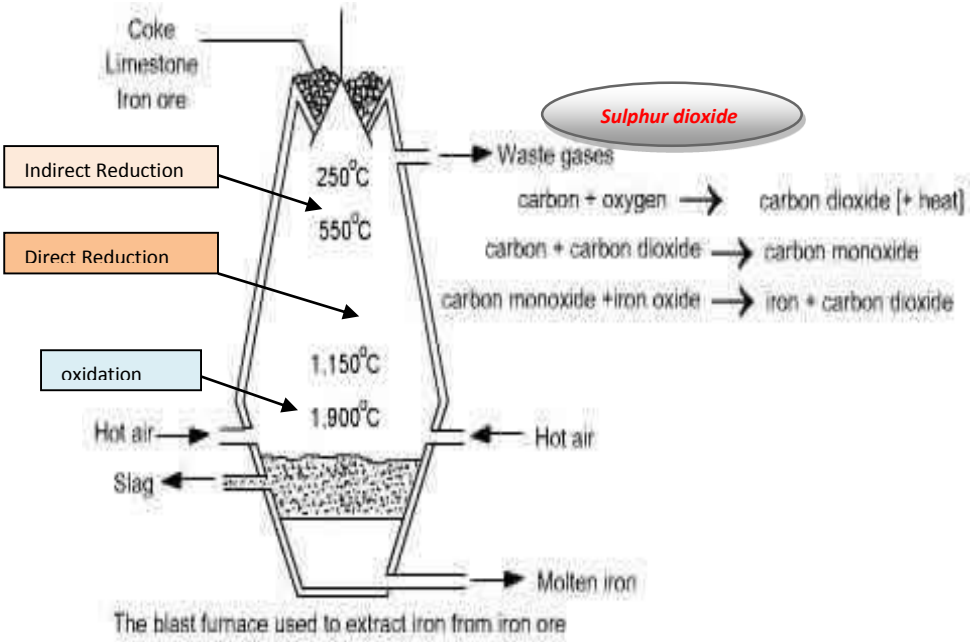

The blast furnace used to extract iron from iron ore

Bottom of the furnace (Oxidation)

The temperature is high (about 1900 0C). The following reactions occur.

Carbon + oxygen = carbon dioxide

Iron ore + oxygen = iron oxide

Limestone + oxygen = calcium oxide + silica

Middle of the furnace (Direct Reduction)

The temperature decreases to about 1000 0C

There is direct reduction of iron oxide by carbon in coke

Iron oxide + carbon (coke) = iron + carbon monoxide

Top the furnace

There is indirect reduction of iron oxide by carbon monoxide

Iron oxide + carbon monoxide = iron + carbon dioxide

Production of molten slag

Calcium carbonate (limestone) + heat = calcium oxide + carbon dioxide

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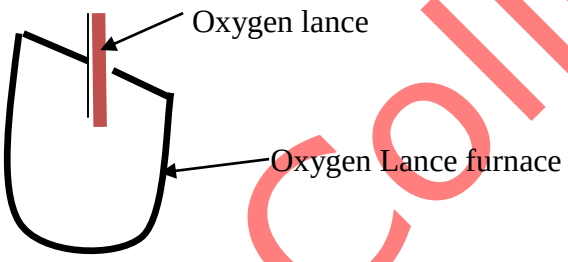
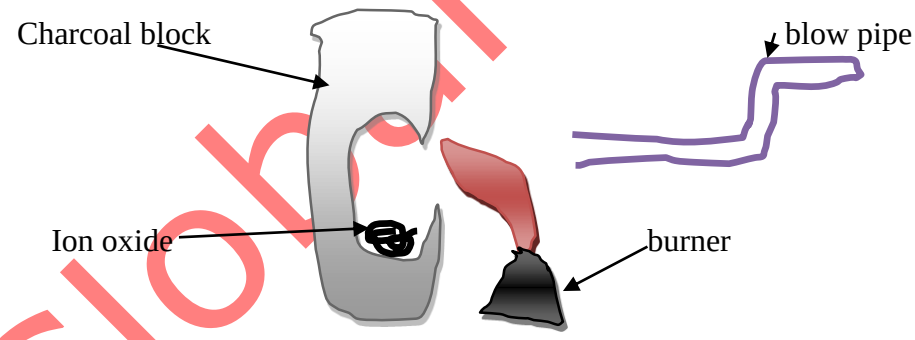
Calcium oxide + silica (impurities) = calcium silicate (slag)

Purification of iron by the oxygen lance process

- Iron from the blast furnace is called pig iron. It contains the following impurities: carbon, sulphur, phosphorous and silicon.
- These impurities are removed in a basic oxygen furnace by the oxygen lance furnace.
- Oxygen under high pressure is blown onto the surface of the molten iron through an oxygen lance.
- The oxygen oxidises the carbon, phosphorus and sulphur into gaseous oxides, which escape into the atmosphere.
- Silica, an oxide of silicon, reacts with calcium oxide to form slag. The slag floats on the metal and is skimmed off from the surface.



Reduction of iron oxide in the laboratory



Method

1. A hole was made on the side of the charcoal block and a spatula full of iron oxide was placed in the hole.
2. A burner was lit and the burner flame directed at the iron oxide in the hole by blowing into the blowpipe for some time.

Observations

- A small bead of greyish metal was seen at the end of the experiment, when the charcoal block had cooled.

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Conclusion

- The iron oxide was reduced by carbon and carbon monoxide.

1. Iron oxide + carbon = iron + carbon monoxide
2. Iron oxide +carbon monoxide = iron + carbon dioxide.

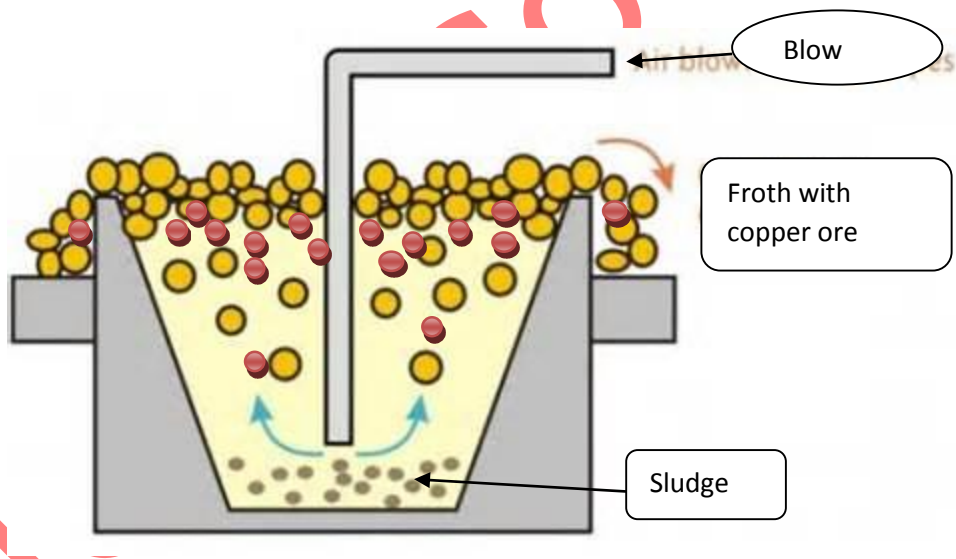
Copper

- Copper occurs mainly as copper pyrites, a compound of copper, iron and sulphur. There are four stages in the extraction of copper from copper pyrites: concentration, roasting, reduction and electrolysis.

Concentration by floatation

- Copper ore is crushed into fine powder and mixed with oily water in a tank and air is blown in forming froth on the surface.
- Sand and rock particles sink to the bottom.
- Froth with copper ore is skimmed off and removed and then dried.

The floatation tank



Roasting

- Copper ore is heated in air and some impurities including sulphur react with oxygen to form gases, which escape into the atmosphere.
- Roasting produces a mixture of copper (I) sulphide and iron oxide.

Smelting

- Smelting is done to remove impurities. The roasted copper ore is put in a furnace and silica is added. The silica reacts with iron oxide to produce slag thereby removing iron oxide. Silica acts as a flux.

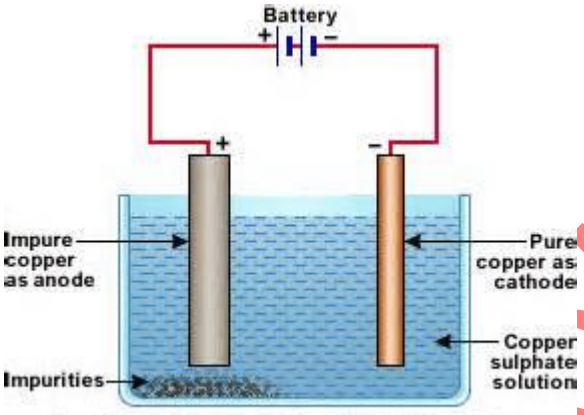
- The copper (I) sulphide is reduced to copper by heating in air.

Copper sulphide + oxygen = copper + sulphur dioxide

Impurities react with the added silica to form slag.

Purification of copper by electrolysis

- Electrolysis is the decomposition of a substance by passing electricity through an electrolyte. An electrolyte is any substance which allows electricity to pass through.



Experimental set up for the electrolytic refining of copper.

Method

1. The apparatus was shown as above
2. Blister copper was moulded into thin sheets and used as the anode (positive).
3. Thin sheets of pure copper were used as the cathode (negative).
4. The electrolyte was acidified copper sulphate solution.
5. Electric current was passed through the circuit.

Reactions at the anode

- When the switch is closed current will start to flow. Reaction between blister copper and copper sulphate solution releases positive copper ions which will move towards the cathode.

Reactions at the cathode

- Positive copper ions are gained.
- Positive copper irons combines with negative copper ions forming atoms of pure copper.

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Observations

- The copper anode got smaller while the cathode got bigger.
- Insoluble impurities fell to the bottom of the tank, while soluble impurities remained in suspension.

Alloys of copper

Alloy	constituents	Properties
Bronze	Copper + iron	Stronger in tension and harder than copper.
Brass	Copper + zinc	Stronger in tension and harder than copper.

Relating Uses of Copper to its Properties

Used for	Property
Electrical wires/cables	Good electrical conductor
Radiators, pots, pans and solar heaters	Good thermal conductor
Water pipes, coinage, and ornaments	Does not corrode and is attractive
Making sheets and pipes	Malleable

Corrosion

- Iron and steel corrodes faster if they are exposed to oxygen or water.
- Rusting is a form of corm of corrosion.

Corrosion can be prevented by: painting, galvanising and electroplating.

1. Painting

- The surface of iron is covered with a thin coat of paint.
- If the paint coat is scratched , the exposed iron will start to rust

2. GALVANISING

- In galvanising , the iron is dipped in molten zinc
- Even if the zinc coat is scratched , the iron does not rust , zinc reacts with iron and corrodes first (it is a sacrificial metal) protecting the iron from rust

3. ELECTROPLATING

- Iron is coated using electricity with metal that is more reactive than it
- The metal which is used to electroplate iron are nickel , copper and chromium
- Electroplating protects the iron from rusting and also gives it an attractive surface

ELECTROPLATING IRON WITH COPPER IN THE LABORITORY

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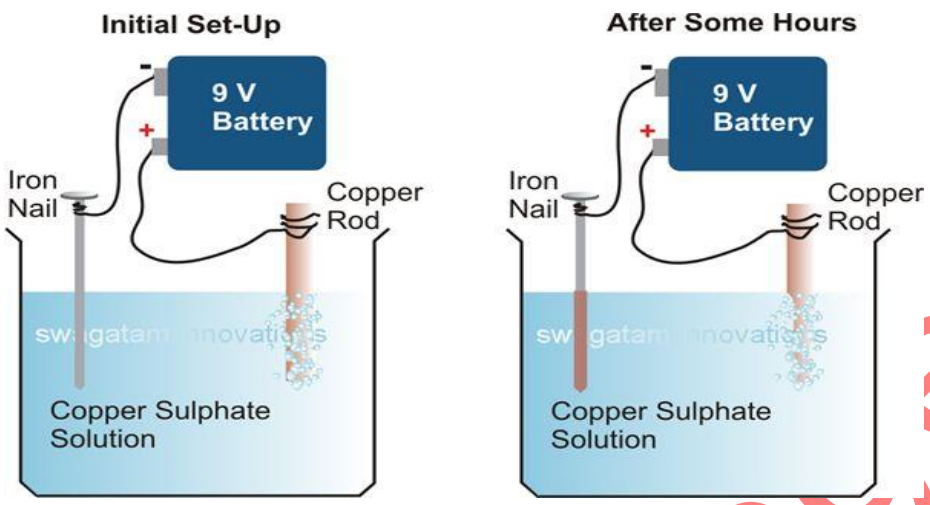

Procedure

- Set the apparatus as shown in the diagram

OBSERVATION

- A copper layer covered the surface of the iron nail after about half hour

EXPLANATION

- When electricity passes through the circuit , copper on the anode dissolves and forms copper ions
- The copper ions moves through the solution to the iron nail , where they gain electrons becoming atoms
- The copper atoms form a layer of copper metal over the iron nail's surface

Industrial Processes

The Manufacture Of Sulphuric Acid By The Contact Process

RAW MATERIALS	SOURCE
Oxygen	Air by fractional distillation
Sulphur dioxide	Sulphur , iron pyrites by burning in the air

STAGES IN THE MANUFACTURE OF SULPHURIC ACID

STAGE 1

- The manufacture of sulphur dioxide
  - Iron pyrites + oxygen = iron + sulphur dioxide

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- Sulphur + oxygen = sulphur dioxide

STAGE 2 (Production of sulphur trioxide)

- The reaction is exothermic (it release a lot of heat)
- We use a catalyst vanadium (v) oxide, temperature and atmospheric pressure
- Sulphur + Oxygen Over A Catalyst Vanadium (V) Oxide =Sulphur Trioxide + Heat
- To get a high yield of sulphur trioxide, the following optimum conditions should be available

1. Catalyst Vanadium (V) Oxide
2. Temperature of 450^0c
3. Atmospheric Pressure

STAGE 3 (Absorption)

- Sulphur trioxide is dissolved in concentration sulphuric acid
  - Sulphur Dioxide + Sulphuric Acid =Oleum
- NB = Water is not added direct to sulphur trioxide because it may produce a mist of sulphuric acid which is difficult to condense

STAGE 4 (Dilution)

- Oleum is now added to water to get sulphuric acid
  - Oleum + water = sulphuric acid

THE USES OF SULPHURIC ACID

- It is used to manufacture fertilizers
- Manufacture of plastics
- Extraction of metals
- Detergency
- Cleaning metals before plating
- Manufacture of textiles
- Drying agents

Manufacture of Ammonia by the Haber process

RAW MATERIALS

a. Nitrogen
   I. From fractional distillation of air
   II. By passing air over hot coke

b. Hydrogen
   I. From electrolysis of water
   II. Passing steam over a hot coke

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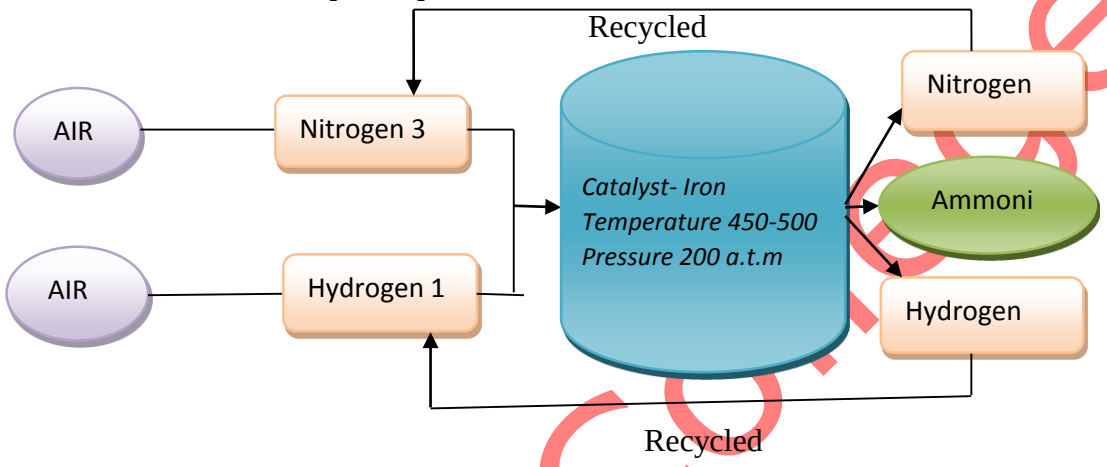
- Nitrogen and hydrogen are mixed in the ratio of 1:3

Nitrogen + hydrogen $\rightleftharpoons$ Ammonia

- The reaction is slow and reversible. To get a high yield of ammonia the following optimum conditions should be available:
  I. Temperature = 450-500^{0}C
  II. Catalyst = iron
  III. Atmospheric pressure =200 a.t.m



USES OF AMMONIA

I. Manufacture of fertilizers
II. Explosives
III. Nitric acids
IV. Manufacture of dyes

MANUFACTURE OF NITRIC ACID

STAGE 1 (Production of Nitrogen oxide)

- The production of nitrogen oxide
- Oxygen is added to ammonia to get nitrogen oxide and water
  - **Ammonia + Oxygen = nitrogen oxide + water**

The Following Optimum Condition Should Be Used

I. Catalyst = Platinum/Rhodium
II. Temperature = 900^{0}C
III. Pressure = 8 to 10 a.t.m

STAGE 2 (Production of nitrogen dioxide)

- **Nitrogen + Oxygen = Nitrogen Dioxide**

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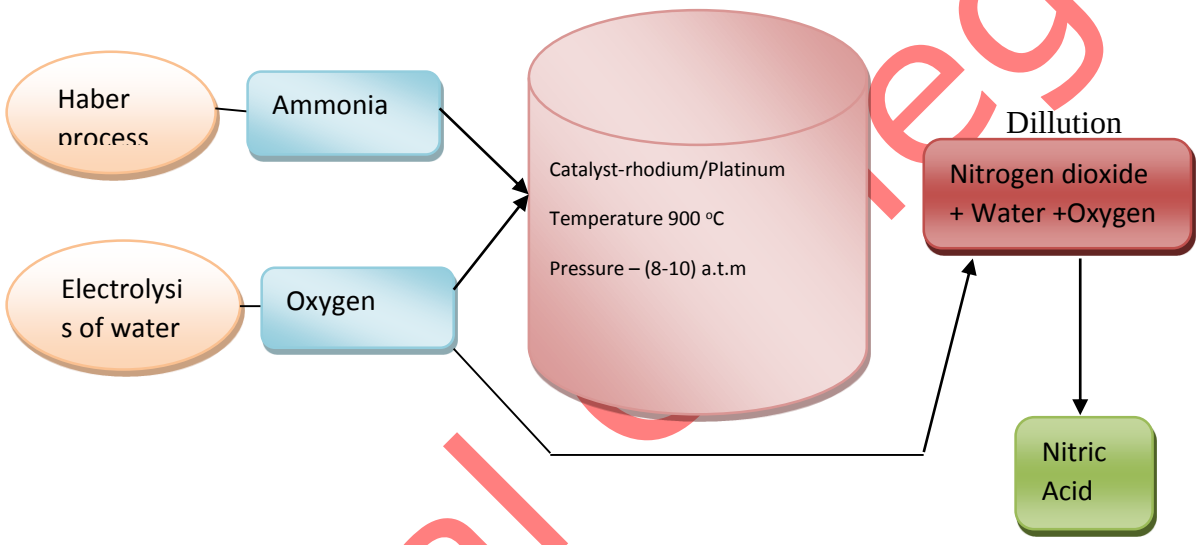
Production of Nitric Acid

- This is done in the absorption chamber
- Nitrogen oxide is reacted with oxygen and water to from nitric acid (oxidation of ammonia)
  - **Nitrogen Dioxide + Water + Oxygen = Nitric Acid**

THE USES OF NITRIC ACID

1. Manufacture of fertilizers
2. Manufacture of plastics
3. Manufacture of dyes
4. In explosives



The Manufacture of Ammonium Nitrate

- The process is called neutralisation of nitric acid.
- Which react nitric acid and ammonia to get nitric + base = salt ammonium nitrate
- The excess of water is evaporated

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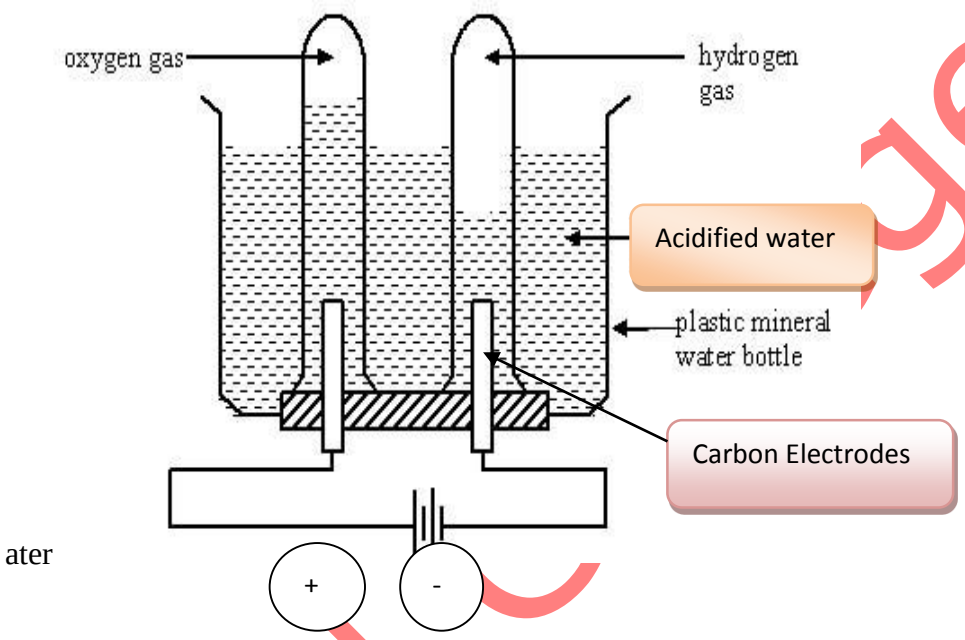
INDUSTRIAL GASES

Electrolysis of Water (Hydrogen and Oxygen)

- This is done to separate water elements
- Electrolysis is the decomposition of a substance (water) by passing electricity through an electrolyte



ater

- Acidified water is used instead of pure water because it allows irons to move freely.
- Carbon electrons are used because they do not react with acid
- When the switch is closed current will start to flow and there is a chemical reaction which takes place at the anode and the cathode
- At the cathode positive hydrogen irons gains electrons to form hydrogen gas which is an atom
  - Hydrogen Irons + Electrons = Hydrogen Gas
- At the anode hydroxyl ions loses electrons to form oxygen and water
  - Hydroxyl Ions- Electrons = Oxygen + Water
- Oxygen and hydrogen are produced in the ratio 1:2

Liquefaction of Air

- We obtain nitrogen and oxygen which are the major gases in the air
- Air is cooled to -190^{0}C
- This is done to solidify carbon dioxide and water which should be removed because they may block the plat

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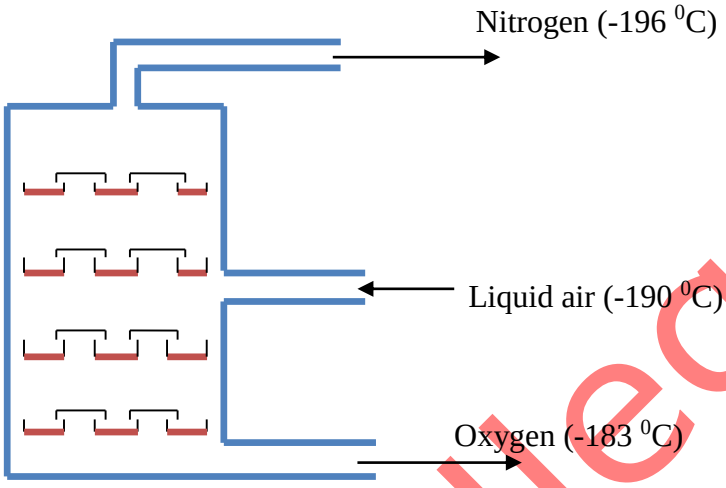
- The remaining gases are compressed and cooled repeatedly allowing it to expand until oxygen and nitrogen liquids = - 200^{0}C
- Nitrogen boils first at -196^{0}C and oxygen remains and boils at -183^{0}C



Hydrocarbons

A hydrocarbon is a compound of hydrogen and carbon, such as any of those which are the chief components of petroleum and natural gases. They are examples of group 14 hydrides. Because carbon has 4 electrons in its outermost shell (and because each covalent bond requires a donation of 1 electron, per atom, to the bond) carbon has exactly four bonds to make, and is only stable if all 4 of these bonds are used

Number of Carbon atoms	Alkane (single bond)	Alkene (double bond)
1	Methane	-
2	Ethane	Ethene (ethylene)
3	Propane	Propene (propylene

Alkanes

Most of the hydrocarbons in crude oil belong to the family of compounds called **Alkanes.** Because Alkanes possesses single bonds they are said to be ***saturated***, as no further atoms can be added.

General Formula for Alkanes

$$C_nH_{2n+2}$$

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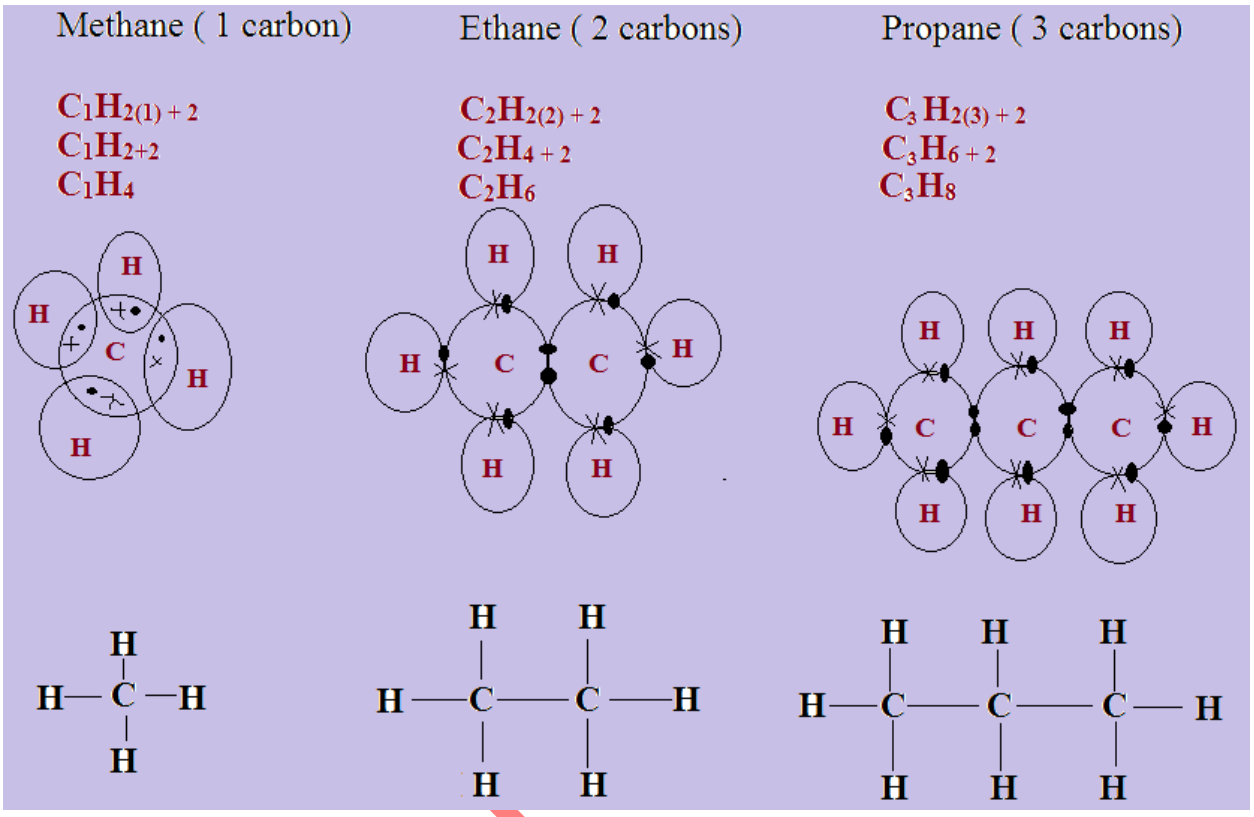
Where ***n*** is the number of carbon atoms.

All Alkanes have names that end with ***ane*** e.g. Methane, Ethane 4and Propane.



Alkene

Alkanes form another homologous series of hydrocarbons. They are more reactive than Alkanes because they each contain a double covalent bond between the carbon atoms.

General formula for Alkenes

$$C_nH_{2n}$$

Where ***n*** is the number of carbon atoms.

All Alkenes have names ending with ***ene*** e.g. Ethene, propene. They are ***unsaturated***, because it is possible to break one of the two bonds to add extra atoms to the molecule. Reaction between Ethene and hydrogen gives ethane, this is called *Hydrogenation*

Ethene + Hydrogen = Ethane

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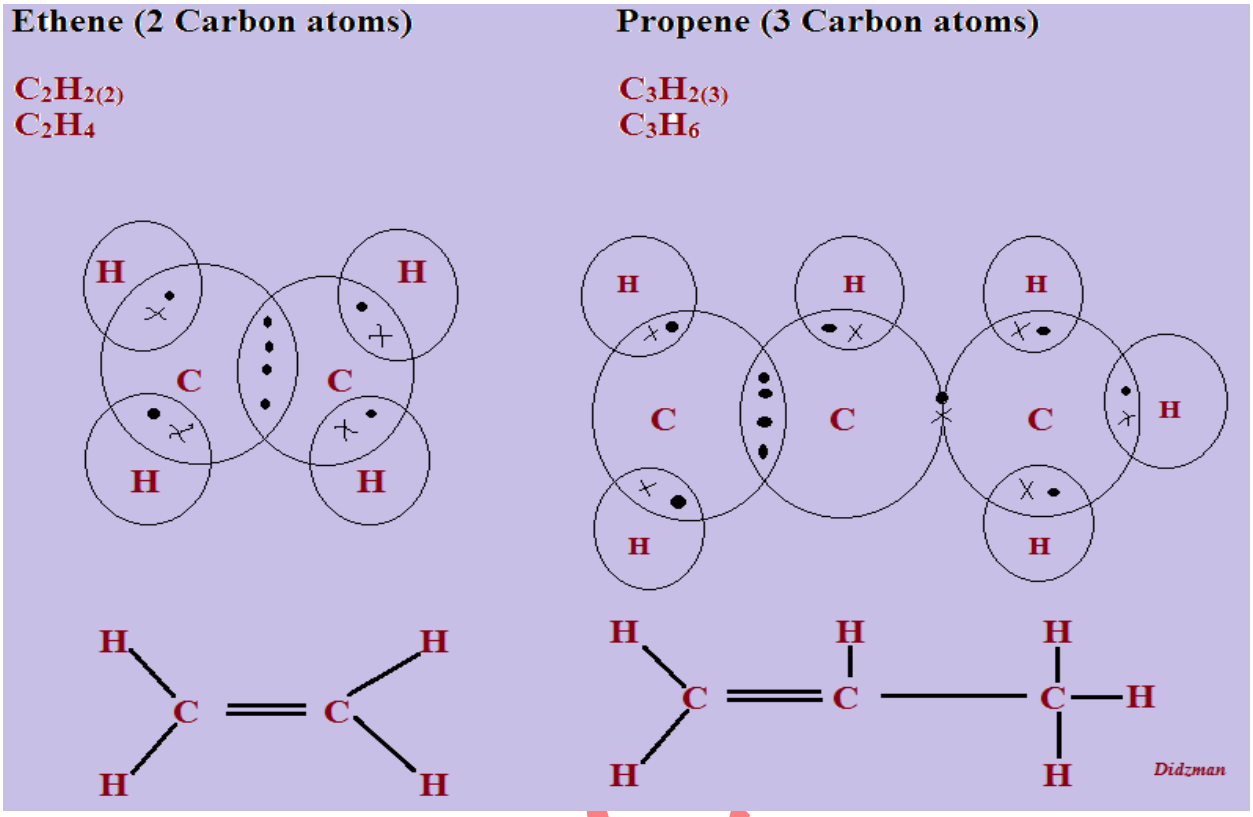


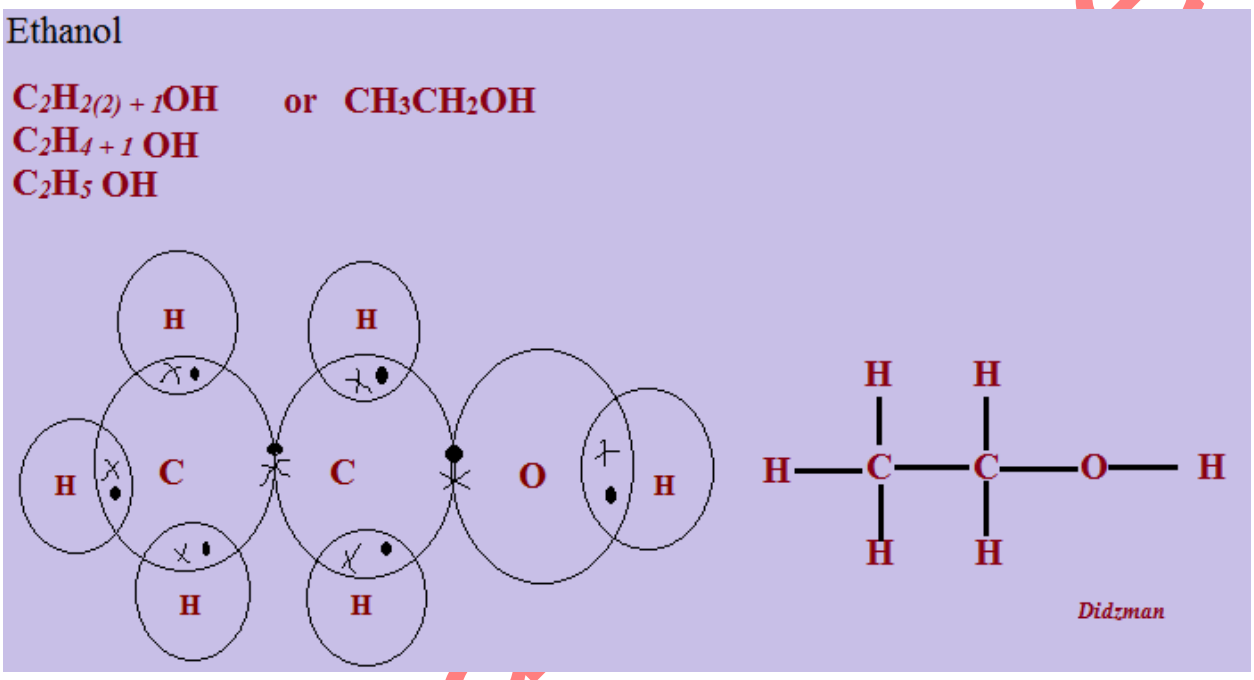
Hydrocarbon	Physical state	Melting point	Boiling point	Use
Methane	Gas	-182	-162	1.Greenhouse gas produced by animals during digestion 2. Used as fuels 3. Heating systems in offices.
Ethane	Gas	-183	-89	1.Used as fuels 2.Used as wax in candles and lubricants
Propane	Gas	-188	-42	1. Burn with very hot flames. 2.Used as LP gas
Ethene	Gas	-169	-104	1. Production of plastics e.g. bags, buckets, bowls 2. Production of alcohols such as ethanol by adding steam
Propene	Gas	-185	-47	1. Production of ropes, packaging materials

Production of Ethanol

Ethanol belongs to the homologous series called Alcohols. They are formed by replacing one of the hydrogen atoms on an Alkane molecule with another group such as **–OH.** This group is called functional group

General formula for Alcoholics

$$C_nH_{2n+1}\,OH \quad \text{or R-OH}$$



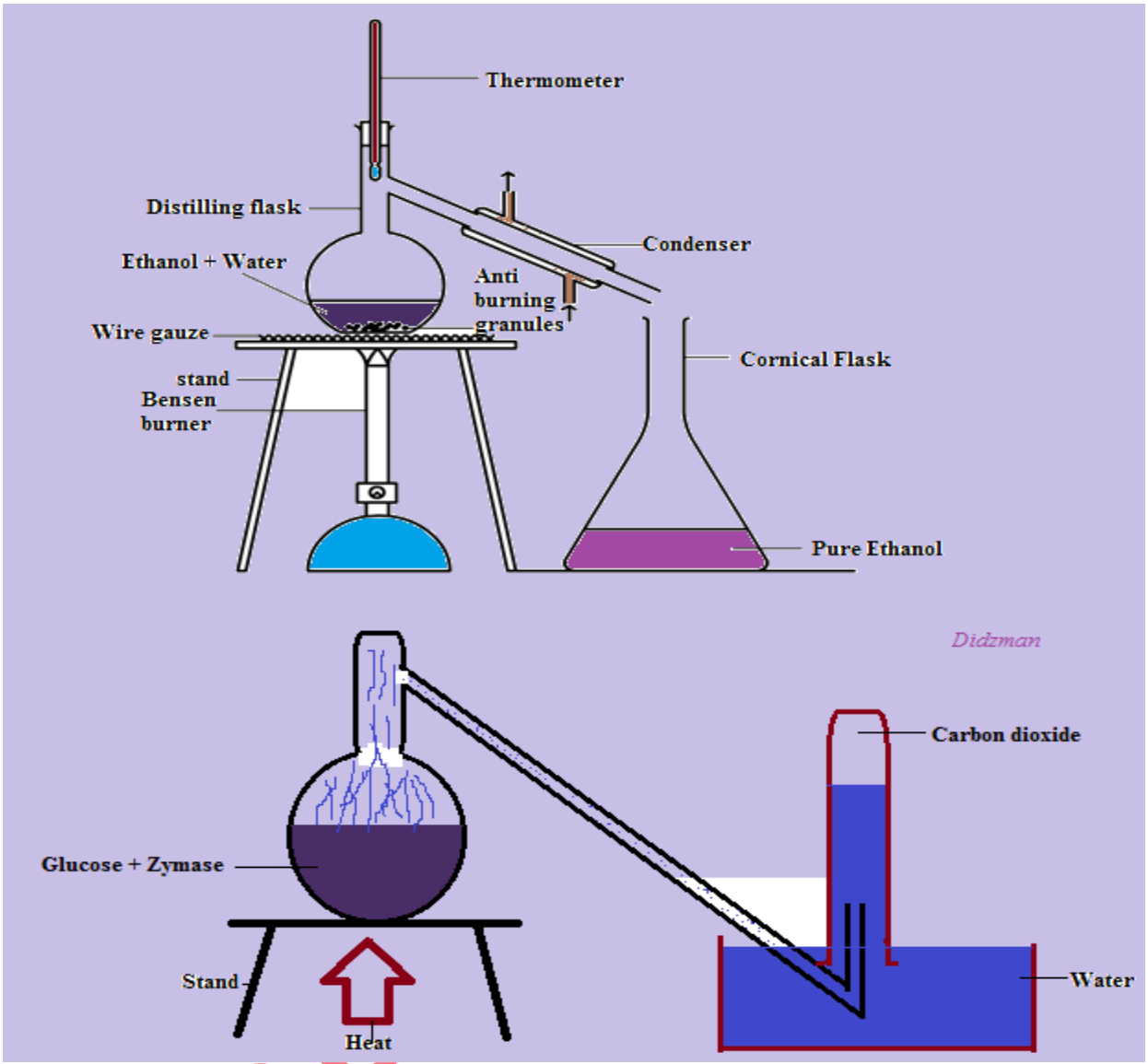
Production of Ethanol is by the process called ***Fermentation***

- This is the breaking down of glucose an aerobically
- This process is done in the presence of an enzyme zymase
- When glucose or starch solution (Maheu) is broken down aerobically by yeast we get ethanol and carbon dioxide.

WORD EQUATION

$$Glucose + Zymase(yeast) = Ethanol + Carbondioxide$$

- Pure ethanol is obtained from the fractional distillation whereby the solution is heated.
- Water and pure ethanol can be separated because they have different boiling points Water100^{0}C and Ethanol 86^{0}C
- Ethanol at 86^{0}C is collected first



Uses of Ethanol

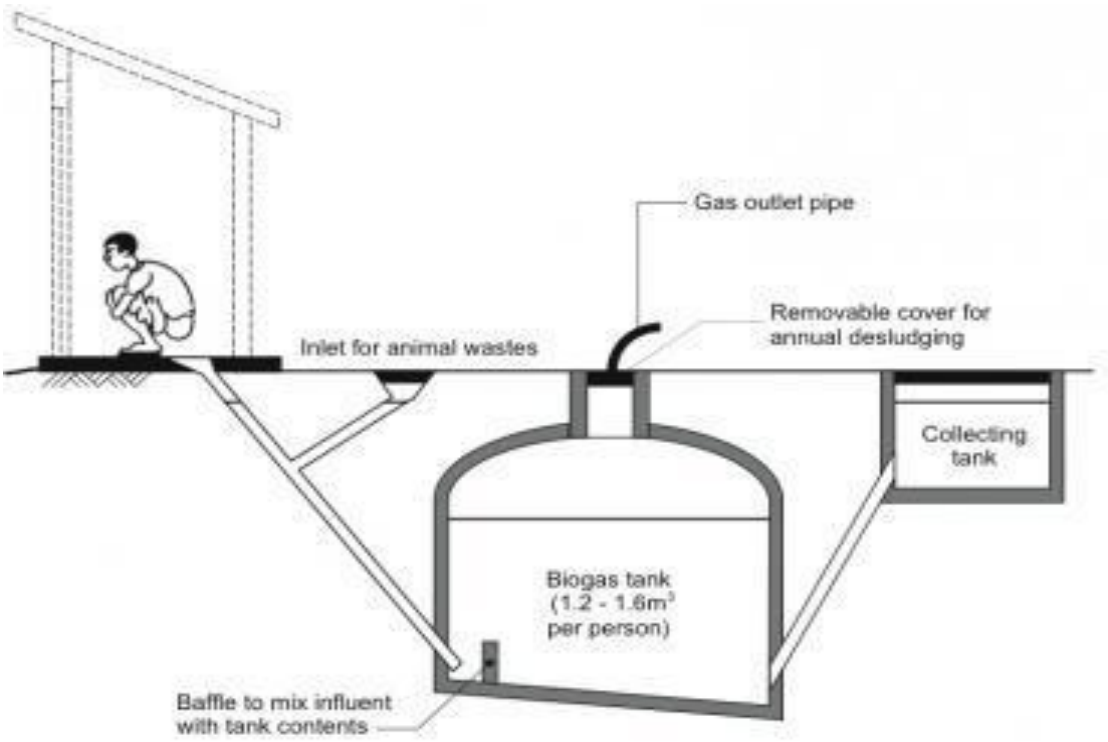
1. Beverage
2. Medical purpose
3. Fuel
4. solvent

USES OF CARBON DIOXIDE

1. Fire extinguishers
2. Fizz drinks
3. Manufacture of margarine

Manufacture of Biogas

It is manufactured from fermentation of biological wastes e.g. human wastes or cow dung
It is the breaking down of biological waste an aerobically by anaerobic bacteria (in the absence of oxygen)



The diagram above shows how biogas is obtained from fermentation of biological waste. A pit is dug in the ground and the walls are lined with brick lining to preserve the optimum temperature for the bacteria. Oxygen must be absent from the pit. The anaerobic bacteria will act on biological waste producing biogas which is then taken for domestic use like lighting. Yeast is not ideal for this purpose because of the higher temperature required. The remains are then used as fertilizer.

OPTIMUM CONDITIONS FOR THE PRODUCTION OF BIOGAS

- No oxygen because they are anaerobic bacteria
- The biological waste must not be too acidic or alkaline
- Type of waste determines the quality of biogas
- Optimum temperature should be about 45 to 55 degrees
- No stones and any material which is not biological waste because they can disturb the production of biogas
- What happens is that the bacteria will first act on the material which will not be digested which then take a long time before the biogas is produced

Physics

Data presentation

Data is given information or facts, especially when examined and used to find out things or to make decisions e.g. number of form four students who are doing combined science. Row data is unanalyzed data.

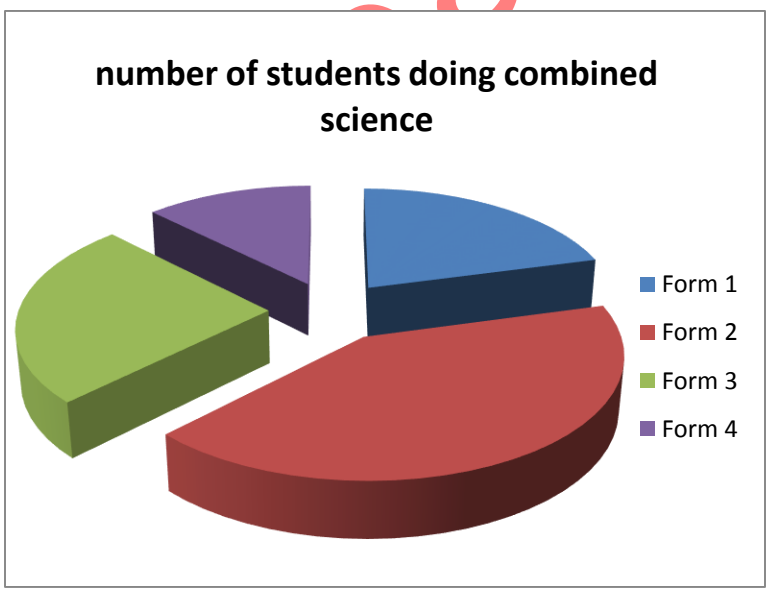
Methods of representing data

1. Pie chart
2. Line graph

The following information represents number of students doing combined science at Global College in 2019

Form	number of students doing combined science
Form 1	25
Form 2	50
Form 3	30
Form 4	15

Pie Chart



It is a diagram consisting of a circle that is divided into sections to show the size of particular amounts in relation to the whole. The sections are measured out of 360^0. The disadvantage may be that, original data may be lost.

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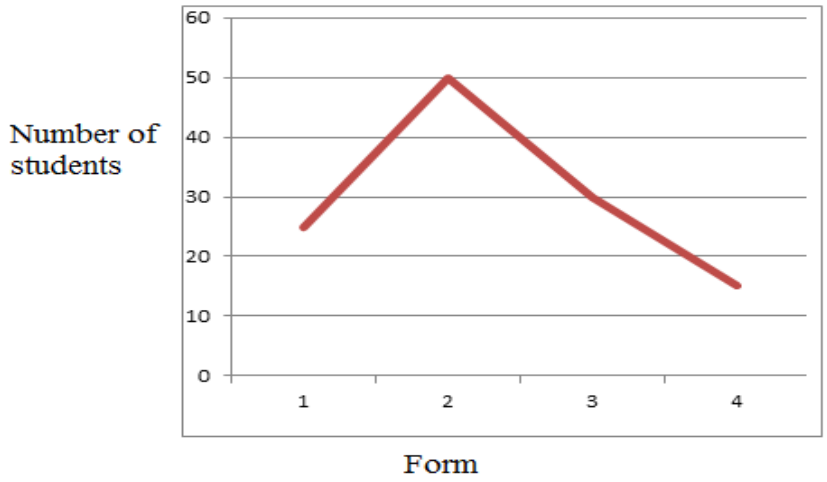
Line graph



It is a graph in which a series of connected straight lines connect points, each of which represents the value of a particular variable

Measurements

Base Units

It is a unit of measurement on which others are based. The SI unit of velocity is meters per second, derived from the base units of time and distance. Examples of base units includes

Base unit of	S.I
Length	Meter
Mass	Kg
Time	Second
Electricity current	Ampere
Thermodynamic temperature	Kelvin
Amount of substance	Mole
Luminous intensity	candela

Derived Units

(In the SI system of units) Any unit derived from one of the seven base units of length (meter), mass (kilogram), time (second), electric current (ampere), thermodynamic temperature (kelvin), amount of substance (mole) and luminous intensity (candela).e.g. S.I unit of velocity is meters per second.

Derived Units	Base units used	S.I unit
Velocity	Speed, time $\frac{Speed(m)}{Time(s)}$	Meters per second
Pressure	Force, Area $\frac{Force\ (newton)}{Area\ (meters)}$	Joules, newton per meter.
Power	Voltage, current voltage x current	watts
current	Voltage, resistance $\frac{voltage}{resistance}$	Ampere

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FORCE

A force is a push or pull. It can cause a body that is at rest to start moving or that which is already moving, to change its speed or direction. It can also cause a body to change its size.

Weight is a vertical force due to gravity exerted on an object. It is the force that pulls an object down.

Momentum force is an impelling/driving force or strength that makes an object continue to move without applying more force. E.g. when a car continues to move without accelerating.

Inertia is the tendency of a body to maintain its state of rest or uniform motion unless acted upon by an external force

Mass is the property of a body that causes it to have weight in a gravitational field

Newton's laws of motion

Law 1

A body stays at rest, or if moving it continues to move with a constant acceleration unless an external force makes it behave differently. Friction and air resistance cause a car to come to rest when the engine is switched off. Without these the car would continue to move at a constant speed.

Mass and Inertia

All matter has a built in opposition to being moved if it is at rest or if it is moving to having its motion changed. This is called inertia. However inertia depends on mass of body. The lager the mass, the greater the inertia

Law 2

The force applied on any matter is directly proportional to mass and acceleration

$$F = ma$$

Assumptions

1. F is the resultant (or unbalanced) force causing the acceleration a
2. F must be in newton, m in kg and a in m/s^2

a will be largest when F is big and m small

law 3

If a body A exerts a force on body B, then B will exerts an equal but opposite force on body A. this explains two forces: force of reaction and frictional force

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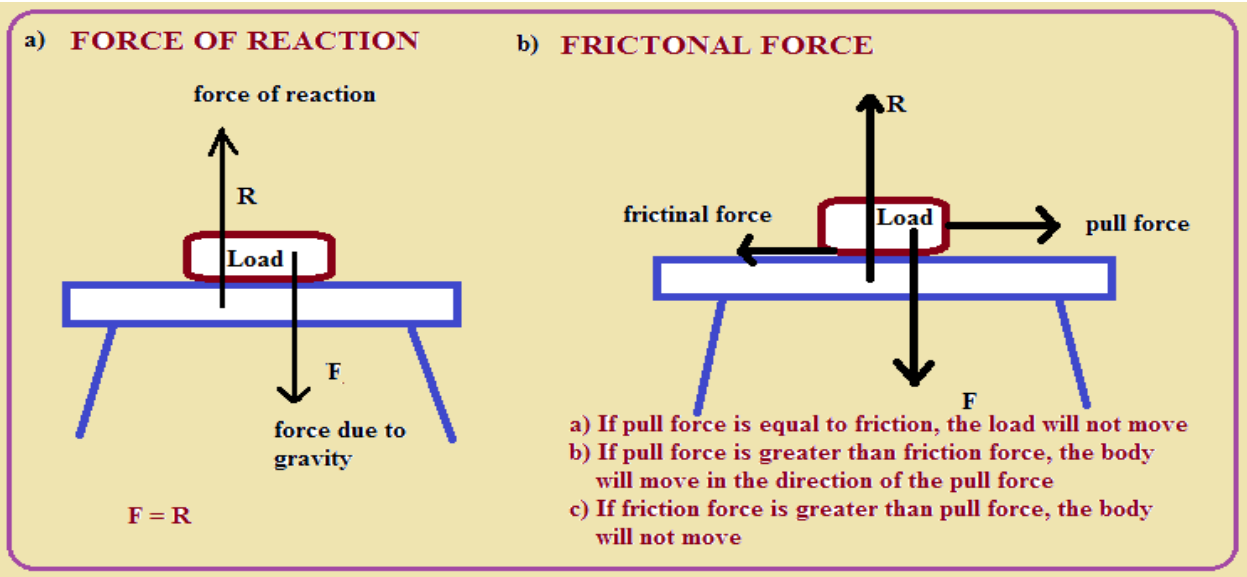
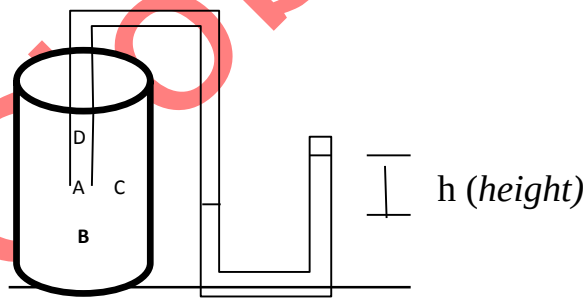


Pressure in Fluids

Pressure

- Pressure is force acting per unit are , (i.e.) pressure is force/area
- The units of pressure are Newton per square meter.
- Pressure is force acting per unit are ,
- The units of pressure are Newton per square meter N/M square or Pascal (PA) , i.e.
- 1 N/M square = 1PA
- A **manometer** is used to measure fluid pressure
- A water **manometer** is used to compare pressure at different depths



*If the tube in the beaker is moved downward to point **B** the level of water in **U** tube moves upwards. If it is moved sideways to point **C** the level of water will not change. If it is moved upwards to point **D** the level of water moves downwards.*

- Density of water = 1000kg/m square

- Pressure due to a liquid , $P = \dot{p} \times g \times h$ where:
- $\dot{p}$ = density of the liquid ,g = acceleration due to gravity (g=10ms square) h =height (m) of liquid column

PROPERTIES OF LIQUID PRESSURE

Diagram 1 diagram 2

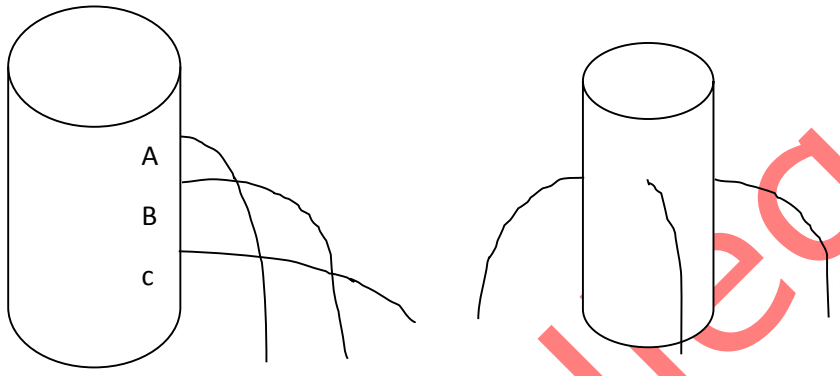
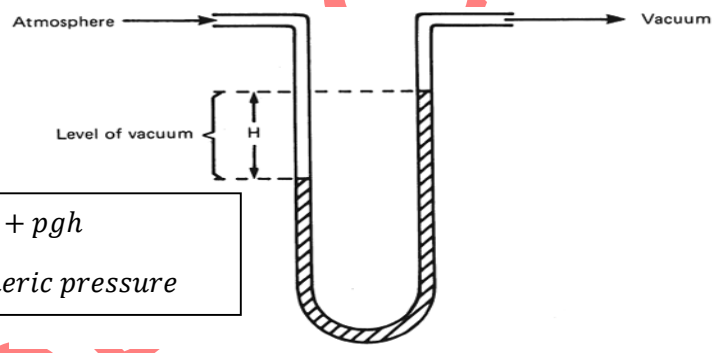


Diagram 1 -*Pressure increases with depth* (pressure is highest at C and lowest at A)

Diagram 2 – pressure at all points is the same

Measuring gas pressure



Gas pressure= $\rho + pgh$

$\rho = atmospheric\ pressure$

Pumps

TYPES OF PUMPS

Lift Pump

Water is drawn during an upstroke

- Have a cylinder , piston , two valves and a spout
- It operates by atmospheric pressure forcing fluids into the pump through valves
- Valves allows fluids to flow in one direction
- One valve closed and the other opened

A standard lift pump operates up to limited depth (10m) because of dependence on atmospheric pressure for the operation

The Operation of the Lift Pump

During the upstroke

- Piston moves up ,
- Atmospheric pressure on water in well pushes water against valve A ,
- Which opens and water enters the cylinder.
- Valve B is closed and water flows out through the outlet.

During down stroke

- piston moves down ,
- Valve A closes, pressure of water in cylinder forces valve B to open and water enters the handle.

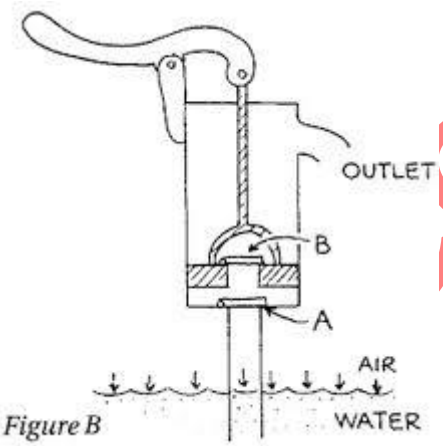


Figure B

ADVANTAGES

- The Blair pump is made of plastic making it is light , cheap and easy to assemble , operate and repair
- No lubrication oil or grease is used (water is colorless and odorless)

The Force Pump

Water is drawn during a down stroke

- Have cylinder, piston, two valves and spout.
- Operates by atmospheric pressure forcing fluid into the pump through valves.
- Valves allow fluid to flow in one direction.
- When one valve is closed the other is open.
- Also use force to operate at depth above (10 m)
- An example is the bicycle pump

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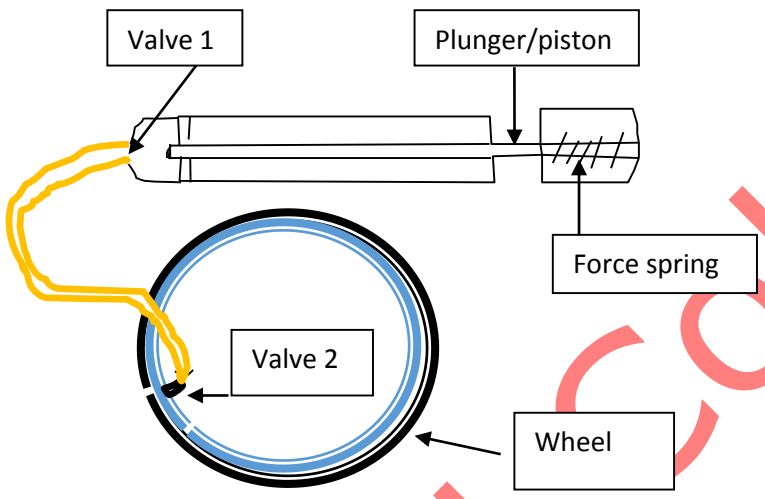
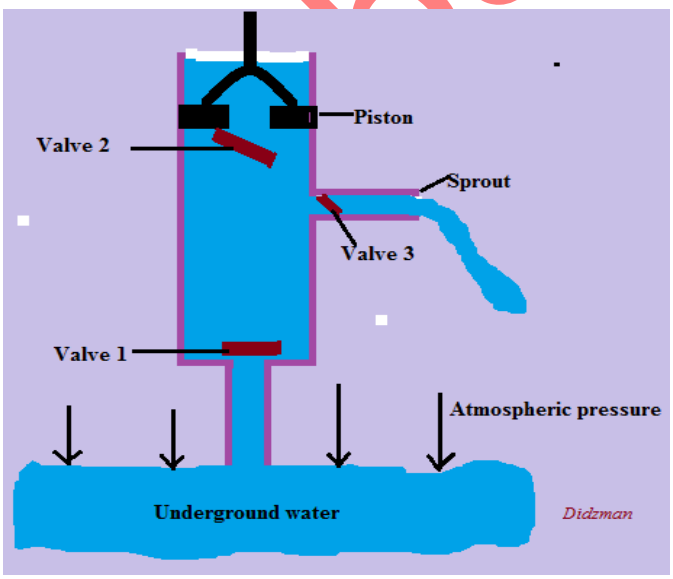
How it Operate

- Pressure in the cylinder forces valve 2 to open and air enters the tube in the wheel. When piston is pushed out as in the diagram below , atmospheric pressure pushes air against valve 1, which opens and air enters the cylinder , valve 2 (tube valve) is closed
- When the piston is pushed inwards valve 1 closes



Operation of a force pump (The Deep Well Force Pump)



Up stroke

➢ Atmospheric pressure pushes water up against valve 1 which opens and water enters the cylinder, while valve 3 will be closed. Valve 2 is opened due to pressure of water above it.

Down stroke

➢ valve 1 and 2 closes , water in cylinder pushes against valve 3 which opens and water flows into the air chamber or the spout

Blair pump

After several up stroke and down stroke, water will continuously flow (on both the down stroke and the up stroke) out of the spout due to air pressure in the air chamber

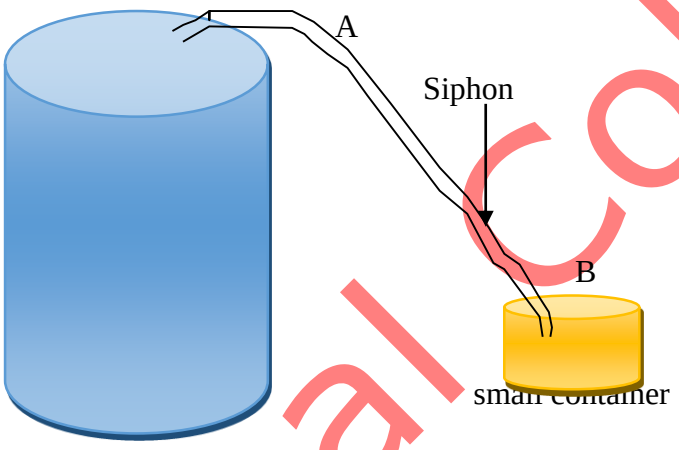
Fluid Systems

THE SIPHON

It is an instrument used to empty water from a large container into a smaller container.

How it operates

Point A should be higher than point B. Pressure at B should be lower than pressure at A. To reduce the pressure suck through point B. When water starts to flow, force of momentum causes water to flow continuously.



Hydraulic Systems

There are three hydraulic systems, namely: Hydraulic **jack, Hydraulic press and the Car braking system**. Hydraulic systems employ the properties of fluids, which are:

- Fluids cannot be compressed
- fluids distribute pressure uniformly

Hydraulic Jack

It is used to lift bigger loads using smaller effort. In the diagram below, pressure that is created at A is the same pressure experienced at B. A smaller area at A creates a bigger effort enough to lift a bigger load at B where the area should be big.

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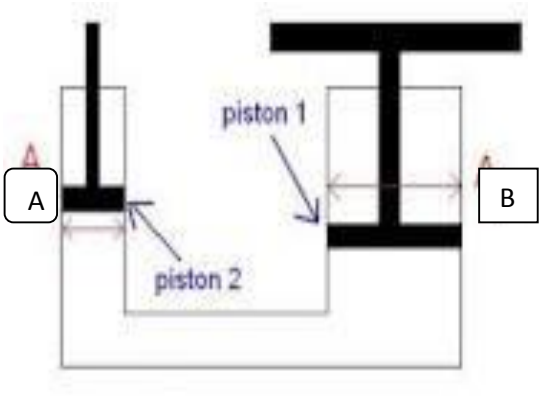
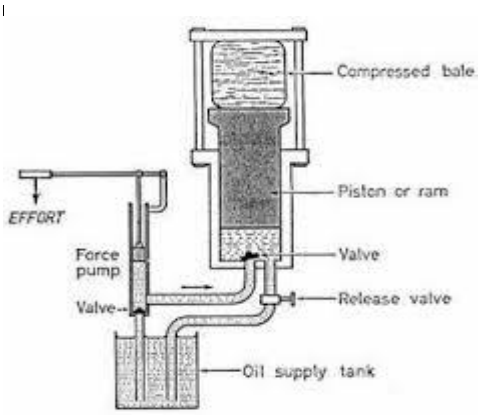
Hydraulic jack



Hydraulic press



Qn.

Calculate area at B given that area and force at A is 10 m^2 and 50 N respectively and that force at B is 80 N.

Solution

To find area at B use the concept that pressure at A is the same as pressure at B.

$$Pressure = \frac{Force(N)}{Area(m^2)}$$

$$Pressure\ at\ A \sim \frac{50}{10} = 10\ p.a \qquad \cong \qquad Pressure\ at\ B \sim \frac{80}{Area}$$

$$\frac{10}{1} = \frac{80}{Area}$$

$$10\ Area = 80 \qquad (cross\ multiply)$$

$$Area\ (B) \sim \frac{80}{10} = 8\ m^2$$

THE CAR BRAKING SYSTEM

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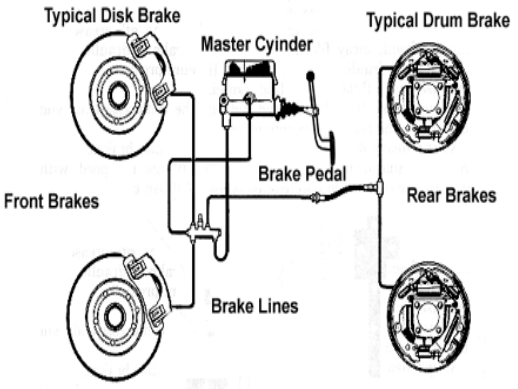

Typical Automotive Braking System

- When the brake pedal is pressed down, the piston in master cylinder pushes in on brake fluid.
- The brake fluid simultaneously transmits the pressure equally to all the four wheel cylinders.
- The wheel cylinder pistons push out against the brake shoes.
- The brake shoes push against the wheel drums and the resulting friction slows and stops the car.
- Wheel pistons generate bigger pressure since they have a smaller cross sectional area than the piston in the master cylinder.

Machines

Mechanical Systems

Machines are instruments that make work easier by applying less effort to move a bigger object. Examples include:

1. Inclined plane
2. Livers
3. Gears
4. Pulley systems

CALCULATIONS

1. Work Done = Force (N) × Distance moved in the direction of force (m)
2. Mechanical Advantage = $\frac{\text{Load}}{\text{Effort}}$
3. Velocity Ratio = $\frac{\text{Distance moved by Effort (m)}}{\text{Distance moved by Load (m)}}$

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4. Efficient = $\frac{\text{work done by Load}}{\text{Work done by Effort}} \times 100\ \%$

$= \frac{\text{Load} \times \text{distance moved load}}{\text{Effort} \times \text{Distance moved by effort}} \times 100\ \%$

$= \frac{\text{Mechanical Advantage (MA)}}{\text{Velocity Ratio (VR)}} \times 100\ \%$

NB mechanical Advantage, Velocity Ratio and Efficient have no units, they are just ratios.

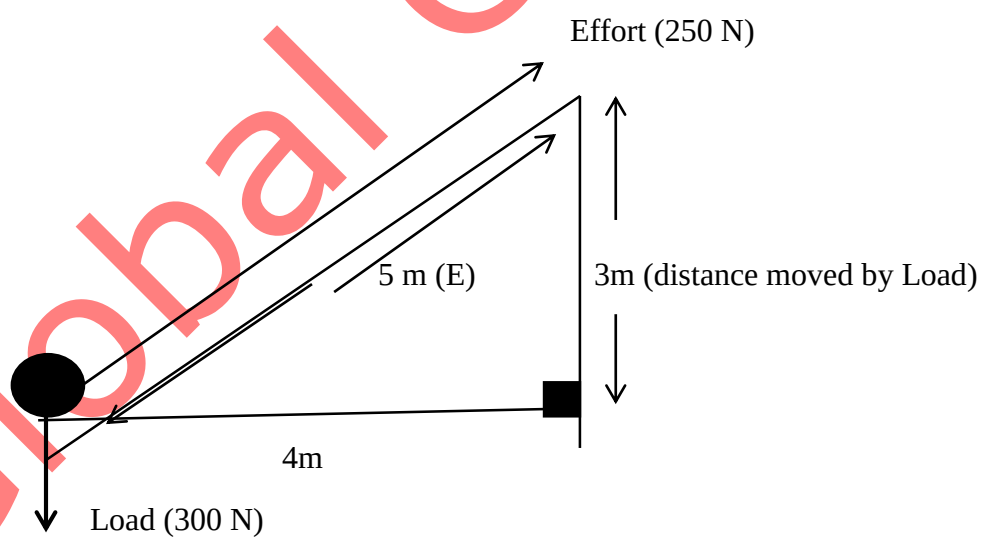
Efficient is always less than 1 or 100 % because:

1. Energy is lost through friction
2. Mass of machine due to its weight is high.

To improve Efficient of Machine:

1. Reduce friction by lubricating/oiling all moving parts.
2. Reduce mass of machine by using lighter material.

Inclined Plane



- Distance moved by Effort is 5m
- Distance moved by Load is 3m

MA = 300/250 = 1, 2

VR = 5/3 = 1,666

Efficient = 1.2/1.666 × 100 % = 72 %

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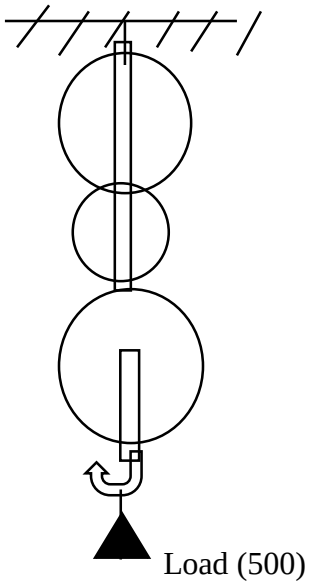
Pulley System



VR = 3 (the number of pulleys)

- Velocity Ratio is found by counting the number of pulleys

$$MA = \frac{\text{Load}}{\text{Effort}} = 500/250 = 2$$

Efficient = MA/VR = 2/3 × 100 = 67 %

Fuel Engines

- We have the petrol engine and the diesel engine

Petrol Engine

- It uses petrol as a fuel. Petrol and air are mixed first and then compressed in the compression stroke. A spark plug produces a spark in the power stroke. This creates kinetic energy which causes the car to move. In the power stroke chemical energy is converted to kinetic energy.

The four stroke petrol engines

a) There is inlet stroke
   - Inlet valve is opened to allow petrol air mixture
   - The exhaust valve is closed.
   - The piston moves down to create a low pressure inside the cylinder

b) COMPRESSION
   - both valves are closed (the inlet and the exhaust) and
   - the piston moves upwards to compress the petrol air mixture

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c) POWER
- both valves closed
- piston moves down,
- Spark jumps from the spark plug; chemical energy is converted t kinetic energy.

d) EXHAUST VALVE
- Inlet valve closed,
- exhausted valve opened,
- piston moves upwards to allow gases to move out
- $Petrol + Oxygen = Energy + Carbon\ Dioxide$

Diesel Engine

This engine operates in a different way as compared to the petrol engine. At first, air is compressed in the compression stroke and the fuel injector injects diesel so that combustion will occur. The diesel engine is different from a petrol engine in a number of ways:

PETROL	DIESEL
It uses petrol as a fuel	Uses diesel as fuel
Have carburettor (generate less power)	Generate more power
Low maintenance cost	Higher maintenance cost
Light weight	Heavy weight
Petrol air mixture mixed and then compressed.	The air is to be compressed first and the fuel injector inject diesel for combustion to take place

$$Diesel + Oxygen = Energy + Carbon\ Dioxide$$

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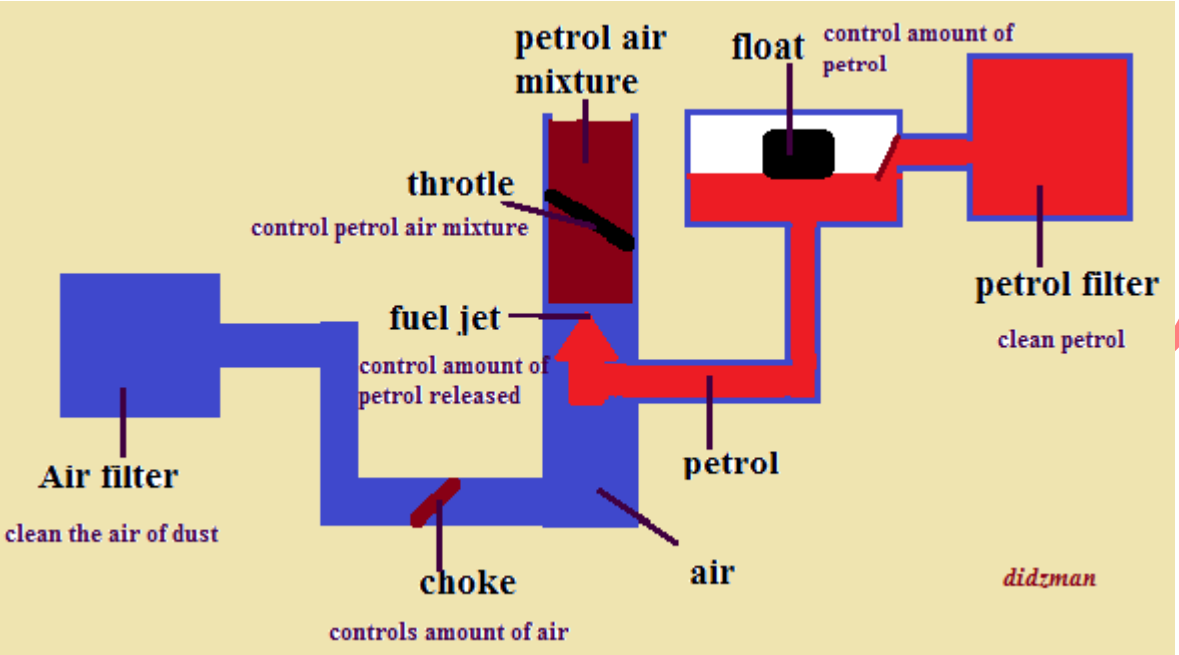
Carburater



Dangers of having worn out jets

This may cause incomplete combustion of fuel. Air filters and petrol filters should be cleaned and replaced regularly.

Social and Economic Effects of Using Fuels

1. Air Pollution
2. Deforestation
3. Global Warming
4. Soil erosion
5. Respiratory diseases
6. Desertification
7. Environmental eye saw.

ENERGY

Solar Energy

Methods of Heat Transfer

- ***Conduction*** heat is transferred through the matter by the vibration of the particles of matter which remain fixed (no change in position) Conduction is the main method of heat transfer in solids

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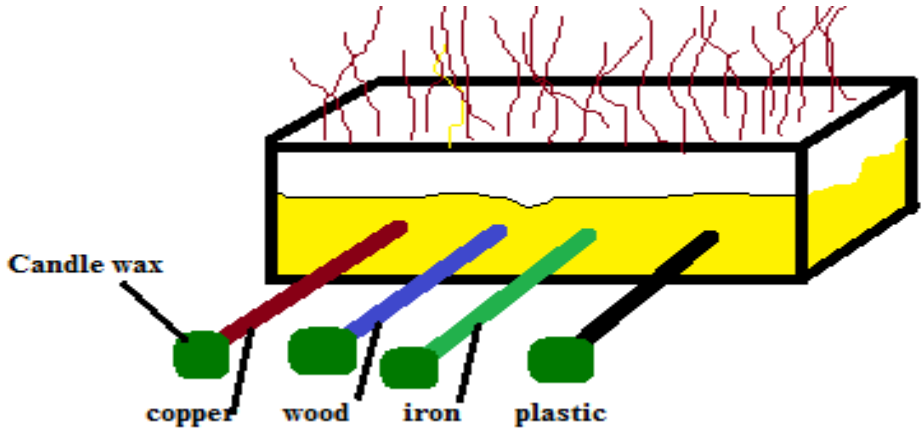
- ***Convection*** heat is transferred through fluids (liquids and gas) by the movement of molecules from one part of the fluid to the other, This movement creates current in the fluids
- ***Radiation*** this is the method by which heat energy travels in a vacuum (empty space)
- No materials are needed. The heat moves in the form of waves

Conduction

Good and Bad Conductors of Heat (Thermal conduction)



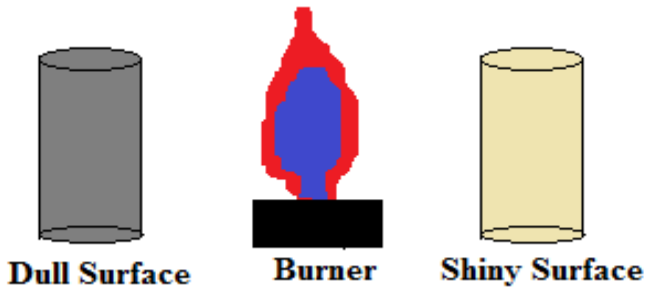
RESULTS

- Match stick on the copper rod fell first, followed by iron and wood and plastic was the last

CONCLUSION

- The copper was the best conductor of heat while wood and plastic were the worst conductor of heat

REFLECTION OF HEAT FROM DULL AND SHINY SURFACE



OBSERVATIONS

- In A the temperature of water the black dull tin increased faster and was higher than that in the shiny tin after 30 minute

- In B the temperature of water in the black dull tin decreased faster and was lower than that of the shiny tin after 30 minutes

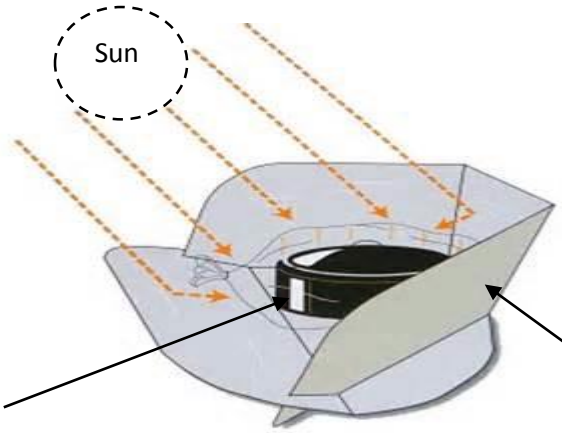
CONCLUSION

- Dull surface are good absorbers but bad reflectors or emitters of the heat energy
- Shiny surfaces are the good reflectors or emitter and bad absorbers of heat energy

Solar Radiation

- Solar radiation consist of light and heat energy from the sun
- Some of the energy is absorbed whilst some is reflected (sent back into the space)

The Solar Cooker

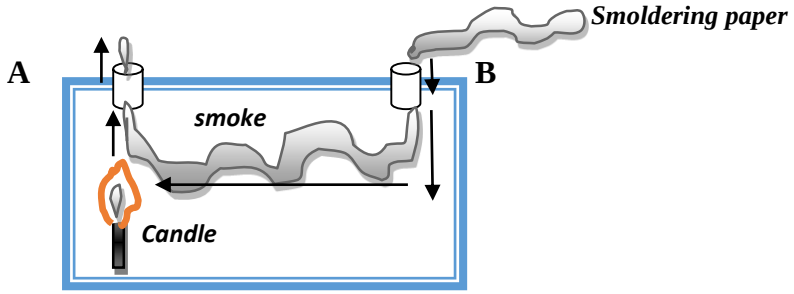


Black Pot

Aluminum curved surface

- Applies knowledge of absorption and reflection of solar energy
- Made up of a curved surface aligned with mirrors
- The curved surface reflects heat from the sun and focuses concentrate heat at a point
- The container for cooking has a dull , black surface for maximum absorption of heat
- Produces enough heat to cook anything

Convection in Gases (Chimney)



RESULTS

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- Smoke seen was seen moving down chimney B and then towards the candle and finally coming out through chimney A

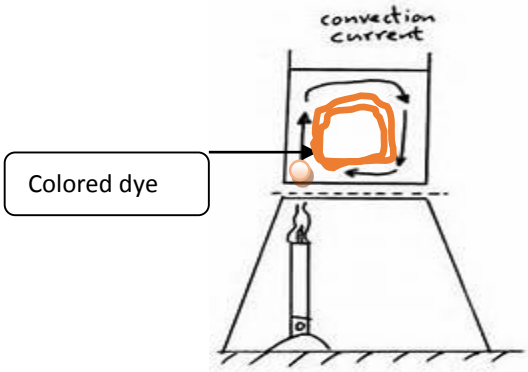
CONCLUSION

- The movement of the smoke particles showed that heat energy moves by convection in gases

EXPLANATION

- Air above chimney A was heated by the candle , become lighter and rose
- Cooler and heavier air with smoke came in through chimney B
- When the air from the chimney B reached the candle it was heated , become lighter and rose with the smoke
- This create convection current and smoke was seen continuously coming out of chimney A

Convection Current in Liquids



OBSERVATION

- Colored streams were seen moving up and then drown as shown in the diagram

CONCLUSION

- Colored dye showed that heat energy moves by convection in liquids

EXPLANATION

- Heated water molecule gained kinetic energy and become lighter and rise.
- Cold denser water molecules moved down to replace the molecules

The Solar Water Heater

- Applies knowledge on conduction , convection and radiation
- Copper plate is blackened so as to absorb as much heat as possible

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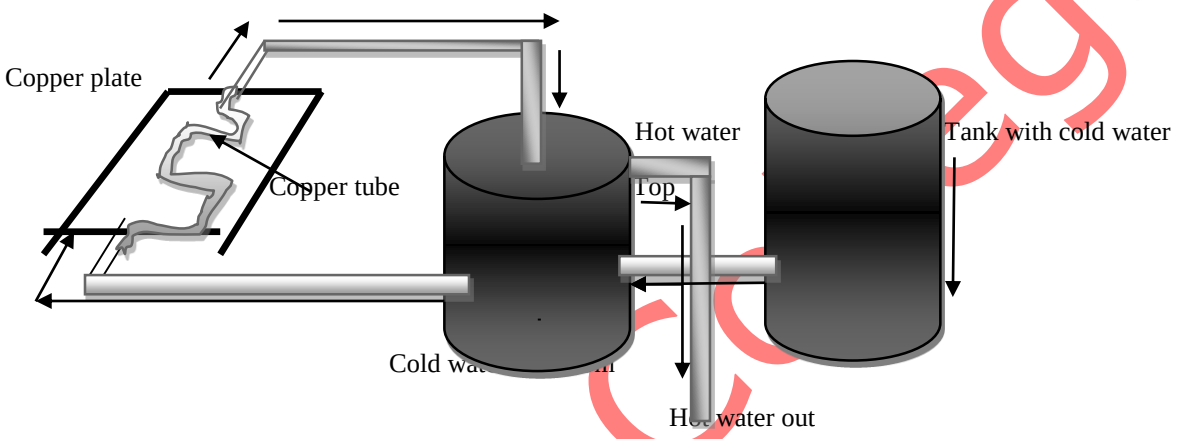
- Glass covering is there to reduce heat loss by conduction. Also traps heat by the greenhouse effect
- Thin coiled copper tubing increases surface are for heating water .Copper is a good conductor of heat energy
- Insulating materials = to reduce heat loss by conduction



- Hot water comes out through the top pipe (hot water rises)
- Cold water enters through the bottom pipe.
- Function is to heat water for domestic uses

Telecommunication

Transmission medium is the physical path between transmitter and receiver. Transmission media are grouped into two: Guided and unguided transmission media.

Guided Transmission Media – provides physical path along which the signals are propagated. Examples include copper coaxial cable, optic fiber

Unguided Transmission media – employs an antenna for transmission through air, vacuum and water. Examples include wireless transmission

Coaxial cable

Consist of two conductors that are constructed differently to permit it to operate over a wider range of frequencies. Coaxial cables are used in:

1. Television distribution

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2. Long distance telephone transmission
3. Short-run computer system links
4. Local area networks.

Optic fibre

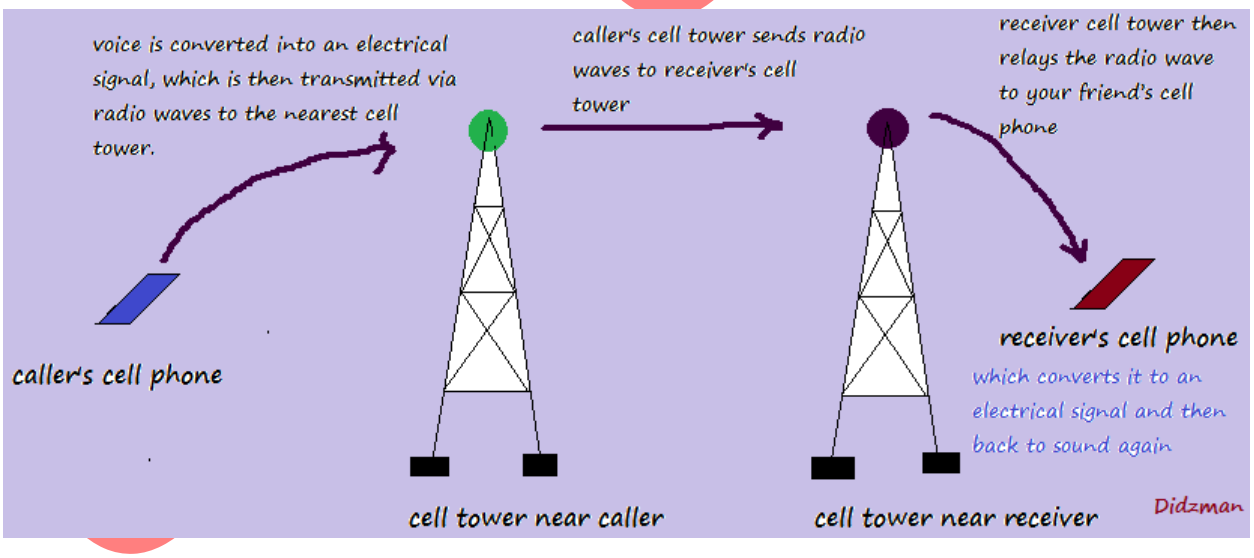
It is a thin flexible medium capable of guiding an optical ray. It is used on long distance telecommunications and in military applications. Advantages include greater capacity, smaller size and lighter weight, lower attenuation.

Wireless transmission

Includes radio broadcast transmission, infrared satellite dishes

Cell phones

It is a two way radio consisting of a radio transmitter and a radio receiver. When you chat with your friend on your cell phone, your phone converts your voice into an electrical signal, which is then transmitted via radio waves to the nearest cell tower. The networks of cell towers then relays the radio wave to your friend's cell phone, which converts it to an electrical signal and then back to sound again. Modern cell phones come with additional functions like taking pictures, playing games, sending text messages and playing music.



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Electromagnetism

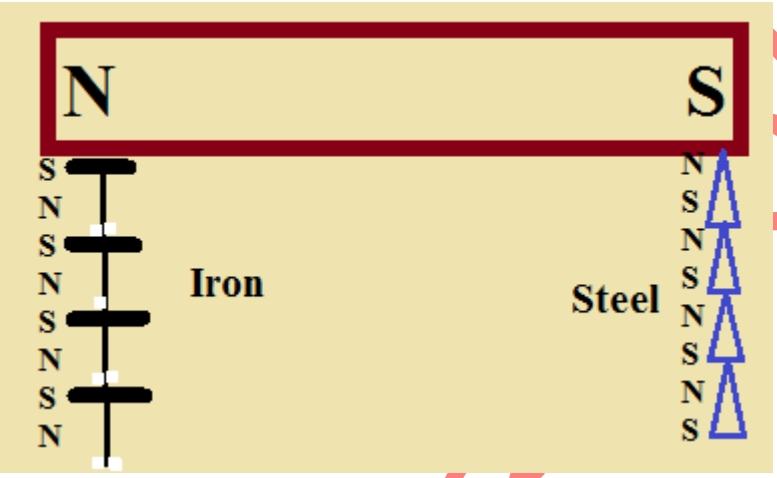
Properties of magnets

a) Magnetic material
Magnets attracts strongly only certain materials such as iron, steel, nickel, cobalt which are called fero-magnetics

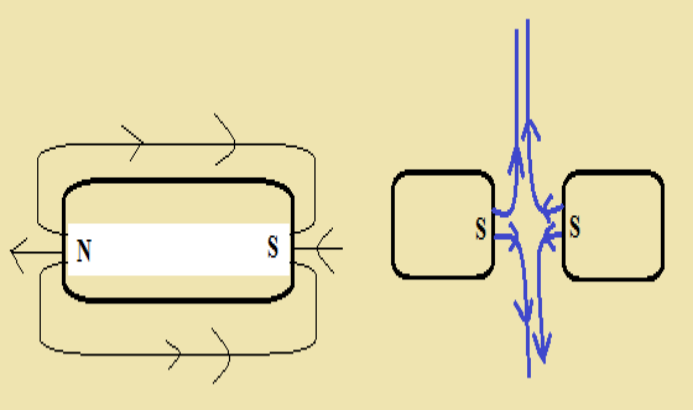
b) Magnetic poles
The poles are the places in a magnet to which magnetic materials such as iron fillings are attracted. They are near the ends of a bar magnet and occur in pairs and equal strength

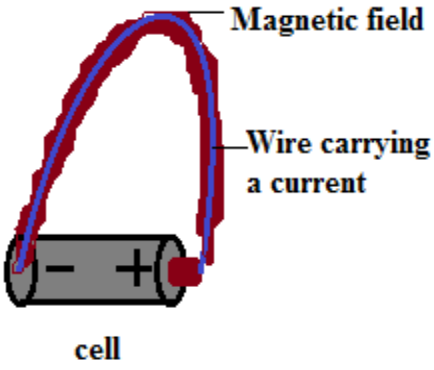
c) North and South poles

d) Law of magnetic poles
   1. Like poles repel
   2. Unlike poles attract



Magnetic Fields

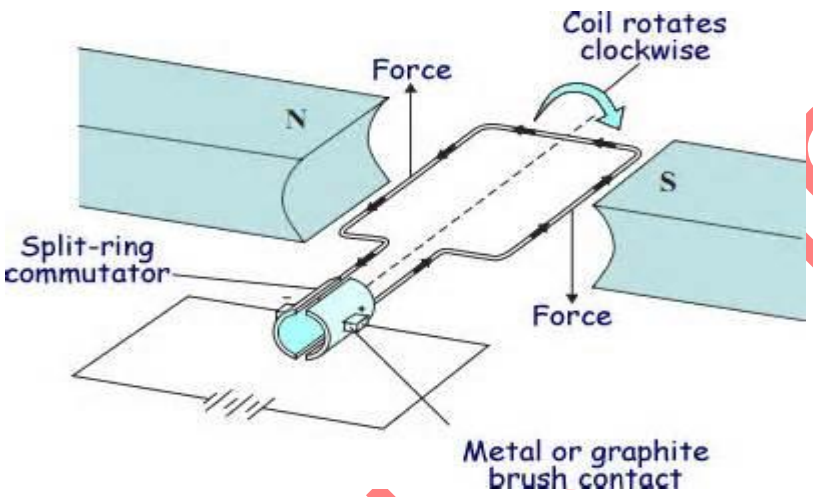




MOTOR AND GENERATOR EFFECT

Motor Effect

- The motor effect converts electrical energy to kinetic or mechanical energy
- It is caused by the interaction between two magnetic fields. A magnetic field is the force of attraction around a magnet or a wire with a current.
- Two fixed magnets has a magnetic field in between them
- So the interaction between the magnetic fields in the wire and magnetic field in between the magnets creates the movement and this is called the motor effect



EXPLANATION OF THE MOTOR EFFECT

- A conductor carrying a current produces a magnetic field
- A fixed permanent magnet has a magnetic field
- The interaction between the two magnetic fields causes the conductor to move
- This is called the motor effect
- In electric motor , the motor effect causes the coils in magnetic field to move or rotate
- Electrical energy is changed to kinetic energy (moving energy) in electric motor

The Generator Effect

- It converts kinetic energy into electrical energy
- In electric generator the coil rotates between the poles of the permanent magnet
- The coil between the permanent magnet starts to rotate due to the magnetic field inside the permanent magnet
- This is the generator effect

EXPLANATION OF THE GENERATOR EFFECT

- Relative motion between a magnet and a conductor produces an electric current
- In electric generator, a coil rotate between the poles of a permanent magnet

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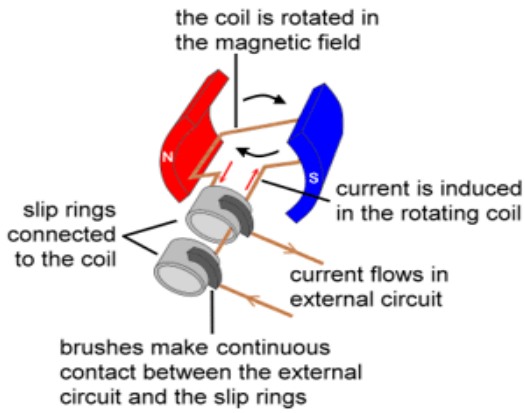
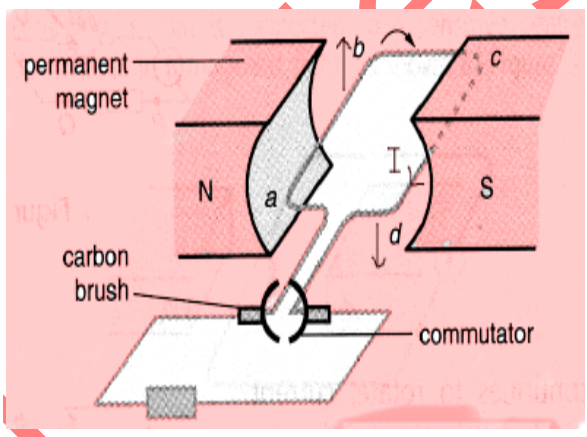
- The faster the rotation of the coil, the more electricity is produced
- In electric generators, kinetic energy is changed to electrical energy
- Generators are motors operated in reverse
- There are two types of generators, the **DC** and the **AC** generator
- The dc generator has a split ring (commutator) to change to change the ac from the coil into dc.
- They are two types of the generator. The **dc** (direct current) and the **ac** (alternating current)
- The **ac** generator current is reversed by a slip ring on the coil
- With a **dc** generator current moves in one direction
- The **dc** generator has a split ring (commutator) to change

A.C Generator



D.C Generator



Hydro power

Hydropower plants capture the energy of falling water to generate electricity. A turbine converts the kinetic energy of falling water into mechanical energy. Then a generator converts the mechanical energy from the turbine into electrical energy.

Parts of a hydroelectric power plant:

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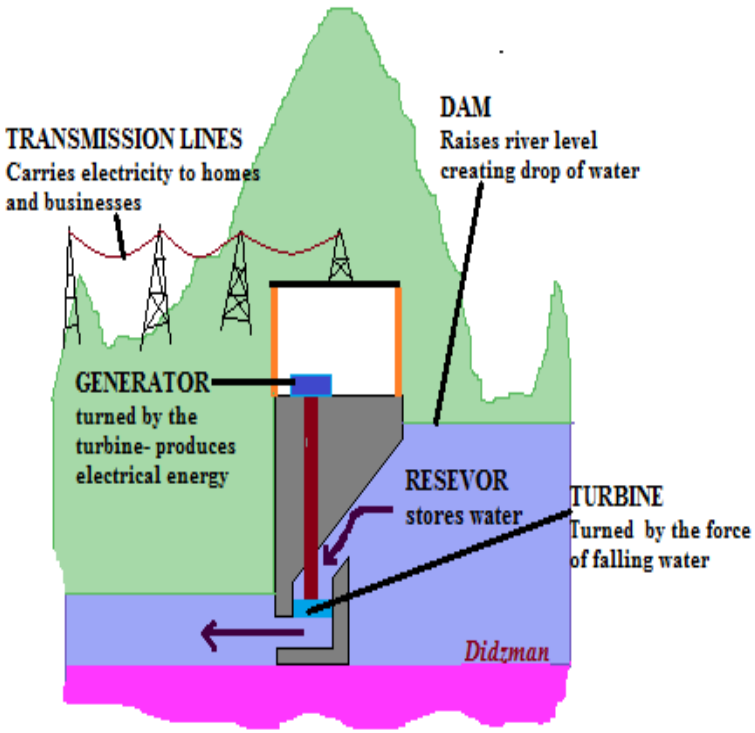
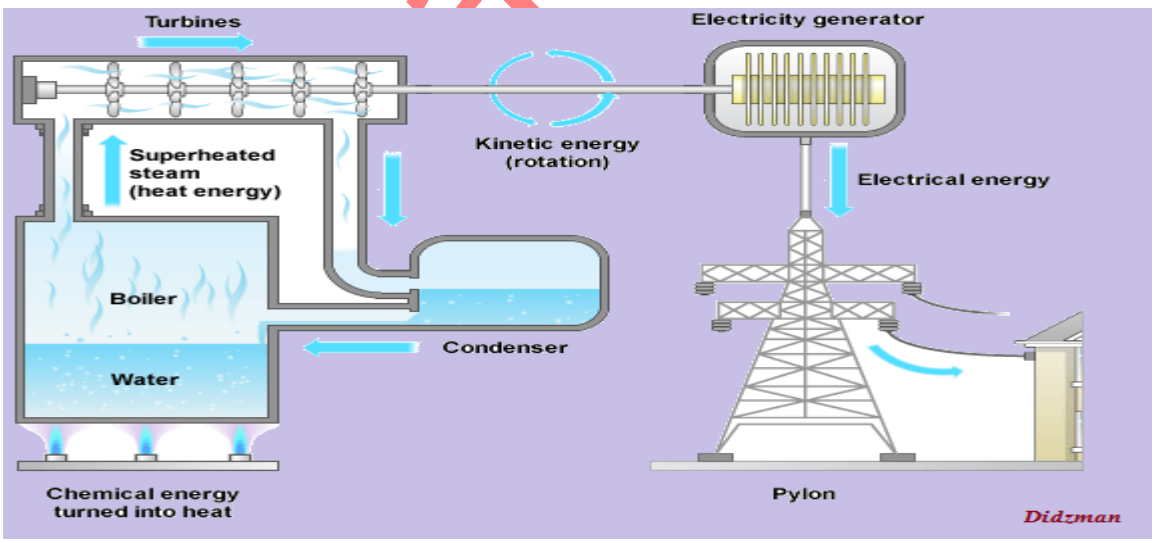


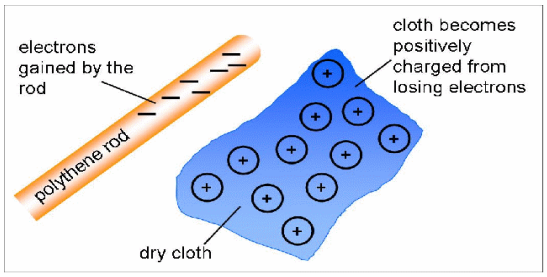
1. **Dam** – Raises the water level of the river to create falling water. Also controls the flow of water. The reservoir that is formed is in effect stored energy.
2. **Turbine** – the force of falling water pushing against the turbine's blades causes the turbine to spin. A water turbine is much like a windmill, except the energy is provided by falling water instead of wind. The turbine converts the kinetic energy of falling water into mechanical energy.
3. **Generator** – connected to the turbine by shafts and possibly gears so when the turbine spins it causes the generator to spin also. Converts the mechanical energy from the turbine into electrical energy. Generators in hydropower plants work just like generators in other types of power plants.
4. **Transmission lines** – conduct electricity from the hydropower plant to homes and businesses

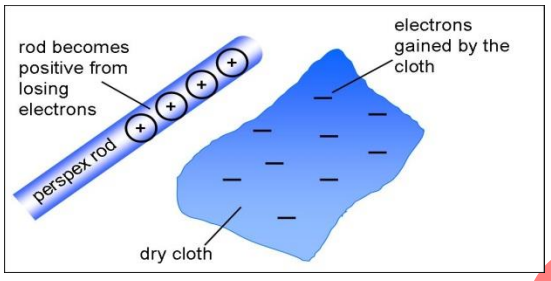
Thermal power generation

A thermal power plant is a plant in which heat energy is converted to electric power. The turbine is steam driven unlike in hydropower generation. Water is heated, turns into steam and spins a steam turbine which drives an electrical generator



Electrostatic





- This is the study of static electricity
- When two objects in each other's vicinity have different electrical charges, an electrostatic field exists between them. An electrostatic field also forms around any single object that is electrically charged with respect to its environment. An object is negatively charged (-) if it has an excess of electrons relative to its surroundings. An object is positively (+) if it is deficient in electrons relative to its surroundings.
- Objects can be charged by adding and removing electrons
- If negative electrons are removed it will become positively charged
- If electrons are added it will become negatively charged

n.b = Unlike Charges They Attract and Like Charges They Repel

- Rubbing of particles produce charges if you rub a ruler on your head it gains electrons
- If you rub a polythene rod e on a woolen cloth it loses electrons and becomes positively charged

Lighting

- Friction between clouds to produce electrons
- The friction is caused by the rubbing together of clouds
- If there is a positively charged particle on the ground there is attraction
- The attraction causes a lighting strike

PRECAUTION AL MEASURES AGAINST LIGHTNING

1. Avoid squatting
2. Avoid being the tallest object
3. Avoid cycling

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Electrical Energy

CURRENT

- It is the flow of electricity in a wire
- It is measured by an ammeter
- The (Si) Unit of the Ammeter Amps

VOLTAGE

- It is the driving force in a wire
- It is measured in volts

RESISTANCE

- It is the stopping effect in a wire if it is opposite to the flow of current in a circuit
- The (S.I) unit is atoms
- The atom low states that the current passing through a wire is directly proportional to the voltage and the resistance across it
- The pyramid explains the relationship between voltage, resistance and current

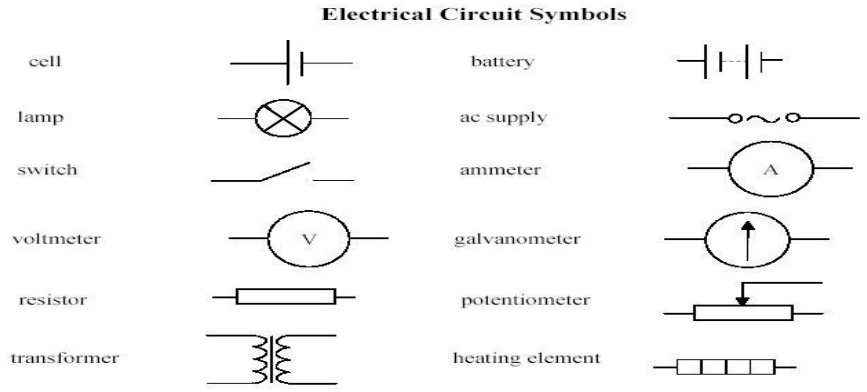
WORD EQUATIONS

1. $CURRENT \quad \frac{Voltage}{Resistance}$

2. $RESISTANCE = \frac{Voltage}{Current}$

3. $VOLTAGE = Current \ X \ Resistance$

Electrical Circuit



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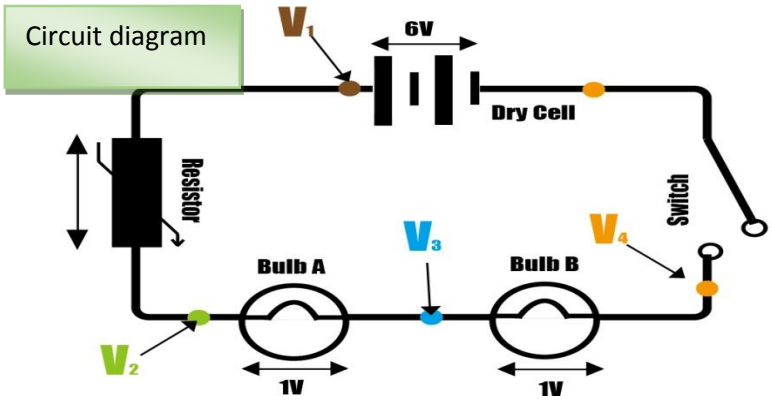
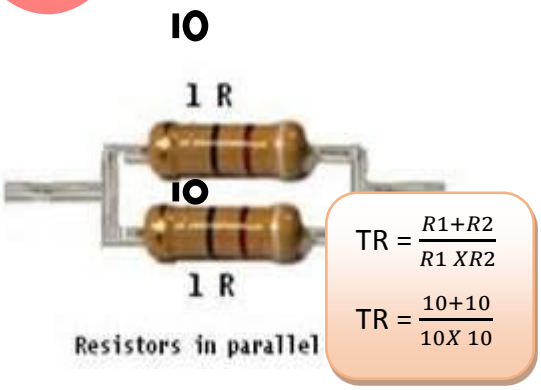


Components of a Circuit

1. CELL - It is the source of electrical energy
2. SWITCH- It breaks or completes electrical energy
3. RESISTER- It offers an opposition to the flow of electricity light bulb
4. FUSE- Fuse is a device that protects appliances and users from electrical damage

RESISTANCE IN SERIES AND IN PARALLEL



Cells

- Is any devise which provides electrical energy when there are wire connected to it
- They have a stored energy (chemical energy)

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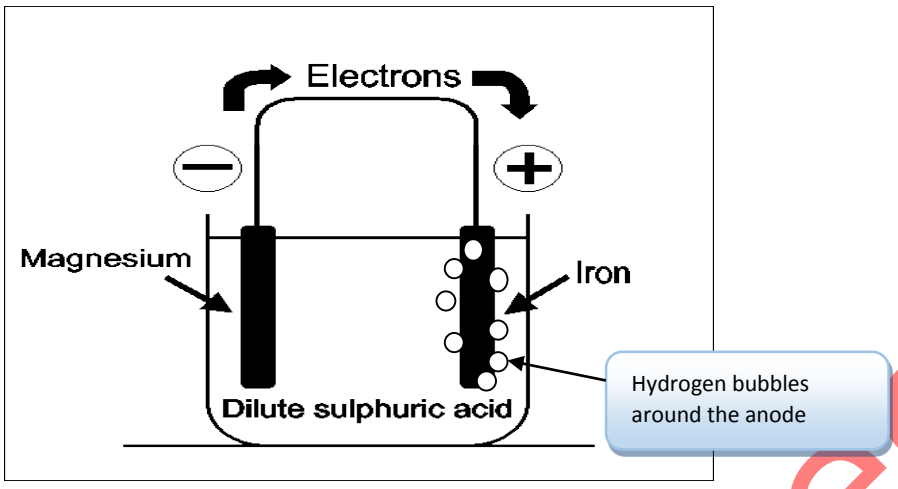
Simple Cell

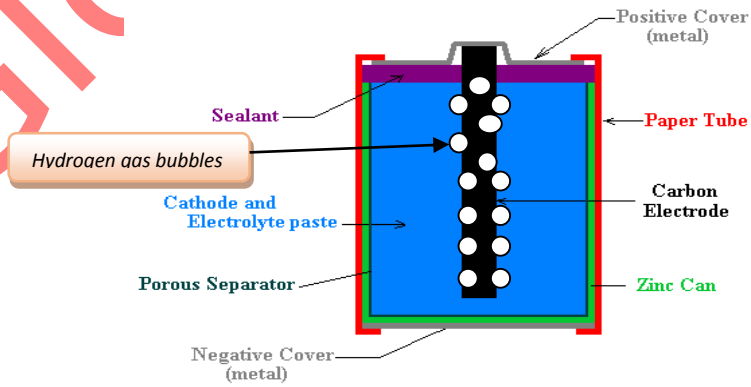


- It is made up of electrolyte and two electrons
- An electrolyte is any liquid which conduct electricity
- Reaction between electrons and electrolyte results in chemical energy being changed to electrical energy
- The reaction results in hydrogen irons moving to copper electrodes and forming hydrogen molecules
- Hydrogen gas molecules form an insulating layer
- This is called ***polarization***
- Hydrogen gas molecules can be reduced by whipping off and adding a depolarizing agent

NB = Always use the metal that have the least reactivity series at the anode

- The most reactive is the cathode
- The further apart the metals in the reactivity series the greater the voltage
- Calcium and lead produce a greater voltage than magnesium and lead

The Dry Cell



ADVANTAGES OF A DRY CELL

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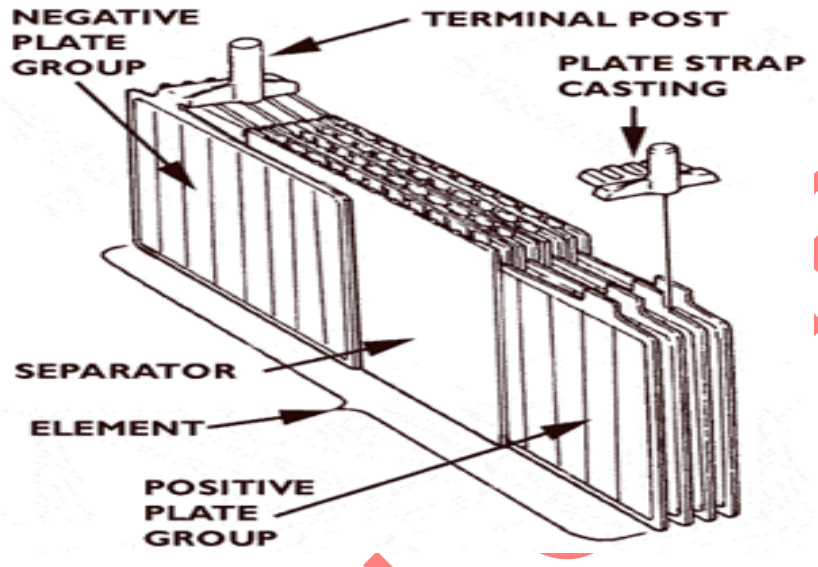
- It is more convenient to use than the simple cell
- It is corrosive (built in depolarizer)

DISADVANTAGES OF A DRY CELL

- Produce small voltage
- Some cannot be recharged

Lead acid accumulator



- Lead cell use lead and lead (IV) oxide as electrons
- Dilute sulphate acid is electrolyte
- Lead (IV) oxide is the anode
- Lead is the cathode

DURING DISCHARGE

- This is when the battery is supplying current (i.e.) when it is in use
- Chemical energy is converted to electrical energy
- Both plats are converted to lead sulphate

1. $\boldsymbol{Lead\ (IV)\ Oxide + Sulphuric\ Acid = Lead\ Sulphate + Water}$
2. $\boldsymbol{Lead + Sulphuric\ Acid = Lead\ Sulphate + Water}$

DURING RECHARGING

1. Electrical energy is converted to chemical energy
2. Lead sulphate is converted back to lead and lead (IV) oxide

1. $\boldsymbol{Lead\ Sulphate + Water = Lead\ (1V)\ Oxide + Sulphuric\ Acid}$
2. $\boldsymbol{Lead\ Sulphate + Water = Lead + Sulphuric\ Acid}$

During recharging the current is supplied in an opposite direction

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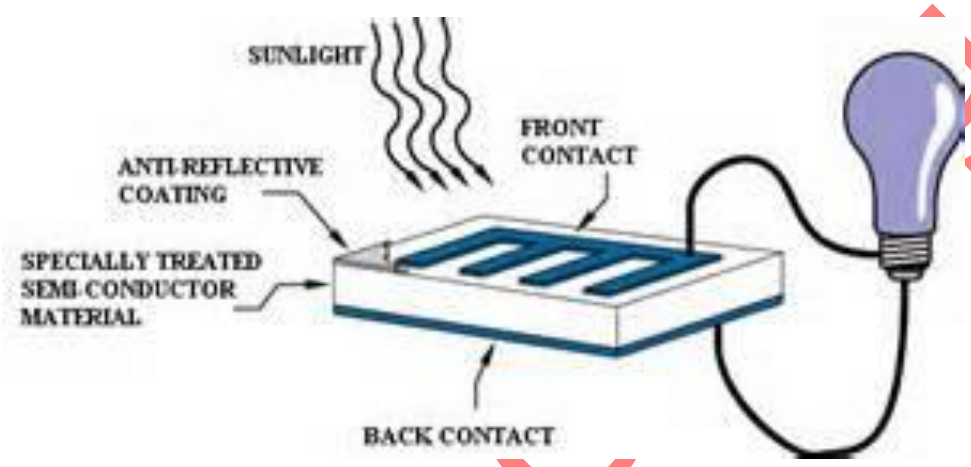
CARE OF LEAD CELLS

- Avoid total discharge
- Check electrolyte density using hydrometer
- Add water to the electrolyte

Photo Voltaic Cells

- They convert solar or sunlight energy to electrical energy
- They are made from silicon which is a semiconductor
- Panel of photo voltaic cells are connected in series and parallel



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