BIOLOGY S.S. 1

RECOGNISING LIVING THINGS

DEFINITION OF SCIENCE.

Science is a systematic process of making enquiry about the living and non-living things in our environment. Science is categorized into 3 major branches; PHYSICS, CHEMISTRY AND BIOLOGY.

Biology is derived from 2 Greek words; *BIOS* meaning life and *LOGOS* meaning study. Therefore, Biology is the study of life/living things. Due to the wide variety of living things, there are several branches of Biology with each branch dealing with a particular variety of living things.

SOME BRANCHES OF BIOLOGY ARE:

1. Zoology: This deals with the study of animals
2. Botany: This deals with the study of plants.
3. Anatomy: This deals with the study of the internal structures of plants and animals.
4. Parasitology: This is the study of parasites.
5. Pathology: This sis the study of the nature, causes and effects of diseases.
6. Herpetology: This is the study of reptiles and amphibians.

ASSIGNMENT: Mention and Explain 7 Branches of Biology (Apart from those in the note).

SCIENTIFIC METHOD

The process of science involves the sequence of making enquiry about an object under study in science. The scientific process involves about nine procedures, this is because clarity and accuracy is of great importance in science. The scientific process involves:

i. Observation
ii. Classification
iii. Inference
iv. Measurement
v. Identification
vi. Hypothesis
vii. Experiment
viii. Conclusion
ix. Theory or Law

ASSIGNMENT: List 10 differences between living things and nonliving things.

LIVING AND NON LIVING THINGS.

All things on earth are classified as either living or non-living thing based on the presence or absence of life in them. Living things have life in them while non-living things do not have life in them. Examples of living things are insects, plants, man, rabbit, hibiscus, grass while examples of non-living things are stone, book, air, water, pen etc. Some characteristics of living things are: Movement, Respiration, Nutrition, Irritability, Growth, Excretion, Reproduction, Adaptation, Competition, and Death. (Mr Niger Adapts and Competes till Death).

1. Movement: This is the ability of an organism to move part or the whole of its body from one place to another.

2. Respiration: The process whereby organisms exchange gases with their environment. Organisms take in oxygen and give out carbon dioxide.
3. Nutrition: This is the ability of an organism to feed. There are 2 major types of nutrition; Autotrophic nutrition (when green plants manufacture their foods) and Heterotrophic nutrition (all animals depend directly or indirectly on plants for their foods).
4. Irritability: This is the ability of an organism to sense things in its environment. This is also called response to stimuli.
5. Growth: This is a process of positive change in mass or size over a given period of time.
6. Excretion: This is a process whereby organisms remove metabolic waste products from their body. Examples of such are water, carbon dioxide e.t.c.
7. Reproduction: This is the ability of an organism to produce off springs. This allows life to continue. There are 2 types of reproduction: Sexual (involves 2 parents for off springs to be produced) and Asexual (involves 1 parent/organism for off springs to be produced).
8. Adaptation: This is the process whereby an organism gets used to its environment so that it survives in this environment.
9. Competition: This is the process by which an organism struggles for its needs in its environment. Examples of such needs are food, water, light, air etc.
10. Death/Life span: All living things have a definite time of existence after which they die.

DIFFERENCES BETWEEN PLANTS AND ANIMALS.

Even if plants and animals are both living things, they differ from each other. Some differences between plants and animals are:

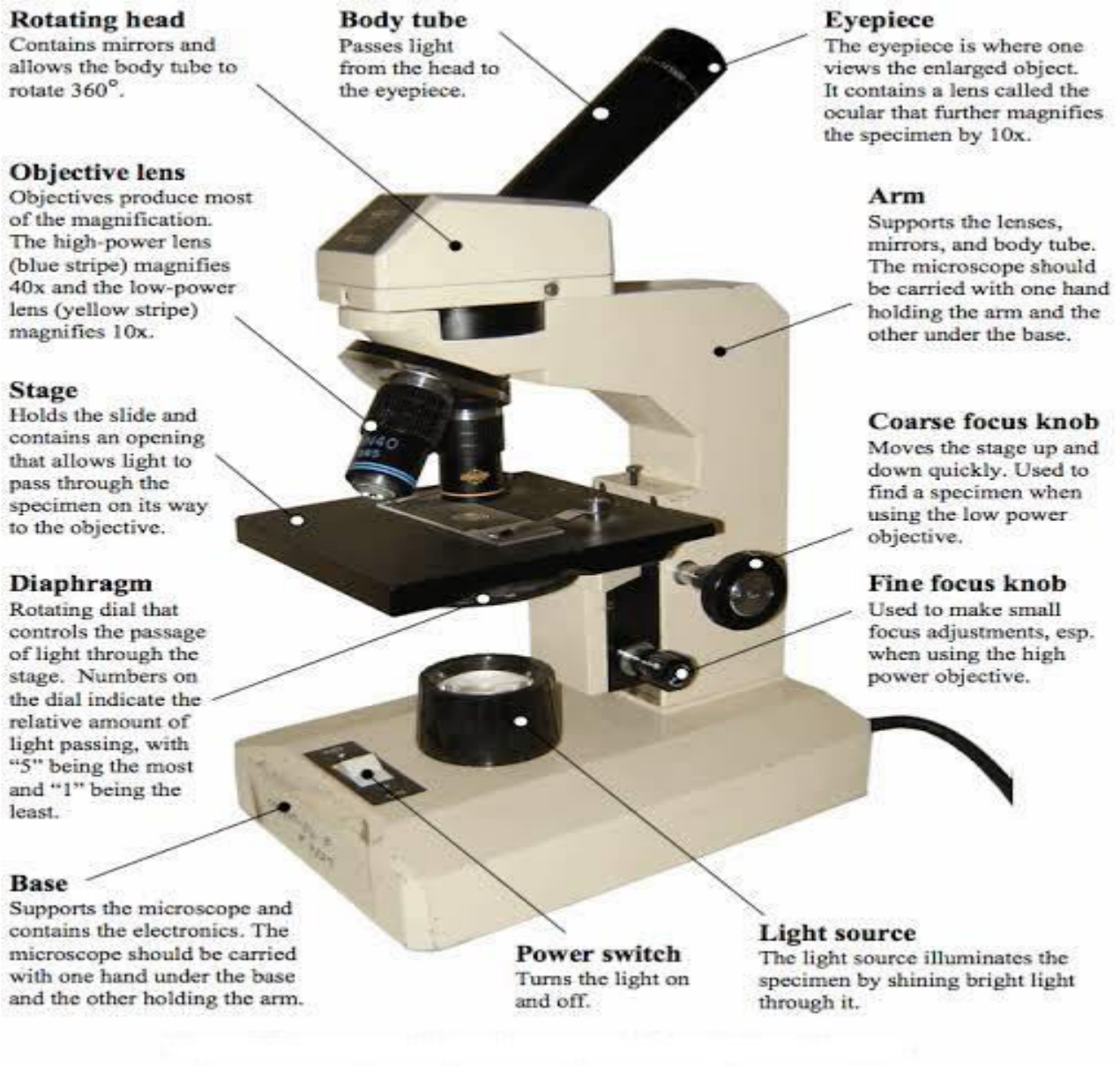
PLANTS	**ANIMALS**
1. Most green plants carry out photosynthesis.	Animals cannot photosynthesize but depend directly or indirectly on plants for their food.
2. Growth is restricted to the apex of the plants.	Growth takes place in all parts of the body.
3. They continue to grow throughout their lives.	Growth is restricted to certain periods in life.
4. They do not have special sense organs.	They have specialized sense organs.
5. Plants cannot move about. They are inactive.	Animals have organs for movement. They are active.

ASSIGNMENT: Draw and label a microscope and write the functions of its parts.

MICROSCOPE; PARTS AND FUNCTIONS.

A Microscope is an instrument used to view objects that are too small for the naked eyes. It is derived from 2 Greek words; Mikros meaning “small” and Skopein meaning “to see”.

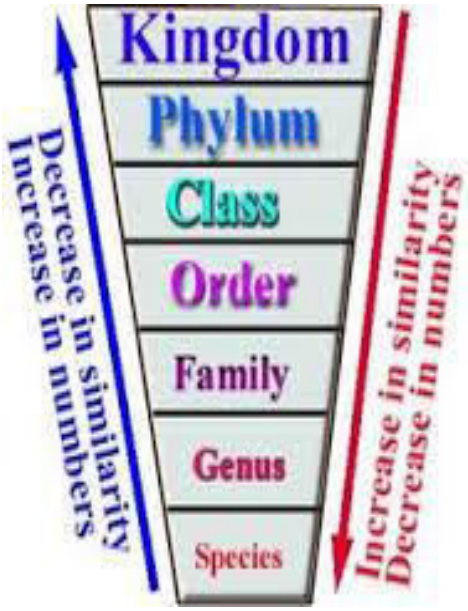
PARTS OF A MICROSCOPE AND THE FUNCTIONS OF ITS PARTS



ASSIGNMENT: Draw and label a simple microscope.

CLASSIFICATION OF LIVING THINGS

All living things are classified into groups based on important features that are shared by a large variety of organisms. Each group is then sub divided based on progressively more important features. This classification occurs in hierarchy from the highest level to the lowest as shown below:



For instance, a brown squirrel is classified as:

Kingdom: Animalia, or "animal".

Phylum: Chordata, or "has a backbone"

Class: Mammalia, or "has a backbone and nurses its young"

Order: Rodentia, or "has a backbone, nurses its young, and has long, sharp front teeth.

Family: Scuridae, or "has a backbone, nurses its young, has long, sharp front teeth, and has a bushy tail.

Genus: Tamiasciurus , or "has a backbone, nurses its young, has long, sharp front teeth, has a bushy tail, and climbs trees.

Species: Hudsonicus , or "has a backbone, nurses its young, has long, sharp front teeth, has a bushy tail, and has brown fur on its back and white fur on its underparts.

BINOMIAL NOMENCLATURE

This is a system of naming organisms as introduced by Carolus Linnaeus which are derived from the organism's genus and species. This scientific name must be italicised or underlined and the first letter of the generic name(the genus) is written in capital letter while that of the species is written in small letter. Examples of some scientific names are:

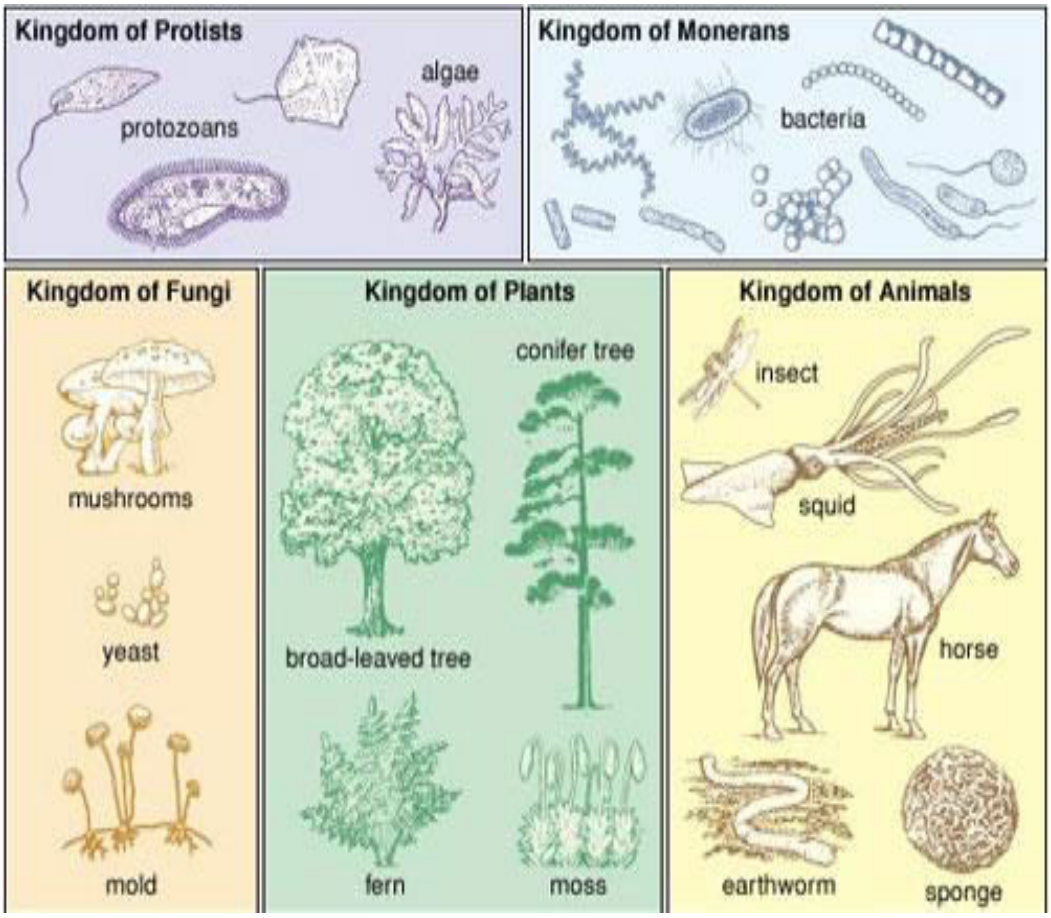
Man	Homosapiens
Maize	Zeamays
Rat	Rattusrattus
Orange	Citrussinensis

Scientists classified all living things into 5 Kingdoms: Monera, Protista, Fungi, Plantae and Animalia. Each of these kingdoms have their various phyla (plural of phylum), classes, orders, families, genera and species. However, viruses did not fall into any of the groups.

VIRUSES

These are microscopic organisms that can only be seen through an electron microscope. Though they do not have a cell structure, they have coiled strand of nucleic acids (DNA or RNA) enclosed within a protein coat. It can only rproduce when it is within a living organism. Some characteristics of viruses are:

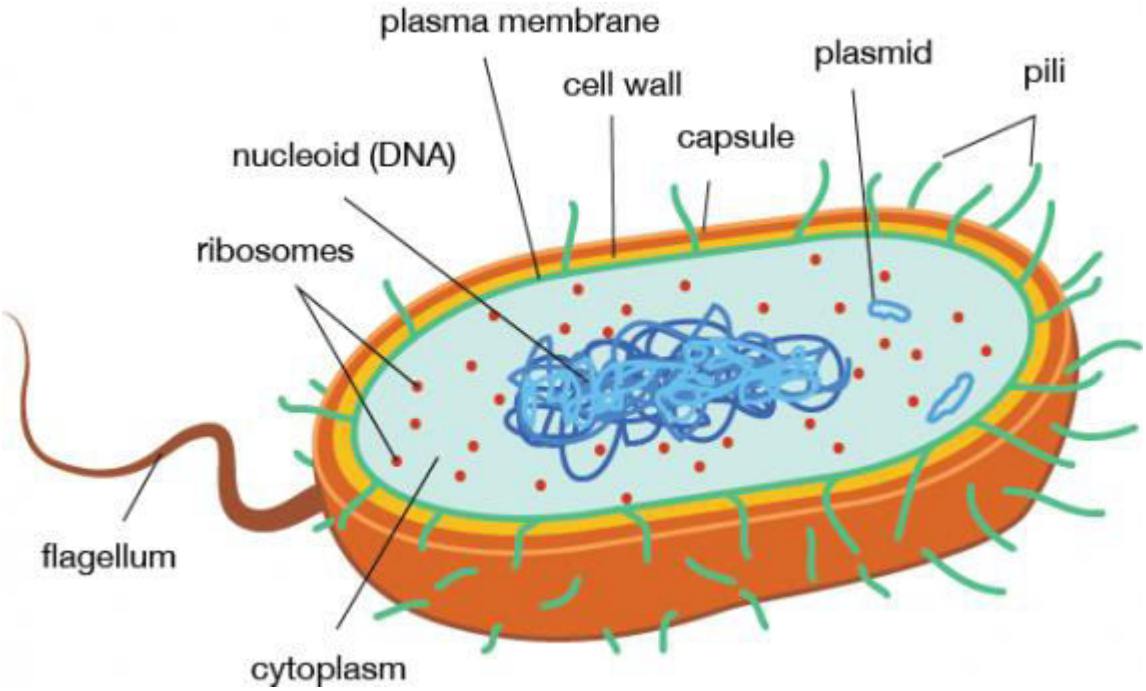
1. They do not respire, feed or excrete
2. They are microscopic in nature
3. They have either DNA or RNA
4. They cause diseases in plants and animals.
5. They reproduce rapidly when present in living cells.



KINGDOM MONERA

These are the simplest living organisms. Examples of this are Bacterium(Plural Bacteria) and Blue-green Algae. Different forms of bacteria are cocci, streptococci,staphylococci, vibrios etc.

GENERAL STRUCTURE OF A BACTERIA



Their characteristics are:

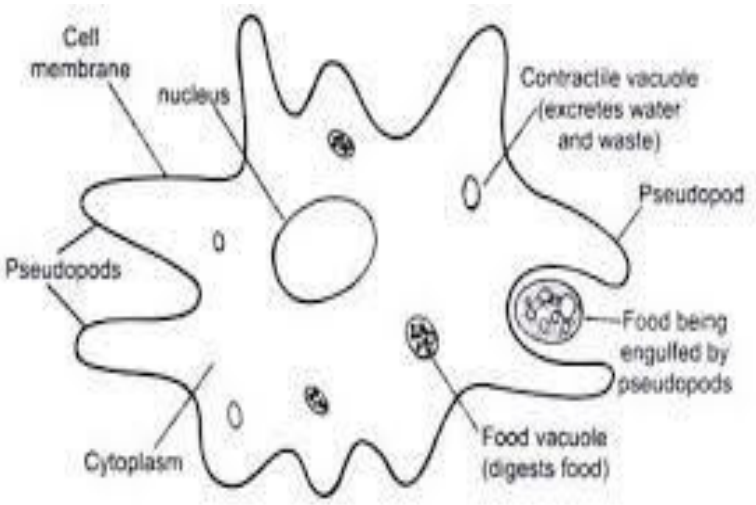
1. They are unicellular
2. They are prokaryotes (their cells do not have membrane)
3. They do not have complex chromosomes
4. They do not undergo sexual reproduction.
5. They may be autotophic

KINGDOM PROTISTA

These are unicellular eukaryotic organisms which may be protozoa(animal-like protists), protophyta (plant-like protist) or euglenophyta (combining both plant and animal features).

PHYLUM PROTOZOA: These are the protists with animal features e.g. amoeba and paramecium

STRUCTURE OF AMOEBA

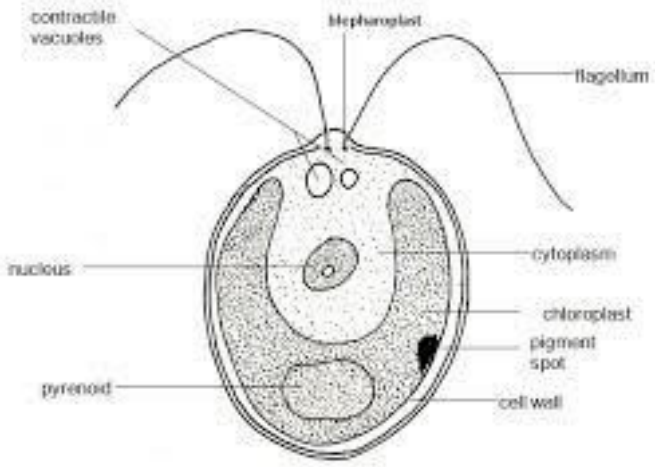


Characteristics are:

1. They are microscopic unicellular organisms
2. They are all eukaryotic(cells have membrane)
3. They reproduce asexually by binary fission
4. They are mainly aquatic and motile organisms.
5. They move about with cilia, flagella or pseudopodia.

PHYLUM PROTOPHYTA: These are protists with plant features e.g chlamydomonas, chlorella etc.

STRUCTURE OF CHLAMYDOMONAS

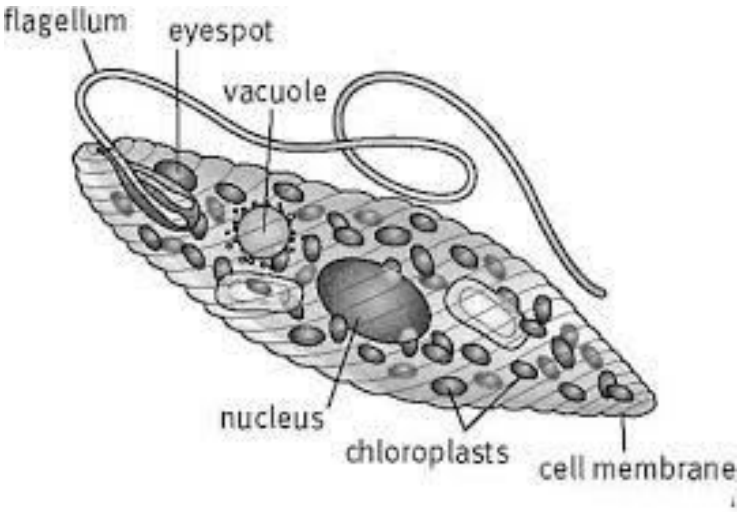


Characteristics:

1. They have cellulose cell walls
2. They have chloroplasts which contain chlorophyll for photosynthesis
3. They are found in fresh water or in the sea.

PHYLUM EUGLENOPHYTA: These are organisms that have both plant and animal features. Example is Euglena viridis.

STRUCTURE OF EUGLENA VIRIDIS



CHARACTERISTICS:

1. They have flagellum for movement
2. It has chloroplasts which enablws it to manufacture food
3. It has eye spot for responding to light
4. It is also able to manufacture its food in he absence of sunlight.

KINGDOM FUNGI

Fungi (singular; fungus) include mushrooms, bread moulds, yeast, slime moulds, Rhizophus etc. All fungi (except slime moulds) are non motile and they differ from plants because they do not have chlorophyll for producing their foods.

CHARACTERISTICS:

1. They are eukaryotic in nature
2. Some are unicellular e.g yeast while others are multicellular e.g. mushroom
3. They are mainly non-motile organisms
4. They lack chlorophyll
5. They store excess food in form of glycogen
6. They are mainly saprophytes while others are parasites
7. They have no true roots, stems and leaves.

STRUCTURE OF MUSHROOM

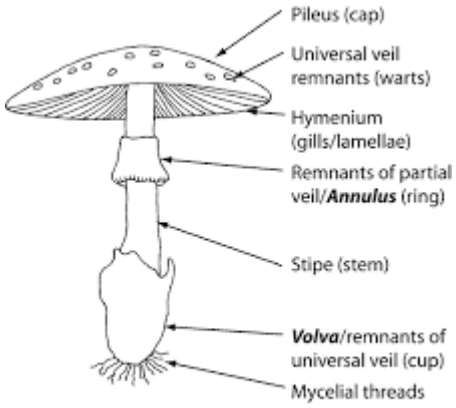


Fig. 1A

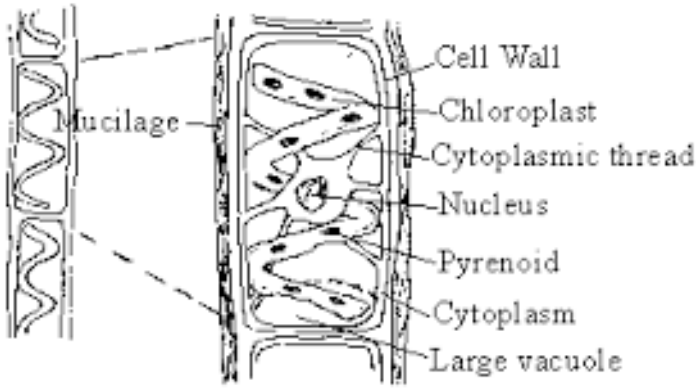
KINGDOM PLANTAE

The green plants that we are familiar with belongs to this kingdom. It consists of all plants; from microscopic plants to aquatic and land plants. Generally, plants are eukaryotic, multicellular non-motile organisms. They possess chlorophyll with which they carry out photosynthesis.

The plant kingdom is divided into 3 main division/phyla:

- PHYLUM THALLOPHYTA
  These are simple aquatic plants examples of which are red algae, green algae, brown algae. They have thread-like or flat (thallus) bodies. Spirogyra is a simple green algae found in ponds and ditches.
  Characteristics of thallophytes are:
  i. They are simple microscopic plants
  ii. They are simple aquatic plants
  iii. They have cellulose cell walls
  iv. They have no true root stem and leaves
  v. They have no specialised reproductive organs, even though they exhibit both sexual and asexual reproduction.

STRUCTURE OF SPIROGYRA



- PHYLUM BRYOPHYTES
  These includes mosses and liverwort. These plants grow in damp places on land.
  Characteristics:
  i. They are complex multicellular green plants

ii. They are non-vascular green plants
iii. They grow in moist places
iv. Some are terrestial while others are aquatic
v. They exhibit both sexual and asexual reproduction
vi. They lack true stems, roots and leaves.

Picture of Moss plant

PICTURE OF LIVERWORT

PHYLUM TRACHEOPHYTES

Tracheophytes are vascular plants (plants that have vascular tissues for transporting water and food). This is the largest group of plants. They are classified into pteridophytes (spore bearing plants) e.g FERNS and spermatophytes (seed bearing plants).

CHARACTERISTICS OF PTERIDOPHYTES

i. They are multicellular and vascular green plants
ii. They are mainly terrestrial plants
iii. They are non flowering plants
iv. They do not produce seed
v. They reproduce sexually by the production of spores.

CHARACTERISTICS OF SPERMATOPHYTES

i. They are multicellular seed producing plants,thus, they are flowering plants
ii. They have well developed vessels for transporting water and minerals
iii. They are mainly terrestrial
iv. They have well developed roots, stems and leaves
v. The seed contains embryo which develops into fruit

Spermatophytes are further divided into gymnosperms and angiosperms

GYMNOSPERMS	**ANGIOSPERMS**
1. They do not bear flowers	They are complex green flowering plants
2. Seeds are naked	Seeds ar enclosed within the fruits
3. Seeds are borne on cones	Seeds develop from ovules and enclosed in the ovary

Angiosperms (flowering plants) are classified into MONOCOTYLEDONS AND DICOTYLEDONS.

DIFFERENCES BETWEEN MONOCOTYLEDONS AND DICOTYLEDONS

MONOCOTYLEDONS	**DICOTYLEDONS**
1. They have one seed leaf/cotyledon	They have two seed leaf/ cotyledon
2. Their vascular bundles are scattered	Their vascular bundles are arranged
3. Their floral parts exist in groups of three	Their floral parts exist in groups of four or five
4. They have parallel venation	They have net venation
5. They have fibrous root system	They have tap root system

Examples of monocotyledons are maize, rice,elephant grass etc. while examples of dicotyledons are beans, mango, water leaf etc.

Angiosperms have four major parts: flowers (for reproduction), leaves (for photosynthesis, excretion, respiration and transpiration), stem (for support,storage of food and holding the plant in position) and root (holding the plant in the soil,storing food and absorbing water and minerals from the soil).

KINGDOM ANIMALIA

All animals belong to this kingdom and are classified into 2 major phyla: PHYLUM VERTEBRATA and PHYLUM INVERTEBRATA.

NB: Draw the chart of kingdom Animalia.

ORGANISATION OF LIFE

All living things are highly organised, being made of simple structures at the lowest level interacting to build up more complex structures at the next level. A complex multicellular living organism evolved from non-living atoms and molecules in several steps. The hierarchy of biological organisation is:

MACROMOLECULES>> ORGANELLES>> CELLS>> TISSUES>> ORGANS>> SYSTEMS>> MULTICELLULAR ORGANISM.

The simplest non-living structures are the macromolecules and organelles while the 4 major levels of organisation of living organisms are the cell, tissue, organ and system.

1. CELL LEVEL: A cell is a basic functional and structural unit of life. It is bounded by a cell membrane containing nucleus and cytoplasm. This is called the protoplasm of a cell i.e.

   Protoplasm= Nucleus + Cytoplasm

All plants and animals are made up of cells. Some are made up of only one cell (unicellular organism) while others are made up of many cells (multicellular organism).

Examples of cells in plants are:

i. Phloem cells
ii. Xylem cells

In animals, examples of cells are:

i. Red blood cells
ii. White blood cels
iii. Nerve cells
iv. Sperm cells
v. Muscle cells
vi. Bone cells

2. TISSUE LEVEL: A tissue is a collection of cells that are similar in structure and perform similar or specific functions. Types of tissues in man and their functions:

TISSUE	**FUNCTION**
1. Epithelial tissue	They line and protect the body surface. They help in skin formation
2. Blood tissue	They transport food and oxygen round the body
3. Skeletal tissue	They support the body and movement
4. Connective tissue	Thye bind other tissues together
5. Nerve tissue	They co-ordinate and transmit nerve impulses
6. Muscle tissue	They form the muscles and are used for movement

Types of tissues in plants:

TISSUE	**FUNCTION**
1. Vascular tissue	For transport of food and water in plants
2. Strengthening tissue	They give strength and support to plants' body
3. Photosynthetic tissue	They are used for manufacturing food
4. Epithelial tissue	They line and protect the plants' surface

5. Packing tissue	They provide surfaces for new cells which are used for storage

3. ORGAN LEVEL: An organ is a collection of different tissues that perform different functions. Examples are: Heart which is a pumping organ for blood, kidney for excretion and osmoregulation. In plants, an organ is onion bulb.
4. SYSTEM LEVEL: A system is a collection of different organs that perform a particular function. Systems are peculiar to higher organisms. Examples of system levels are:
   i. Digestive system which are made up of mouth, intestine, duodenum etc.
   ii. Reproductive system consisting of testes, ovaries, fallopian tube, uterus, scrotum etc.
   iii. Excretory system consisting of the kidney, bladder, skin, liver, lungs etc.
   iv. Respiratory system which consists of lungs, alveoli, bronchus etc.
   v. Circulatory system consisting of arteries, veins, capillaries, heart etc.

COMPLEXITY OF ORGANISMS

Advantages of complexity of organisms

1. It leads to specialisation
2. Specialisation leads to division of labour
3. Division of labour leads to efficiency to the tissue, organs and the system.
4. One body function does not adversely affect the other body function. Therefore, various systems operate side-by-side without affecting each other.
5. It increases adaptation to environment.

Disadvantages of complexity in higher organisms

1. Inability of individual cells to exist on their own.
2. It leads to slower rate of diffusion.
3. It leads to decrease in ability to regenerate.
4. It leads to slower rate of expulsion of waste products.
5. There is difficulty in reproduction.

THE CELL

CELL AS A LIVING UNIT

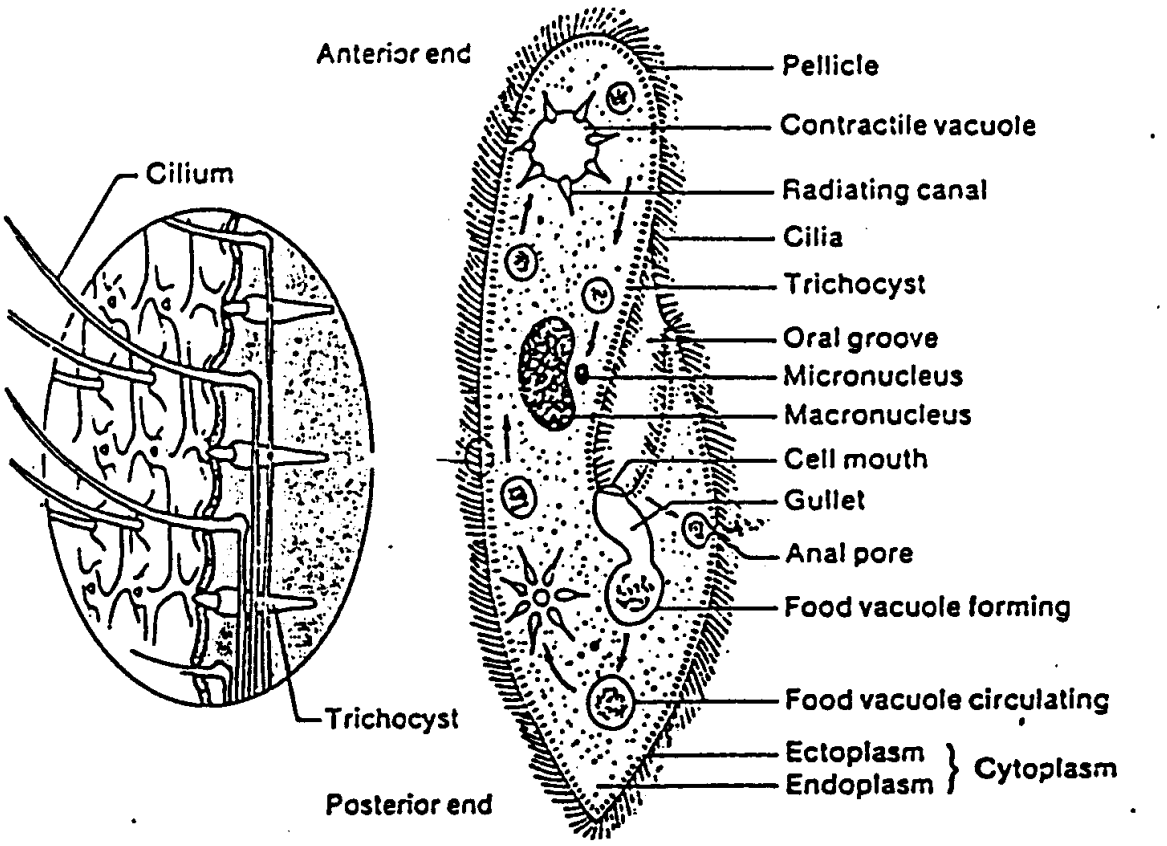
This is the simplest bit of living matter that can exist independently. A cell is a living unit because it displays the characteristics of living things. They range from extremely small bacteria cells (1mm) which can only be seen through a strong or powerful microscope, to a large yolk of an ostrich egg (100mm).

FORMS IN WHICH CELLS EXIST

Living cells exist in different forms; some as independent organisms, some in colonies, some in filaments while others are part of living organisms.

1. Cell as an independent organism:
   Organisms such as amoeba, paramecium, euglena, chlamydomonas consist of only one cell (unicellular organisms).

STRUCTURE OF PARAMECIUM



a. Structure: It is a unicellular organism visible with a light microscope. It's size is about 0.15mm-0.3mm. The shape resembles that of a slipper.
b. Habitat: It is found in muddy ponds and stagnant water containing decayed organisms.
c. Locomotion: Paramecium moves by means of cilia(ciliary movement) which occus on the surface of the body.
d. Feeding: It feeds on microscopic organisms such as bacteria and other protozoa. As the cilia in the oral groove beats, food particles are carried towards the gullet. Cilia in the gullet move in such a way that the food particles are carried to the bottom of the gullet.
e. Respiration: Oxygen dissolved in water is used by paramecium and it brings out carbondioxide.
f. Excretion: Carbondioxide and nitrogenous waste products are passed out by diffusion through the entire body surface into the surface of the surrounding water.

2. Living cells as a colony:
   Some organisms are made up of many similar cells which are joined together but can be differentiated from each other. This aggregation of similar cells is called the colony. Typical examples are volvox, pandorina and sponges.

STRUCTURE OF VOLVOX

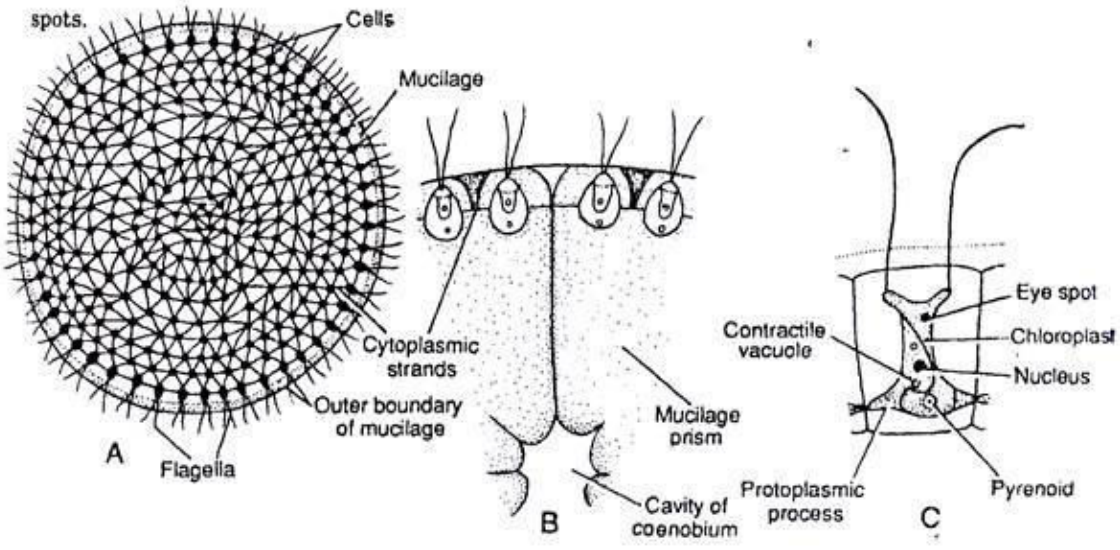
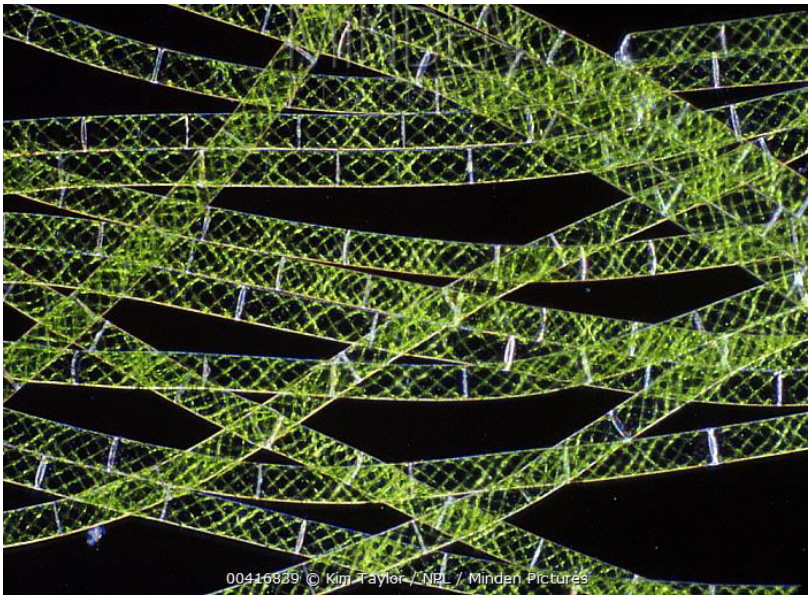


Fig. 1. (A-C) *Volvox*. A. A colony; B. A part of colony; C. Single cell.

3. Living cells as filaments:
   Some cells are organised into filaments in which identical cells are joined from end to end to form unbranched filaments. Each cell functions as an independent cell. Examples are oedogonium and spirogyra.



CELL THEORY

In 1665, an English scientist called ROBERT HOOKE designed one of the earliest light microscope with which he eaxmined a thin section of the cork of an oak tree.He discovered many empty spaces surrounded by walls. He called these empty spaces ‘cell’ (from the latin word cella which means small room). He later examined plant parts saw that the cells were filled with juice-like structure.

In 1835, a french biologist FELIX DUJARDIN discovered that the cells were made up of living substances which he named protoplasm.

In 1838, a german botanist named MATTHIAS SCLEIDEN revealed that the body of all plants are made up of cells which he described as a unit of life.
In 1839, a german zoologist THEODORE SCHWANN discovered that all animals are made up of cells.
In 1859, another german biologist RUDOLF VIRCHOW concluded that all cells come from pre-existing cells.

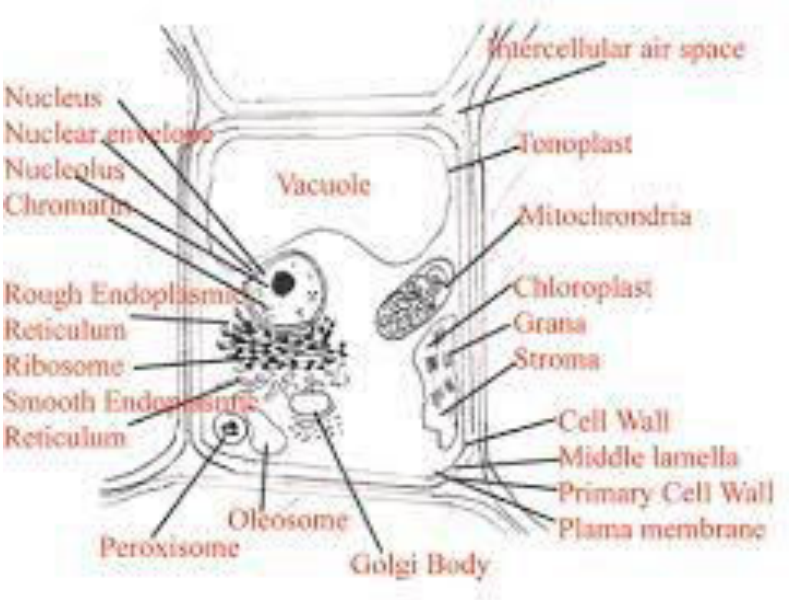
In the past centuries, scientists have established that cells contain materials through which information is passed from one generation to the next. The cell theory states that:

1. The cell is the structural and functional unit of all living things.
2. All cells come from pre-existing cells.
3. Cells contain information needed for their development and working of the hereditary materials.
4. All living organisms are composed of one or more cells.

STRUCTURE OF PLANT CELL AND ANIMAL CELL

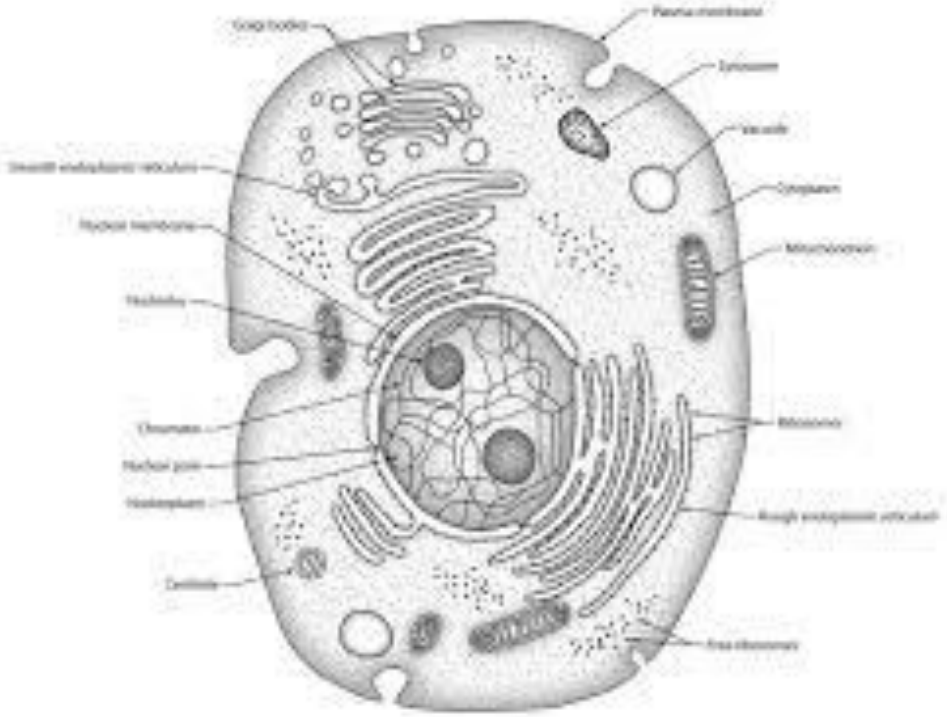
The structure of both plant and animal cell can be seen under a microscope. Each cell is bounded by a membrane and it is composed of a protoplasmwhich can be further divided into cytoplasm and nucleus. The cytoplasm is a fluid-filled material that consists of lysosome, golgi bodies, mitochondrion, endoplasmic recticulum, vacuole etc. The nucleus is bounded by a nuclear membrane and it is made up of chromosomes and nucleolus.

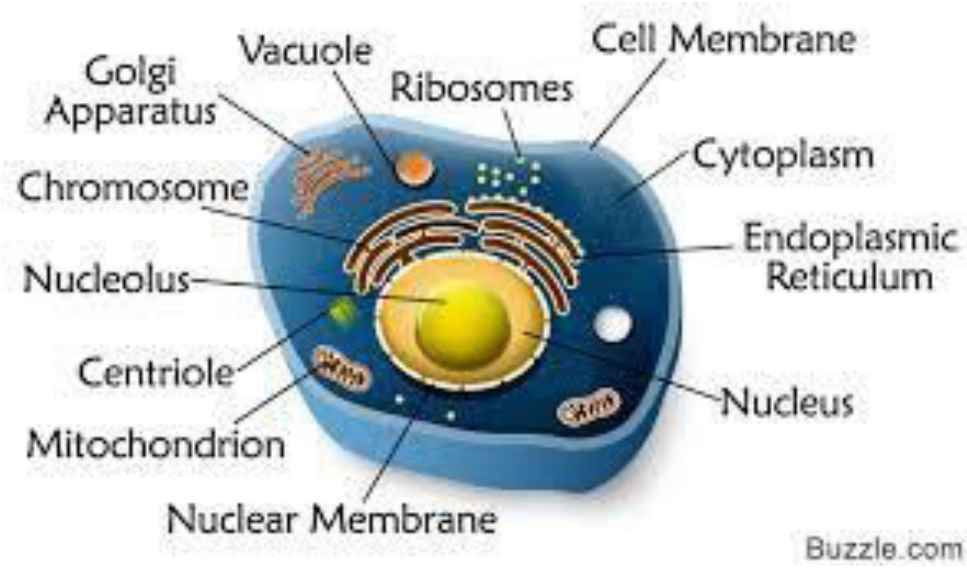
ASSIGNMENT: DRAW A WELL LABELLED STRUCTURE OF PLANT AND ANIMAL CELL



Anatomy of a plant cell

A Typical Animal Cell





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DIFFERENCES BETWEEN PLANT AND ANIMAL CELLS

PLANT CELL	**ANIMAL CELL**
1. Presence of chloroplast	Absence of chloroplast
2. Definite rectangular shape	Irregular or spherical shape
3. Presence of rgid cellulose cell wall	Absence of rigid cellulose cell wall
4. Large but few vacuoles	Small but numerous vacuoles
5. Nucleus is at the edge of the cytoplasm	Nucleus is centralised
6. Absence of centrioles	Presence of centrioles

CELL COMPONENTS AND THEIR FUNCTIONS

CELL COMPONENT	**FUNCTIONS**
1. Cell membrane	i.It selects absorption of materials into the cell ii.It protects the cell and its components
2. Cell wall	i.It allows free passage of nutrients in and out of the cell ii.It provides shape and mechanical support for the cell
3. Ribosomes	It is responsible for protein synthesis
4. Lysosomes	This is the site for respiratory enzymes
5. Chloroplast	i.It contains chlorophyll for photosynthesis

	ii. It is the site for sugar synthesis
6. Golgi bodies	Functions in the synthesis packaging and distribution of materials
7. Endoplasmic recticulum	It aids transport of materials within the cytoplasm
8. Mitochondrion	i.It is the site for cellular respiration and release of energy ii. It is known as the power house of the cell because it helps to release energy for all cellular activities
9. Nucleus	i.It controls all life activities of the cell ii. It stores hereditary information because it contains DNA(deoxyribonucleic acids) inside the chromosomes
10. Nuceolus	It produces ribosomes for protein synthesis

SIMILARITIES BETWEEN PLANT AND ANIMAL CELLS

1. They both have nucleus
2. They both have golgi bodies for packaging and distribution of materials
3. They have chromosomes which contain DNA.
4. They both have have ribosomes
5. They both have cell membrane
6. They both have lysosomes and endoplasmic recticulum
7. They both have mitochondrion

THE CELL AND ITS ENVIRONMENT

DIFFUSION

This is the process by which molecules or ions of a substance move from a region of high concentration to a region of low concentration until they are evenly distributed. This substance may be solid, liquid or gas.

Factors affecting the rate of Diffusion

1. State of matter
2. The size of molecules being distributed
3. Difference in concentration of both regions
4. Temperature

EXPERIMENT TO DEMONSTRATE DIFFUSION

AIM: To demonstrate the diffusion of potassium permanganate crystals ($KMnO_4$) in water.

APPARATUS: A glass beaker, spatula, petri dish,white tile, water, potassium permanganate crystals.

METHOD:

i. Take a beaker and fill it with distilled water

ii.Use a spatula to deliver some quantity of potassium permanganate crystals ($KMnO_4$) at the bottom of the beaker and leave it to stand for few minutes.

OBSERVATION: The purple colour of the $KMnO_4$ starts to spread itself outside. Eventually, the colour spreads evenly throughout the water medium so that the water has the same shade of the purple colour.

Life processes that involve diffusion

1. Exchange of gases between organism and its environment such as during respiration
2. Movement of gases in plants during photosynthesis
3. Mineral uptake by plant roots
4. Transfer of digested food fron the intestine into tissue, fluids and cells.
5. Removal of excretory products in unicellular organism
6. Exchange of nutrients and metabolic products between the foetus and pregnant mother through the placenta.

OSMOSIS

This is the flow of water or solvent molecules from a region of lower concentration or weaker solution to a region of concentrated solution or stronger solution through a semi permeable membrane. The environment of an organism is classified as follows:

i. Hypotonic solution
ii. Hypertonic solution
iii. Isotonic solution

Hypotonic solution: This occurs when the solution of the surrounding medium of the cell is weaker than that of the medium within the cell.This will cause the cell to swell until it eventually bursts.

Hypertonic solution: This occurs when the solution of the surrounding medium is stronger within the cell and water moves out to dilute the environment and the cell continues to shrink.

Isotonic solution: This is when the surrounding medium has the same concentration with the cell and there is no movement of water in and out of the cell.

Processes in which osmosis occurs

1. Entering of water from the soil into the root hairs
2. Movement of water from one living cell to another
3. Re-absorption of water back into the kidney tubules

PLASMOLYSIS

When a living cell is placed in a hypertonic solution, water leaves the cell vacuoles and enters the stronger solution. The cell vacuoles and the protoplasm shrink away from the cell wall. It is said to be plasmolysed. If plasmolysis process continues, the cell membrane will tear and this results in permanent damage and eventual death of the plant.

HAEMOLYSIS

Haemolysis is defined as the process by which red blood cells become splitted or burst as a result of too much water passing into it. This situation will occur when a red blood cell is placed in a weaker or hypotonic solution where the red blood cell takes in water and becomes swollen (turgid) and eventually burst.

TURGIDITY

Turgidity is defined as the condition in which cells absorb plenty of water up to a point where the cell is fully stretched. At this point, the cell is said to be turgid. Turgidity occurs when a cell is placed in hypotonic solution (distilled water)as a result of the fact that the cytoplasmic solution is stronger than the water, the cell absorbs water and becomes turgid.

Turgidity is useful to the plant because it makes them stand erect, gives support to the plant stem, leaves, flowers and guard cells.

ASSIGNMENT:

1. Give 3 differences between plasmolysis and haemolysis
2. Give 3 differences between diffusion and osmosis.

PROPERTIES AND FUNCTIONS OF CELLS

RESPIRATION

This is the process by which food is broken down to release energy. Respiration is also the process whereby oxygen taken in breaks down part of the digested food to produce carbon(iv) oxide, water vapour and energy which is in form of ATP. Respiration takes place in the mitochondria of cells. The energy released is stored as ATP.

..\..\Videos\Cellular respiration-Science Animated Video.mp4

Respiration is divided into 2 namely:

1. External respiration (Gaseous exchange): This is the process whereby oxygen enters into the living organism. It occurs throughout the body in some organisms while in some other organisms, it occurs in specialised organs like the trachea, the gills, the lungs etc.
2. Internal respiration: This is the process in which sugar is broken down by series of enzyme-control reactions to release energy. Internal respiration may be of two types:
   i. Aerobic respiration
   ii. Anaerobic respiration

AEROBIC RESPIRATION is the type of respiration in which food substances are broken in the presence of oxygen to release large amount of energy. The overall reaction of aerobic respiration is as follows:

$$C_6H_{12}O_6 + 6O_2 >>>>> 6CO_2 + 6H_2O + ENERGY$$

ANAEROBIC RESPIRATION is the breakdown of food substances in the absenceof oxygen to release little amount of energy. This respiration is the partial breakdown of food substances. Alcohol and carbon (iv) oxide are produced while little amount of energy is released. The reaction is:

$$C_6H_{12}O_6 >>>>>> 2C_2H_5OH + 2CO_2 + ENERGY$$

A form of anaerobic respiration is alcohol fermentation. The process of respiration is similar in both plants and animals but the difference is the mechanism of gaseous exchange.

IMPORTANCE OF ANAEROBIC RESPIRATION

1. Yeast is used for fermenting during the process of producing alcohol and in baking industries
2. Certain bacteria that are present in grapes and other fruits change wine into vinegar.

IMPORTANCE OF RESPIRATION

1. It may be used as chemical energy for metabolism in living cells which keep the organism alive.
2. For the active transport of materials in plants e.g. absorption of mineral from the soil.
3. As mechanical energy for muscular contraction and reproduction in animals

4. As heat energy to keep the body warm and maintain a constant body temperature (Homeostasis) in mammals.
5. As sound energy for the production of voice in mammals and also for croaking in toads and frogs
6. As light energy in organisms that naturally emit their own light e.g. fire flies.

DIFFERENCES BETWEEN AEROBIC AND ANAEROBIC RESPIRATION

AEROBIC RESPIRATION	ANAEROBIC RESPIRATION
1. Oxygen is needed for this process	No oxygen is required
2. Simple sugars are broken down completely	Simple sugars are partially broken down
3. Energy is released in large amounts	Little energy is released
4. Carbon (iv) oxide, water and large amounts of energy are released during the process	Alcohol, carbon (iv) oxide and little amount of energy is released during the process
5. It is common in large multicellular organisms	It is common in unicellular microscopic organisms

NUTRITION

Nutrition is the series of processes by which living organsims obtain food substances and use them to provide energy and materials for their growth, activities and reproduction.

MODES OF NUTRITION

Plants may be able to obtain raw materials and prepare their own organic food or can be dependent on others (dead or living) for the same. They are respectively known as autotrophic (autos = self, trophien = to nourish) and heterotrophic (heteros - other, trophien - to nourish).

AUTOTROPHIC NUTRITION

Autotrophs synthesize organic materials from inorganic materials. Some organisms derive their energy for this process from sunlight and are called photoautotrophs. Example: Green plants

Other organisms use chemical energy and are called chemoautotrophs. Example: Nitrifying bacteria. Photoautotrophs are the primary producers in food chains.

HETEROTROPHIC NUTRITION

Heterotrophs eat ready - made complex organic food. From this they obtain energy for metabolism, atoms and molecules to build new protoplasm or repair worn - out parts, and ions, co-enzymes and vitamins vital for chemical processes. The types of heterotrophic nutrition include – holozoic, saprophytic, parasitic, symbiotic (mutualistic) and carnivorous (insectivorous) plants.

A. HOLOZOIC NUTRITION:

Most animals are holozoic and thus ingest complex organic food. They either feed solely on plants (*herbivores*), flesh (*carnivores*) or both (*omnivores*). Carnivores that hunt other living animals (*prey*) for food are known as *predators, while scavengers* are those that feed only on dead animals.

B. SAPROPHYTIC NUTRITION:(sapros - rotten phyton - plant)

Saprophytes are decomposers and liberate energy for their own use by breaking down complex organic matter from the dead bodies of other organisms. At the same time this process releases vital chemical elements into the soil which are absorbed by autotrophs. Thus saprotrophs aid the recycling of materials from dead organisms to living ones. Fungal and bacterial saprotrophs are referred to as saprophyte, while animal saprotrophs are called saprozoites.

Mucor hiemalis is a saprophyte and has their branched hyphae, providing a large absorptive surface. These penetrate dead, decaying matter and secrete enzymes into it. The food is digested extracellularly and is subsequently absorbed and transported to other parts of the fungal mycelium.

C. PARASITIC NUTRITION:

Parasites are organisms that live in or on other living organisms (called the host) generally receiving shelter and deriving nutrients from it. The parasites may cause harm to the host plant. Those that stay on their host are called *ectoparasites* while those that live within their host are called *endoparasites. Parasites include viruses, bacteria and fungi* that cause disease to animals and plants.

HOME WORK: find out and make a list of 5 animal and plant parasites.

D. SYMBIOTIC OR MUTUALISTIC NUTRITION:

This involves 2 organisms that live together and benefit from each other. Examples are termites and the protozoa living in their gut. The protozoa receive protection and food. Termites feed on wood (composed of cellulose) which they are not able to digest. The protozoa help them to digest it. (On your own, study other examples of mutualism).

E. INSECTIVOROUS PLANTS:

Insectivorous plants are autotrophic but obtain organic matter and animal nitrogen from insects, however not bigger than the size of a grasshopper. There are about 450 species of insectivorous plants. These plants have special devices or structural adaptation for trapping and digesting insects and other small organisms. Examples include: pitcher plants, bladderwort, sundew, and Venus flytrap.

PLANT NUTRITION: Photosynthesis

Photosynthesis is derived from the Greek*[photo-]*, "light," and *[synthesis]*, "putting together", "composition"). It is a process used by plants and other organisms to convert the light energy captured from the sun into chemical energy that can be used to fuel the organism's activities. Photosynthesis occurs in plants, algae, and many species of bacteria. Photosynthetic organisms are called *photoautotrophs*, since they can create their own food. Photosynthesis uses carbon dioxide and water, releasing oxygen as a waste product. Photosynthesis is vital for all aerobic life on Earth. In addition to maintaining normal levels of oxygen in the atmosphere, photosynthesis is the source of energy for nearly all life on earth, either directly, through primary production, or indirectly, as the ultimate source of the energy in their food, the exceptions being chemoautotrophs that live in rocks or around deep sea hydrothermal vents. As well as energy, photosynthesis is also the source of the carbon in all the organic compounds within organisms' bodies.

$$\underset{\text{Carbon dioxide}}{6CO_2} + \underset{\text{Water}}{6H_2O} \xrightarrow{\text{Light}} \underset{\text{Sugar}}{C_6H_{12}O_6} + \underset{\text{Oxygen}}{6O_2}$$

The process always begins when energy from light is absorbed by chlorophylls. Some of the light energy gathered by chlorophylls is stored in the form of adenosine triphosphate (ATP). The rest of the energy is used to remove electrons from a substance such as water. These electrons are then used in the reactions that turn carbon dioxide into organic compounds. Photosynthesis comprises of 2 stages: light and dark stages.

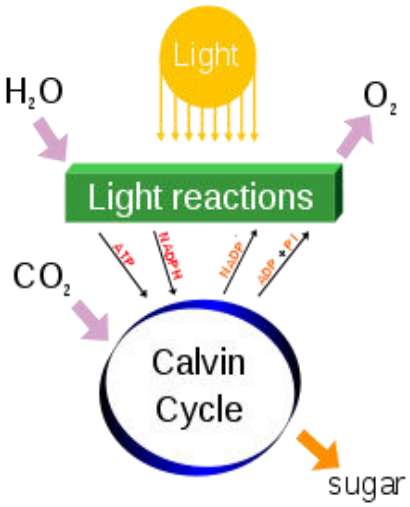
Light reactions

In the light reactions, sunlight changes into chemical energy, and splits water to liberate O_2. This chemical reaction must, therefore, take place in the light and is known as photolysis. It releases hydrogen to be used in the dark reactions.

$2\ H_2O + 2\ NADP^+ + 3\ ADP + 3\ P_i + \text{light} \rightarrow 2\ NADPH + 2\ H^+ + 3\ ATP + O_2$

Light-independent/dark reactions

The dark reaction takes place within the chloroplast, and converts CO_2 to sugar. This reaction doesn't directly need light in order to occur, but it does need the products of the light reaction. The dark reaction involves a cycle called the **Calvin cycle** in which CO_2 and energy from ATP are used to form sugar.



MATERIALS AND CONDITIONS NECESSARY FOR PHOTOSYNTHESIS

For photosynthesis to take place, certain materials and conditions must be available. These are:

i. Carbon (iv) oxide
iii. Water
iv. Chlorophyll
v. Sunlight
vi. Mineral salts
vii. Suitable temperature
viii. Enzymes

IMPORTANCE OF PHOTOSYNTHESIS TO LIFE

Animals and other heterotrophs can't make use of the sun's energy to manufacture their food. Therefore, all living

organisms depend driectly or indirectly on green plants for food. Photosynthesis also helps to purify the environment by removing carbondioxide from the atmosphere and adding oxygen to it.

ANIMAL NUTRITION

Nutrition in animals means the sum total of the processes invloved in the intake, digestion, absorption and utilization of food.

Food is any substance which when eaten, serves as a form of energy or is used to build the body or for growth.

CLASSES OF FOOD

Food is classified on the basis of their chemical composition into:

1. CARBOHYDRATES: These are made up of carbn, hydrogen and oxygen. They are composed of sugars which are either of 3 types;
   i. Monosaccharides (simple sugars): Examples are glucose, fructose and galactose. They have general structure of $C_6H_{12}O_6$. It sources are orange, grape, apples e.t.c.
   ii. Disaccharides (Reducing sugars): They are made up of 2 simple sugars combined together.They have a general formular of $C_{12}H_{22}O_{11}$. Examples are sucrose (sugar cane), maltose (malt) and lactose (milk).
   iii. Polysaccharides (complex sugars): These are made up of 3 or more simple sugar molecules combined together. Examples of these are starch, cellulose, glycogen, chitin e.t.c.
2. PROTEINS: These contain nitrogen, carbon, hydrogen and oxygen. They are the body building food substances used for growth and repair of worn out tissues. Sources of protein include fish, egg, beans.
3. FATS AND OIL: They are known as lipids. They have high proportion of carbon and hydrogen but very little oxygen. Fats are solids at room temperature while oils are liquid at room temperature. They provide the body with energy. Also, they are stored in organs like the kidney and under the skin surface where they act as insulators to reduce heat from the body.
4. VITAMINS: These are food substances which are required by the body in very small amount. They protect the body from diseases. Vitamin A, D, E and K are fat soluble while vitamin B and C are water soluble.
5. MINERALS: They regulate the metabolism of the body. E.g. calcium, potassium and hydrogen which are required in fairly large amounts while others like iron are only needed in small amount.
6. WATER: About 70% of the body is made up of water. Water is essential for various body functions such as digestion, build up of blood cells, for metabolic reactions e.t.c.
7. ROUGHAGES: This is an indigestible fibrous material derived from vegetables, fruits, carbohydrates and proteins. It aids easy movement in the bowels. Lack of roughages in the diet causes constipation.

BALANCED DIET

Balanced diet is a diet that contains all the seven classes of food in the correct proprotion. A diet which is balanced for one individual may not be balanced for the other because the nutrients required by each individual varies according to the following:

1. Age: Growing children need more food than the adults
2. Sex: Men need more energy rich foods than women because they produce more heat compared to women of the same size. This ia because they have less fatty tissues in their body, so they can’t prevent heat loss as efficiently as women.
3. Occupational activity: A person whose occupation requires a lot of physical work requires more energy rich food.
4. Physiological state: Pregnant women or lactating mothers need more food than normal adults for proper growth and development of the foetus. Also, sick people require a healthier diet than healthy people.

ASSIGNMENT: DRAW A TABLE SHOWING TEN (10) MINERALS REQUIRED BY HUMANS, THEIR FUNCTIONS, DEFICIENCY SYMPTOMS AND SOURCES.

ENZYMES.

Enzymes are biological molecules(catalysts) that speed up the rate of reactions. Catalysts are substances that increase the rate of chemical reactions without being used up.

CHARACTERISTICS OF ENZYMES

1. They are soluble.
2. They are proteins. Some enzymes require certain non-proteins called co-enzymes to activate them.
3. They are specific in their actions.
4. They are organic catalysts.
5. They are sensitive to high temperature. Note that heat denature enzymes (proteins generally).
6. They are sensitive to the acidity or alkalinity of their environment. While some require acidic media, some work better in alkaline or even a neutral media.
7. They can be inactivated (inhibited) by inhibitors such as cyanide and mercury.
8. Many enzymes bring about reversible reactions.

Enzymes are classified according to the type of reactions they take part in.

IRRITABILITY

This is the ability of the cell to detect and respond to external stimuli.

TYPES OF RESPONSES

1. TACTIC MOVEMENT (TAXIS): This is the locomotory movement of an organism or cell in response to directional stimulus. It occurs in plants and animals. In animals, the whole organism moves in response to the stimuli while plants move only a part. Examples of such external stimulus are light, temperature, water etc. Examples of tactic movement are:

STIMULUS	NAME OF RESPONSES	EXAMPLES
1. Light	Phototaxis	Euglena and Chlamydomonas swim towards light of low intensity (positive

		phototaxis) and away from light of high intensity
2. Chemicals	Chemotaxis	In a moss plant, their sperms swim towards the chemical by the egg cell (positive chemotaxis)
3. Temperature	Thermotaxis	Motile bacteria move from cold regions to hot region

2. Tropic movement: This is a directional movement of some parts of an organism in response to directional stimulus. Theyare very slow growth movement.The direction of the response is related to that of the stimulus and it is positive if the plant part grows towards the stimulus and negative if the plant grows away from it. Tropism movements are named according to the stimuli for example; Phototropism is a response to light while hydrotrpism is a response to water.

Examples of tropic movement (tropism)

Stimulus	Name of Response	Examples
i. Light	Phototropism	Shoots of green plants bend towards light (positively phototropic) while roots move away from it (negatively phototropic)
ii. Gravity	Geotropism	Shoots of green plants bend away from gravity (negatively geotropic) while roots bebd towards it (positively geotropic).
iii. Water	Hydrotropism	Shoots of green plants are negatively hydrotropic while roots of green plants are positively hydrotropic.

3. Nastic Movement (Nastism): This is a non-directional movement made by parts of a stationery plant in response to changes such as light intensity, temperature, humidity etc. Examples are found in:-

i. Closing of the morning glory flower when the light intensity is low.

ii. Folding of the leaves by Mimosapudica when touched.

Environmental Factors that Affect Responses

1. Light: Response to light is called phototropism.
2. Temperature
3. Water
4. Gravity

GROWTH

Growth is an irreversible and permanent increase in an organism. In unicellular organisms, growth is marked by an increase in the number of individuals while in multicellular organisms, it is marked by an increase in the number of cells. When these cells get nourished, they enlarge and differentiate into tissues, showing an increase in size, length and mass.

Process of Growth

1. Cell division (Mitosis)
2. Cell enlargement
3. Cell differentiation.

Unlike animals in which growth takes place in every parts of their bodies, plant growth is restricted to specific parts of the plants; the tips and apex.

GROWTH HORMONES

Hormones are chemical substances secreted into the blood stream for the coordination of the various biochemical activities (e.g. growth, responses) in the body of an organism. Hormones are produced in both plants and animals.

The growth hormones in animals are:

1. Thyroxine which is produced in the thyroid gland and is found in the neck
2. Pituitary gland (also known as the master gland)

In plants, the growth hormones are: auxins, gibberellin and cytokinin.

FACTORS THAT INFLUENCE GROWTH IN ANIMALS

1. Food
2. Vitamins
3. Growth hormones
4. Heredity

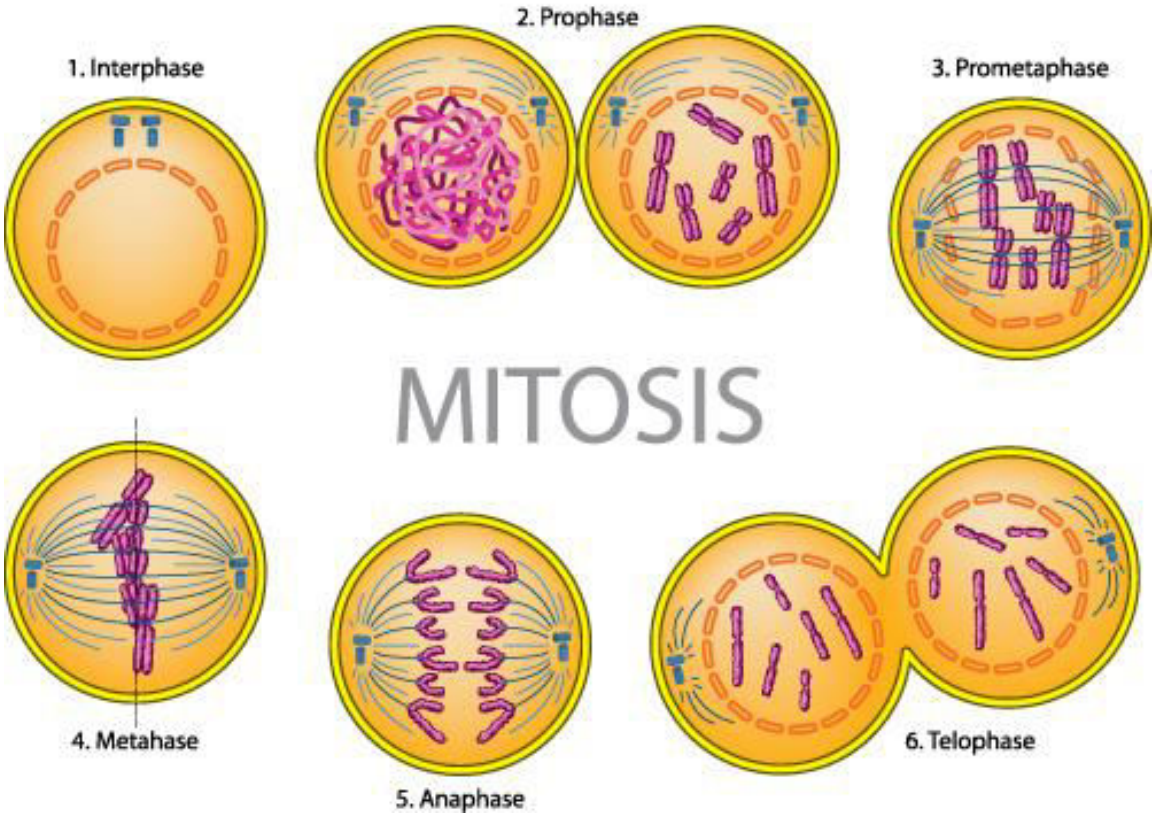
FACTORS THAT INFLUENCE GROWTH IN PLANTS

1. Heredity
2. Growth hormones
3. Sunlight
4. Temperature
5. Oxygen
6. Moisture
7. Wind
8. Chemicals
9. Soil organisms.

CELL GROWTH (MITOSIS)

Mitosis takes place in somatic cells (all cells of the body apart from the reproductive cells). It also occurs during cell growth, development and asexual reproduction. It is a division following the duplication of chromosomes whereby each daughter cell is exactly the same number of chromosomes as the parent cell.

STAGES OF MITOSIS



1. INTERPHASE: This is the resting stage of the cell, the phase between 2 mitotic stages. At this stage, the chromosomes are not visible.
2. PROPHASE: In early prophase; (i) the nucleolus disappears (ii) the nuclear membrane disintegrate (iii) the chromosomes live freely in the cytoplasm of the cell. In late prophase; The chromosomes become very visible. They are seen to be composed of a pair of chromatids joined together at the centromere.
3. METAPHASE: Here, (i) The spindle fibre appears (ii) the chromosomes lie at the equator attached to the spindle fibre at the centromere.
4. ANAPHASE: (I) Sister chromatids are pulled apart to opposite sides of the pole by the spindle fibres (ii) The chromosome number doubles.
5. TELOPHASE: This is a reverse of prophase. (i) Chromosomes end their movement towards the pole (ii) Chromosomes begin to uncoil and elongate (iii) Spindle fibres disappear (iv) Nucleolus re-appear and nucleaar membrane begin to form around the chromosomes (v) Two daughter cells are formed each with the same number of chromosomes as the parent cell.

Sexual reproduction in cells is known as MEIOSIS. This is two successive cell division with only one duplication of chromosomes to produce 4 daughter cells. Each of the daughter cells contain half of the chromosome number in the parent cell. Meiosis takes place in the ovules and pollen grain of flowering plants and in the ovaries and testes of animals.

IMPORTANCE OF MITOSIS

1. Growth, development or specialization takes place as a result of mitosis
2. Repair of cells are possilble through mitosis
3. Mitosis ensures that exact copy of genes are transmitted to daughter cell, thus, ensuring consistency of DNA configuration
4. Mitosis is the basis of asexual reproduction
5. It produces red blood and white blood cells in the bone marrow.

IMPORTANCE OF MEIOSIS

1. It aids formation of sperms/male gamete in animals
2. It aids formation of ova(eggs)/ female gametes in animals
3. It aids formation of pollen grains in anthers of flowering plants
4. It aids formation of ovules in ovary of flowering plants
5. It aids the formation of zygote in the womb of female animals by splitting the fertilized ova.

ASSIGNMENT: WRITE 7 DIFFERENCES BETWEEN MITOSIS AND MEIOSIS.

REPRODUCTION

This is the process by which living organisms give rise to young ones of the same specie. This leads to increase in the population and ensures continual existence of the specie.

FORMS OF REPRODUCTION

1. Sexual reproduction
2. Asexual reproduction

Sexual reproduction is characterised by the fusion of the sex cell of two parents while in asexual reproduction, sex cells are not formed i.e. only one parent is involved.

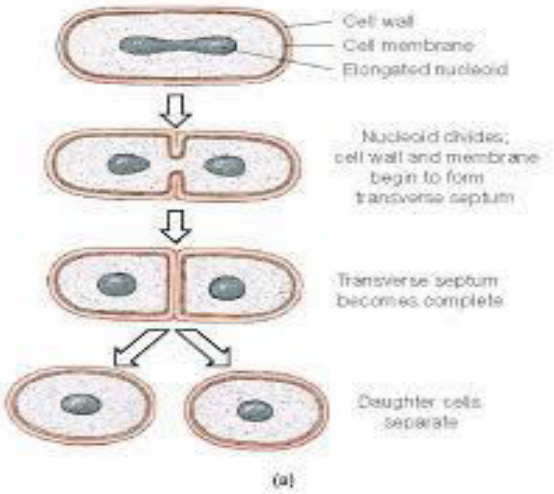
DIFFERENCES BETWEEN SEXUAL AND ASEXUAL REPRODUCTION

SEXUAL REPRODUCTION	ASEXUAL REPRODUCTION
1. Sex cells/ gametes are formed	Sex cell/ gametes are not formed
2. It involves 2 parents but occassionally one in the case of hermaphrodites (organisms that have both male have female sex organs)	It involves only one parent
3. It involves fusion of male and female gamete	Fusion does not occur

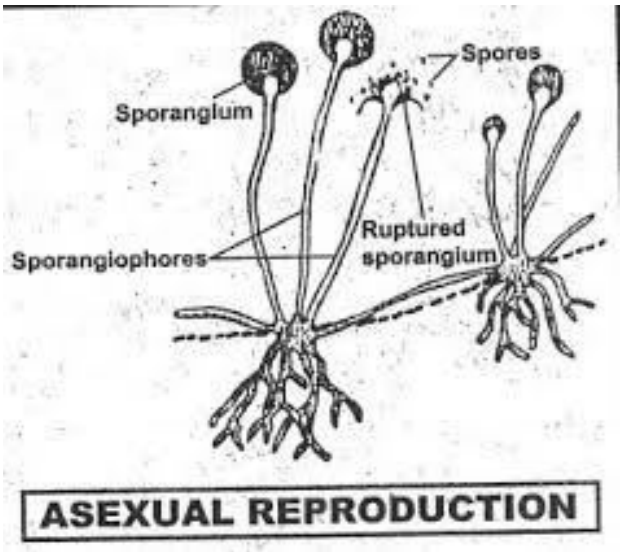
4. Zygote is formed	No zygote is formed

TYPES OF ASEXUAL REPRODUCTION

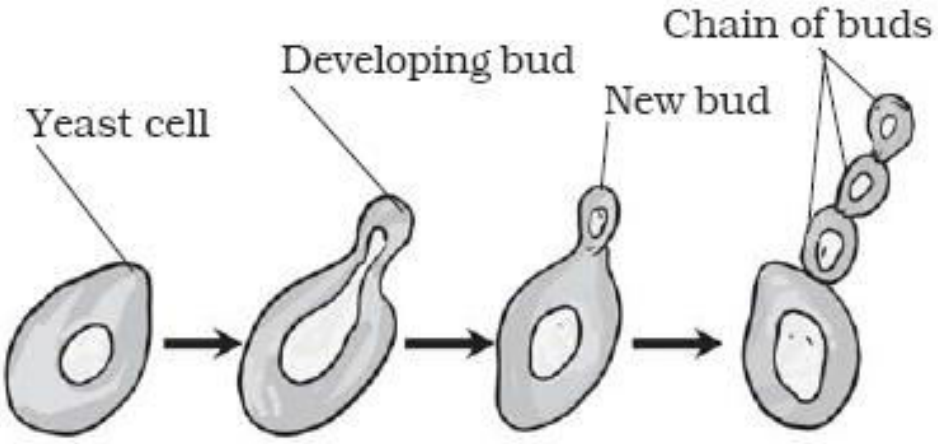
1. Binary fission: This is the division of cells into two parts with each half dveloping into a new individual. This is exhibited mostly by unicellular organisms e.g. amoeba, paramecium, bacteria, chlamydomonas e.t.c.



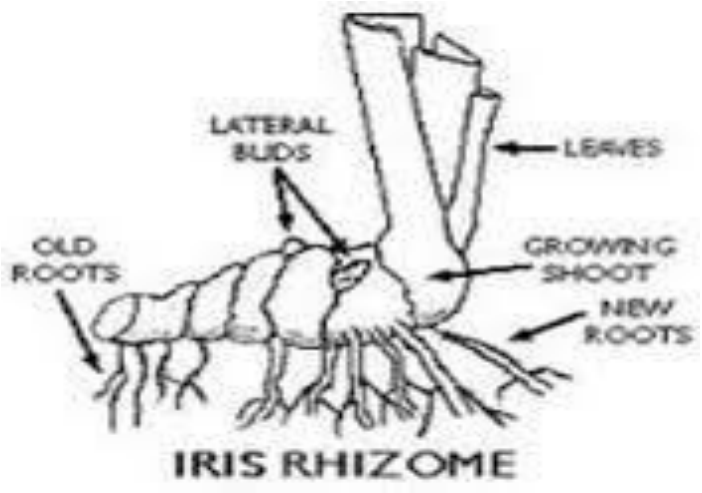
2. Fragmentation: Here, the parent plant breaks into many parts with each developing into a full organism. E.g. of this is spirogyra.
3. Spore formation: Spores are asexual reproductive bodies formed by certain lower organisms like Rhizopus (bread mould), mucour and ferns. They produce numerous spores in structures called sporangia.



4. Budding: In this, the parent organism forms a bud which then grows into a new organism from the parent. It only occurs in hydra and yeast.



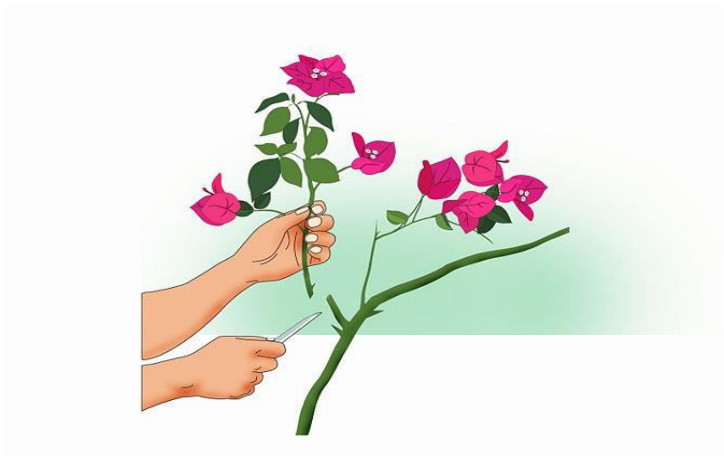
5. Vegetative propagation: This is the production of young ones from the vegetative parts of the plant such as root, stem, leaves e.t.c. Vegetative propagation can either be natural or artificial.
   Some natural means of vegetative propagation are:
   a. Underground stem: Here, buds from the node of stems give rise to new shoot and develop into a new plant e.g. rhizome in ginger and cocoyam, stem tuber in potatoes, suckers in banana and plantain.



   b. Creeping stems: These are stems that grow on the surface of the soil. E.g sweet potato.
   c. Underground shoots: This can be found in bulbs e.g. onion.

Artificial vegetative propagation involves the use of the intelligence of man to grow new plants from cut portion of the vegetative body of an older parent plant. This can be done by :

a. Cutting part of the plant into portions e.g. cassava, sugarcane, hibiscus, sweet potato.



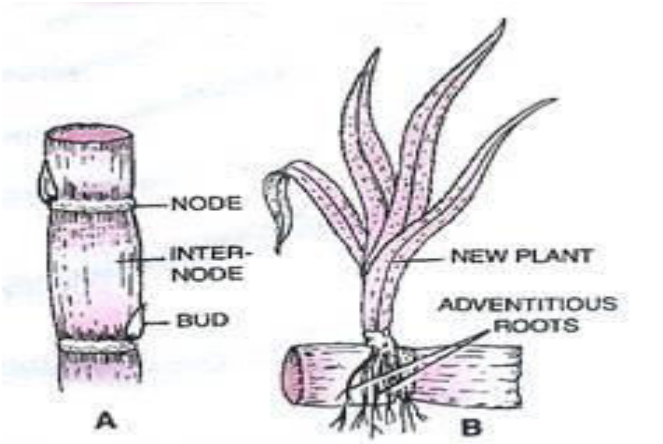


Fig. 1.21. A, a portion of sugarcane stem having buds. B, a bud growing into new plant.

b. Layering: This involves bending a branch that is growing near the ground so that one or two of its nodes could touch the ground. This node is then slitted and covered with soil. E.g. tomato, cocoa e.t.c.
c. Budding: This is similar to, but more technical than cutting. It involves cutting a bud from a matured branch. E.g. orange, cocoa, some flowers e.t.c.

Other means are grafting and marcotting.

ADVANTAGES OF VEGETATIVE PROPAGATION

1. Young plants use food reserves of the parent, thus, they are easily established.
2. Growth in this new plant is rapid as there is no resting period.
3. Only one parent is needed
4. Desirable characters are retained
5. Offsprings are identical to the parent.

DISADVANTAGES OF VEGETATIVE PROPAGATION

1. No new varieties of species are produced
2. There is no mixing of characters
3. It reduces resistane of plants to diseases.

SEXUAL REPRODUCTION

This involves the fusion of the male gametes and the female gametes to form a zygote which later develops int a young offspring. There are 2 main types of sexual reproduction; conjugation and fusion of gametes (fertilization).

CONJUGATION

This is a process in which nuclear material is passed from one cell to another. E.g. in mucour, rhizopus, paramecium and spirogyra.

FUSION OF GAMETES (FERTILIZATION)

Fusion of gametes is the union of the haploid male and female gametes to produce diploid organisms called ZYGOTE. This union is called fertilization. In higher animals, these gametes are formed in special organs called GONADS. The male gamete is called SPERM produced in the testes and the female gamete is called OVUM (plural;ova) or eggs produced in the ovary. In higher plants, the male gametes are the POLLEN GRAINS produced in the anther while the female gametes are the OVULES produced by the ovary.

ADVANTAGES OF SEXUAL REPRODUCTION

1. It permits new variety of organisms to be produced
2. It allows an organism to adapt to a changing/new environment
3. It enhances formation of new species of organisms
4. It allows for preservation of chromosome number from generation to generation.

BASIC ECOLOGICAL CONCEPTS

Ecology is formed from the greek word ''OIKOS'' meaning dwelling place or home. It is a branch of science that deals with the relationship between living organisms and their environment. Some ecological terms are:

1. Environment: This is the total surrounding of an organism.
2. Habitat: This is a place where an organism lives which is suitable for its way of life. It is the natural home of an organism. There are 3 main types; aquatic, teresstial and aboreal.
3. Ecological niche: This is the specific role an organism plays in its habitat.
4. Population: This is the combination of organisms of the same kind living together in the same habitat.
5. Community: Is made up of all the population of living organisms that exist together in a habitat
6. Biosphere: This includes the part of the atmosphere where lives can be found. It is made up of atmosphere, hydrosphere and lithosphere. It is also known as ecosphere.
7. Lithosphere: this is the solid portion of the earth, the putermost layer of the earthcrust.
8. Hydrosphere: this is the liquid or aquatic part of the earth. It makes up about 70% of the earth's crust. E.g. lake, pools, spring, ocean, rivers e.t.c.

ECOSYSTEM

An ecosystem is a self supporting unit that is made up of living and nonliving parts. Various ecosystems form the biosphere.

Components of an Ecosystem

1. Biotic factors (living things)
2. Abiotic factors (non living things)

The biotic component is composed of all the living organisms in an environment which is often called biotic community. It includes population of

a. Producers (green plants)
b. Consumers (heterotrophs)
c. Decomposers.

The non-living part of an ecosystem consists of abiotic resources and abiotic conditions

1. Abiotic resources: These are the things that organisms need in order to survive. They include sunlight, inorganic nutrients like carbondioxide, nitrogen, water and phosphate.
2. Abiotic conditions: These affect the behaviour, growth and breeding patners of organisms that are found in a particular ecosystem. They include; temperature, light, intensity, humidity, water current, wind, turbidity e.t.c.

BIOMES

These are large natural terrestial ecosystem. A biome is identified by its vegetation because plants form the bulk of the vegetation in any ecosystem and this is largely determined by climatic factors such as rainfall and temperature.

The local biomes of Nigeria are:

1. Tropical rainforest
2. Guinea savanna
3. Sudan savanna
4. Sahel savanna
5. Swamp/ Estuarine region
6. Desert

1. Tropical rainforest: This is found in states likeEdo, Delta, Imo, Ondo, Abia, Ogun, Rivers, Bayelsa, Akwa Ibom e.t.c. The characteristics are:

a. The vegetation is dense with tall trees havinghaving broad leaves
b. Trees have buttress roots and evergreen leaves
c. Trees form 3 layers/ strata. The top trees form a canopy that prevents sunliht from reaching the forest floor.
d. Annual rainfall is around 200 - 225 cm and evenly distributed throughout the year.
e. Epiphytes are common in this habitat.
f. Examples of rain forest animals are
g. Trees found in this habitat are

2. The characteristics of savanna zones are;

a. They record low amount of rainall
b. They a low relative humidity
c. They have long periods of dry season
d. They have tall grasses as their predominant vegetation

Stratification a Trophical Forest

BIOMES OF THE WORLD

1. Tropical rainforest: This is composed of many types of trees. Epiphytes and climbers are common featues of this forest. Rainfall is common here and the temperature is about 27^0c.
2. Temperate forest: This forest is mainly composed of broad-leaved decidous trees i.e. they shed their leaves during the winter. These forests are less dense than tropical forests, so that sunlight can penetrate into the forest enabling the growth of plants at many levels from the ground.
3. Corniferous forest: This is a forest of needle-leaved evergreen cornifers such as pines and firs. The forest has 2 layers; a dense layer of tall trees forming the upper storey and a layer of shrubs, ferns and mosses forming the lower storey. There is liight rainfall and snow here.
4. Temperate shrub land: this consists of drought resistant shrubs, aromatic plants and dwarf trees often fire resistant. This area has low rainfall.
5. Temperate grassland: this region consists of large streches of perennial grasses growing on very fertile soil. It supports herds of grazing mammals. The climate is moderately dry with cold winter and hot summer.
6. Afro-Alpine: This region consists of evergreen rainforest which occurs on the slope of mountains. The forests are less luxuriant than the tropical rainforest.

SCHEME OF WORK FOR THIRD TERM

WEEK 1	Basic ecological concepts: Local biomes in the world.
WEEK 2	Population; factors that affect popuation, measurement of ecological factors
WEEK 3	Ecological management; types of association, tolerance and adaptation.

WEEK 4 Functioning ecosystem; Role of autotrophs, heterotrophs and decomposers in the ecosystem. Trophic levels; food chain and food web.

WEEK 5 Energy transformation in nature; laws of thermodynamics, application of the laws to ecological phenomena (Energy flow along trophic levels, pyramid of energy, pyramid of biomass)

WEEK 6 Microorganisms around us; Definition, where they can be found and the groups of microorganisms.

WEEK 7 Mid term break.

WEEK 8 Practical session; Identification of microorganisms in air, pond water, our bodies and food.

WEEK 9 Microorganisms in action; growth of microorganisms, Economic importance

Diseases caused by microorganisms (symptoms, mode of transmission and control)

WEEK 10 Towards better health; control of harmful microorganisms, vectors (definition and ways of controlling them), roles of health organisations in maintaining good health (WHO, NMA, UNICEF, Red cross).

POPULATION STUDIES

Population is defined as a group of living things of the same specie which inhabit a defined area. In an ecosystem, many populations make up a community.

Population characteristics

1. Population size: This is the total number of individuals in a given popuation.
2. Population density: This is the average number of individuals of a specie per unit area of the habitat. To estimate the population size, Density= Population size/ Area of habitation
3. Frequency: This is the number of times a specie occurs at varying size in its habitat.
4. Distribution: This is the way in which individuals of a particular population are arranged in a given habitat

FACTORS AFFECTING POPULATION

1. Migration of organisms to other habitats
2. Invasion by new species
3. Increase/ decrease in birth rate and death rate.

All these factors operate during;

1. Seasonal climatic changes
2. Changes in food availability
3. Breeding periods
4. Unfavorable natural disasters.

CONDUCTION OF POPULATION STUDIES

To carry out population studies, small areas of the habitat are picked for investigations. This method is known as SAMPLING.

ECOLOGICAL FACTORS

These are divided majorly into 2; BIOTIC AND ABIOTIC FACTORS.

1. **ABIOTIC FACTORS**which includes;
   a. Climatic factors
   b. Edaphic factors

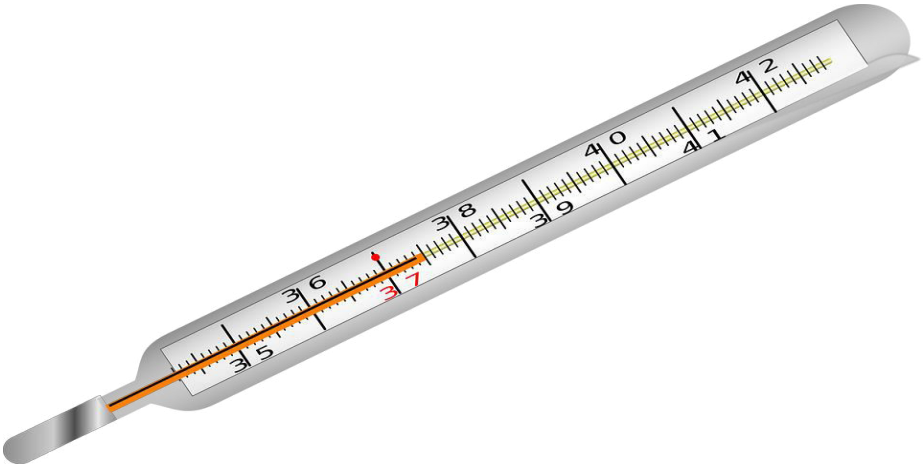
The climatic factors are made up of physical and chemical factors. Physical factors are temperature, rainfall, humidity, light intensity, wind and pressure. The chemical factors are oxygen content, water content and amount of mineral salts.

The Edaphic factors can be classified into topographic factors and soil condition. Topographic factors are altitude (the height of a place above sea level) and gradient (the degree of steepness/ slopiness of an area). Soil conditions or factors include soil texture, water content, air content, humus content, soil nutrients, types of soil, types of microorganisms, degree of acidity or alkalinity, organic content of the soil, soil profile e.t.c.

ECOLOGICAL INSTRUMENTS AND THEIR USES

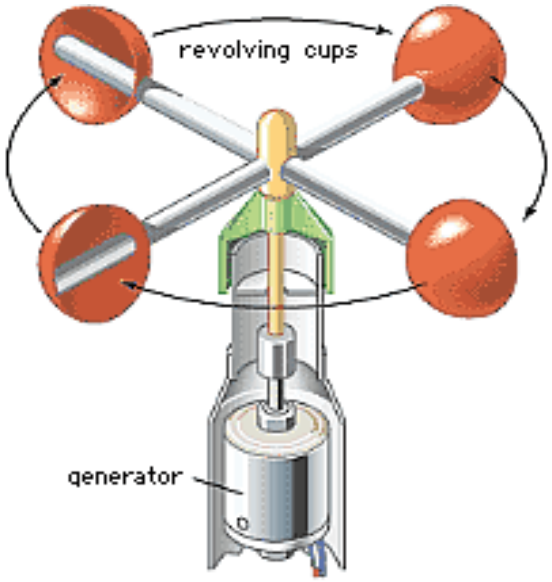
INSTRUMENT	USES
1. Thermometre	Measurement of temperature
2. Rainguage	Determining the amount of rainfall
3. Anemometre	Measurement of wind speed
4. Wind vane	Determining the direction of wind
5. Quadrant	Determining the population of plants and animals in a particular habitat
6. Insect net	For collecting flying insects
7. Photometre or light metre	Determining light intensity
8. pHindicator	Determining the acidity or alkalinity of a solution
9. Hygrometre	Determining the relative humidity of a place
10. Barometre	Determining the atmospheric pressure
11. Hydrometre	For determining water density
12. Secchi disk	For determining turbidity
13. Metre rule	For measuring depth, length and distance

SOME OF THE INSTRUMENTS



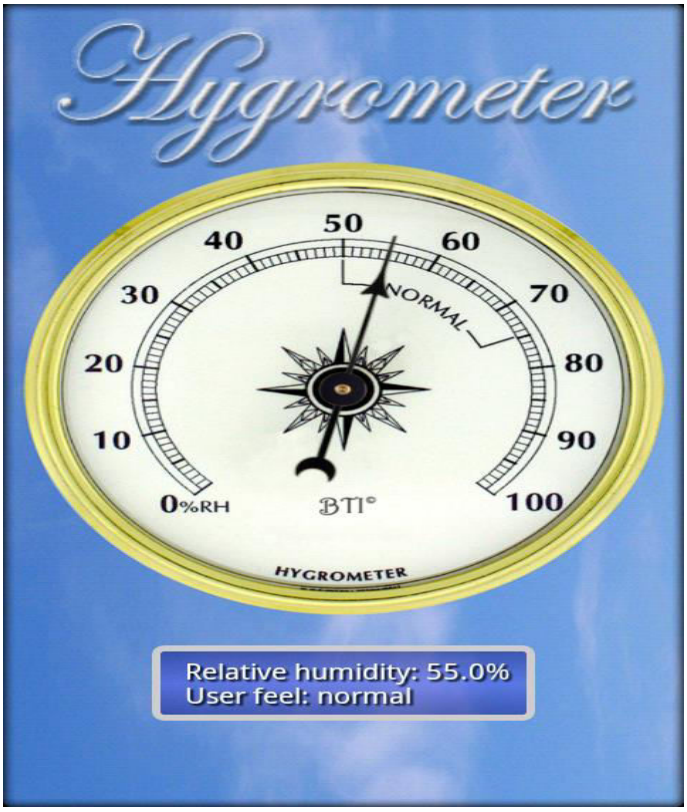
Thermometre

RAINGUAGE



Todays 4 Cup Anemometer

WIND VANE


Hygrometer
50
40
60
30
70
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90
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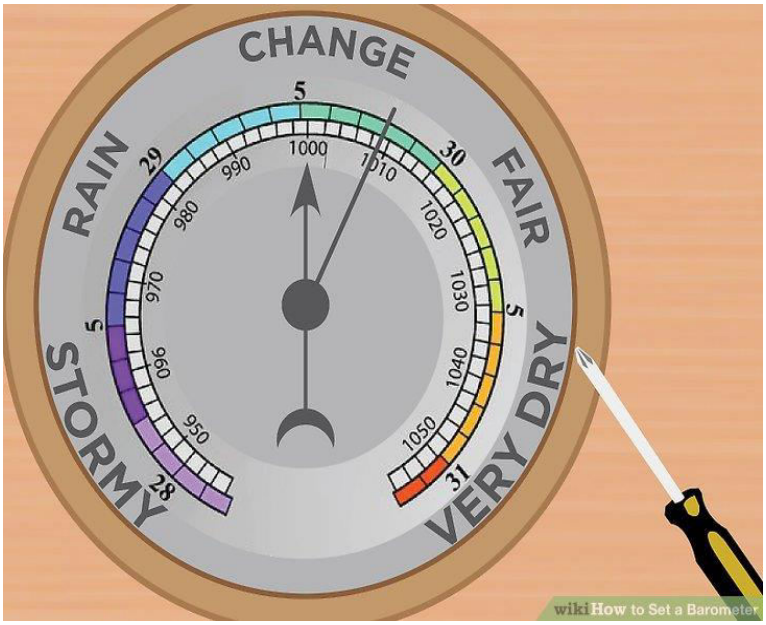
HYGROMETER
Relative humidity: 55.0%
User feel: normal


CHANGE
5
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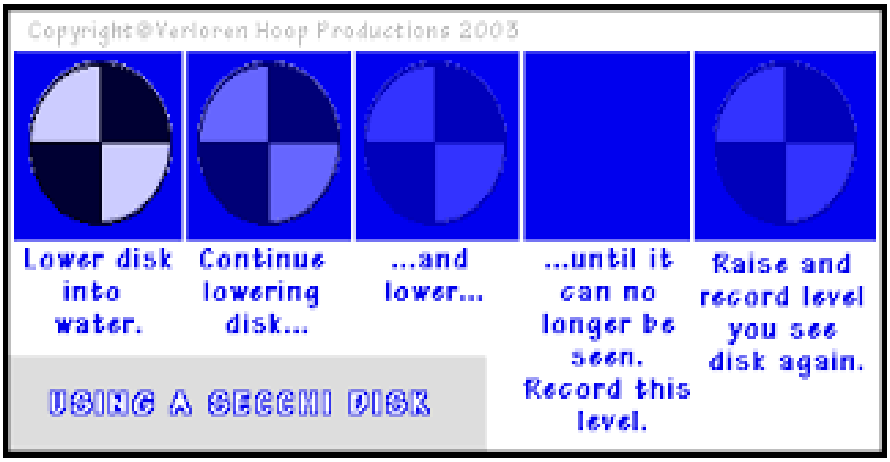
wikiHow to Set a Barometer

BAROMETRE



Secchi disk

2. **BIOTIC FACTORS**

Biotic factor is simply the activities of living organisms in a habitat. It is divided into plants and animals.

PLANT FACTORS

These are subdivided into green and non green plants. The green plants are the producers and they carry out photosynthesis. The non green plants are the bacteria and fungi. They carry out decomposition and the allow balance in nature.

ANIMAL FACTORS

These are subdivided into man and other animals. Animals use plants as food. Other effects of animals on plants are:

a. Direct destruction of vegetation
b. Destruction of vegetation through flood
c. Change of vegetation through overgrazing of animals such as cattle, cow e.t.c.
d. Transmission of plant diseases by animals such as millipede, insects, e.t.c.
e. Pollination of plants by insects and birds
f. Dispersal of seeds and fruits
g. Enrichment of soil fertility through animal droppings.

Man is the most powerful destroyer of the activities of the ecosystem by his engagement in activities such as:

a. Felling of trees
b. Farming
c. Bush burning
d. Civilisation and organisation

ECOLOGICAL FACTORS THAT AFFECT TERRESTIAL HABITAT

1. Topographic factor: This factor influences the distribution of plants and animals in a habitat e.g. the base of a mountain has a thick forest while high on the mountain, we have a sparse vegetation.
2. Edaphic factor: Soil texture influences the distribution of the population in a community. The type of vegetation determines the distribution of animals.
3. Relative humidity: This is the amount of water vapour in the atmosphere. Relative humidity influence the distribution of plants and animals.

ECOLOGICAL FACTORS THAT AFFECT AQUATIC HABITAT

1. Hydrogen ion concentration: Some survive in alkaline condition and are unable to survive in acidic conditions and vice versa.
2. Water current: This improves the temperature and transparency of the water. It also encourages air and nutrients circulation for aquatic organisms to float.

3. Turbidity: Higher turbidity increases the water temperature because suspended particles absorb more heat. This, in turn, reduces the concentration of dissolved oxygen warm water holds less oxygen than cold water.
4. Salinity: This is the salt content of the water. This would determine the type of organisms that would survive/ live in the water.
5. Dissolved oxygen.

ECOLOGICAL FACTORS COMMON TO BOTH TERRESTIAL AND AQUATIC HABITAT

1. Temperature
2. Rainfall
3. Light
4. Hydrogen ion concentration
5. Wind
6. Pressure
7. Turbidity
8. Salinity
9. Water current
10. Dissloved oxygen
11. Water density and viscosity

SOIL

Soil/ Edaphic factors are related to:

a. Type of soil particles
b. The humus, minerals, water and air content
c. The ph
d. The depth of the water table

Basically, there are 3 types of soil. These soil factors determine the vegetation/plants of an area.

NB: DRAW THE SOIL PROFILE

ECOLOGICAL MANAGEMENT

In an ecosystem, living organisms interact with one another mainly through their feeding relationship. The feeding relationship that exists between organisms is known as ASSOCIATION. In the habitat, organisms attempt to survive by developing tolerance to adverse environmental factors.

ASSOCIATION

This is a close feeding relationship between organisms of different specie. The forms of association are symbiosis, commensalism and parasitism.

1. SYMBIOSIS (+/+): This is a close association between 2 organisms of different species in which they both gain. It is also known as mutualism. Examples are:
   a. Nitrogen fixing bacteria in the root nodules of leguminous plants. E.g is Rhizobiumleguminosarium. These leguminous plants obtain nitrogen from the atmosphere and fix it into the plant. In the process, plants supply carbohydrate to the bacteria.
   b. Bacteria in the rumen and large intestine ofherbivores: Herbivores feed on plant materials which contain cellulose present in the cell wall of plants, though they lack theenzymefor digesting it. The bacteria present in their rumen help break the cellulose to sugar. In this process, the bacteria receives shelter whilehelping the ruminant digest its food.

c. Termites and protozoa in their alimentary canal: Termites feed on wood which contains cellulose that cannot be digested by their system. The protozoa help the termite breakdown the cellulose to sugar while obtaining protection and provision.

2. PARASITISM (+/--): This is a relationship between 2 organisms of different species in which one known as the parasite lives on and feeds at theexpense of the other called thehost. The parasite benefits while thehost suffers. There are plant and animal parasites. Examples of such relationship are:
   a. Man and round worm: Some other parasitic worms are hook worm, blood fluke, guinea worm, tape worm.
   b. Plant and mistle toe: Mistle toe is a semi plant parasite that lives on other large plants like orange tree, avocado and oil bean plant. It is a semi parasite because it has green leaves for photosynthesis but obtains water and minerals from thehost plant while thehost plant gains nothing.
3. COMMENSALISM (+/ neutral): This is a close relationship in which one organism (the commensal) benefits while the other organism (thehost) is not affected. Examples of this association are:
   a. Ramora fish and shark
   b. Hermit crab and sea anemone: Thehermit crab is a crustacean that lives in the shell of dead snail in salt water while the sea anemone is an invertebrate that attracts itself to the shell in which thehermit crab lives. The sea anemone protects thehermit crab by stinging the potential attackers of the crab. The sea anemone neither gains nor loses.
   c. Man and intestinal bacteria.

TOLERANCE

Tolerance is the ability of organisms to withstand unfavourable changes in their environment which affects their survival. Some organisms can only tolerate slight changes in their environment, some can tolerate severe changes while others cannot tolerate changes at all.

MINIMUM AND MAXIMUM RANGE OF TOLERANCE

The difference between the tolerance of an organism to various environmental factors is known as its range of tolerance. Within this range,it is able to exhibit the characteristics of living things. The minimum limit is the lowest possible limit at which an organism can tolerate changes in environmentalfactors. The maximum limit is the upper limit beyond which the organism would not survive.

ADAPTATION

Adaptation is the ability of an organism to survive in any given environment or habitat. To achieve this, organisms have different adaptive features to help them survive.

ADAPTATION OF ANIMALS TO AQUATIC HABITAT

1. Possession of gills for breathing
2. Possession of fins in fishes and webbed toes in toads for swimming
3. Possession of lateral line which detect vibration or sound in the water
4. Possession of dark dorsal side and light ventral side for camouflage against predators
5. Possession of streamlined body shape for easy swimming e.g fish, tadpole.

ADAPTATION OF ANIMALS TO TERRESTIAL HABITAT

1. Ability to regulate body temperature by possession of skin or fur
2. Presence of sweat glands for excretion and lowering of body temperature
3. Presence of skin in mammals and exoskeleton in insects for protection

4. Possession of powerful limbs for movement

ADAPTATION OF ANIMALS TO ABOREAL HABITAT

1. Possession of powerful limbs for flight and balance
2. Possession of tails for balance
3. Possession of feather for warmth
4. Possession of hollow bones to make them light for flight
5. Possession of wings for flight

PLANT ADAPTATION TO TERRESTIAL HABITAT

1. Reduction of leaves to spine in desert plants to reduce water loss
2. Green colouration of leaves to allow photosynthesis to take place
3. Possession of succulent stem for water storage
4. Possession of deep tap root for trapping water from soil
5. Possession of thick waxy cuticle and hairs on leaf to reduce water loss by transpiration

NOTE: Plants that survive in extremely dry places are called XEROPHYTES. Those that survive in moderate places (not too dry or wet) are called MESOPHYTES and aquatic plants are called HYDROPHYTES.

FUNCTIONING ECOSYSTEM

An ecosystem is a basic functional unit in nature made up of biotic and abiotic components.

The biotic component of an ecosystem comprises: Producers/ autotrophs, consumers/ heterotrophs and decomposers.

1. Producers

They provide food for other organisms in the habitat. They are able to do this because they use sunlight energy to synthesize their food. E.g. grasses, trees, phytoplankton, sea weeds.

2. Consumers

These are the organisms that feed on other organisms in the habitat. Types of consumers are primary consumers, secondary consumers, tertiary consumers and quartenary consumers. Examples of consumers are caterpillar, lion, cow, dog, water fleas, and mosquito larva e.t.c.

3. Decomposers

These are organisms that help to breakdown dead organic matters and release nutrients in them. E.g. termites, maggots, fungi and bacteria.

FOOD CHAIN AND FOOD WEB

A food chain is a simple linear feeding relationship which involves transfer of energy through food from the producers to the consumers.

Examples of terrestrial food chain:

Guinea grass ----> Grasshopper ------> Toad -------> Snake -------> Hawk

Grass ------> Antelope ------> Lion

Example of Aquatic food chain:

Diatoms ---------> Mosquito larva ---------> Tilapia fish ---------> Shark

A food web is a complex feeding relationship exiting among two or more inter-related food chains.

Examples: Construct a food web with the following organisms; a. grass, grasshopper, goat, grass cutter, man, field mouse, lion, hawk, snake, toad. B. Turtle, small fish, water flea, aquatic insects, algae, tadpoles, large fish.

TROPHIC LEVEL

Trophic level 1 always consists of the the primary producers or autotrophs. Trophic level 2 consists of primary consumers which include herbivores, birds and some insects which feed on pollen grains, nectar, leaves, seed and fruit of plants. Consumers above trophic level 2 are mainly carnivores (predators), parasitic organisms like the ticks and worms and scavengers like vulture and hyenas. The final consumers that escape being eaten up eventually die and are fed on by decomposers.

ECOLOGICAL PYRAMIDS

There are 3 pyramids in an ecosystem:

a. Pyramid of number
b. Pyramid of energy
c. Pyramid of biomass

PYRAMID OF NUMBER

This is the diagrammatic representation of the number of organisms at each trophic level of the food chain. It decreases progressivel;y from the first trophic level to the last trophic level. The length of each bar in the pyramid illustrate the approximate number of individuals in that tropic level.

DIAGRAM

PYRAMID OF BIOMASS

This represents the total wet or dry mass of organisms in each trophic level. The unit is kg/km^2.

DIAGRAM

PYRAMID OF ENERGY

This represents the amount of energy in kilojoules (Kj) present in the living organisms at the different tropic levels of the food chain. This also decreases progressivley from the first level to the last level.

DIAGRAM

ENERGY TRANSFORMATION IN NATURE

As energy flows in an ecosystem, it is transformed from one form to the other. This energy transformation is governed by the laws of thermodynamics. More than 50% of the solar energy reaching the atmosphere is reflected or absorbed by the clouds and ozone layer while only 1-2% is absorbed by green plants. This energy passes through the food chains. In the ecosystem, ennergy is lost through the following:

a. Vegetation

b. Soil
c. Air
d. Heat
e. Evaporation of water
f. Effects of wind

LAWS OF THERMODYNAMICS

There are 2 laws of thermodynamics;

1st law

This law states that energy can neither be created nor destroyed but can be transformed from one form to another.

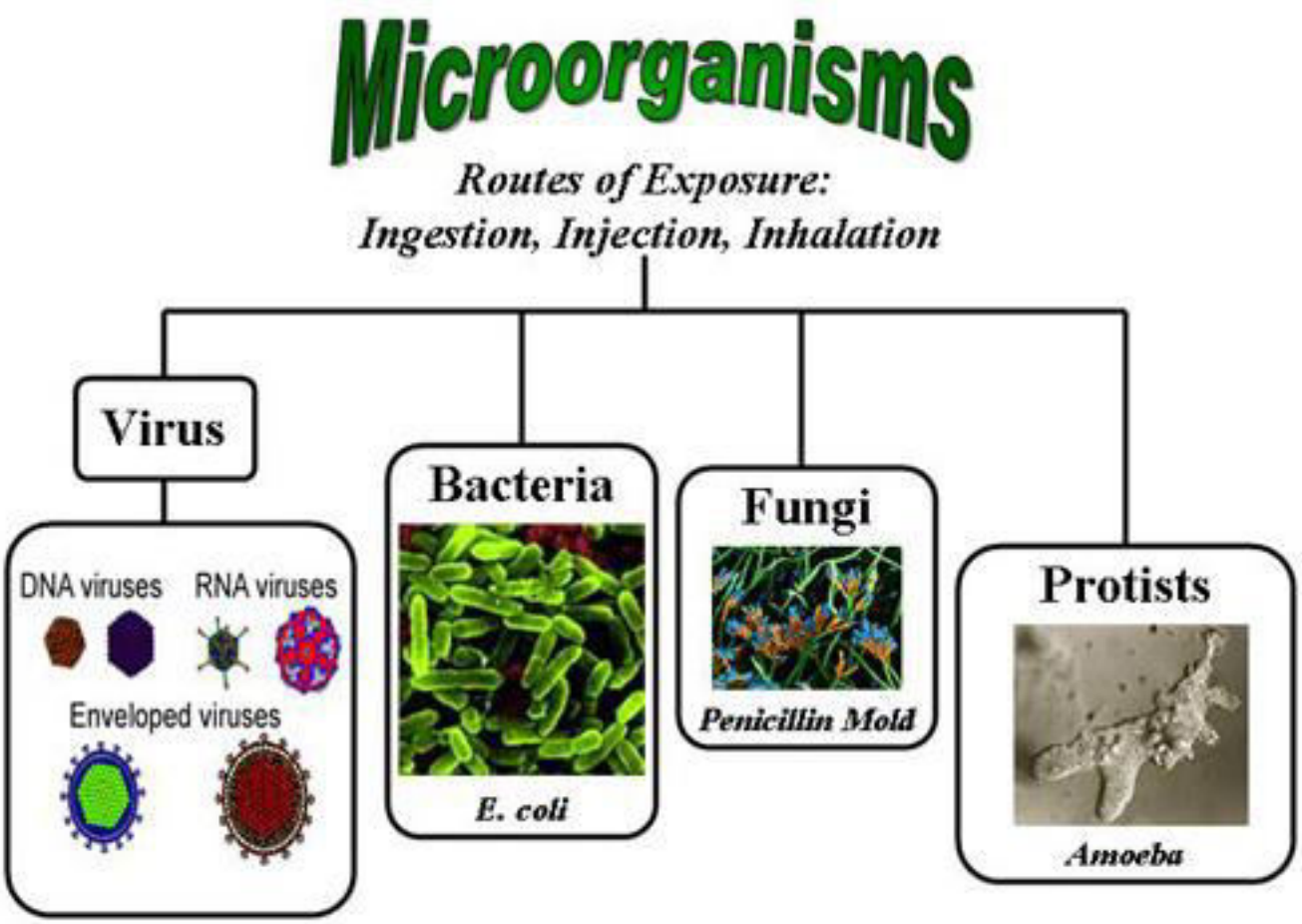
That is, plants convert solar energy to heat energy and animals convert chemical energy into kinetic energy when they move around.

2nd law

This law states that in any transformation of energy from one form to another, there is always a decrease in the amount of useful energy. In other words, this law states that no energy transformation is 100% efficient.

MICROORGANISMS AROUND US

Microorganisms are those organisms that cannot be seen with the ordinary eyes but with a microscope. . Microbiology is the branch of biology that deals with its study. The scientist that discovered the microscope and also discovered microorganisms is Anton van Leewenhoeck. Microorganisms are ubiquitous in nature because they are found everywhere; in the soil, air, food, water and our body. Harmful microbes are called PATHOGENIC MICROORGANISMS while the unharmful or useful ones are called BENEFICIAL MICROORGANISMS.



Types of microorganisms are:

a. Viruses (they have no cell structure)
b. Bacteria
c. Protozoa (protists)
d. Algae
e. Fungi

VIRUSES

They are the smallest, simplest and most primitive of all living organisms. Examples of viruses are Adenovirus, Ebola virus, Human immume virus e.t.c.

ASSIGNMENT: a. Draw the structure of virus

b.. List 5 characteristics of viruses.

BACTERIA

They are bigger than viruses and are cellular i.e. they have cytoplasm, nucleus, cell membrane, and cell wall. However, the nucleus is not as developed as that of higher organisms. Types of bacteria based on their need for oxygen are:

1. Aerobic bacteria: Those that require oxygen to survive
2. Anaerobic bacteria: Those that cannot survive in the presence of oxygen but require carbon dioxide for survival
3. Facultative bacteria: They survive with or without oxygen or carbon dioxide.

However, bacteria are also classified based on their cell shape into:

1. Cocci: Bacteria with spherical cells
2. Diplococci: These bacteria adhere in pairs, are non-motile, non-sporing and are in form of capsules e.g. pneumococci.
3. Staphylococci: These are dome shaped, adhering in grape-like clusters. They are also non-motile and non-sporing. Examples are Staphylococcus aureus, S. epidermis.
4. Streptococci: These bacteria adhere in long chain. They are non-motile and non-sporing. E.g. S. virdens which is found on the upper respiratory tract.
5. Bacilli: These bacteria have rod shaped cells. They may occur singly or in chains. They are motile, capsulate and non sporing. E.g. E. coli.
6. Vibrios: They have a rigid, curved rod shape. They are motile and non-sporing. E.g. Vibrio cholera.
7. Spirillae: These are cock-screw shaped, rigid and motile in nature.

PROTOZOA

These are mainly free living unicellular organisms, though, some of them are pathogenic in nature. Examples are amoeba, paramecium, plasmodium.

ALGAE

These are microscopic green plants that are mainly aquatic in nature e.g. diatoms, spirogyra, volvox e.t.c.

FUNGI

These are saprophytic or parasitic microorgansisms e.g. mushroom, penicillium, rhizopus, mucor, yeast e.t.c.

WEEK 8

PRACTICALS

WEEK 9

MICROORGANSISMS IN ACTION

Based on their activities, there are 3 types of microorgansisms:

1. Beneficial
2. Harmful or pathogenic
3. Free-living microorganisms

BENEFICIAL EFFECTS OF MICROORGANISMS

1. <u>Friendly Microorganisms</u>

Microorganisms are a crucial part of the ecosystem and take part in activities like production of minerals like nitrogen, gases like oxygen, carbon dioxide, cleaning by action on dead matters etc. In various industries, microbes are used intentionally due to their role in human welfare.

2. <u>Food Industry and Beverages</u>

a. They are used in the manufacture of bread, curd, wine and alcohol etc.
b. *Lacto bacillus* bacteria are responsible for the curd formation (used for making cheese).
c. Yeast is used commercially for alcohol and wine production by a process called fermentation.
d. Yeast is also used in baking industries for the preparations of bread and cakes.

3. <u>Micro-flora</u>

Bacteria which live in the digestive system are collectively known as microflora.

a. They support the process of digestion by releasing certain enzymes.

b. They produce vitamin K and thus help in blood clotting.
c. They also prevent the invasion of the body by other fatal microbes.

4. Pharmaceutical Industry

a. Antibiotics are well-known examples of the role of microbes in the medical field. Antibiotics are obtained from microorganisms.
b. Recently many drugs for a variety of diseases are obtained from microorganisms.
c. Vaccines are partially killed or weakened microorganisms used to produce antibodies against an antigen (foreign particles) entering the body.

5. Environment

a. Nitrogen fixing bacteria such as Rhizobium, Azotobacter etc. nourish soil with a mineral like nitrogen.
b. As cleaners, they decompose the dead and organic matter and result in the decay of toxic substances.
c. Sewage treatment

Harmful effects of microorganisms

1. They cause plant and animal diseases
2. They cause food spoilage
3. They cause deterioration of bacteria
4. They cause death of animals and plants.

TABLE 24-4 A Summary of Bacterial Diseases

Disease	Pathogen	Areas affected	Mode of transmission
Botulism	*Clostridium botulinum*	nerves	improperly preserved foods
Cholera	*Vibrio cholerae*	intestine	contaminated water
Dental caries (tooth decay)	*Streptococcus mutans, sanguis,* and *salivarius*	teeth	bacteria enter the mouth from the environment
Gonorrhea	*Neisseria gonorrhoeae*	urethra, fallopian tubes, epididymis	person-to-person by sexual contact
Lyme disease	*Borrelia burgdorferi*	skin, joints, heart	tick bite
Rocky Mountain spotted fever	*Rickettsia ricketsii*	blood, skin	tick bite
Salmonella food poisoning	*Salmonella*	intestine	contaminated water and food
Strep throat	*Streptococcus pyogenes*	upper respiratory tract, blood, skin	person-to-person by sneezes, coughs, or direct contact
Tetanus	*Clostridium tetani*	nerves at synapses	contaminated wounds
Tuberculosis	*Mycobacterium tuberculosis*	lung, bones, other organs	person-to-person by coughs

**Space for Assignment- One and half pages

The important types of disease causing micro- organisms in human beings are:

1. Virus
2. Bacteria
3. Fungi
4. Protozoa

Pathogenic micro- organism cause infection or communicable diseases i.e. diseases which can be spread from infected person to a healthy person.
Pathogenic micro- organisms generally have defined parts by which they enter the body of person and leave the body of an infected person to find a new one. Pathogens can spread through the following ways:

1. Through Air- Air-borne pathogens
2. Water- Water-borne pathogens
3. Food
4. Direct skin contact
5. Animal vectors

TOWARDS BETTER HEALTH

Microorganisms enter our bodies through various means such as:

1. Cuts and wounds on the skin. Examples of such microbes are Clostridiumtetani(found in the soil and causes tetanus).
2. Through the nose and mouth when we breathe in contaminated air e.g. influenza virus.
3. Through the mouth and oesophagus when we eat or drink contaminated food or water. E.g. Entamoeba histolytica (which causes amoebic dysentry).
4. Through direct contact (sexual or blood). E.g. ringworm.
   These microbes are carried around by agents or vehicles known as VECTORS i.e. vectors are carriers of microorganisms. Examples of vectors are mosquito, housefly, cockroach, dog, tse-tse fly e.t.c.

CONTROL OF HARMFUL MICROORGANISMS

Microorganisms that cause infections can be controlled in various ways such as:

1. HIGH TEMPERATURE: Most microorganisms thrive well around the normal human body temperature, thus, at high temperatures, they are killed. This can be achieved by:
   a. Cooking our foods properly
   b. Boiling our water before drinking
   c. Boiling/ sterilizing contaminated objects in an autoclave
2. ANTISEPTICS: These are chemicals that kill or inhibit the growth of microbes. Examples are hydrogen peroxide, iodine e.t.c.
3. DISINFECTANTS: They kill or inhibit the growth of microbes but they are stronger chemicals than antiseptics. E.g. izal, dettol e.t.c.
4. ANTIBIOTICS: These are chemicals which in low concentration selectively kill microbes. They are usually produced from bacteria and fungi and are usually effective against pathogenic bacteria but ineffective on virus and protozoa.
5. HIGH SALINITY: High salt content ususally affects the osmotic balance between microbes and their environment. This inhibits the growth of their cell thus, prevent its multiplication. Washing wounds and cuts with salt solution would prevent them from being infected.
6. Immunization
7. Dehydration
8. Isolating patients with infectious disease
9. Personal hygiene

PUBLIC HEALTH

Maintaining the health of the people in the country is the responsibility of individuals, community, the government and the health organisations. These should help in the following ways:

1. Refuse and waste disposal

2. Protection of water supply and provision of clean water
3. Food hygiene
4. Control of diseases
5. Health organisations.
   FOOD HYGIENE

Food must be produced, stored, prepared and cooked in an hygienic way. Public health authorities must ensure:

a. Market sanitation
b. Food storage sanitation
c. Sanitation of public eating places e.t.c.
   ROLES OF HEALTH ORGANISATIONS

The main local health organisations whether govermental or voluntary, are under the ministry of health. Examples of government health organisations are National health service (NHS) and Public health authority (PHA). Voluntary health organisations include the Nigerian red cross society, Saint John's Ambulance e.t.c. Other Health organisations are WHO, UNICEF, FAO.