REGINA PACIS COLLEGE, GARKI 2, ABUJA
SUBJECT: BIOLOGY
TERM: FIRST TERM, 2025/2026
NAME OF TEACHER: MS. ASUQUO VICTORIA OKON
CLASS: SS ONE

SCHEME OF WORK

1. Recognizing Living Things
2. Classification of Living Things
3. The Cell
4. Cell and its Environment
5. Properties and Functions of the Cell
6. Excretion
7. Growth
8. Irritability
9. Movement
10. Reproduction
11. Revision
12. Examination and Closure

TOPIC: RECOGNIZING LIVING THINGS

Meaning of Science

Science can be defined as the systematic process of making enquiries about living things and non-living things in our environment.

Definition of Biology

Biology is coined from two Greek words; 'Bio' meaning life and 'Logos' meaning study. Biology can simply be defined as the study of life. It is also the scientific study of living matter (pants and animals) in all its forms and processes.

Scientific Approach

It involves sequences of making enquires about an object or things under study in science. Scientific methods of science include; Observation, classification, inference, measurement, identification, hypothesis, experiment, control or conclusion and theory or law.

LIVING THINGS AND NON-LIVING THINGS

Living thing is any organism or a living form that possesses or shows the characteristics of life. Thus, they have an organized structure being made up of a cell or cells, which requires energy to survive, ability to reproduce, grow, metabolize, respond to stimuli, move, respire and to adapt to the environment.

Examples of living things include; the bacteria, protozoa, plants, fungi, animals, humans, etc. Viruses are not absolutely living or non-living. When outside their host, viruses are inactive and seemingly inanimate. When inside their host, they become active and alive, capable of utilizing the host cell's structures and replicate.

A non-living thing is one that lacks or has stopped displaying the characteristics of life. Thus, they lack or no longer display the capability for growth, reproduction, respiration, metabolism, and movement. They are not capable of responding to stimuli and adapting to their environment. They also do not require energy to continue existing. Examples of non-living things are rock, water, and sun.

CHARACTERISTICS OF LIVING THINGS

1. **Movement**: Generally, living things are capable of carrying out one form of movement or the other. Most animals move from place to place on their own accord, while plants can only move certain parts of their body such as shoots and roots in growth movement.
2. **Respiration**: All living things exchange gases with their environment. Animals take in oxygen and breathe out carbon dioxide.
3. **Nutrition**: All living organisms need to take substances from their environment to obtain energy, to grow and to stay healthy.
4. **Irritability** or Sensitivity: Living things react to changes around them. We react to touch, light, heat, cold and sound, as other living things do.
5. **Growth**: When living things feed they gain energy. Some of this energy is used in growth. Living things become larger and more complicated as they grow.
6. **Excretion**: Excretion is the removal of waste from the body. If this waste was allowed to remain in the body, it could be poisonous. Humans produce liquid waste called urine. We also excrete waste when we breathe out.
7. **Reproduction**: All living things produce young ones. Humans make babies, cats produce kittens and pigeons lay eggs. Plants also reproduce. Many make seeds which can germinate and grow into new plants.
8. **Adaptation**: This is the way living organisms get used to their various environments in such a manner that

they would be comfortable. This is done in order to survive.

9. **Competition**: This is the ability of living things to struggle for all the necessities of life in order to survive in their various environments.
10. **Death/Life span**: All living things must die because they have a definite and limited period of existence. All living things must pass through these five stages of life namely:

Birth ⟶ Growth ⟶ Maturity ⟶ Decline (old age) ⟶ Death

Differences between Plants and Animals

PLANTS	ANIMALS
1) Plants generally are rooted in one place and do not move on their own (locomotion).	Most animals have the ability to move freely.
2) Plants contain chlorophyll and can make their own food, this is called Photosynthesis.	Animals cannot make their own food and are dependent on plants and other animals for food.
3) Plants give off oxygen and take in carbon dioxide given off by animals.	Animals give off carbon dioxide which plants need to make food and take in oxygen which they need to breathe.
4) Plants have either no or very basic ability to sense.	Animals have a much more highly developed sensory and nervous system.
5) Growth is apical.	Growth occurs equally on all parts.

Organization of Life

Living organisms are highly organized. This organization occurs in steps and levels and each level interact to build up even more complex structure. Therefore, organization of life is the existence of life from single celled organism to a multicellular organism with complex forms that perform different functions.

Levels of Organization

Multicellular organisms have the following four levels of organization ranging from simplest to most complex:

Cell level: Cells are the basic unit of structure and function in living things and this may serve a specific function within the organism. Examples are blood cells, nerve cells, bone cells, muscle cells, etc. There are some organisms at the cellular level (i.e. with single cell performs all life functions). Examples are Amoeba, Paramecium, Euglena, Chlamydomonas, etc.

Tissue level: A tissue is a collection of cells that are similar in structure and perform similar function. Examples are blood, bone, etc. Example of animal that exist at tissue level is Hydra.

Types of Tissue in Man and their Function

1. Epithelial Tissues: They line and protect the body surface. They help in the formation of skin.
2. Blood Tissues: They transport food and oxygen round the body.
3. Skeletal Tissues: They support the body and aid movement.
4. Connective Tissues: They bind other tissues together.

5. Nerve Tissues: They coordinate and transmit nerve impulses.
6. Muscle Tissue
s: It is for movement for the parts of the body.

Types of Tissue in Plant

1.Vascular Tissues: For transport of food and water in plant. They include phloem and xylem.
2.Strengthening Tissues: They give strength and support to the plants body. They include sclerenchyma, collenchyma and parenchyma.
3.Epithelial Tissues: They line and protect the plants surface.
Organ Level: An organ is made up of tissues that work together to perform a specific activity. Examples are heart, brain, skin etc.
System Level: System is a group of two or more organs that work together to perform a specific function for the organism. Examples are circulatory system, nervous system, skeletal system, etc. The human body has 11 organ systems which are the circulatory, digestive, endocrine, excretory (urinary), immune (lymphatic), integumentary, muscular, nervous, reproductive, respiratory, and skeletal.

Complexity of Organization in Higher Organisms

As one moves from unicellular to multicellular organisms, there are gradual complexity in the level of organization. For instance, smaller animals require no backbones, while the bigger ones require support and have backbones.

Advantages of Complexity in Organization

1. There is specialization of various cells.
2. Specialization leads to division of labour.
3. There is efficiency.
4. One body function does not adversely affect other body functions.

Disadvantages of Complexity in Organization

1. Individual cells are not capable of existing independently and therefore depend on one another's activity to exist.
2. Due to complexity, organisms must obtain enough food and oxygen to activate them and avoid risk of death.
3. More effort is needed to eliminate toxic wastes.
4. Energy and time are wasted.

Assignment

1. Define the term *biology.*
2. Mention **four** characteristics of living things, and explain any two.
3. State two differences between plants and animals.

TOPIC: CLASSIFICATION OF LIVING THINGS

Classification of living things consists of placing together in categories those living things that resemble each other. It involves placing living things into group that have certain features in common which distinguish them from other groups. Thus, **classification is the science of arranging living organisms into groups based on structural, genetic or cellular organization.** The system of classification of living things used today was introduced by a Swiss scientist called Car Von Linné (1707-1778). His name was Latinized to Carolus Linnaeus. He published the classification of plants in 1753 and that of the animals in 1758. Living things are first split into Kingdoms. The kingdoms are further split into a large number of smaller groups called Phyla (singular, Phylum) for animals and divisions for plants. All the numbers of a phylum or division have certain features in common. Each phylum or division is broken down into classes. Each class is further broken down into orders, orders into families, families into genera (singular, genus), genera into species.
There are seven major groups used in classification of living things.
These are:
Kingdom
Phylum (animal) or Division (plants)
Class
Order
Family
Genus
Species

Binomial system of nomenclature
Carolus Linnaeus also introduced a system of naming living things which is popularly used by biologist today. This system is called binomial system of nomenclature. In this system, each organism or living thing is giving two names, hence the term binomial nomenclature. The first name is the generic name (common to the genus) and it always begins with a capital letter. The second name is the specific name which begins with a small letter. These scientific names are written in italics or are underlined. Example of scientific names of some organisms are given below.

GENERA AND SPECIES OF SOME ORGANISMS

COMMON NAME	GENUS	SPECIES
Man	Homo	sapiens
Lion	Panthera	leo
Plantain	Musa	sapientum
Banana	Musa	paradisiacal

Mango	Magnifera	lindica
Maize	Zea	mays
Rat	Rattus	rattus
Housefly	Musca	domestica
Groundnut	Arachis	hypogea
Cocoa	Theobroma	cacao
Dog	Caris	familiaris
Rice	Oryza	sativa
African Elephant	Loxodonta	africana
Amoeba	Amoeba	proteus
Orange	Citrus	sinensis
Paramecium	Paramecium	caudatum
Plasmodium	Plasmodium	sp.

Kingdoms

Carolus Linnaeus classified all living organisms into two major kingdom, plant and animal kingdom. However certain organisms like sponges and bacteria cannot fit in so easily into either of the two kingdoms. This made scientist agree to create five kingdoms to accommodate other organisms.

These kingdoms are:

Monera, Protista, Fungi, Plantae, Animalia

Again, virus specifically could not fit into any of the five kingdoms. They are said to have identity crisis.As a result of this, it has to be treated separately.

VIRUS

Virus is a Latin word Virulentus meaning poisonous. Virus is a microscopic organism which cannot be seen by an ordinary microscope but with an electron microscope. Virus does not have a cell structure but is just made up

of a coiled strand of nucleic acid (i.e. Ribonucleic acid (RNA) or deoxyribonucleic acid (DNA) enclosed within a protein coat. E g Retrovirus. Virus is seen as being on the borderline between living and non-living things. When outside the living cells, it forms crystals and becomes inactive but when it finds its way inside a living cell ,it replicates (reproduces) and becomes a living organism.

Characteristics of virus

1. Virus is microscopic in nature.
2. It possesses either RNA or DNA.
3. It cannot reproduce by binary fission.
4. It does not have structures used in the synthesis of protein.
5. It does not respire, feed, excrete, etc.
6. It is responsible for the causes of many chronic diseases like AIDS, small pox, influenza and measles.

Examples of viruses include Herpes virus, Human papilloma virus, Corona virus, influenza(flu), Rita virus, Human immuno deficiency virus.

Virus as a Living (Animate) Organism

1. It can reproduce when present in another living cell.
2. It possesses characteristics which can be transmitted from one generation to the next.

Virus as a non-living (inanimate) thing.

Virus is often regarded as a non-living thing because of the following reasons:

1. When a virus is extracted from a living cell and placed in a non-living medium, it assumes a crystalline form and becomes non-living.
2. It cannot respire, excrete or respond to stimuli.

KINGDOM: MONERA (PROCARYOTES)
CHARACTERISTICS.

1. Single-celled, motile or non-motile organisms.
2. Organisms are microscopic.
3. They are procaryotes.(They lack nucleus and membrane bound organelles).
. Bacteria and blue-green algae make up this kingdom.
4. They do not have complex chromosomes.
5. The cells have no mitochondria, no endoplasmic reticulum, and no chloroplasts.
6. The cell wall does not contain cellulose.
7. They may possess autotrophic or heterotrophic mode of nutrition.

It is divided into schizophyta and cyanophyta.

KINGDOM: PROTISTA (EUCARYOTES)
CHARACTERISTICS.

1. They are Single-celled

2. Some are non-motile, others are motile(cilia,flagella or amoeboid in nature) .

3. Organisms are much larger than the monerans.

4. They are eucaryotes(Cell structure is complex with a definite nucleus).
5. Some are heterotrophic while others are both heterotrophic and photosynthetic.
    1. Mode of reproduction is either sexual or asexual.

Members include Chlamydomonas (Chlamydomonas rivalis), Amoeba, Trypanosome and Plasmodium.

The four phyla in this kingdom are: Protozoa, Euglenophyta, Chrysophyta, Pyrrophyta.

PHYLUM PROTOZOA

CHARACTERISTICS OF PROTOZOA.

1. They are microscopic.
2. They have membrane.
3. They reproduce asexually.
4. They are mainly aquatic organisms.
5. The organisms in this group move by different organelles e.g Amoeba moves by means of Pseudopodia, Paramecium moves by means of cilia, Trichomonas moves by means of Flagella. Plasmodium has no organelle for movement.

EUGLENOPHYTA

Euglena viridis is a protist and a typical example of an organism sharing both plants and animal characteristics.

ANIMAL CHARACTERISTICS OF EUGLENA.

1. Possession of flagellum for movement.
2. Possession of gullet for passage of food.
3. Possession of contractile vacuole for osmo-regulation.
4. Presence of eyespot to respond to light.

PLANT CHARACTERISTICS OF EUGLENA.

1. Possession of chloroplast for photosynthesis.
2. Possession of pyrenoids for storage of starch.
3. It has autotrophic mode of nutrition.

KINGDOM: FUNGI (singular: fungus**)**

CHARACTERISTICS.

1. Some are unicellular while others are multicellular.
2. They are non-green plants.
3. They are mainly saprophytes while others are parasites.
4. They lack true roots, stems and leaves.
5. They are mainly non motile
6. They are made of thread-like structures called hyphae while the whole mass is called mycelium. They possess many nuclei.
7. They are eucaryotes (cells with membrane).

Examples include bread moulds (Rhizopus nigricans), mushrooms, toadstools, mucor (Mucor mycelium), mildews, yeast and slime moulds.

KINGDOM: PLANTAE (EUCARYOTES)

Many-celled, non-motile organisms which contain the green pigment chlorophyll that enables them to make their own food by photosynthesis. Members include mosses, ferns, pines, oil palms, yam and bean plants.

The plant kingdom consists of three main divisions (phyla). These are:

1. Thallophyta (e.g green, brown, red algae)
2. Bryophyta (liverworts and mosses)
3. Tracheophyta (vascular plants)

PHYLUM THALLOPHYTA

This is divided into three:

a. Rhodophyta (red algae e.g. Coralline).
b. Chlorophyta (green algae e.g. Spirogyra and Volvox).
c. Phaeophyta (brown algae e.g. Kelp and Sargassum).

CHARACTERISTICS OF THALLOPHYTA.

1. They are simple microscopic plants.
2. Some are unicellular.
3. They are simple aquatic plants.
4. They have cell walls.
5. They have no true roots, stems and leaves.

PHYLUM BRYOPHYTA

CLASS I: Musci e.g. Moss plant

CLASS II: Hepatica e.g. Liverworts

CHARACTERISTICS OF BRYOPHYTA.

1. **They are complex multicellular green plants.**
2. Their cells are differentiated into tissues.
3. They are non-vascular plants.
4. They are found in moist places.
5. Examples are liverworts and mosses

TRACHEOPHYTA

It is divided into pteridophyta (Ferns) and spermatophyta (Seed plants).

PHYLUM PTERIDOPHYTA

CHARACTERISTICS OF PTERIDOPHYTA.

1. They are unicellular and vascular green plants.
2. They are non-flowering plants
3. They have no true roots, stems and leaves.
4. They are mainly terrestrial plants while few are aquatic.
5. They are non-seed producing plants.

PHYLUM SPERMATOPHYTA

CHARACTERISTICS OF SPERMATOPHYTA.

1. They are multicellular seed producing flowering plants.
2. They are vascular plants.
3. They have true roots, stems and leaves.

4. They reproduce sexually.
5. They are mainly terrestrial green plants.

Spermatophyte is divided into gymnosperms and angiosperms.

Gymnosperms are plants with naked seeds; they do not bear flowers. The seeds are borne in special structures called cones.

Angiosperm is divided into dicotyledonous plants and monocotyledonous plants.

DIFFERENCES BETWEEN MONOCOTYLEDONOUS AND DICOTYLEDONOUS PLANTS.

MONOCOTYLEDONOUS PLANTS	DICOTYLEDONOUS PLANTS
(a) They possess only one seed leaf or cotyledon.	They possess two seed leaf or cotyledon.
(b) They have fibrous root system.	They have tap root system.
(c) They exhibit hypogeal germination.	They exhibit epigeal germination.
(d) They possess parallel venation.	They possess net venation.
(e) They do not undergo secondary growth.	They undergo secondary growth.

A typical angiosperm whether a dicotyledonous or monocotyledonous plant has four major parts. These parts and their functions are as follows:

PLANT PARTS	FUNCTIONS
1. Flowers	i. It is responsible for reproduction.
2. Leaves	i. It is responsible for photosynthesis. ii. It aids in excretion iii. It aids in respiration
3. Stem	i. It gives support to plants. ii. It holds the leaves in the best position to receive sunlight. iii. Some part of the stem can manufacture food.
4. Root	i. it holds the plant firmly to the ground. ii. It absorbs water and dissolved mineral salts from the soil. iii. It stores food in some plants.

KINGDOM: ANIMALIA (EUCARYOTES)

Many-celled motile organisms that feed on other organisms. Members include corals, worms, insects, snails, frogs, snakes and cows.

Animals are put into two main groups:

Invertebrata (invertebrates): animals with no back bone.

Vertebrata (vertebrates): animals with backbones.

Invertebrata: There are about 23 invertebrate phyla. Eight of the more familiar phyla are:

PHYLUM PORIFERA.

CHARACTERISTICS.

1. They are simple aquatic invertebrates.
2. They do not move about but are attached to rocks or shells.
3. They live in colonies.
4. They are primitive multicellular animals.
5. Example is sponges.

PHYLUM COELENTERATA

CLASS I: Hydrozoa e.g. Hydra

CLASS II: Scyphozoa e.g. Jelly Fish

CLASS III: Anthozoa e.g. Sea anemone

CHARACTERISTICS

1. They are multicellular organisms.
2. The body is made up of two layers.
3. They are mainly aquatic organisms.
4. They have soft jelly like bodies.
5. They reproduce asexually by budding.

PHYLUM PLATYHELMINTHES (FLAT WORMS)

CHARACTERICSTICS

1. They are multicellular flat worms.
2. They do not have body cavity.
3. The body is made of three layers.
4. They are mainly parasites in man and other animals.
5. They reproduce sexually.
6. Examples are planaria, liver flukes, Tapeworm and blood fluke

PHYLUM NEMATODA (ROUND WORMS)

CHARACTERISTICS

1. They have round and cylindrical bodies.
2. They lack body cavity.
3. Some are parasites while some are free living things.
4. The body is made of three layers.
5. Examples are round worms, guinea worms, threadworms, hookworms and filarial worms.

PHYLUM ANNELIDA

CHARACTERISTICS

1. The body is long and cylindrical.
2. They have true body cavity.
3. They produce sexually.
4. Their bodies are made of three thick layers.
5. Examples include Sea worm, Earth worm,Leech

PHYLUM MOLLUSCA

CHARACTERISTICS

1. They have soft unsegmented bodies.
2. They have tentacles on their heads.
3. They possess muscular foot adapted for crawling.
4. Some are terrestrial while others are aquatic.

Examples include Snails,Mussels, Octopus

PHYLUM ARTHROPODA

This is the largest phylum in the animal kingdom. It is divided into the following classes:

CLASS I: Insecta e.g grasshoppers, cockroach (Periplaneta americana), ants, butterflies (Papilo demodocus), beetles and aphids.

CLASS II: Arachnida e.g spiders, scorpions, mites and ticks.

CLASS III: Crustaceans e.g crabs, crayfish, lobsters, barnacles, prawns and water fleas.

CLASS IV: Myriapoda e.g centipedes and millipedes.

CHARACTERISTICS

1. They have segmented bodies.
2. They have hard, rigid exoskeleton made of chitin.
3. They exhibit moulting or ecdysis (shedding of their exoskeletons at interval to allow their bodies to increase in size).
4. Some are aquatic while others are terrestrial.
5. They have two or three body layers.

PHYLUM ECHINODERMATA

CHARACTERISTICS

1. They have spiny skin.
2. They are mainly marine animals.
3. They have three body layers.
4. The body is not segmented.
5. Examples are starfish, sea urchins and sea cucumbers.

PHYLUM CHORDATA

It has a sub-phylum called vertebrata. They are divided into five classes:

1. Pisces (fishes)
2. Amphibia (amphibians)
3. Reptilia (reptiles)
4. Aves (birds)
5. Mammalia (mammals)

GENERAL CHARACTERISTICS OF VERTEBRATA

1. They possess an internal jointed skeleton made of cartilage or bones.
2. The body is divided into head, trunk and tail.
3. They have two pairs of limbs.
4. They have well developed central nervous system with brain and spinal cord.
5. They have well developed sense organs.
6. They possess skin which may be naked or have scales, feathers or hairs.

CLASS PISCES (FISHES)

CHARACTERISTICS

1. The skin is covered by scales but few without scales.
2. They have fins which are used for movement in water.
3. They are cold blooded (poikilothermic) animals.
4. They have gills which are used for gaseous exchange.
5. They have lateral line system.

Pisces are divided into two based on the nature of their skeletons. These are bony and cartilaginous fishes.
Bony fish: These are fishes with skeleton e.g. tilapia, salmon.
Cartilaginous fish: These are fishes whose bones are made of cartilages e.g. dog fish, shark.

CLASS AMPHIBIA

CHARACTERISTICS

1. They are cold blooded (poikilothermic) animals.
2. They have two pairs of limbs.
3. They have moist skin with no external scales.
4. Reproduction is sexual while fertilization is external.
5. They have three chambered heart.
6. They carry out respiration by gills, lungs, skin and mouth.
7. Examples are toads, frogs,Newt, Salamander.

CLASS REPTILIA

CHARACTERISTICS

1. They are cold blooded (poikilothermic) animals.
2. They have dry skin covered with scales.
3. They have two pairs of limbs except snakes.
4. They have lungs which are used for gaseous exchange.

Examples are lizard, chameleon, crocodile, turtle, wall gecko, and tortoise.

CLASS AVES (BIRDS)

CHARACTERISTICS

1. They are warm blooded (homoiothermic) animals.
2. Their entire bodies are covered with feathers except the hind limbs which are covered with scales.
3. They have two pairs of limbs.
4. They have wings used for flight.
5. Examples are all types of birds, both flightless and flying birds.

CLASS MAMMALIA

CHARACTERISTICS

1. They are warm blooded (homoiothermic) animals.
2. Their bodies are covered with hairs.
3. They have heterodont dentition.
4. They have lungs used for gaseous exchange.
5. Reproduction is sexual and fertilization is internal.
6. Examples are man, whale. Rabbit, whale, bat, monkey, goat, lion, elephant etc.

Assignment

1. Explain the concept of *Binomial nomenclature.*
2. State **two** important characteristics of *Kingdom fungi.*
3. Mention at least one example of *Kingdom fungi*.

TOPIC: THE CELL

The cell was discovered by Robert Hooke in 1665. Cell theory was first developed in 1839 by Matthias Jakob Schleiden and Theodor Schwann.

What is a Cell?

Cell can be defined as the structural and functional unit of life. It could also be describe as the simplest and basic unit of life in which living organism are made. The cell (from Latin cella, meaning "small room") is the basic structural, functional, and biological unit of all known living organisms. A cell is the smallest unit of life that can replicate independently, and cells are often called the "building blocks of life". The study of cells is called cell biology or Cytology.

Classification of Living Organism Based on the Number of Cells

This Includes:

Unicellular Organism: These are organisms which consist of only one cell e.g. Amoeba, Paramecium, Chlamydomonas,Euglena.

Multi-cellular Organism: These are organisms which consist of two or many cells e.g. Man. flowering plant, Bird, Hydra etc.

History of Cell

Many scientist have contributed to the study and history of cell which are listed below;

Robert Hooke: He is regarded as the father of cell. He was the first human being to discover the honey comb structure of the cell in 1665. In his book, Micrographia, he magnified a thin slice of a cork from an oak tree. He observed there were tiny rooms which he called Cells.

Felix Dujardin: He was a French biologist in 1835, which he discovered that the cell was made up of living substance. He named the living substance protoplasm.

Matthias Schledien: He is also a German botanist in 1838 revealed that the bodies of plants are made of cells which were described as units of life.

Theodore Schwann: He was also a German zoologist in 1839; He discovered that the bodies of all animals are composed of cells.

Rudolf Von Virchow: He was also a German biologist in 1855, concluded in his research that all cells come from previously existing cell.

The Cell Theory

The cell theory is stated below;

1. The cell is the structural and functional unit of life.
2. All living organisms are made of cells.
3. All cells come from previously existing cells.
4. There is no life apart from the life of cells.
5. All living things are either single cells or multicellular cell.

Forms in Which Living Cells Exist

These include;

1. As Independent or Single and Free Living Organism: This means organisms that possesses only one cell and is capable of living freely on their own. E.g. Amoeba, Paramecium.
2. As a Colony: This means that some organisms are made of many similar cells which are joined or massed together but they cannot be differentiated from each other .e.g. Volvox, Pandorina, etc.
3. As a Filament: This simply means that certain cells are organised into filaments. Each cells functions as an independent living cell. E.g. Spirogyra and Zygnema.
4. Cells as Part of a Living Organism: This means that in a multi-cellular organism, a group of numerous, similar cells are arranged together to perform specific functions and this is called a tissue. A group of similar tissue forming a layer in an organism which performs a specific function is called an organ. A group of organs which work together to perform specific functions is called a system.

Differences between colonial organism and filamentous organism

Colonial Organism	Filamentous Organism
1. There is absence of intercellular wall.	There is presence intercellular wall.
2. The identical cells form a mass.	The identical cells form end to end arrangement in linear form.

Structures of Plant and Animal Cells and Functions of their Components

The cell is composed of protoplasm which can be divided into two main parts namely;

A. The cytoplasm

B. The nucleus

Each cell is bounded by a thin membrane. The cytoplasms are fluid materials that consist of cytoplasmic organelles such as Lysosome, golgi bodies, endoplasmic reticulum, and mitochondria, etc. The nucleus is bounded by a nuclear membrane and it consists of chromosomes and nucleolus. The animal cell in addition has centrosome. It also has starch granules, cellulose cell wall and some plastid e.g. chloroplast.

The table below shows some cell organelles and functions.

Cell Organelles	Functions
Nucleus	It controls all life activities of the cell.
Chromosome	It controls the DNA which stores genetic traits.
Mitochondria	It is described as the power house of the cell.
Vacuole	It contains cells sap which act as an osmoregulation by helping to remove excess water in cells.

Nucleolus	It produces the ribosome for protein synthesis.
Endoplasmic reticulum	It aids the transport of materials within the cytoplasm.
Golgi bodies	It functions in synthesis, packaging and distribution of materials.
Chloroplasts	They contain chloroplast which aids photosynthesis in green plants.
Lysosomes	They are sites for respiratory enzymes.
Ribosomes	They are responsible for protein synthesis.
Cell wall	It provides protection, shape and mechanical support for the cell.
Centrioles	They are important in cell division. They may also serve as basal body from which flagella or cilia arise.
Starch granules	They store starch for cell.

Similarities between Plant and Animal Cell

Both plant and animal cells have in common the following organelles;
(a) Nucleus (b) Mitochondria (c) Cytoplasm (d) Ribosome (e) Cell membrane
(f) Lysosome (g) Chromosome (h) Endoplasmic reticulum (i) Golgi bodies
(j) Nucleolus

The Difference between Plant Cell and Animal Cell

Plant Cell	Animal Cell
Plant cell has chloroplast	Animal cell has no chloroplast
It is usually rectangular and definite in shape	Animal cell is usually spherical
It has rigid cell wall	It has no cell wall
It lacks flexible cell membrane	It has flexible cell membrane
It has a large vacuole	It has a small vacuole
It stores lipid as oil	It stores lipid as fat
Nucleus is at the edge of the cell	Nucleus is at the center of the cell

Assignment

1. What is a cell?

2. State the function of the following cell organelles:
   i. Mitochondria
   ii. Nucleus
   iii. Ribosome
   iv. Chromosome

TOPIC: THE CELL AND ITS ENVIRONMENT

DIFFUSION

Diffusion is defined as the process by which molecules or ions of a substance (i.e. gases and liquids) move from a region of high concentration to a region of low concentration until they are evenly distributed.

FACTORS AFFECTING OR CONTROLLING DIFFUSION

1. State of Matter: Diffusion varies with the three states of matter. The diffusion of gases is much faster than that of liquids while liquids is much faster than solid.
2. Molecular Size: The smaller the molecules, the fasterthe rate of diffuse while the larger the molecules, the slower the rate of diffusion.
3. Differences in Concentration: The greater the differences in concentration of the molecules, the greater the rate of diffusion.
4. High Temperature: The higher the temperature, the faster the rate of diffusion.

IMPORTANCE OF DIFFUSION TO ANIMALS

1. There is intake of oxygen or nutrients from the mother to foetus (embryo) through placenta.
2. Gaseous exchange in mammals occurs in the lungs during respiration.
3. Gaseous exchange in many cells and organisms, e.g. Amoeba takes in oxygen and gets rid of carbon dioxide by diffusion.
4. There is movement of carbon dioxide from the lung capillaries into the air sac.

IMPORTANCE OF DIFFUSION TO FLOWERING PLANTS

1. Movement of carbon dioxide through the stomata of the leaves during respiration.
2. There is movement of carbon dioxide through the stomata into the leaves during photosynthesis.
3. Water vapour leaving the leaves during transpiration.
4. Movement of oxygen into the leaves through the stomata during respiration.

OSMOSIS

Osmosis is defined as the flow of water or solvent molecules from a region of dilute,lower or a weaker solution to a region of concentrated or stronger solution through a selectively or differentially permeable membrane.

In osmosis, there are usually two solutions which are separated by a differentially permeable membrane. The weaker solution is said to be hypotonic while the stronger solution is said to be hypertonic. When both solutions have the same concentration, they are said to be isotonic.

The Differences between Diffusion and Osmosis

DIFFUSION	OSMOSIS
It occurs in gases and liquid.	It occurs in liquid medium only.
It occurs in living and non in living things.	It occurs naturally in living organism.

PLASMOLYSIS

This is defined as the outward movement or flow of water from living cells when they are placed in a hypertonic solution. It is often regarded as the opposite of osmosis.

HAEMOLYSIS

This is defined as the process by which red blood cells or corpuscles split 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 take in too much water and become swollen and may even burst.

Similarities between Plasmolysis and Haemolysis

1. They both occur in living cells.
2. Both processes can lead to the death of the cells concerned.

Differences between Plasmolysis and Haemolysis

PLASMOLYSIS	HAEMOLYSIS
It occurs in plant cells.	It occurs in red blood cells.
Plant cells shrink.	Red blood cells burst.
It occurs in hypertonic solution	It occurs in hypotonic solution

TURGIDITY

It is defined as the condition whereby cells absorb too much water until it is fully stretched.This occurs in a hypotonic solution.The cell does not burst because of it's rigid cell wall.

Importance of Turgidity

1. It help plant stand erect.
2. It gives support to the stem, flower, leaves and guard cells.

FLACCIDITY

This is defined as the condition where plants lose water to their surrounding faster than they can absorb. When a plant loses more, it is said to be flaccid.This occurs during the period of drought.It can lead to wilting and plant death.

Assignment

1. Define the following terms:
   i. Diffusion
   ii. Osmosis
   iii. Plasmolysis
   iv. Haemolysis
   v. Turgidity

TOPIC: SOME PROPERTIES AND FUNCTIONS OF THE CELLS

NUTRITION (FEEDING)

Nutrition is the process by which food is taken in by living organisms in order to supply the nutrients required for the continuous metabolic reactions going in the body. Food is the source of nutrients.

Usefulness of Food

Living cells or organisms require food for various reasons. These reasons are:

1. To provide energy needed for various physical and metabolic activities.
2. To make essential substances such as hormones and enzymes.
3. To make new cells for growth and replacement of worn-out tissues.
4. To supply various substances required for healthy growth and development.

Types of Nutrition

All living organisms are capable of carrying out different modes of nutrition. However, the mode of nutrition can be grouped into two major classes referred to as autotrophic and heterotrophic nutrition.

Autotrophic Nutrition

This is the type of nutrition in which organisms are able to manufacture their food. Organisms which can manufacture their food are called autotrophs.

Autotrophic nutrition is further divided into two groups. These are holophytic or photosynthetic nutrition and chemosynthetic nutrition.

1. Holophytic (Photosynthetic) Nutrition: Holophytic nutrition is the type of nutrition in which all green plants are able to manufacture their own food making use of carbon dioxide and water in the presence of sunlight. This process is called photosynthesis.

✓

2. Chemosynthetic Nutrition: Chemosynthetic nutrition is another mode of nutrition in which certain bacteria are able to synthesise organic compounds from simple inorganic materials such as carbon (iv) oxide, ammonia, water or nitrite to manufacture their food.

✓

✓

3. Heterotrophic Nutrition: This is the type of nutrition in where organisms cannot manufacture their food but depend directly or indirectly on plants (autotrophs) for food. Organisms which cannot manufacture their own food are called heterotrophs. Most animals, fungi, protozoa and some bacteria belong to this group. Heterotrophic nutrition is also sub-divided into the following groups or types:

a. Holozoic Nutrition: Holozoic nutrition involves the feeding on other organisms or solid organic substances synthesised by green plants.

b. Parasitic Nutrition: This is the type of nutrition in which certain organisms feed on another organism in order to derive nourishment from it and still cause harm to the host Organism.

c. Saprophytic Nutrition: This is the type of nutrition in which certain organisms called saprophytes; feed on dead and decaying organic materials.

d. Symbiotic Nutrition: This is the type of nutrition in which two organisms of different species called symbionts live together and derive nutrients or food from each other.

ROLES OF ENZYMES

Enzymes are biological catalysts made of protein. They alter the rate of chemical reactions without themselves being chemically changed at the end of the reaction. Catalysts are substances that can change the speed of a chemical reaction.

MINERAL SALTS

Plant cells require mineral salts or elements obtained from the soil in form of solution for healthy growth and development. These elements or plant nutrients are grouped into two classes depending on the quantity that is required by plants.

Macro-nutrient or major elements: These are elements or nutrients required by plants in large quantities for healthy growth and development. Examples are: Nitrogen, phosphorus, potassium, magnesium, calcium, oxygen, hydrogen, carbon, sulphur and iron.

Micro, Trace or minor elements: These are elements or nutrients required by plants in small quantities for healthy growth and development. Examples are: Zinc, copper, boron, molybdenum, cobalt, chlorine and manganese.

METABOLISM

Metabolism in living organisms is grouped into two parts. These are anabolism and catabolism.

Anabolism: This is defined as the building up of complex organic molecules from simple ones in a biological system. Common examples of anabolic processes are:

1. The formation of glycogen from glucose.
2. The formation of starch from glucose.
3. The formation of proteins from amino acids.
4. The formation of fats and oil from fatty acids and glycerol.
5. Photosynthesis in green plants.

Catabolism: This is defined as the breaking down of complex organic molecules into simple substances couples with the release of energy. Examples of catabolism in the body are: respiration, fermentation (the breakdown of carbohydrates by microorganisms) and digestion.

FEEDING IN AMOEBA

Protozoa like Amoeba exhibit holozoic mode of nutrition. Amoeba feeds on micro-organisms like diatoms, demids or other organic particles. It engulfs the food particles by putting out its pseudopodia which surround the food particle by forming a cup-shape when the two ends of the pseudopodia touch. The pseudopodia on meeting or touching fused and enclosed the food into the body with little drops of water; this forms a food vacuole. The food is digested inside the food vacuole.

CELLULAR RESPIRATION

Cellular respiration refers to a series on chemical reaction that involves the enzymatic breakdown of glucose to release energy and produce carbondioxide and water as bi- products. The energy released is in form of ATP (Adenosine Triphosphate). ATP is the form in which energy is stored, carried and used by living cells.

✓

TYPES OF CELLULAR RESPIRATION

There are two types of cellular Respiration

Aerobic Respiration

This type of respiration involves the breakdown of food(glucose) in the presence of oxygen to release a large amount of energy, water and carbon dioxide.

✓

THE PROCESS OF AEROBIC RESPIRATION

This reaction takes place over the course of three major pathways;

1. Glycolysis
2. The Krebs Cycle
3. Electron Transport Phosphorylation (chemiosmosis)

Glycolysis (glyco = sugar; lysis = breaking): it involves the breakdown of glucose into a 3- carbon molecule called Pyruvate or pyruvic acid, producing energy in the form of ATP and NADH. This is the first step in cellular Respiration. Oxygen is not required during Glycolysis and it takes place in the cytoplasm of the cell. 2 ATP and 2 NADH molecules are formed per glucose molecule.

Glycolytic process begins with glucose phosphorylation (conversation of glucose into glucose -6- phosphate) by an enzyme called Hexokinase in the cell.

What happens to the pyruvic acid produced depends on the presence of absence of oxygen. Hence Glycolysis takes place both in aerobic or anaerobic organisms. In anaerobic organisms, pyruvic acid is converted into alcohol in plants and lactic acid in animals. In aerobic organisms, pyruvic acid enters the mitochondria and is converted into an enzyme called Acetyl Co A; a 2- carbon compound that will give off carbondioxide and hydrogen atoms. Acetyl Co A links Glycolysis and Kreb's cycle. It is also formed during the breakdown of fats and protein.

The Krebs Cycle

This is also called the Citric acid cycle or the tricarboxylic acid cycle. Kreb cycle begins with pyruvic acid that was formed during Glycolysis and combines with Acetyl Co A to form citric acid. Kreb cycle takes place in the mitochondria in the presence of oxygen. Carbondioxide and hydrogen are produced at various stages of the Kreb cycle. The hydrogen reacts with oxygen to form water. During this process, large amount of energy (ATP) for use (36 ATP). The total breakdown of glucose from Glycolysis to Kreb cycle yields 38 ATPs.

Anaerobic Respiration/Fermentation

This is a type of cellular respiration that does not require oxygen to produce energy. Here, glucose is broken down to yield carbondioxide, alcohol (ethanol) and energy.

✓

A form of anaerobic respiration is fermentation. Fermentation is when glucose is broken down in the absence of oxygen to yield alcohol(ethanol), carbondioxide and energy by an enzyme in yeast called Zymase.

Anaerobic respiration in animals

$C_6H_{12}O_6$ $2C_3H_6O_3$ + 2ATP/Energy/150 k cal.

(Glucose) (Lactic acid)

OXYGEN DEBT

The build-up of lactic acid, during strenuous exercise is poisonous and makes the muscles ache, oxygen is needed to break down or get rid of the lactic acid, that is why athletes continue breathing heavily even after the exercise is over, the oxygen needed to get rid of the lactic acid is known as oxygen debt.

ACTIVITIES THAT CAN RESULT IN OXYGEN DEBT

Running, boxing, swimming , dancing, jumping etc.

Difference between Aerobic and Anaerobic Respiration

Aerobic Respiration	Anaerobic Respiration
1. Aerobic respiration uses oxygen	Anaerobic respiration is respiration without oxygen
2. Aerobic respiration occurs in most cells.	Occurs in many anaerobic bacteria and human muscle cells.
3. CO_2 and water is produced	Lactic Acid or Alcohol is produced
4. Lot of energy is liberated (36-38 ATP)	Relatively small energy is liberated (2ATP)

Assignment

1. Explain the following terms:
   i. Enzymes
   ii. Glycolysis
   iii. Kreb's cycle
   iv. Autotrophic nutrition
   v. Feeding in Amoeba

TOPIC: EXCRETION

Excretion is the removal of toxic or waste products of metabolism and substance in excess from the body of organisms.

The table below shows the excretory organs/organelles and waste products of some organisms

Organisms	Excretory systems / organs	Waste products
Protozoa e.g. Amoeba and paramecium	Contractile vacuole	Carbon dioxide, excess mineral salt and water
Flatworms e.g. Tapeworms	Flame cells	Carbon dioxide, urea, nitrogenous waste and water
Annelids e.g. Earthworms	Nephridia	Carbon dioxide, urea, nitrogenous waste and water
Insects e.g. cockroach	Malpighian tubules	Carbon dioxide, uric acid and water
Crustaceans	Green glands	Carbon dioxide, urea, ammonia and water
Fishes	Kidneys	Carbon dioxide, urea and water
Amphibians e.g. Toad	Kidneys	Sweat containing urea, salt and water
Reptiles	Kidneys	Bile salts, water and urea
Birds	Kidneys and lungs	Carbon dioxide, and water vapour
Mammals	Kidneys, skin, liver and lungs	Urine containing urea, salts, water, hormones and uric acid
Flowering plants	i. Stomata and lenticels ii. Bark of trees	i. Carbon dioxide, oxygen and water ii. Tannins, mucilage, gum, crystals, anthocyanin, alkaloid, resin, oil and latex

EXCRETION IN FLOWERING PLANTS

The gums, oils, latex, resins, etc. are some waste products stored in plant parts like barks, stems, leaves, etc. Eventually, plants shed off these parts.

FORMS IN WHICH WASTE PRODUCTS ARE EXCRETED

LIQUID FORM: They include water, uric acid, sweat, urine, urea, latex, gums etc.

GASEOUS FORM: They include carbon dioxide, oxygen, ammonia gas etc.

SOLID FORM: They include uric acid in some animals and alkaloids, mucilage in plants.

Assignment

1. What is excretion?
2. Why is water regarded a waste product?

TOPIC: GROWTH

Growth is defined as the irreversible increase in the dry mass of an organism. It is brought about by an increase in cell size or number.

DIFFERENCE BETWEEN PLANTS AND ANIMALS GROWTH

GROWTH IN PLANTS	GROWTH IN ANIMALS
Mainly restricted to growing regions or apical meristem	Diffuse or takes place in all parts of the body
Continuous throughout life (in growing regions)	Limited to certain periods in life
Indefinite number of parts	Definite number of parts

BASIS OF GROWTH

For an organism to grow it must pass through three phases, usually referred to as basis of growth. They are:
Cell division: The number of cells multiply, one divides into two, two into four and so on.
Cell enlargement: The size of daughter cells increase in mass and in size after cell division.
Cell differentiation: In this stage, structure of the cells changes to perform specific functions. And similar type of cells having same functions form a group, which is known as tissue.

TYPES OF CELL DIVISION

MITOSIS: This is a type of cell division in which daughter cells have same number of chromosomes as the parent cell. Mitosis takes place in somatic or body cell that are not involved in the production of gametes.Mitosis takes place during growth, development and asexual reproduction. Mitosis produces diploid number of cells (2n).

STAGES OF MITOSIS

1. Interphase: This is the resting stage of the cell.The cell has normal appearance. At this stage, chromosomes are too threadlike for clear vision.
2. Prophase: The prophase is divided into two, the early and late prophase. The chromosome shortens and thickens with a tight packaging of their components. Each chromosome consists of two chromatids held together by a centromere. The centrioles move to opposite poles of the cell. The nucleoli shrink and disappear, Nucleus and nuclear membrane disappears too and spindle fibers are formed.
3. Metaphase: This also exists in the early and late forms. The chromosomes line up around the equator of the spindle fibers. They are attached by their centromeres to the spindle fibres.
4. Anaphase: Here, chromatics migrate to opposite poles of the cell.
5. Telophase: Chromatids now reach the poles of the cells. It uncoils and lengthens to form chromatin again, thus can no longer be seen easily. Nuclear envelop re-forms around the chromosomes at each pole. The nucleolus re-appears. The chromosomes eventually regain their thread-like form and the cell returns to resting

condition (i.e. interphase).

IMPORTANCE OR ROLE OF MITOSIS

1. Leads to growth as a result of multiplication of the cells.
2. Leads to cell and tissue replacement.
3. Ensures genetic stability.
4. Is the basis for asexual reproduction

LIFE PROCESSES INVOLVED IN MITOSIS

Life examples of mitotic processes in animals include:

1. Cell division in liver.
2. Binary fission.
3. Growth in spermatogenesis.
4. Repair or healing of wound.
5. Production of red blood cells in the malpighian layer of the skin.

Life examples of mitotic processes in plants include

1. Mitosis occurs in root tip or apex.
2. It also occurs in stem tip or apex.
3. It also occurs in cambium.
4. It is found in meristems.

MEIOSIS

Meiosis is a type of nuclear division in which the chromosome number is halved i.e. from the diploid number (2n) to haploid number (n).

Meiosis occurs during the formation of sperms and eggs in animals, and spore formation in plants. The process of gamete formation is called gametogenesis. The process involved in the production of spermatozoa is called spermatogenesis and for the egg or ova; Oogenesis.

STAGES OF MEIOSIS

The stages in meiosis are two stages i.e. the first meiotic division and the second meiotic division. As a result of the divisions a single diploid cell gives rise to four haploid cells.

FIRST MEIOTIC DIVISION

Interphase: This is the latent or resting stage. At this stage the chromosomes are not seen.

Prophase I: This is the longest phase. The chromosomes become short and are seen as single structures. The homologous chromosomes pair up each pair is called a bivalent. The homologous chromosomes repel each other and partially separate. The chromatids are seen to be joined at several points along their lengths called chiasmata. At this point genes from one chromosome may be seen as crossing over to the other chromosome.

Metaphase I: The bivalent chromosomes arrange themselves around the equator and spindles attached to their centromeres

Anaphase I: The spindle fibres pull homologous chromosomes towards opposite poles of the spindle. This process separates the chromosomes into two haploid sets.

Telophase I: The end of meiosis 1 finishes, with the appearance of the homologous chromosomes at the opposite poles. The chromosomes still have two chromatids. This sets in the second meiotic division as the chromatids are not genetically identical.

SECOND MEIOTIC DIVISION

Prophase II: The nucleoli and nuclear envelopes disappear, the chromatids shorten and thickens, centriole

moves to opposite poles, new spindle fibres appear.
Metaphase II: Chromosomes line up separately around the equator of the spindle
Anaphase II: Centromere divides and spindle fibre pulls the chromatids to opposite poles.
Telophase II: This stage leads finally to four haploid daughter cells, spindles fibres disappear, chromosome uncoils becoming distinct. Nuclear membrane reforms around each of the four nuclei i.e. with haploid chromosome (n).

IMPORTANCE OR ROLES OF MEIOSIS

1. It aids the formation of sperms or male gametes and ova (eggs) or female gametes in animals.
2. It aids the formation of pollen grains in anthers and ovules in ovary of flowering plants.

Life examples or areas where meiosis occur in plants
Meiosis occurs in ovules.
It is also occurs in anthers.
Life examples or areas where meiosis occur in animals
Meiosis occurs in ovaries.
It also occurs in testes.

DIFFERENCES BETWEEN MITOSIS AND MEIOSIS

MITOSIS	MEIOSIS
1. Two offspring cells are formed	Four offspring cells are formed
2. Occurs in somatic or body cell	Occurs in reproductive cell.
3. There is no crossing over	There is exchange of genetic material.
4. Mitosis involves only one stage of division	Meiosis involves two stages of division
Daughter cells are identical to parent cell.	Daughter cells are different from parent cell.
Homologous chromosome do not associate	Homologous chromosome associates to form bivalent.
Number of chromosome remains the same after division. Diploids	Number of chromosome is halved after division.Haploid
Occurs in asexual reproduction	Occurs in sexual reproduction

FACTORS AFFECTING GROWTH

Factors which affect growth of organisms are grouped into two parts which are: External and Internal Factors.
External Factors Include:
(a) Availability of nutrients (b) Humidity (c) Light (d) Temperature (e) pH (f) Accumulation of metabolic product;
Internal Factors include the hormones
Plant hormones are:

a. Auxins promotes or inhibit cell elongation in stems and roots. They also stimulate cell division.
b. Gibberellins promotes cell elongation and bring about growth in the stem.

Assignment

1. Define the term *Mitosis.*
2. Mention and explain the stages of mitosis.

TOPIC: IRRITABILITY

CELL REACTION TO ITS ENVIRONMENT

All living things are capable of responding to internal and external stimuli. The ability to do this is called irritability or sensitivity. By this means, plants and animals are able to detect and respond to changes in their environment. Irritability is one of the basic characteristics of living organism.

TYPES OF RESPONSE

Generally, animals respond very quickly to external stimuli while plants respond slowly. Only certain organs respond to external stimuli in plants but in animals, often, the whole organism respond to the stimulus. Organs of higher plants that respond to stimuli are:

(a) Flowers (b) Leaf (c) Root (d) Stem (e) Tendril

There are three major types of responses. These are tactic, nastic and tropic movements.

TAXIS OR TACTIC MOVEMENTS

Taxis or tactic response is a directional type of response or movement in which a whole organism moves from one place to another in response to external stimuli such as light, temperature, water or certain chemicals. Locomotion or movement could be positive or negative.

Examples of tactic movements are

a. Thermotaxis: this is the movement of organism in response to temperature or heat. E.g. Motile bacteria or snail moving away from hot region to a cold region(negative thermotaxis).
b. Phototaxis: This is the movement in response to light stimulus. E.g. A typical euglenoid has a pair of flagella, or whiplike appendages used in swimming, at the front end. It also executes a kind of crawling movement by changing the shape of its body. An eyespot enables it to move toward or away from light.
c. Hydrotaxis: This is the response of a whole organism to the stimulus of water or humidity. E.g. Woodlouse moves towards areas of high humidity.
d. Chemotaxis: This is the movement of an organism in response to a chemical stimulus. e.g. Amoeba and paramecium moving away from chemicals.

EXAMPLES OF TACTIC RESPONSE

Stimulus	Name of Response	Examples

Light	Phototaxis	Euglena and chlamydomonas swim towards light of low intensity(positive phototaxis) and away from light of high intensity(negative phototaxis)
Chemicals	Chemotaxis	Sperms swim towards the chemical produced by the egg cell(positive chemotaxis)
Temperature	Thermotaxis	Motile bacteria swim from cold regions to warm regions(positive thermotaxis)

NASTISM OR NASTIC MOVEMENTS

Nastism is a type of response in which a part of a plant moves in response to non-directional stimuli such as changes in light intensity, temperature or humidity. Examples of Nastic movements are:

a. Closing of the Morning glory flower when the light intensity is low.
b. The folding of the mimosa plant when it is touched.
c. The petals of Sunflower which open in the light and close in the dark.

Tropism or Tropic movement

Tropism is a type of response in which a part of plant moves in response to a directional stimulus. The direction of the response is related to that of the stimulus and is positive if the plant part grows toward the stimulus, and negative if the part grows away from it. Tropisms are very slow growth movements. They are named according to the stimuli.

Types of Response

a. Phototropism: This is the response of plants to light. The shoots are positively phototropic while the roots are negatively phototropic.
b. Hydrotropism: This is the response of plants to water. The roots are positively hydrotropic while the shoots are negatively hydrotropic.
c. Geotropism: This is the response of plants to gravity. The roots are positively geotropic while the shoots are negatively geotropic.

d. Thigmotropism: Plants with tendrils for climbing,twine around a support. This shows positive response to touch while the root tips grow away from it showing negative response to touch.

How Environmental Factors Evoke Response

A plant that is starved of adequate light responds towards any source of light available. The shoot will respond positively to the source of light while the root will respond negatively.

Placing a plant in a horizontal position causes an unequal diffusion of hormones. This will make the shoot negatively geotropic by growing upwards.

In a shaded area, smaller plants in an attempt to get light from the top, grow taller. This is called aetiolation.

Assignment

1. Explain the following:
   i. Tactic movement
   ii. Nastic movement
   iii. Tropic movement
2. Mention one example of each.

TOPIC: MOVEMENT

Movement is the ability of living organisms to move from one place to another.nreasons for movement include searching for food, escape from danger, response to stimuli (either positively or negatively) and for the sake of reproduction. All organisms that can move are equipped with various organelles or organs for movement.

Movements that are due to external stimuli may be nastic, tactic or tropic movement.

Cyclosis: This is the streaming rotary movement of protoplasm within certain cells and one-celled organisms, i.e. circulation of cytoplasm or cell organelles, such as food vacuoles in some protozoan.in animals, cyclosis occurs in protozoa like Amoeba popularly known as amoeboid movement. Amoeboid movement is aided by a mechanism called cytoplasmic streaming.

Movement in plants is not as conspicuous as found in animals. Their movement is by continuous and uniform flow of cytoplasm. In animals, cyclosis occurs in protozoa like amoeba (amoeboid movement).

Organelles for Movement

Organelles which cause movements affecting the whole cells and leading to cellular locomotion in Paramecium, Chlamydomonas and Euglena are flagella and cilia.

Flagella: They are long and are used in moving in liquid medium by flashing against water current. Euglena and Chlamydomonas have flagella.

Cilia: They are usually numerous and short. It aids movement in water just like flagella. Paramecium has cilia.

Assignment

1. What is *cyclosis*?
2. Describe cyclosis in Amoeba.

TOPIC: REPRODUCTION

Reproduction is the ability of living organisms to give rise to new individuals of the same species. The purpose of reproduction is to ensure the continuity of life.

TYPES OF REPRODUCTION

Asexual Reproduction:

It involves a single parent without the production of gametes. It results in offspring that are genetically identical to each other and to the parent. All prokaryotes and some eukaryotes reproduce this Offsprings from asexual reproduction are called Clones.Cell division occurs by Mitosis(occurs continuously in body or somatic cell).

Sexual Reproduction:

It involves two parents and the fusion of male gamete(sperm cell) and female gamete (ova) to form a zygote which later develops into an offspring.Cell division occurs by meiosis (in germ cell during gametogenesis).

DIFFERENCES BETWEEN SEXUAL AND ASXEUAL REPRODUCTION

Sexual Reproduction	Asexual Reproduction
Two parents involved	One parent involved
Gametes or sex cell formed	No gametes formed
Meiosis involved	Meiosis not involved
Offspring varies genetically	Offspring identical/no genetic variation
Fewer individuals are produced	More individuals are produced
Reproduction is slower	Reproduction is rapid.

GENERAL FORMS OF ASEXUAL REPRODUCTION

BINARY FISSION

Binary fission: This is a process of asexual reproduction in unicellular organism in which a single cell (parent) divides into two equal parts by mitosis to produce two new daughter cells. Examples are found in protozoa like Amoeba, Paramecium and Bacteria.

BUDDING

Budding is a form of asexual reproduction in which the parent organism forms an outgrowth(bud) which then grows into a new organism. The new organism later separates from the parent organism. This occurs mainly in hydra and yeast.

SPORE FORMATION

Spore are asexual reproduction units formed by some lower organisms especially fungi, e.g. Rhizopus, which produces numerous spores in sporangia that are borne at the ends of upright hyphae called sporangiosphores. When the sporangia become mature, they burst and the spores are dispersed by the wind. If a spore falls on a suitable substance, it germinates and gives rise to a new mycelium.

VEGETATIVE REPRODUCTION

Vegetative reproduction involves the production of new individuals from the vegetative parts of the plant such as stem, roots and leaf.

TYPES OF VEGETATIVE REPRODUCTION

There are two types of vegetative reproduction.

a. Natural Vegetative Reproduction: This involves the use of natural or vegetative parts of plants to reproduce and get new individuals. Such parts include stems, leaves and roots.

b. Artificial Vegetative Reproduction: This involves the use of intelligence by man to grow new plants from cut portions of the vegetative body of an older parent plant.E.g cutting, layering, budding, grafting and marcotting.

FORMS OF NATURAL VEGETATIVE REPRODUCTION

a. Use of Modified Underground Stem:

*Some underground stems such as rhizome, e,g. cana lily, ginger. Sucker, e.g. banana, plantain and pineapple.

*Corm, e.g. cocoyam.

*Bulb, e.g. onion is one of many forms of natural vegetative reproduction.

b. Use of Fleshy Leaves: This involves the use of some fleshy leaves of some plants to produce new individuals, e.g. Bryophyllum.

ARTIFICIAL VEGETATIVE REPRODUCTION

1. Cutting: This is cutting part of a plant into portions, which is planted to produce new plants. Such cut portions are called cuttings.This could be done in plants whose stem or leaves produce roots. The stem must possess nodes which is inserted into a fertile soil. The stem is cut from a distance of 20 to 30 cm. and is buried in the moist soil in natural position. Example of plants propagated by stem cuttings are cassava, hibiscus, sugar cane, cocoa, cola and sweet potato. An advantage of cuttings method is that by using this method we can produce many new plants from just one plant quickly, without waiting for flowers and sexual reproduction.

2. Layering: In this method, a branch of the plant is pulled towards the ground so as to touch the soil leaving

the tip of the branch exposed above the ground. This is pegged for proper anchorage.After some time, new roots develop from the part of the branch buried in the soil. The branch is then cut off from the parent plant. The part of the branch which has developed roots grows to become a new plant (just like the parent plant). Wherever the ends of such runners touch the ground, new plants are formed at those places. Examples of plants propagated by layering are Tomato, Cocoa, Cola, Coffee, Jasmine, Strawberry, Raspberry, Lemon, Guava, Hibiscus (China rose), Bougainvillea and many slender ornamental plants.

3. Budding: This is a skilled technique used,where bud with flat shield- shaped piece of stem(Scion)is cut. An inverted T- shaped cut is made in the bark of another tree with desirable characteristics (stock). The scion is inserted into the stock and fastened.The joint is made water proof by using polythene tape with the bud left exposed. A successful union between the scion and stock will show development of new shoot after three weeks.The shoot above the union is removed while branches below the scion are carefully detached and transplanted. Examples of plants propagated using this method are orange, cocoa, rubber.

4. Grafting: Grafting is similar to budding.Here,a shanty cut is made on a whole shoot of a plant(scion) is applied on the shoot of another plant(stock) and fastened in such a way that both vascular cambia come in contact. The joint is covered with polythene tape to prevent infection by bacteria and fungus.If the union is successful, both plants grow as one plant.The scion continues to produce its original leaves, flowers and fruits but it gets water and minerals for making food from the chosen stock. So, the fruits will have the characteristics of both plants. Plants easily propagated by grafting are mainly the citrus, e.g. Orange, Grape and tangerine. Other plants propagated by grafting are: Apple, Peach, Apricot, Pear, Banana, and Pineapple etc.

ADVANTAGES OF GRAFTING

a. Grafting enables us to combine the most desirable characteristics of the two plants (scion and stock) in its flowers and fruits.
b. By grafting method, a very young scion (shoot part of a plant) can be made to flower and produce fruits quite fast when it is grafted to the stock (stem having roots) of a mature plant.
c. It enables us to obtain flowers and fruits having different desired characteristics by grafting scions from different varieties of plants on the same stock. Many varieties of mango have been produced by grafting method.
d. Grafting can be used to produce varieties of seedless fruits.

5. Marcotting: In marcotting, the roots grow from the part of a branch in which a ring of tissue has been removed. This branch can then grow into a new plant. Plants usually propagated by marcotting include garden shrubs, mango and lemon.

ADVANTAGES OF VEGETATIVE PROPAGATION

a. Only one parent is needed.
b. Offspring are identical to parents.
c. Offspring mature more rapidly.
d. Desirable characters are retained.

e. Plants are less susceptible to adverse weather condition

DISADVANTAGES OF VEGETATIVE PROPAGATION

a. Diseases of parents can easily be transmitted to offspring.
b. It reduces resistance to diseases and changes in climate.
c. There is no mixing of characters.
d. No new varieties of species are produced.
e. Undesirable characters are easily transmitted to offspring

SEXUAL REPRODUCTION

Sexual reproduction is a type of reproduction which involves the fusion of the male and female gametes to form a zygote which later develops to a young offspring.

TYPES OF SEXUAL REPRODUCTION

There are two types of sexual reproduction. These are conjugation and fusion of gametes.

CONJUGATION

Conjugation is a simple type of sexual reproduction which occurs in some lower organisms such as Mucor, Rhizopus, Paramecium and spirogyra. Conjugation is the process by which nuclear material is passed from one cell to another. In spirogyra, for example, conjugation starts with two filaments called conjugants coming together to lie side by side. Lateral outgrowth starts to develop opposite each other from opposite cells in the two filaments. The outgrowth meets and the separating walls dissolve to form a continuous channel called conjugation tube. Meanwhile the cytoplasm of each cell shrinks away from the cell walls and round up to form a gamete. One of the gametes regarded as the male migrates through the conjugation tube into the other cell. The cytoplasm of the two cells, the nuclei also fuse and a zygote is formed. After sometime, the zygote or zygosphere will germinate and a new filament is formed.

FUSION OF GAMETES (FERTILISATION)

Fusion of gamete is the union of the haploid male and female gametes to produce diploid organisms called zygote. The process of this union of the gametes to form this zygote is called fertilisation. In higher animals these gametes are formed in special organs called gonads. The male gamete called spermatozoa is produced in the testes by a meiotic cell division called spermatogenesis while female gamete called egg or ova is produced in the ovary also by a meiotic cell division called oogenesis.

During mating or coitus,these male and female gametes unite or join together by a process of fertilisation to form a diploid zygote which later develops into a new organism.

In higher plants, male and female gametes are also produced. The flowers are the reproductive units in plants. The male gametes called pollen grains are produced by the anthers while the female gametes called ovules are produced by the ovary of the flower. The pollen grains and the ovules fuse together during fertilisation to form a zygote. After fertilisation, the ovules form the seeds while the ovary becomes the fruit.

REPRODUCTION IN FLOWERING PLANTS

Reproduction in flowering plants begins with pollination, the transfer of pollen from anther to stigma on the same flower or to the stigma of another flower on the same plant (self-pollination), or from anther on one plant

to the stigma of another plant (cross-pollination). Once the pollen grain drops on the sticky and receptive stigma, a pollen tube grows from the pollen grain to an ovule. Two sperm nuclei then pass through the pollen tube. One of them unites with the egg nucleus and produces a zygote. The other sperm nucleus unites with two polar nuclei to produce an endosperm nucleus. The fertilized ovule develops into a seed.

ADVANTAGES OF SEXUAL REPRODUCTION

a. New varieties and species are produced.
b. It enhances survival in new or changing environment.
c. It allows for the production of hybrids for some desirable traits.
d. It provides the means for the maintenance of chromosome number from generation to generation.

Assignment

1. What is reproduction?
2. Briefly describe four major forms of asexual reproduction and mention at least **one** example of organism that exhibit such form of asexual reproduction.