**BIOLOGY SS 1**

**FIRST TERM**

## SCHEME OF WORK

WEEK TOPIC

1. Biology and Living Things
2. Living things and Non Living Things, Classification
3. Classification of Living Things
4. Classification of Animals and Organization of Life
5. The cell (Definition, Forms, Structure, Functions and Theory)
6. The cell and ItsEnvironment (Osmosis, Diffusion, Biological Significance)
7. Properties and Functions of the Cell (Cellular Respiration)

8&9. Mode of Nutrition and Plant Nutrition (Photosynthesis and Chemosynthesis)

1. Growth (Basis and Aspects of Growth)
2. Revision and Examination

**WEEK ONE**

# BIOLOGY AND LIVING THINGS

## CONTENT

Biology as Inquiry in Science

Process or Method of Science

Microscope Parts and Functions

## BIOLOGY AS AN INQUIRY IN SCIENCE

Science is the study of nature (living and non-living things). Biology, a branch of science, focuses on the intricate realm of living organisms in their natural habitat. The term "Biology" derives its origin from the Greek words "Bio," signifying life, and "logos," denoting the study of.

In the realm of biology, organisms are generally categorized into two main groups: plants and animals. As such, biology branches into two principal disciplines:

1. Botany: The study of plants.

2. Zoology: The study of animals.

Biology extends its reach into a myriad of specialized domains, including microbiology, parasitology, anatomy, physiology, biotechnology, and more.

The Relevance of Biology

Biology plays a pivotal role in numerous aspects of human life, offering its applications in various domains, including:

1. Medicine: Facilitating the production of drugs and vaccines for disease prevention and treatment. Notable examples include penicillin and organ transplants, such as kidney (renal) transplants.

2. Agriculture: Enabling the creation of hybrid crops and animals with desirable characteristics, and utilizing biological pesticides to control agricultural pests.

3. Bioremediation: Harnessing naturally occurring bacteria to remediate oil spills and toxic chemicals in the environment.

4. Biotechnology: Leveraging genetic engineering to combat genetic diseases.

5. Food Production: Contributing to the generation of single-cell protein (SCP) to mitigate protein deficiency issues, and advancing food storage and preservation techniques.

Evaluation

1. What is biology?

2. Describe the following branches of Biology:

(a) Parasitology

(b) Anatomy

(c) Physiology

The Scientific Method: Unraveling Nature's Mysteries

The scientific method is a systematic approach employed to investigate questions stemming from observations made in the natural world. This method serves as the tool for unveiling the intricacies of life, encompassing the following steps:

1. Observation: Initiating the process by utilizing the senses to describe what has been seen or sensed about an object.

2. Classification: Sorting observations into categories.

3. Inference: Employing logical reasoning to derive conclusions from observations.

4. Measurement and Identification: Measuring and identifying the existing problem.

5. Hypothesis: Formulating a reasonable explanation that can be tested experimentally.

6. Experiment: Conducting experiments to test the hypothesis.

7. Control or Conclusion: Establishing a control experiment with unchanging factors to ensure accurate results.

8. Theory or Law: A hypothesis that has been tested and verified becomes a theory. Multiple verified hypotheses collectively form a theory. Extensively tested and proven theories may evolve into laws or principles, subject to change based on ongoing research.

During experimentation, scientists adhere to a generally accepted pattern, which encompasses the following elements:

- Aim: The purpose of the experiment.

- Apparatus/Materials Required: The tools and materials needed.

- Method/Procedure: The steps followed during the experiment.

- Observations: The findings and observations made.

- Conclusion: The conclusions drawn from the observations and the final results.

- Precautions: Safety measures and precautions to mitigate hazards.

Evaluation

1. Define:

(a) Hypothesis

(b) Theory

(c) Principle

2. List the steps in the scientific method.

Microscope Parts and Functions

A microscope is an essential instrument used for magnifying and examining organisms smaller than 0.1mm, imperceptible to the naked eye. A compound light microscope comprises the following components:

1. Revolving Nosepiece: Selects the lens to be used and aligns it with the eyepiece.

2. Objective Lenses (Low, Medium, and High Power): Magnify the observed object.

3. Eyepiece Lens (Ocular): Allows the viewer to observe the magnified object.

4. Body Tube: Connects the eyepiece, revolving nosepiece, and objective lenses.

5. Coarse Focus Knob: Used for focusing on objects at low power.

6. Fine Adjustment Knob: Enables precise focusing for medium and high power magnifications.

7. Arm: Facilitates lifting or carrying the microscope.

8. Clip: Secures a glass slide on the stage.

9. Stage: Displays the slide and specimens under examination.

10. Condenser: Regulates the amount of light entering the microscope and illuminating the object.

11. Knob: Adjusts the condenser's height.

12. Base: Provides stability for the microscope on the table.

13. Mirror: Gathers and directs light rays to the condenser and the object under observation.

Evaluation

1. List five major parts of a microscope and their functions.

2. Mention two other types of microscopes.

General Evaluation

1. "Biology is a science that studies life." Elaborate on this statement.

2. Enumerate various professions that benefit from a comprehensive knowledge of biology.

3. How does biology relate to you as a living organism?

4. Define the scientific method.

5. Describe the pattern followed during experimentation in scientific studies.

WEEKEND ASSIGNMENT

1. Biology is a subject concerned with the study of \_\_\_\_ (a) living things (b) non-living things (c) living and non-living things (d) climate.
2. A parallel experiment done alongside a laboratory experiment is said to be \_\_\_\_\_\_\_ (a) side experiment (b) certainty experiment (c) controlled experiment (d) emergency experiment.
3. A reasonable explanation for any observation made in nature is scientifically termed \_\_\_\_ (a) idea (b) theory (c) hypothesis (d) notion.
4. \_\_\_\_\_ is a scientific fact (a) observation (b) theory (c) idea (d) hypothesis
5. The part that regulates the amount of light entering a microscope is the (a) knob (b) fine adjustment (c) condenser (d) objective lens

### THEORY

1. State four relevance of biology to life.
2. List five careers in biology.

**WEEK TWO**

**LIVING THINGS AND NON LIVING THINGS**

### CONTENT

Characteristics of Living Things

Differences between Plants and Animals

Classification of Living Things

### CHARACTERISTICS OF LIVING THINGS

Everything in nature can be classified into two groups: living and non -living things.

The living things can be distinguished from their nonliving counterparts through the following characteristics observable in all living things:

1. MOVEMENT: Animals can move from place to place on their own in search of food. Higher plants move certain parts of their body in response to growth or external stimuli
2. RESPIRATION: In order to perform the numerous life processes, living things need much energy. The energy can only be obtained when the organism respires. Therefore, respiration is the oxidation of food substances in the presence of oxygen to produce energy with carbon (iv) oxide and water released as by products.
3. NUTRITION: The act of feeding is called nutrition. All organisms need food to carry out their biological activities. Green plants can manufacture their food. Hence, they are autotrophs while animals are dependent on plants for their food, so they are heterotrophs.
4. IRRITABILITY: Is the ability of living things to respond to external and internal stimuli in order to survive. External stimuli may be light, heat, water, sound or chemical substances.
5. GROWTH: this is the tendency of organisms to increase irreversibly and rapidly in length and size and in mass. The essence of growth is to enable organisms to repair or replace damaged or old tissues in their bodies. The food eaten by an organism provides the basis of growth.

6 EXCRETION: Toxic waste products of metabolism & other unwanted materials have to be eliminated to ensure proper functioning of the bodies of organisms. Such wastes include water, carbon (iv) oxide etc.

1. REPRODUCTION: Is the ability of a living organism to give birth to young ones (off springs). The essence is to ensure life continuity. Reproduction can be sexual (involving two organisms) or asexual (involving one organism)
2. LIFE SPAN / DEATH: Every organism has a definite and limited period of existence. Life , for all organism has five main stages , namely : origin ( birth ) , growth, maturity, decline and death.
3. COMPETITION: Living things tend to struggle for the basic things of life in order to survive. Hence, they compete for food, water, light, mates and space.
4. ADAPTATION: To survive, every organism possesses ability to get used to change in its environment.

### EVALUATION

1. State the characteristics that must be possessed by an organism to be referred to as living things.

1. Which of these characteristics does a virus possess.

### DIFFERENCES BETWEEN PLANTS AND ANIMALS

All living organisms can be generally classified as plants or animals. However, plants can be distinguished from animals in the following ways:

### PLANTS ANIMALS

|  |  |
| --- | --- |
| 1. Undergo passive movement. | Undergo free or active movement with well developed organs of locomotion. |
| 2. Gaseous exchange takes place through the entire body. | Gaseous exchange is through special organs. |
| 3. Green plants photosynthesize i. e.  they are autotrophs. | Animals do not photosynthesize i. e. they are heterotrophs. |
| 4. They exhibit slow response to stimuli. | They exhibit fast response to stimuli. |
| 5. Growth is apical and indefinite (continuous). | Growth is uniform and definite (limited). |
| 6. No specialized sense organs. | Possess specialized sense organs. |
| 7. No specialized excretory systems. | They have special and well developed excretory systems. |
| 8. Cell has rigid non living cellulose cell wall which provides mechanical support. | Have thin, flexible cell membrane. Mechanical support is provided by external exoskeleton or internal endoskeleton. |

9. They store food (carbohydrates) as They store carbohydrates as glycogen starch except fungi which store food as glycogen.

### EVALUATION

1. Differentiate between autotrophs and heterotrophs
2. State four differences between plants and animals

### CLASSIFICATION OF LIVING ORGANISIMS

Nature comprises millions of organisms, hence the need for identification, naming and classifying them in a meaningful manner. The present and widely accepted method of classification of organism was introduced by Carolus Linnaeus. The study of the general principles of classification is called taxonomy or systematic. Classification is an arrangement of organisms into groups, each group is then split into smaller groups and the members of each group have certain features in common which distinguish them from other groups. The largest group of organisms is the kingdom. The arrangement of living organisms from the highest to the lowest (with decreasing variety of organisms) is as follows:

KINGDOM PHYLUM OR DIVISION CLASS ORDER FAMILY GENUS

SPECIES

### BINOMIAL NOMENCLATURE

This is the standard system of naming living organisms. Each type of organism is given two names:

The name of the genus (generic name) to which the organism belongs. The name of the species (specific name) to which it belongs.

The generic name is always written first using initial capital letter (underlined or italicized) e.g.

Homosapiens is man’s scientific name.

### EVALUATION

1. Define taxonomy.

1. What is binomial nomenclature.

### GENERAL EVALUATION

1. Explain the differences between growth in plants and animals
2. Define the following characteristics of living things (a) respiration (b) irritability (c) excretion
3. What are the similarities between living and non-living things
4. What are the similarities between plants and animals
5. Define (a) species (b) genus (c) phylum in classification of organisms

### WEEKEND ASSIGNMENT

1. The ability of living things to get used to their environment is \_\_\_\_ (a) survival (b) adaptation (c) adjustment (d) photosynthesis
2. Response to stimuli in animals can be said to be \_\_\_\_\_\_\_ (a) very slow (b) very flow (c) fast (d) steady.
3. Fungi store their food (carbohydrate) as \_\_\_\_\_ (a) starch (b) glycogen (c) hormone (d) antibody

4 Sensitivity of a living organism to external factor around it is technically known as

\_\_\_\_\_\_\_\_ (a) alertness (b) irritability (c) sense organ (d) knowledge

5. Which of the following is the lowest in the category of classification? (a) Class (b) Species (c) Family (d) Genus

### THEORY

1. With five of the characteristics above, distinguish between plants and animals.
2. Classify human being fully.

**WEEK THREE**

**CLASSIFICATION OF LIVING ORGANISMS**

### CONTENT

Modern Classification of Living Organisms

Kingdom Monera, Protista, Fungi

Kingdom Plantae

Kingdom Animalia

### MODERN CLASSIFICATION OF LIVING ORGANISMS

All organisms cannot be suitably classified as either plants or animals based on

CarolusLinneaus classification. Therefore five kingdoms have been generally accepted for all living organisms, these include Monera, Protista, fungi, plantae and animalia.

### KINGDOM MONERA (Prokaryotes)

This group consists of simplest living organisms (bacteria, blue-green anabaena).

They are microscopic single-celled.

The cell wall does not contain cellulose. It is made up of protein and fatty materials. They have no definite nucleus. Nucleus lack nuclear membrane and DNA are scattered in the cytoplasm.

They lack most cell organelles except the ribosome.

Reproduction is asexual by binary fission.

### KINGDOM PROTISTA

They are unicellular organisms.

The organisms are all eukaryotes i. e. cell have definite nucleus.

Most protists are aquatic organisms.

They move either by cilia, flagella or pseudopodia. Some are free living while few are parasitic.

Protists can be broadly divided into two groups;

a. Protozoa: animal-like protists e.g. amoeba, paramecium, plasmodium, trypanosome.

1. Protophyta: Plant-like protists e. g. Diatoms, chlorella, chlamydomonas.

Note: Euglena is a protist with plant and animal like features.

### KINGDOM FUNGI

They are non-green organisms which do not photosynthesize (lack chlorophyll).

All fungi except slime moulds are non-motile.

They have rigid cell wall made up of chitin and polysaccharides.

They reproduce asexually by producing spores and sexually as well.

Most of them are saprophytes while some are parasites.

They lack true roots, stem and leaves.

Few are unicellular (yeast) while most are multicellular (rhizopus, mushroom).

Multicellular fungi have filamentous bodies that are made up of a network of fine, branching filaments called **hyphae** (singular: **hypha**). This mass of hyphae is known as **mycelium** (plural: **mycelia**).

### EVALUATION

1. Describe the features of a named (a) Animal like protist (b) Fungi (c) Bacteria

1. State the phyla of fungi.

### KINGDOM PLANTAE

This consists of organisms with cellulose cell wall and chlorophyll for manufacturing their food. It consists of three major phyla i. e thallophyta, bryophyta and tracheophyta.

### a. THALLOPHYTA (ALGAE)

Examples include spirogyra, volvox, sargassum and kelp

These are simple aquatic photosynthetic plants

They are non vascular plants

They lack true root, stem and leaves.

They are either unicellular or multicellular and may be green, brown or red.

They reproduce asexually (by cell division, fragmentation, spore) or sexually. They exhibit alternation of generation.

### b. BRYOPHTA

These include hornworts, liverworts and mosses

Bryophytes are multicellular, non vascular plants.

They also lack true roots, stems and leaves.

They have chlorophyll as the only photosynthetic pigment.

They are terrestrial but live in moist place.

They produce spores asexually and also reproduce sexually. Hence, they also show a distinct alternation of generation.

### c. TRACHEOPHYTA

They are green multicelluar, terrestrial vascular plants i.e. they have tissues for conducting water and food.

They have true roots, stem, and leaves.

It is the largest group of plants and can be subdivided into two i. e. pteridophytes and spermatophytes.

### i. PTERIDOPHYTA (FERNS)

Examples include Dryopteris, platycerium, ferns etc

They are spore bearing plants.

They possess well developed vascular tissues and chlorophyll

Asexual and sexual reproductive organs are referred to as sori and prothalusrespectively

The stem grows horizontally and is referred to as rhizome **ii. SPERMATOPHYTA**

These are seed bearing plants. They can be grouped into two

### GYMNOSPERMS

Examples are cycads (whistling pine, fir), conifers and gingkos

Their seeds are borne naked in special structures called cones. They don’t have flowers e.g conifers, cycads.

These are trees or shrubs with needle, broad or scale like leaves.

### ANGIOSPERMS

They form the largest group in the plants kingdom and are adapted to almost every kind of habitat. Examples are oil palm tree, water leaf, maize plant etc.

They bear true flowers for sexual reproduction.

They have more abundant water conducting vessels than gymnosperms.

They bear seeds enclosed in fruits.

They show more specialized and complex reproductive mechanism involving pollination and fertilization.

Angiosperms are grouped into two, monocotyledons and dicotyledons.

### MONOCOTYLEDONOUS PLANTS

Examples include maize, guinea grass, rice, oil palm etc.

They have seeds with one seed leaf (cotyledon).

They are generally herbs with scattered vascular bundles in their stem.

They have leaves with parallel venation and fibrous root system.

They undergo hypogeal germination (i.e. their cotyledons remain below the ground at germination.)

They do not undergo secondary growth.

### DICOTYLEDONOUS PLANTS

Examples include orange, hibiscus plants etc.

They are more primitive angiosperms having seeds with two seed leaves

They have tap root system

They usually undergo secondary growth

The leaves have veins arranged in branched network

They undergo epigeal germination (i.e the cotyledons are borne above the soil).

### EVALUATION

1. Differentiate between thallophytes and bryophytes
2. Differentiate between angiosperms and gymnosperms

### KINGDOM ANIMALIA

This consists of multicellular organisms with no cell wall; they have no chloroplasts in their cell therefore they feed heterotrophically. Animals can be classified into two main groups:

a. Invertebrates – animals without backbones.

1. Vertebrates – animals with backbones.

These two groups can further be divided and subdivided based on body symmetry, body design and body cavity.

### INVERTERBRATES

1. **Phylum Porifera (sponges):**
2. They are primitive multicellular, aquatic animals (colonies of cells)
3. They lack true tissues and nervous system
4. Reproduce asexually and sexually (hermaphrodites

**b. PhylumCoelenterata (Cnidaria: Hydra, jelly fish, sea anemones):**

They have two layered bodies surrounding a central hollow cavity called enteron.

They have tentacles and most of them are marine Possession of stinging cells called nematocysts

There is only one opening called mouth. No anus.

### c. Phylum Platyhelminthes (Flatworms: Tapeworm, planaria, liver fluke)

They have soft, flat, unsegmented elongated bodies They lack body cavity.

They are bilaterally symmetrical and mainly parasites in man and other animals

They possess alimentary canal. No anus

### d. Phylum Nematoda (roundworm, hookworm, guinea worm)

They have thread like, cylindrical, unsegmented body with no body cavity.

They are bilaterally symmetrical.

They have alimentary canal with mouth and anus

Some are parasitic, while others are free living

### e. Phylum Annelida (earthworm, leeches)

They have internal and external segmented bodies which are long and cylindrical.

They have true body cavity (ceoloma).

The appendages (setae) are not jointed

### f. Phylum Mollusca (snail, squid, octopus)

They have soft unsegmented bodies

Tentacles are present in most members

Some have shells e.g snails, squid etc while others have no shell e. g. octopus, slug

### g. Phylum Echinodermata (star fish, bristle star, sae lily)

They possess tough, spiny and calcerous exoskeleton

The head is not usually distinct

They are all marine

Most of them are stay shaped

Examples are britle star, star fish, sea urchin, sea lily etc

1. **Phylum Arthropoda (**the largest group in the animal kingdom)

They have segmented bodies

They have exoskeleton made up of chitin Their appendages are jointed.

They have body divisions

They are bilaterally symmetrical.

They can be subdivided into four classes

1. Insectae.g cockroach, housefly, grasshopper etc.

1. Arachnida e.g. spider, scorpion, tick etc.

1. Crustaceans e.g. crab, crayfish, prawns etc.

1. Myriapoda e.g. centipedes and millipedes.

### EVALUATION

1. Define the following in relation to body symmetry (a) asymmetrical (b) radially symmetrical (c) bilateral symmetrical
2. Write short note on body cavity

### GENERAL EVALUATION

1. Differentiate between an algae and a fungi
2. Describe the structural features of a named algae
3. Differentiate between pteridophytes and spermatophytes
4. What do you understand by alternation of generation
5. State four differences between mollusca and arthropoda

### WEEKEND ASSIGNMENT

1. Angiosperms and gymnosperms belong to the plant group known as A. scizophyta B.

bryophyta C. pteridophyta D. spermatophyte

2 Sting cells are normally found in A. Flatworms B. Hydra C. Snails D. Paramecium

1. Which of the following are differentiated into true roots, stems and leaves? A. Schizophyta B. Bryophyta C. Pteridophyta D. Algae
2. Each of the following is an arthropod EXCEPT A. crab B. millipede C. spider D. snail
3. In which of the following groups of animals are flagella and cilia found A. Flatworms B. Protozoa C. Nematodes D. Coelenterates

### THEORY

1. State two distinguishing features each of the four classes of the phylum arthropoda

1. In a tabular form, state four differences between monocot and dicot plants

**WEEK FOUR**

**CLASSIFICATION OF ANIMALS AND ORGANIZATION OF LIFE**

### CONTENT

The vertebrates

Level of organization of life

Complexity of organization in higher organization

### THE VERTEBRATES (PHYLUM CHORDATA)

All vertebrates have the following features:

1. A bilaterally symmetrical body which is divided into a head, trunk and a tail with a neck joining the head to the trunk in most vertebrates.
2. An internal skeleton (endoskeleton)
3. Well developed central nervous system and sense organs.
4. A closed blood system
5. Skin covered with scales, feather or hair.

The phylum chordata (animals with notochord) can be subdivided into five classes. Thee include

### a. Class Pisces (tilapia, shark, dogfish)

These are fishes which are aquatic, cold blooded (poikilothermic) i.e. the body temperature varies with that of the surrounding).

Their bodies are covered with scales.

They breathe through their gills

Fertilization is external

They posses fins for locomotion

Their bodies are streamlined in shape

### b. Class Amphibians (toad, frog, newt)

They are cold blooded animals.

They spend most of their time on land but reproduce (lay eggs) in water.

They carry out gaseous exchange using gills, lungs, skin or mouth living.

They have naked moist skin

Fertilization is external

They have two pairs of limbs with webbed toes

### c. Class Reptilia (lizards, snakes, crocodiles etc)

Their skin is covered with dry scales which prevent water loss from the body. Gaseous exchange is carried out through their lungs Fertilization is internal and eggs are laid on land.

They are cold-blooded

### d. Class Aves (birds)

They are warm- blooded (homoiothermic) i.e. they are able to keep their body temperature more or less constant.

Their body is covered with feathers

They have toothless beak for feeding. Fore limbs modified into wings for flight Fertilization is internal.

### e. Class Mammalia (rats, bats, dogs, whales, monkey, kangaroos, man etc)

They are warm-blooded

They have skin covered with hair.

They possess heterodont teeth i.e. different sets of teeth.

They have a well-developed brain

They give birth to their young ones alive (viviparous) They use lungs for gaseous exchange.

### EVALUATION

1. State five distinguishing features of the phylum chordata

1. Differentiate between a named amphibian and a reptile

### LEVELS OF ORGANIZATION OF LIFE

Every living thing is made up of a cell or a number of cells. A single-celled organism is called unicellular while a many-celled organism is called multicellular. Organization of life is therefore the existence of life from a single-celled organism to a multicellular organism with complex forms that performs different functions. Four levels of organization of life exist, namely: cell, tissue, organ and system.

1. **Cell:** A cell is a functional and structural unit of protoplasm bounded by a membrane and containing nuclear and cytoplasmic materials. Some living things exist as cells which have cytoplasmic structures such as pseudopodia, cilia, flagella and vacuoles e.g. Amoeba, Chlamydomonas, Paramecium and Euglena. Common cells that perform distinct functions in plant and animals include sperm cells, nerve cells, bone cells, red blood cells, root hair cells etc.
2. **Tissues:** A tissue is a collection of cells which are similar in structure and functions. Hydra is an example of an animal that is made up of tissues only. Examples of tissues in animals and plants are epithelial tissue, blood, nerve tissue, muscle tissue, xylem and phloem tissues etc.

3 **Organ:** An organ is a collection of different tissues that perform a common function or functions e.g. Kidney, heart, brain, stem, roots etc. Example of organ in plant is onion bulb.

4. **System:** A system is a set of organs which co-operate to carry out one of the vital functions of life e. g. Digestive system, respiratory system, reproductive system, transport system etc.

### EVALUATION

1. List four types of cells in organisms and their functions

1. State the functions of five types of tissues in man

### COMPLEXITY OF ORGANIZATION IN HIGHER ORGANISMS

Higher organisms have bodies that are differentiated into specialised parts performing different functions. The different specialized parts made up of tissues, organs and systems make higher organisms more complex and efficient to carry out various activities of life.

### Advantages of complexity

1. It leads to division of labour and specialization
2. It has led to the efficiency of the various organs of the body.
3. The complexity of higher organism has led to their survival (adaptation) in their different habitats.
4. Various systems operate side by side without adversely affecting each other
5. Reproduction in complex organisms does not lead to the disintegration of the parents

### Disadvantages of complexity

1. Individual cells are not capable of existing independently and therefore depend on one another’s activities to exist
2. With complexity, ability to regenerate lost parts decreases.
3. Difficulties in acquisition of food materials and oxygen and loss of waste product
4. Difficulties in reproduction
5. It leads to slower rate of diffusion because the surface area to volume ratio is small and the distance from exterior to the center of the body is great

### EVALUATION

1. Why are higher organisms referred to as ‘complex’
2. State the advantages of complexity.

### GENERAL EVALUATION

1. Distinguish between Pisces, and amphibian.
2. Using their biological features distinguish between a cold-blooded animal and a warmblooded animal.
3. How can you recognize a vertebrate?
4. List five systems in flowering plants and their functions
5. State four advantages and three disadvantages of a complex organisms

### WEEKEND ASSIGNMENT

1. The feature that distinguishes a toad from a fish is the absence of A. scales B. lungs C. tail D. paired appendages
2. Some of the features of an animal are scales, teeth, nails and backbone. The animal is likely to be A. bird B. lizard C. toad D. rat
3. Which of the following animal is cold blooded? A. cat B. Lizard C. Whales D. Bird
4. A peculiar characteristics of mammals is that they A. have teeth B. are warm blooded

C. have sebaceous gland D. have lungs

1. The third level of organization of life is A. cell B. tissue C. system D. organs

### THEORY

1. In a tabular form, differentiate between the five classes of mammals under the following sub

headings

(a) Body temperature (b) fertilization (c) dentition (d) type of heart (e) body covering 2. State four advantages of complexity in higher organisms

WEEK FIVE THE CELLL

CONTENT

Definition of cell and forms of cellular existence

Cell structure and functions of the cell components

Similarities and Differences between plant and animal cell Cell theory

### DEFINITION AND FORMS OF CELLULAR EXISTENCE

The cell is the simplest, smallest, basic, structural and functional unit of life. The cell can carry out all life activities such as growth, respiration e. t. c.

Cells can exist in various forms which include

1. **As a single cell (unicellular forms)** e. g. Amoeba, Chlamydomonas, Chlorella, Euglena
2. **Chlamydomonas***(Chlamydomonas rivalries*)

Chlamydomonas is a unicellular plant like protist, motile using its flagellum and has a cup shaped chloroplast. It is sensitive to light using its eye spot. In the presence of light, starch grains appear in the cytoplasm. These disappear in a dark environment.

Chlamydomonas cells through its flagella (whip like) respond to changes in the surrounding such as moving from a dark region to a region of light. This organism disposes off its excess water using its contractile vacuoles. It reproduces asexually and sexually when it reaches its maximum size.

i **Amoeba** (*Amoeba proteus)*

Amoeba is a unicellular animal like protest and the simplest organism with heterotrophic mode of feeding. It is shapeless. It digests its complex food with its food vacuole. The undigested food materials are got rid of with excess water through its contractile vacuole. Amoeba moves about and captures its food with the aid of its pseudopodia (‘’false fe**et**’’). At maximum growth, amoeba reproduces asexually by dividing into two daughter cells (binary fission)

### i. Paramecium

Paramecium is a more complex unicellular organism compared to Amoeba. It is slipper- shaped and moves with the aid of its cilia, which also directs food into its gullet. The undigested food material is removed through the anal pore. Excess water is got rid of through the anterior and posterior contractile vacuoles. Two types of nucleus are visible in this organism, the micronucleus and mega nucleus

i. **Euglena (***Euglena viridis)*

*Euglenaviridis* is a protist that has both plant and animal features.

As a plant, it has chloroplasts (star shaped) for photosynthesis, pyrenoid for starch storage and paramylum granules (form in which starch is stored).

As an animal, it has no cellulose cell wall, but a plasma membrane called pellicle, a gullet, eye spot, contractile vacuole and flagellum for movement.

**In colonial forms** e. g. Volvox, Sponges, Pandorina

### Volvox

Volvox is made up of severalchlamydomonas- like cells which are arranged in angular layer to form a hollow ball-like structure. The cells are connected by cytoplasm strands.

The cell of Volvox moves about through the beating of the flagella. Most cells of Volvox lose their ability to reproduce. Only a few of them can reproduce to form two daughter cells **In filamentous forms** e. g. Spirogyra, Oscillateria, Oedogonium

### Spirogyra

Spirogyra is a filament of identical cells which are joined end to end without branching. Each cell of spirogyra carries out its function independent of another cell. Spirogyra has spirally arranged chloroplast for photosynthesis.

The filament grows indefinitely. The break-off cells from the filament have the ability to reproduce asexually to form a new filament. Spirogyra also has ability to reproduce sexually.

### As a part of multicellular organisms

A multicellular organism is made up of interdependent cells carrying out several special functions. The cells of the multicellular organisms are arranged to perform similar functions and then form tissues. A group of specialized tissues performing similar function forms an organ.

Organs are further organized to carry out special functions in form of system or organ system.

Ultimately, the interdependent biological system results in the complex multicellular organisms.

### EVALUATION

1. What is a cell, list four forms of cellular existence with examples?
2. Discuss feeding, movement and reproduction in a named unicellular organism

### CELL STRUCTURES AND THEIR FUNCTIONS

The study of a cell is called cytology. A cell consists of a living material called protoplasm, which is surrounded by a membrane called plasma membrane. In plants, a cell wall (non-living part) is also present surrounding the plasma membrane. The protoplasm is made up of two major parts: a. cytoplasm b. Nucleus

The cytoplasm contains cell organelles or inclusions, which are cellular structures with specific functions. The cells which contain a nucleus and organelles are called eukaryotic cells. These show a high level of cellular organization. However, some cells lack definite nucleus and organelles. In such cells (prokaryotic cells e.g. bacteria), materials containing instructions for growth and development are found in a particular part of the cell and so are not enclosed in any membrane.

Nucleus is the largest cellular organelle enclosed by a double-layered nuclear membrane with many pores. It contains chromosomes and nucleolus which are rich in proteins and nucleic acids.

The nucleus performs the following functions:

1. Exchange of materials between the nucleus and the cytoplasm through the nuclear pores.
2. Storage of hereditary information by the chromosomes
3. Control centre of cellular activities

Structure of a typical animal cell

**CELL COMPONENTS AND THEIR FUNCTIONS**

### CELL FUNCTIONS COMPONENT/ORGANELLES

|  |  |
| --- | --- |
| Mitochondrion | Site of cellular respiration for energy production. It consists of enzymes and DNA. The enzymes convert ADP to ATP. |
| Vacuole | Surrounded by a membrane called tonoplast. It contains cell sap mineral salt and sugar. It act as an osmoregulator (removing excess water). |
| Endoplasmic reticulum (ER) | Aids transport of materials within the cytoplasm. Rough endoplasmic reticulum(RER) (having ribosome attached) is for protein synthesis and transportation. Smooth endoplasmic reticulum (SER) is for lipids and steroids synthesis and transportion. |
| Golgi bodies/apparatus | For synthesis, packaging and distribution of materials. |
| Chloroplast | Contains chlorophyll for photosynthesis in green plants |
| Lysosomes | Site for production of enzymes for respiration and destruction of worn out cells. |
| Ribosome | For protein synthesis |
| Centrioles | Active in cell division by producing spindle fibres to which chromosomes are attached. (present only in animal cell). |
| Cell plasma) membrane | This is flexible and selectively permeable. It controls the materials entering or leaving the cell |

Cell wall It protects the cell, thus providing mechanical support in

plants.

Structure of a typical plant cell

**EVALUATION**

List five cell organelles and their functions

### SIMILARITIES BETWEEN PLANT AND ANIMAL CELLS

Both plant and animal cells have the following in common

(a)Nucleus (b) golgi bodies (c) mitochondria (d) cytoplasm (e) chromosomes (f) endoplasmic reticulum (g) nucleolus (h) ribosomes (i) lysosomes (j) cell membrane

**DIFFERENCES BETWEEN PLANT AND ANIMAL CELL**

### PLANT CELL ANIMAL CELL

|  |  |
| --- | --- |
| 1 Has chloroplast | No chloroplast |
| 2 Rectangular and definite in shape | Usually spherical or shapeless |
| 3 Has rigid cellulose cell wall | No cell wall |
| 4 Centrioles are absent | Centrioles are present for cell division |
| 5 Cytoplasm is less dense | Cytoplasm is dense granular |
| 6 Starch granules present | Glycogen granules present |

7 Presence of large central permanent Vacuoles are absent or small and temporary vacuole when presnt

### CELL THEORY

This is the summary of research efforts of many scientist like Robert Hooke, Matthias Schleidein and Theodore Schwann in 1838 and 1839 likewise, Rudolf Virchow (1855) etc.

The cell theory states that:

a. All living organisms are composed of one or more cells.

1. The cell is the structural and functional unit of all living organisms i.e. the basic organizational unit of life.

1. All existing cells come from pre-existing ones.

1. A cell contains information for its structural and functional development in its nucleic acids. This information is passed down from the parents to the off spring

### EVALUATION

1. State three similarities and five differences between plants and animals cell

1. Write short note on the history of the cell

### GENERAL EVALUATION

1. Describe briefly the history of the cell
2. State the four forms of cell existence.
3. Discuss, with a diagram, a named plant- like unicellular protest.
4. Discuss, with a diagram, a named animal-like protist .
5. Draw the diagram of a named filamentous organism.
6. Differentiate between: (a) cells forming tissues and those forming colonies

(b) Colonial and filamentous organisms

### WEEKEND ASSIGNMENT

1. A cell that is capable of self existence is a/an A. amoeba B. ovum C. amoeba

D. onion epidermal cell

1. Which of these organelles is common to both plants and animals cells? A. Chloroplast B. Centriole C. Mitochondrion D. Pyrenoid
2. Which scientist did not contribute to the formation of cell theory? A. Isaac Newton B. Robert Hooke C. Matthias Schliemann D. Theodor Schwann
3. The organelle which is contractile in function in Euglena is the A. eye spot B. gullet

C. myoneme D. paramylon

1. Which of the following cells are not regarded as specialized? A. Muscle cells B. Root tip cells C. Somatic cells D. Sperm cells

### THEORY

1. Differentiate between prokaryotic and eukaryotic cells
2. Describe and state three functions each of (a) rough endoplasmic reticulum (b) vacuoles

**WEEK SIX**

**CELL AND ITS ENVIRONMENT**

### CONTENT

Environment/Nature and state of matter

Diffusion (Definition, process and significance)

Osmosis (Definition, process and significance)

Relationship between osmosis and diffusion

Haemolysis and plasmolysis

Flaccidity and turgidity

### Environment/Nature and State of Matter

Living cells are known to be surrounded by a watery environment. This may include:

Fresh/salt water in which the unicellular organisms live, Intercellular fluid that bath the bodies of cells of higher animals.

The nature of states of matter makes diffusion and osmosis possible.

Matter can be defined as any material that has mass and occupies space. It includes all the living and non-living things around us. Matter is also made up of tiny particles which may be molecules or irons and can exist in three forms; solid, liquid, and gas.

**EVALUATION**

What is a matter, mention the three state of matter

### DIFFUSION

Diffusion is the process by which molecules of substances move from a region of higher concentration to a region of lower concentration (through the medium of air or liquid) until equilibrium is reached. The difference in the concentration of the substances in the two regions before diffusion occurs is called concentration/diffusion gradient, e.g. If KMn04 (Potassium tetraoxomanganate VII) is placed in a beaker of water and allowed to stand, the purple colour of the KMn04 start to spread outward from the crystal. Eventually, the colour spread evenly throughout the water medium.

Diffusion is also observed in the spread of odour of perfume, insecticide which is used to spray a room and also in the release of gases from the anus.

Diffusion is affected by the following factors

1. Change in temperature: The higher the temperature, the faster the rate of diffusion
2. Molecular size: Diffusion increases with decreasing size of molecule
3. State of matter Diffusion of gases is much faster than that of liquid.
4. Difference in concentration: The greater the difference in concentration of molecules, the faster the rate of diffusion.

### IMPORTANCE OF DIFFUSION IN LIVING ORGANISMS

1. The movement of carbon (IV) oxide through the stomata of leaves during the process of photosynthesis.
2. Movement of oxygen into the leaves during respiration.
3. Movement of water vapour out of the leaf in the process of transpiration
4. Gaseous exchange in the lungs of mammals
5. Intake of oxygen and nutrients and the removal of waste product by the foetus from its mother through placenta.
6. Movement of digested and soluble food from the villi of small intestine to the blood stream.
7. Removal of waste product in small organisms such as amoeba

### EVALUATION

1. Define diffusion, state the factors that can affect the rate of diffusion 2. Outline five importance of diffusion

### OSMOSIS

Osmosis can be defined as the movement of water molecules from a region of lower concentration to the region of higher concentration through a semi-permeable membrane.

A permeable membrane allows molecules to pass through it freely while a selectively permeable membrane only allows certain molecules to pass through it. Osmosis will only occur when a semi-permeable membrane separates weak and strong solutions.

Living cells may find themselves in any of the following situation:

When the fluid surrounding the cell is more concentrated than the inside of the cell, the surrounding fluid is said to be **hypertonic** to the content of the cells. A net movement of water molecules out of the cell into the surrounding fluid occurs and causes the cell to shrink. This process is known as Exosmosis.

When the fluid surrounding the cell is less concentrated than the inside of the cell, the surrounding fluid is said to be **hypotonic** to the content of the cell. There is a net movement of water molecules from the surrounding fluid into the cells. This process is known as Endosmosis.

When the surrounding fluid and the cell concentration have the same concentration, they are said to be **Isotonic**. A net movement of water molecule in and out of the cells does not occur.

### IMPORTANCE OF OSMOSIS

1. It aids the absorption of water from the soil into the vacuole of the root hairs
2. It aids the movement of water from the root hairs into the cells of other parts of the plants
3. It helps to control the opening and closing of the stomata pores
4. It gives turgidity to the plant cells i.e. it gives support.
5. It aids intracellular movement of water in animals
6. It aids reabsorption of water from the kidney tubules into the blood
7. It causes haemolysis of red blood cells.

### EVALUATION

1. What is osmosis, mention three condition necessary for osmosis 2. State three differences between osmosis and diffusion

### PLASMOLYSIS

Plasymolysis is the shrinkage of the vacuole and pulling away of the cytoplasmic lining from the cell wall when placed in hypertonic solution. When a plant cell is surrounded or place in hypertonic solution, exosmosis will occur i.e. water moves out of the cell into the surrounding fluid leading to the shrinking of the vacuole and pulling the cytoplasm away from the cell wall.

When cells are plasmolysed, it eventually leads to wilting or death of the plant.

### HAEMOLYSIS

This is the process whereby red blood cells (corpuscles) splits and burst as a result of too much water passing into it. Red blood cells and blood plasma are always isotonic i.e. having the same osmotic concentration, if for some reasons the concentration of blood plasma falls; endosmosis will occur (water moves from the plasma into the red blood cells). Continuous absorption of water into the cell makes it turgid and when fully stretched, it burst.

### EVALUATION

1. Define plasmolysis and haemolysis
2. In a tabular form, differentiate between plasmolysis and haemolysis

### TURGIDITY AND BIOLOGY SIGNIFICANCE

Turgidity is the condition in which cell absorbs plenty of water up to a point where the cell is fully stretched. Turgidity is observed in plants where it makes them erect and support the stem, leaves and flowers.

### FLACCIDITY AND BIOLOGICAL SIGNIFICANCE

Flaccidity is the condition in which plant lose water to their surrounding faster than they can absorb. When a plant loses more water than it absorbs, it becomes flaccid. Flaccidity usually occurs when there is no water in the soil, especially where there is drought. The continuous loss of water can result in the death of the plant.

### EVALUATION

1. Differentiate between flaccidity and turgidity

1. State two application flaccidity and turgidity

### GENERAL EVALUATION

1. Explain the following terms: Hypertonic, Hypotonic and Isotonic solution 2. State the differences between osmosis and diffusion

1. Define diffusion and state factors that can affect it.
2. How does endosmosis lead to turgidity?
3. Plasmolysis results from exosmosis. Explain.
4. Of what importance is diffusion to life?

### WEEKEND ASSIGNMENT

1. Which structures must be present in a cell for osmosis to take place? A. cell (sap) vacuole and cell wall B. cell wall and cell membrane C. chloroplast and cytoplasm

D. cytoplasm and cell membrane

1. The scent from a bunch of flowers spreads throughout a room. How does the scent spread? A. by conduction B. by diffusion C. by osmosis D. by transpiration

1. Which of the following environmental conditions is ideal for plant cells to remain turgid? A. Hot, dry weather B. Cold, dry weather C. Cool, humid weather

D. Windy weather

1. Osmosis occurs through a membrane that can be \_\_\_\_\_ permeable A. Fully B. slowly C. differentially D. freely

1. Which of the following processes takes place when a plant cell is put in a hypotonic solution? (a) water moves into the cell and the cell bursts (b) water leaves the cell and the cell becomes flabby (c) water moves into the cell and the cell becomes turgid (d) the cell becomes plasmolysed

### THEORY

1. State the similarities and differences between

1. Osmosis and Diffusion

1. Plasmolysis and haemolysis

**WEEK SEVEN**

**SOME PROPERTIES AND FUNCTIONS OF THE CELL**

### CONTENT

Cellular respiration

Mechanism of cellular respiration

CELLULAR (INTERNAL/TISSUE) RESPIRATION

The oxidation of glucose in the cell to release energy is known as cellular respiration and it occurs in the mitochondria of all living cells. There are two types of cellular respiration i.e. aerobic and anaerobic respiration

AEROBIC RESPIRATION

When cellular respiration takes place in the presence of oxygen is known as aerobic respiration. The largest amount of ATP possible is generated through it from one molecule of glucose with the release of carbon (iv) oxide and water as by product.

C6 H12 O6 + 6O2 6CO2 + 6H2O +

38ATP

ANAEROBIC RESPIRATION

In some organisms such as bacteria, fungi and endoparasites, the cells gets energy from breaking down glucose in the absence of oxygen this is known as anaerobic respiration. In this type of respiration, lesser amount of ATP is produced. The pyruvic acid produced is converted to alcohol in plants (alcoholic fermentation) while in animals, lactic acid is produced which leads to muscle fatigue in athletes

In plants

C6 H12 O6

CH2COCOOH C2H5OH + CO2 + 2ATP In animals

C6 H12 O6 CH2COCOOH CH2

CHOHCOOH + CO2 + 2ATP

EVALUATION

1. What is internal respiration?

1. Differentiate between aerobic and anaerobic respiration

MECHANISM OF CELLULAR RESPIRATION

Cellular respiration involve two main stages

a. Glycolysis: this occurs in the cytoplasm of the cells. First the glucose molecule is phosphorylated by the addition of a phosphate group to the glucose to become glucose-6phosphate which is carried out by an enzyme known as hexose kinase. There are ten steps in this pathway that leads to the breakdown of One molecule of 6 – carbon into two molecules of the 3 carbon pyruvic acid by the enzymes in the cytoplasm. This process does not require oxygen. Glycolysis takes place in the cytoplasm. At the end of the pathway, 2 ATP is used to produce 4 ATP (2 ATPs from each pyruvate) so that a net energy of 2 ATP is generated in glycolysis, this is called “substrate level phosphorylation”.

Kreb’s cycle (also known as citric acid cycle CAC or Tricarboxylic acid cycle TCA): Here, each pyruvic acid is further oxidized completely to carbon dioxide and water in the mitochondria. The pyruvic acid from the glycolysis is coverted to acetic acid through the removal of one molecule of CO2. The acetic is carried into the kreb’s cycle by co enzyme A. The combination of acetic acid and co enzyme A forms acetyl-coA. Acetyl-coA combines with oxaloacetatic acid to form citric acid which is an important started of the kreb’s cycle. Kreb’s cycle takes place in the matrix of the mitochondrion. Most of the ATP is generated in the cycle. The oxidation process in kreb’s cycle leads to the production of 36 ATPs (18 ATP from each pyruvate). The process used in the production of ATP in kreb’s cycle is called Oxidative phosphorylation. A total of 38 ATP is generated from the aerobic breakdown of glucose. The kreb’s cycle is particularly important because it is key pathway that connects protein, fats and carbohydrates.

EVALUATION

Differentiate between glycolysis and kreb’s cycle

GENERAL EVALUATION

1. Differentiate between micro and macro elements
2. State four importance of macro elements in plants
3. Differentiate between external and internal respiration
4. Explain briefly ‘the Kreb’s cycle
5. What do you understand by (a) muscle fatigue (b) oxygen debt

WEEKEND ASSIGNMENT

1. The organelle involved in tissue respiration is the A. endoplasmic reticulum B. golgi body C. mitochondrion D. ribosome
2. In the absence of oxygen, the pyruvic acid produced during glycolysis is converted to CO2 and A. water B. glycerol C. ethanol D. citric acid
3. Glycolysis takes place in A. lysosome B. Mitochondrion C. Nucleus D. ribosome
4. The starting substance in kreb’s cycle is A. Citric acid B. Acetic acid C. oxalic acid D. Malic acid
5. A total of \_\_ ATP is produced from one glucose during aerobic respiration A. 34 B. 36 C. 38 D.40

### THEORY

1. In a tabular form, differentiate between aerobic and anaerobic respiration
2. State three importance of alcoholic fermentation

**WEEK EIGHT AND NINE**

**MODE OF NUTRITION AND PLANT NUTRITION**

### CONTENT

Autotrophic nutrition

Heterotrophic nutrition

Modes of Autotrophic Nutrition (Photosynthesis and Chemosynthesis)

Photosynthesis

Mechanisms of photosynthesis

Importance of photosynthesis

Experiments on photosynthesis

Chemosynthesis

Mineral Requirements of Plants

### AUTOTROPHIC NUTRITION

Plants are referred to as autotrophs, i.e. being able to manufacture their food (Organic compound from inorganic materials such as water, carbon dioxide)

Autotrophs generally have two modes of nutrition which are chemosynthesis and photosynthesis (holophytic).

### HETEROTROPHIC NUTRITION

This is a type of nutrition in which organisms depend directly or indirectly on autotrophs for food. All animals, fungi, protozoa and some bacteria belong to this group and they are referred to as heterotrophs

**HETEROTROPHIC MODES OF FEEDING**

### (a) Holozoic Nutrition

This is the mode of feeding in which food is ingested in the form of complex organic substances which is digested and assimilated into the body. Holozoic organisms are grouped into carnivores, herbivores, omnivores and scavengers.

### (b) Parasitic Nutrition

This is the mode of feeding in which certain organisms (parasites) feed on other organisms (host). Parasites can be endoparasites (tapeworm, liver fluke) or ectoparasites (lice, ticks) depending on whether they live inside or outside the host. Plant parasites include dodder, mistletoe. Parasites have special structures such as haustoria, sucker, hooks, and muscular lips e. t. c.

### (c) Saprophytic Nutrition

This is feeding process in which certain organisms (saprophytes) feed on non living organic matter i. e. plant and animal remains. Saprophytes secrete digestive enzymes into the dead organic matter to digest the food (extracellular digestion) and the soluble food substances are then absorbed into their body. Examples include fungi i.e. mucor, mushroom, yeast and some bacteria

### (d) Symbiotic Nutrition

This is a mode of feeding in which two organisms of different species called symbionts live together and derive mutual benefits e.g. nutrients or food, shelter, moisture e. t. c from each other. Examples are nitrogen-fixing bacteria called Rhizobia, which live in root nodules of legumes, algae and fungi in a lichen.

### (e) Carnivorous / Insectivorous Nutrition

This is a feeding process in which some plants that have special devices trap and digest insects. These plants grow in poor soil and proteins obtained from the insects are used to supplement their nitrogenous compound requirement. These plants secrete enzymes which help in digesting their victim. Examples include bladderwort (Ultricularia), Pitcher plant, sundew and venus fly trap

### EVALUATION

1. List five types of heterotrophic nutrition giving two examples of organisms where each occur
2. What are carnivores, omnivores and herbivores

### MODES OF AUTOTROPHIC NUTRITION

Plants are referred to as autotrophs, i.e. being able to manufacture their food (Organic compound from inorganic materials such as water, carbon dioxide)

Autotrophs generally have two modes of nutrition which are chemosynthesis and photosynthesis

### PHOTOSYNTHESIS

This is the process by which green plants synthesize organic compounds from inorganic raw materials in the presence of chlorophyll and light. light

6C02 + 6H20 C6H12O6 + 602

(Inorganic materials) Chlorophyll (organic compound) (by product)

The main product of photosynthesis is sugar (carbohydrate) while the oxygen given up is a byproduct which is released into the atmosphere.

FEATURES (CHARACTERISTICS) OF PHOTOSYNTHESIS These are as follows:

1. Photosynthesis occurs in the chloroplast of cells in the presence of light.

1. The raw materials required are low energy containing inorganic compound i.e. CO2  and H2O

1. The final product is a high energy containing compound (C6H12O6 )n

Photosynthesis, therefore is an anabolic process (metabolic building up process)

1. The energy required is obtained from solar energy through the chlorophyll (the green pigment present in the chloroplast of green plants.

1. The carbon dioxide and oxygen diffuse in and out (respectively) between the surrounding air and leaf passing through the stomata opening on the leaf surface. These gases are stored in insoluble form until the day is dark. Then, the sugar is converted and transported to other parts of the plants where it is needed. The movement of the sugar is called translocation.

1. Leaf is the main photosynthetic organ of the plant although all green parts of a plant are photosynthetic. The main site of photosynthesis in a leaf is the pallisade mesophyll.

### EVALUATION

1. What is photosynthesis?

1. Outline four features of photosynthesis

1. Draw a labeled diagram of the internal structure of a leaf

### MECHANISM OF PHOTOSYNTHESIS

Photosynthesis involves two stages

1. **Light phase**: it takes place during the day. It involves four stages
2. Activation of chlorophyll: the chlorophyll trap light energy from the sun and get energized
3. Photolysis of water: splitting of water molecules by light energy H2O H+ + OH

— OH− H2O

1. Hydrogen transfer by NADP (NADP + H+ NADPH2)
2. Formation of ATP from ADP: this takes place to store energy for the dark phase reaction

**b. Dark phase:** In the dark phase of photosynthesis (occurring in the stroma of chloroplast in the presence of NADPH and ATP), neither light energy nor chlorophyll is needed. This stage takes place in the dark or at night.

During this phase, hydrogen ion and carbon dioxide molecule combine chemically under the control of enzymes to form the simple sugar.

4H+ + CO2 CH2O + H2O

Simple sugar forms the chemical structural basis for other carbohydrates, lipids and proteins

### IMPORTANCE OF PHOTOSYTHESIS

The enzyme-rich product of photosynthesis is used by plants and animals in the following ways:

1. The source of energy for their metabolic activities

1. It is needed in food cycle being the only process that can trap sun energy.

1. All animals and other heterotrophic plants are directly or indirectly dependent on green plants for food.

1. Photosynthesis assists in the purification of the environment by removing carbon (iv) oxide from it while oxygen is released into it.

1. Basis for manufacturing other complex organic compounds such as lipids, proteins

### EVALUATION

1. Differentiate between the two stages of photosynthesis
2. State two importance of photosynthesis.

### EXPERIMENTS IN PHOTOSYNTHESIS

The occurrence of photosynthesis in plants can be shown by experiments. Experiment is carried out to show the importance of carbondioxide, sunlight energy, chlorophyll. There is the need to prove that oxygen is given off.

### Testing a leaf for starch

The leaf to be tested is detached from the plant and put into boiling water for about 10-15mins. This kills the protoplasm of the leaf and makes iodine to easily penetrate the starch granules.

The boiled leaf is put into alcohol. This is to extract the chlorophyll from the leaf. The leaf becomes white and brittle. It is then dipped into hot water to soften the tissues.

The bleached leaf is spread on a white tile a few drop of iodine is added to it. The colour of the leaf is then tested against a light source.

If the leaf appears blue-black in colour, it contains starch, if the colour is yellowish-brown, it contains no starch

**To show that light is necessary for photosynthesis**.

Two potted plants are kept in darkness or 48-72 hours to make it starch-free or carry out the above experiment in destarching leaves. One of the potted plants remains in darkness while the other is exposed to sunlight for 4 hours. Leaves from the potted plants exposed to light turns blue-black when tested with iodine while the leaves kept in darkness remains brown. This shows that without light, photosynthesis cannot take place

### To show that oxygen is given off as a by-product of photosynthesis

In this experiment, gas is collected in the test tube placed over the green plant and tested with a glowing splint. If it re-kindles the glowing splint, it shows that oxygen is given off because it is the only colourless gas that re-kindles a glowing splint.

**Experiment to show that chlorophyll is necessary for photosynthesis**

The same experiment in destarching a leaf is carried out here

### Experiment to show that carbon (IV) oxide is necessary for photosynthesis

In this experiment, the leaves are destarched. Two potted plants are placed in two bell jars labeled A and B. Each of the potted plants is place on a Vaseline glass plate to prevent air containing carbon (iv) oxide from leaking into the bell jar. A dish containing lime water is placed in one of the jars to absorb carbon (iv) oxide. Both jars are left exposed to sunlight for about 4 hours and tested for starch.

### CONDITIONS (FACTORS) FOR PHOTOSYNTHESIS

The two major conditions necessary for photosynthesis are

a. External factors which include light, water, carbon (iv) oxide and mineral salt.

1. Internal factors include chlorophyll and enzymes.

Temperature is partly external (from sunlight) and partly internal (from the chemical reactions taking place in plant

### EVALUATION

1. List four factors that affects photosynthesis

1. Describe an experiment to show that sunlight is necessary for photosynthesis

### CHEMOSYNTHESIS

This is the process by which non-green plants (e.g. Nitrosomonas, Nitrobacter, iron bacteria etc) synthesize organic compound from inorganic materials (carbon dioxide and water). The energy used in this process is got from inorganic substances such as ammonia and by hydrogen sulphite.

H2S + O2 S + H2O + chemical energy

chemical

H2O + CO2 CH2O

energy

### EVALUATION

1. What is chemosynthesis
2. Give two examples of chemosynthetic plants

### MINERAL REQUIREMENTS OF PLANTS

Mineral elements are required for normal growth and development of green plants. In addition to Carbon, oxygen, and hydrogen, other mineral requirements are discussed below. Unlike glucose and other carbohydrates made from carbondioxide and water by green plants, mineral salts are obtained from the soil.

### Macronutrients

These are mineral nutrients that are required by plants in large quantities. They include the following;

### Macronutrients Importance Deficiency

|  |  |  |
| --- | --- | --- |
| Nitrogen(N) | Protein synthesisNucliec acid  synthesisProper root developmentComponent  of chlorophyll and enzymes | Stunted growth and chlorosisPoor flower and fruit formation |
| Phosphorus(P) | Formation of co-enzymes and proteinsFormation of DNA, RNA and ATPStem, root, fruit and seeds formation | 1. Poor root development 2. Stunted growth |
| Sulphur(S) | Formation of certain proteins in the protoplasm | 1. Stunted growth 2.  Chlorosis |
| Potassium(K) | 1. Protein synthesis 2. Cell membrane formation 3. Activates respiration and photosynthesis 4. Crop maturation | 1. Premature death 2. Leaf  margin turns yellow and brown |
| Magnesium(Mg) | 1. Formation of chlorophyll 2. Helps in cell division 3. Activates many co-enzymes | 1. Poor growth 2.  Chlorosis |
| Calcium(Ca) | 1. Formation of cell wall 2. Helps in storage of protein and carbohydrates in roots and tubers  3. Gives rigidity to plants | 1. Death of terminal buds 2. Roots develops poorly 3. Stunted growth |

Iron(Fe) 1. Formation of chlorophyll 2. Formation of 1. Poor growth 2.

protein Yellowing of leaves

**MICRO NUTRIENTS**

These are mineral nutrients required by plants in small quantities. They include the following;

### Micro nutrients Importance Deficiency

|  |  |  |
| --- | --- | --- |
| Zinc(Zn) | 1. Necessary for the synthesis of the starting material of auxin 2. Activates some enzymes 3. Plays a role in the synthesis of protein | 1. Poor growth |
| Copper(Cu) | Component of respiratory enzymes | Poor growth |
| Manganese(Mn) | Activates some enzymes involved in cellular respiration | Death of shoot |
| Boron(B) | Translocation of sugar and calcium | Poor growth of pollen tubes |
| Chlorine(Cl) | Necessary for oxygen release during photosynthesis | Affects growth |

Molybdenum(Mb) 1. Necessary for nitrogen fixation by nitrogen-fixing bacteria Poor

2. Activates the enzyme that reduces nitrate to nitrite growth

### EVALUATION

1. What are macro nutrients
2. list three macro elements that are essential for protein synthesis

### GENERAL EVALUATION

1. What is autotrophic nutrition?
2. List the two modes of autotrophic nutrition. (b) Differentiate between the two modes listed above.
3. State the characteristics of photosynthesis.
4. What is the significance of leaf in photosynthesis?
5. State the two stages involved in the process of photosynthesis.

### WEEKEND ASSIGNMENT

1. The main photosynthetic organ of plant is —– (a) leaf (b) seed (c) fruit (d) root
2. Which of these is not a macro element needed for plant growth? A.

potassium B. magnesium C. sodium D. molybdenum

1. Yellowing of leaves is a symptoms associated with deficiency of A. iron, calcium and magnesium B. nitrogen, sulphur and potassium C. sulphur, phosphorus and iron D. iron, magnesium and nitrogen
2. Trace elements are required by plants mainly for the A. formation of pigments and enzymes B. production of energy and hormones C. manufacture of carbohydrates

D. manufacture of protein

1. The dark phase of photosynthesis occurs in the ——- of chloroplast (a) cells (b) tissues (c) fluid (d) stroma

### THEORY

1. State five importance of photosynthesis
2. Differentiate between light and dark phase of photosynthesis

**WEEK TEN**

**GROWTH**

### CONTENT

Basis of growth

Aspects of growth

Regulation of growth by hormones

### GROWTH

Growth is the irreversible increase in dry mass, size and complexity of an organism brought about by the synthesis of new protoplasm.

For growth to be effective, building up of materials (anabolism) must exceed the rate of breaking down (catabolism).

In plants, growth is indefinite and apical while it is definite and uniform in animals.

### BASIS OF GROWTH

The basis of growth involves three major phases i.e. cell division (mitosis), cell enlargement and cell differentiation.

Life begins as a single fertilized cell, continuous as the cell divides into two daughter cells then into four and so on. After cell division, the daughter cells increase in mass and size (enlargement). Eventually, each cell develops into a special type of cell (specialization) by changing its shape and structure to carry out a particular function. Most specialized cells, at maturity lose their ability to divide.

**TYPES OF CELL DIVISION**

There are two types of cell division: (a) Mitosis (b) Meiosis

### Mitosis

Mitosis is a cell division to produce two daughter cells with the same number of chromosomes and characteristics as those of the parent cell. This cell division takes place only in somatic cells (i.e. body cells that are not involved in the production of gametes) such as skin, bone marrow and meristematic tissues in plants.

Mitotic cell division involve five main stages

1. Interphase: This is referred to as the resting stage where the chromosomes becomes elongated and form a network of fine threads called chromatids
2. Prophase: in early prophase chromosomes become visible, nucleolus shrinks, centrioles start moving away from each other in opposite direction and the formation of spindle fibres begins. During the late prophase, chromosomes become shorter, thicker and visible. Each chromosome now forms two distinct chromatids joined by a centromere. Nucleolus and nuclear membrane disappear entirely.
3. Metaphase: paired chromatids arrange themselves along the equator of the spindle andare attached to the spindle at the centromere.
4. Anaphase: sister chromatids separate and start migrating to the opposite poles of the cell and eventually reach the poles.
5. Telophase: the cell starts dividing into two by constricting at the equator, nucleolus and nuclear membrane are reform in each daughter cell, spindle fibres degenerates and chromosomes eventually regain their threadlike form

### Importance of mitosis

1. It brings about growth, development and specialization especially in multicellular organisms.
2. Asexual reproduction binary and multiple fissions in protozoa, budding in yeasts are result of mitosis.
3. It ensures the diploid condition of the cells is retained from generation to generation
4. It aids the repair of damaged cells

### Life processes involved in mitosis

1. Formation of new cells in Malpighian layer of the skin
2. Production of red and white blood cells in the bone marrow
3. Healing of wounds
4. Growth in meristem
5. Binary fission

### EVALUATION

1. Define growth
2. What is mitosis, state three importance of mitosis

### ASPECTS OF GROWTH

Growth varies from one organism to another. To measure growth, the following parameters are used:

1. Man: the dry mass is more accurate and reliable than the wet mass
2. size and length e.g. height of man
3. increase in number of cells e.g. budding in yeast cell

### REGIONS OF FASTEST GROWTH IN PLANTS

The regions of fastest growth in plants are the root and stem apices. Since growth in plants is apical, the root and stem apices can be divided into

a. Region of cell division (called the apical meritstem) brings about primary growth of a plant

1. Region of elongation

1. Region of cell maturation/specialization

### GROWTH CURVE

The growth rate of a living organism is measured using a growth a curve. The growth pattern of man shows a sigmoid curve. The growth pattern consists of three phase:

1. **Lag phase:** This is the initial stage where slow growth is experienced. At this stage, the cell is still accumulating the necessary material to begin the process.

1. **Log or exponential phase:** This is the phase of rapid of rapid growth.

1. **Stationary phase:** This is a stage where no observable growth is experienced.

The growth curve of insect is like a step. Each growth phase (instar) is interrupted by a period of molting (ecdysis)

### FACTORS AFFECTING GROWTH

a. External factors it include availability of nutrients, humidity, light, temperature, PH and accumulation of metabolic products.

1. Internal factors are mainly hormones. The two major growth hormones in plant are auxin and gibberellins. In animals, the hormones concerned with growth are secreted by the anterior pituitary gland, thyroid gland and the gonads. Over or under secretion of any of these hormones leads to abnormal growth.

### GENERAL EVALUATION

1. How can growth be measured

1. List four external factors that can affect growth

1. Mention two growth hormones each in plants and animals

1. Discuss the stages involved in mitotic cell division

1. Outline four life processes involving mitosis

1. List four places where mitosis takes place in organisms

### WEEKEND ASSIGNMENT

1. Growth include the following processes except A. differentiation B. meiosis C. mitosis D. elongation
2. When the zygote of an organism continues to grow, it produces new cells by A. meiosis B. mitosis C. crossing-over D. gestation
3. The aspect of growth in living organisms include all the following except A. increase in dry weight B. irreversible increase in length C. reversible increase in size

D. increase in number of cells

1. The organelle involved in tissue respiration is the A. endoplasmic reticulum B. golgi body C. mitochondrion D. ribosome
2. In the absence of oxygen, the pyruvic acid produced during glycolysis is converted to CO2 and A. water B. glycerol C. ethanol D. citric acid

### THEORY

1. In a tabular form, differentiate between growth in plants and animals 2. State three importance of alcoholic fermentation