



SECOND TERM E-LEARNING NOTE

SUBJECT: BIOLOGY

CLASS: SS 1

SCHEME OF WORK

WEEK TOPIC

1. Reproduction (Meaning, Types and Form of Asexual Reproduction)
2. Sexual Reproduction (Conjugation, Meiosis) and Excretory Organelles in Living Cells
3. Reproduction in Unicellular Organisms and Invertebrates
4. Irritability and Movement
5. Nutrition in Animals (Food Substances and Digestive Enzymes)
6. Basic Ecological Concepts
7. Biomes
8. Population Studies
9. Functioning Ecosystem
10. Ecological Management
11. Revision and Examination

REFERENCES

- Modern Biology for Senior Secondary Schools by S.T. Ramlingam
- Essential Biology by M.C Michael
- New Biology by H. Stone and Cozen
- SSCE, past questions and answers
- New System Biology by Lam and Kwan
- College Biology by Idodo Umeh
- UTME, SSCE and CAMBRIDGE past questions and answers
- Biology practical text

WEEK ONE

DATE

TOPIC: REPRODUCTION

CONTENT

- Meaning and Types of Reproduction
- Forms of Asexual Reproduction
- Sexual Reproduction (Conjugation and Fusion of Gametes)
- Meiosis and Importance of Meiosis

MEANING AND TYPES OF REPRODUCTION

Reproduction is the ability of an organism to give rise to new individuals of the same species in order to ensure continuity of life.

There are two types of reproduction

a. asexual reproduction



b. sexual reproduction

- a. **Asexual Reproduction:** is the process whereby an organism produces an offspring by itself. I.e. only one parent is present. No gametes involved thus there is no fusion of nuclei, but the cells that give rise to the offspring usually divide by means of mitosis. Offspring produced are identical to the parent in all respects and are called clones
- b. **Sexual Reproduction:** is a type of reproduction that involves two parents and the fusion of the male and the female gamete to form a zygote. Offspring produced show new variation. The sex cells (gametes) are produced by meiotic cell division and after fertilization the new individual continues to grow and produce new cells by mitosis.

EVALUATION

1. What is reproduction?
2. Why is reproduction necessary?
3. Differentiate between the two types of reproduction.

FORMS OF ASEXUAL REPRODUCTION

- a. **Binary Fission:** *Fission* is the simplest form and involves the division of a single organism into two complete organisms, each identical to the other and to the parent. Fission is common among unicellular organisms such as bacteria, many protists and some algae.
- b. **Budding:** The parent organism develops an outgrowth which subsequently forms the new individual organism. These buds break off from the parent without causing any injury and live an independent life. Budding is common in yeast and hydra
- c. **Spore Formation:** Spores are DNA-containing capsules capable of sprouting into new organisms; unlike most seeds, spores are produced without sexual union of gametes, when dispersed, each spore is capable of developing into a new organism. Spores are common in lower organisms especially fungi such as rhizopus and penicillium.
- d. **Fragmentation:** A part of the parent organism breaks up and develops into a new independent organism. This type of reproduction is also called regeneration. Fragmentation is common in spirogyra and coelenterates.
- e. **Vegetative Propagation:** It occurs in higher plants. In this process, a new plant grows from any portion of an old one other than the seeds. There are two methods of vegetative propagation, this includes natural and artificial vegetative propagations.

Natural vegetative propagation involves the use of vegetative parts such as stems, leaves, roots or buds. The part involved must have a store of food and sometimes able to act as a perennating organ i. e. enable the plant to survive from one growing season to the next. Organs of vegetative propagation include;

- **Bulbil:** Axillary buds growing from the veins of **leaves** e. g. Bryophyllum and Begonia.
- **Runners or stolons:** Stems that creep horizontally on soil surface. Buds and adventitious roots develop from the nodes of the parent plants e. g. sweet potato, grass.
- **Rhizomes:** Underground horizontal stem. It has scaly leaves which cover lateral buds at the nodes. Lateral buds grow into new aerial shoots e. g. ginger, canna lily.
- **Corms:** Underground stems which grow vertically in the soil. Buds develop from the axils of scale leaves, grow upward and form leaves and flowers e. g. cocoyam.



- Stem tubers: Underground stems which have swollen tips. Axillary buds on tubers give rise to new aerial shoots e. g. yam, sweet potato
- Suckers: Short underground horizontal branches e. g. banana, pineapple
- Bulb: Underground condensed shoots with compressed stems and scaly leaves e. g. onion, garlic.

Artificial propagation is the use of parts of the parent plant to multiply the plants. Budding, grafting, layering, cutting and marcotting are types of artificial propagation.

EVALUATION

1. List four types of asexual reproduction with examples.
2. Discuss spore formation in a named fungus.

GENERAL EVALUATION/REVISIONAL QUESTIONS

1. List four forms of asexual reproduction giving one example of organism that exhibit each.
2. List four common natural vegetative parts in plant giving one example of plant in each case.
3. Describe five types of artificial vegetative propagation.
4. Briefly describe fragmentation in spirogyra.
5. Describe sporulation in amoeba.

READING ASSIGNMENT

College Biology, chapter 16, page 292 – 301

WEEKEND ASSIGNMENT

1. Bacteria multiply rapidly by A. fragmentation B. binary fission C. spore formation D. budding
2. The type of reproduction that is common to both Hydra and Yeast is A. conjugation B. binary fission C. grafting D. budding
3. During asexual reproduction in paramecium, how many times does the zygote divide to produce eight nuclei A. 1 B. 2 C. 3 D. 4
4. Vegetative propagation is described asexual reproduction because A. reproductive organs are not involved B. many new plants are produced C. there is no exchange of genetic materials D. new individuals are not formed
5. Which of these organs of vegetative propagation is not a perennating organ?
A. Rhizome B. Sucker C. Bulbil D. Bulb

THEORY

1. Describe two types of artificial propagation.
2. State three advantages and two disadvantages of asexual reproduction.



WEEK TWO

DATE

TOPIC: SEXUAL REPRODUCTION

CONTENT

- Sexual Reproduction
- Conjugation
- Fusion of Gametes
- Meiosis
- Excretion

SEXUAL REPRODUCTION

There are two types of sexual reproduction, this include conjugation and fusion of gametes.

- Conjugation:** the simplest form of sexual reproduction, as contrasted with asexual reproduction. This is observed in some unicellular organisms e. g. paramecium, fungi e. g. rhizopus, algae e. g. spirogyra. Two similar organisms (conjugants) join together and exchange genetic material contained in their nuclei. After the exchange, the organisms separate. The zygote or zygosphere form is capable of developing into a new organism.
- Fusion of Gametes:** This occurs in higher organisms where gametes (male and female sex cells) are produced in special structures by a process known as gametogenesis which involves meiotic cell divisions. Fertilization, the process in which haploid male and female sex cells fuse together to producing a single diploid cell (zygote) that develops into an adult organism occurs after gamatogenesis.

EVALUATION

1. Describe conjugation in spirogyra.
2. Define spermatogenesis and oogenesis.

MEIOSIS

Meiosis is the reduction method of division that leads to the formation of four daughter cells that are haploids. Meiosis differs from mitosis, in that it involves two consecutive cell divisions instead of one and the genetic material contained in chromosomes is not copied during the second meiotic division. Whereas mitosis produces identical daughter cells, meiosis randomly mixes the chromosomes, resulting in unique combinations of chromosomes in each daughter cell. Meiosis ensures the chromosome number of an individual remains the same from generation to generation.

Meiosis consists of two successive divisions:

First Meiotic Division

- a. Interphase: resting phase, chromosomes are not seen.
- b. Prophase I: At early prophase, chromosomes contract and become clearly visible. At middle prophase, homologous chromosomes come together and spindle is formed. At late prophase crossing over takes place between homologous chromosomes at a place called chiasma.



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- c. Metaphase: Nuclear membrane disappears, the bivalent chromosomes assemble at the equator and are attached to the spindle by their centromere.
- d. Anaphase: Bivalent chromosomes separate completely and move to the opposite pole of the cell.
- e. Telophase: bivalent chromosomes arrived at the pole, nuclear membrane are formed around the chromosomes at the two poles, two daughter cells result with half the number of chromosomes in the parent cell.

Second Meiotic Division

It consists of four stages similar to mitosis, no resting stage and no replication of chromosomes. At the end, four daughter cells are formed.

Importance of Meiosis

Meiosis aids the formation of

- a. Spermatozoa.
- b. Ova or egg cells.
- c. Pollen grains in flowering plants.
- d. Ovules in flowering plants.

EVALUATION

1. What is crossing over?
2. Outline four life processes involving meiosis.

GENERAL EVALUATION/REVISIONAL QUESTIONS

1. Describe conjugation in Mucor.
2. Mention two structures each where meiosis takes place in plants and animals.
3. Describe sexual reproduction in hydra.
4. What is meiosis?
5. Outline four importance of meiosis to life.
6. List five excretory products in living organisms.

READING ASSIGNMENT

College Biology, chapter 16, page 301 - 305

WEEKEND ASSIGNMENT

1. The process which ensures that the chromosome number for each species of organism remain constant from generation to generation is called A. fission B. meiosis C. mitosis D. oogenesis
2. The cell organelle, from which spindle fibres originate during cell division in animal cells is known A. centrosome B. chromosome C. lysosome D. ribosome
3. In animals meiosis comes A. after fertilization B. after every mitotic division C. before fertilization D. before every meiotic division



4. One of the ways in which body cells differ from gamete cells is in
A. Type of centromeres they contain
B. Number of chromosome pairs they contain
C. Type of chromatids they contain
D. Number of chromosomes they contain.
5. Which of these excretory structures is not found in amphibians?
A. Gills
B. Lungs
C. Skin
D. Flame cell

THEORY

1. In a tabular form, state five differences between
 - a. Mitosis and meiosis.
 - b. Sexual and asexual reproduction.
2. Explain the phases of meiosis.

WEEK THREE

DATE

TOPIC: REPRODUCTION IN UNICELLULAR ORGANISMS AND INVERTEBRATES

CONTENT

- Reproduction in Amoeba(Binary and Multiple Fission)
- Reproduction in Paramecium(Sexual and Asexual)
- Reproduction in Spirogyra
- Reproduction in Earthworm
- Reproduction in Cockroach
- Reproduction in Housefly
- Reproduction in Snail

REPRODUCTION IN AMOEBA

Amoeba reproduces asexually by binary fission and multiple fission (sporulation) during adverse condition.

In **binary fission** when an amoeba reaches full size, it stops moving and divides into two equal parts starting from the nucleus. This is followed by the division of the cytoplasm, after which two daughter amoebae are formed.

In **multiple fission** amoeba becomes rounded and secretes around itself a cyst. Inside the cyst, the nucleus divides several times. When conditions becomes favourable, the cyst burst; each nucleus surrounded by a part of the cytoplasm of the parent. In this way, very small amoebae are formed.

REPRODUCTION IN PARAMECIUM

Paramecium reproduces asexually by binary fission and sexually by conjugation.

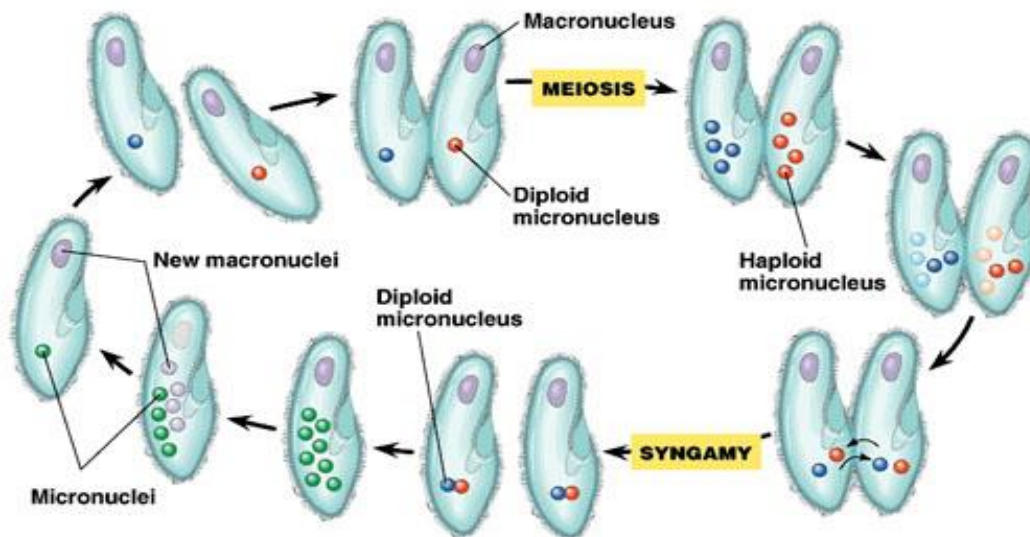
Binary fission occurs under favourable conditions, the micronucleus divides into two equal halves by mitosis and each moves to the opposite side of the cell, the meganucleus elongates and the cytoplasm constricts after which two young paramecia are produced.

Sexual reproduction is by **conjugation** of two individuals of different lines of descent. Stages in conjugation include

1. Two matured paramecium come together and get fused by their oral grooves.
2. The micronucleus divides twice by meiosis and four nuclei are formed in each conjugant



3. The smaller micronuclei are exchanged between the two conjugants
4. The migratory micronucleus fuses with the stationary micronucleus in each conjugant to form a zygote
5. The zygote in each conjugant divides thrice to form eight nuclei
6. The ex-conjugant with four meganuclei and four micronuclei divide to form four paramecia each having a meganucleus and a micronucleus.



Conjugation in paramecium

EVALUATION

1. Describe binary fission in amoeba.
2. Describe sexual reproduction in paramecium.

REPRODUCTION IN SPIROGYRA

Spirogyra reproduces asexually by fragmentation and sexually by conjugation.

In fragmentation, when a filament reaches a certain length, parts of it break away and grow into new filaments

In conjugation

1. The cells of two filaments come to lie side by side and a conjugation tube is formed between them.
2. the cells in one filament act as the male gamete while the other act as the female
3. The male gamete passes through the conjugation tube to meet the female gamete and fuses to form a zygote.
4. The zygote secretes a resistant wall around itself and form a zygospore.
5. After a period of rest and favourable condition, the outer coats burst and a young filament grows out.

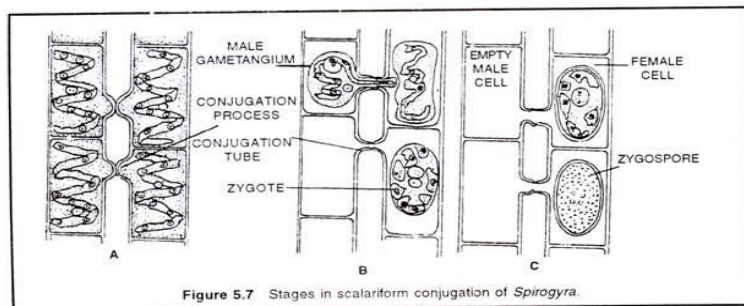


Figure 5.7 Stages in scalariform conjugation of *Spirogyra*.

REPRODUCTION IN EARTHWORM

Earthworms are hermaphrodites i. e. each has both male and female sex organs and therefore produces both male and female gametes. reproduction is by sexual means.

Process of Copulation

Two worms to be engaged in copulation come to lie close together with their ventral surfaces touching. Copulation takes place at night outside the burrows. The reproductive organs of earthworms are anteriorly located. The worms lie in such position that the segments 9-15 of one worm are opposite the clitellum (segments 32-37) of the other and are held firmly by chaetae during copulation.

After copulation, the two worm separate. After few days eggs are laid and fertilized in a cocoon secreted by the clitellum. The development of the embryo takes place inside the cocoon and one worm hatches from a batch of eggs in one cocoon.

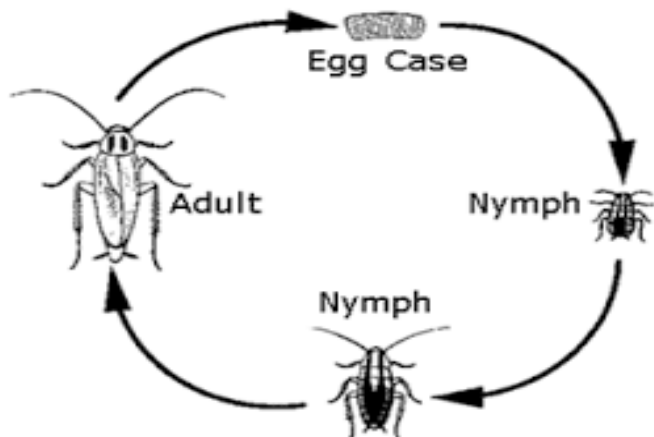
EVALUATION

1. Describe conjugation in a named alga.
2. What is hermaphroditism?
3. Describe the process of copulation in earthworm.

REPRODUCTION IN COCKROACH

Sexual reproduction takes place in cockroaches and fertilization is internal. Male and female cockroaches mates and the male introduces sperm into the genital opening of the female. The sperms are then stored in the sperm pouch until the eggs are released from the two ovaries. As the eggs are released, they are fertilized by the stored sperm. Fertilized eggs are laid (about 10–16 eggs) in a horny egg case (ootheca) which the female carries in her abdominal pouch for some time and later deposit it in a safe dark place. After 30 – 100 days, the eggs hatch into nymphs which are wingless, small and whitish in colour.

The nymphs feed, grow, and become brown, moult about 13 times to become adults. In the process of moulting, the wings first appear as wing pad and later develop into full grown wings. Cockroaches require 11 – 20 months to develop from eggs to imagos. Metamorphosis is incomplete.



REPRODUCTION IN HOUSEFLY

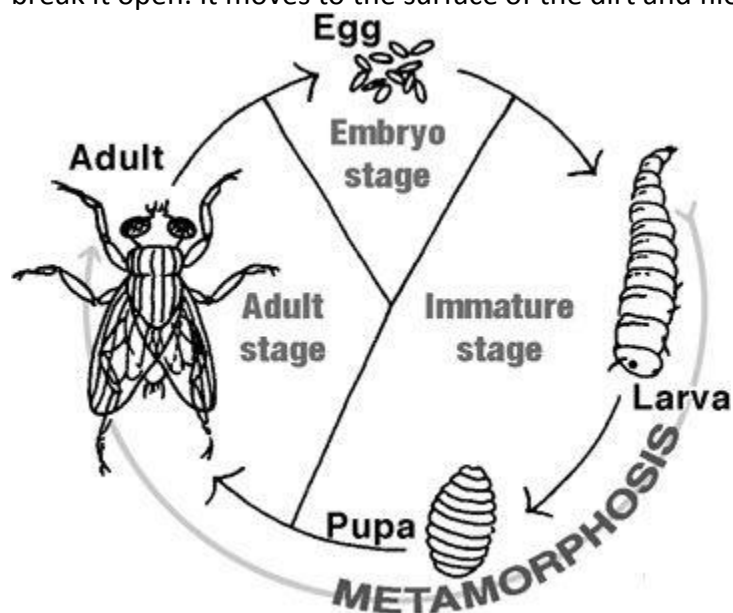
Adult male and female mates and within two to three days fertilized eggs are laid. The laying of eggs takes place in the day light. Housefly undergoes complete metamorphosis.

2 – 7 batches of eggs (100 – 150 eggs in a batch) are laid by the female housefly in a moist dirty environment. The eggs hatch into white larvae in about 8 – 24 hours.

The larva called **maggot** has a segmented body. The head bears a pair of hook for tearing food and drawing the larva along. On the ventral surface of the segmented body lie spiny pads for movement. It has two pairs of spiracles for breathing. The larva moults several times and lasts for about 5 – 14 days after which it moves to a dry place to begin the pupal stage.

The maggot shortens; its skin becomes hard and brown forming the pupal case (puparium). It does not feed or move. Internal re-organisation takes place at this stage. In about 3 – 10 days, the young adult hatches out of the puparium.

The adult housefly called imago emerges from the puparium using a sac-like organ (ptilinum) to break it open. It moves to the surface of the dirt and flies away when the wings are dry.



REPRODUCTION IN SNAIL



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Reproduction in land snails is hermaphroditic and fertilization internal. The female snail has a fertilization pouch for sperm to travel into. The snails will transfer their spermatophores to a place called **epiphallus**. The epiphallus is part of the sperm duct to the penis to help put the spermatophores into place by using their flagellum. From here, sperm is travelled to the **bursa duct** where fertilization takes place. During snail development, there is a 180° twist of the visceral mass that brings the anus and the mantle cavity forward to a position above the head. This process is known as **torsion**.

EVALUATION

1. Differentiate between metamorphosis in housefly and cockroach.
2. Describe fertilization in snails.

GENERAL EVALUATION/REVISIONAL QUESTIONS

1. What is conjugation?
2. Describe conjugation in a named fungi.
3. Differentiate between complete and incomplete metamorphosis.
4. Describe sexual reproduction in tapeworm.
5. Mention five structural parts of a earthworm involved in reproduction.

READING ASSIGNMENT

College Biology, chapter 6, page 301 - 344

WEEKEND ASSIGNMENT

1. Conjugation occurs in the following organisms except A. spirogyra B. paramecium C. mucor D. hydra
2. The possession of the male and female reproductive parts by a single organism is termed A. oviparous B. meiosis C. hermaphroditism D. parthenogenesis
3. Internal fertilization takes place in the following organisms except A. earthworm B. tapeworm C. butterfly D. toad
4. The zygote of spirogyra secretes a resistant wall around itself known as A. membrane B. cyst C. clot D. zygospore
5. Paramecium reproduces asexually by A. binary fission B. meiosis C. mitosis D. budding

THEORY

1. Describe sexual reproduction in tapeworm.
2. What are the advantages and disadvantages of sexual reproduction?

WEEK FOUR

DATE.....

TOPIC: IRRITABILITY / CELL REACTIONS TO ITS ENVIRONMENT

CONTENT

- Irritability and Type of Responses



- Movement
- Organelles for Movement

IRRITABILITY AND TYPES OF RESPONSES

Irritability is the ability of organisms to respond to stimuli. A stimulus is any change in external or internal environmental condition which can bring about a change in the activity of the whole or part of the organism.

Response is the term used for the change in activity of the organism. There are three major types of responses, these include tactic, nastic and tropic movements.

- TAXIS OR TACTIC MOVEMENT:** is a directional movement or response of a whole organism from one place to another in response to external stimuli such as light, temperature, water and certain chemicals. Examples of tactic movement include;
 - Euglena or chlamydomonas swimming away from high light intensity (Negative phototaxis).
 - In a moss plant, sperm swim towards the chemical produced by the egg cell (positive chemotaxis).
- NASTISM OR NASTIC MOVEMENT:** is a non-directional sleep movement or response of a part of a plant in response to non-directional stimuli such as light intensity, temperature and humidity. Example of nastic movement include;
 - The folding of the leaflets of mimosa plant when touched.
 - Closing of the morning glory flower when light intensity is low.
- TROPISM OR TROPIC MOVEMENT:** is a unilateral growth and directional movement of a part of a plant in response to directional stimuli. These responses are experienced in growth regions (root and shoot apices) and are controlled by certain plant hormones known as auxins. Tropic movement are named according to the stimuli e.g.
 - Shoots bend towards light (positive phototropism) while roots bend away from light (negative phototropism).
 - Shoots bend away from gravity (negative geotropism) while roots bend toward gravity (positive geotropism).
 - Tendrils of climbing plants twine around a support (positive thigmotropism) while root tips grow away from it (negative thigmotropism).

EVALUATION

1. Give two other examples each of nastic, tropic and tactic movement.
2. List four environmental factors that evokes responses.

MOVEMENT

Organisms moves from one place to the other in search of food, water, mates and escaping predator or harsh weather conditions.

Cyclosis in Cell

Cyclosis (cytoplasmic streaming) is the mass rotational movement of the cytoplasm and its contents in cells. Cyclosis brings about the transportation of substances from one part of the cell to the other and the exchange of materials between the cell organelles. Cyclosis occur in



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- Protozoa like amoeba known as amoeboid movement.
- Chloroplasts of some plants where they move independently to place their broad surface parallel to the surface of the leaf to receive sufficient sunlight for photosynthesis.

EVALUATION

- What is cyclosis?
- State two examples of cyclosis.

ORGANELLES FOR MOVEMENT

- Flagella: they are long whip like projections usually one or two on the cell surface. Flagella are organelles for movement in Euglena, Trypanosome, Spermatozoa, Chlamydomonas etc.
- Cilia: They are short hair like structures, numerous and closely packed together on the cell surface. Cilia can be found in paramecium and on cells lining the human wind pipe.

GENERAL EVALUATION

- Mention the structure for movement in paramecium, amoeba and euglena.
- Describe briefly movement in amoeba.
- Outline two functions of cyclosis.
- State two examples of nastic movement.
- How is tropic movement related to growth?
- Differentiate between tactic and nastic movement.
- Describe an experiment to demonstrate geotropism in root and shoot.

READING ASSIGNMENT

College Biology Chapter 12, page 236 – 243

WEEKEND ASSIGNMENT

- The response shown by the tips of the root and shoot of a plant to the stimulus of gravity is
A. haptotropism B. phototropism C. hydrotropism D. geotropism
- The streaming movement of cytoplasm observed in a freshly cut leaf of a water plant is termed
A. osmosis B. ciliary motion C. amoeboid D. cyclosis
- The movement of the whole organism to an external stimuli is termed
A. tropism
B. nastic movement C. taxis D. phototropic movement
- The Closing of the morning glory flower when light intensity is low is an example of
..... movement A. Tactic B. Nastic C. Tropic D. Cyclosis
- A klinostat is an instrument used to demonstrate
A. phototaxis B. chemotropism C.
phototropism D. nastism

THEORY

- In a tabular form, state four differences between tropic and nastic movement.
- What would be observed when a green seedling is placed horizontally?



WEEK FIVE

DATE.....

TOPIC: NUTRITION IN ANIMALS

CONTENT

- Animal Nutrition
- Classes of Food
- Balance Diet and its Importance
- Digestive Enzymes

ANIMAL NUTRITION

Animals generally cannot manufacture their food. Rather, they depend directly or indirectly on plants for their food. Hence they are called heterotrophs. Based on their food types, animals are grouped into three:

- a. Carnivores which feed on flesh or other animals e.g. lion.
- b. Herbivores which feed on plants e.g. goat.
- c. Omnivores, which feed on both plants and animals e.g. man.

CLASSES OF FOOD SUBSTANCES

Foods eaten by animals are generally classified into seven i. e.

- a. Carbohydrate
- b. Proteins
- c. Fat and oil
- d. Mineral Salt
- e. Vitamins
- f. Water
- g. Roughages

CARBOHYDRATE

This is got from food like bread, yam rice etc. It basically consists of carbon, hydrogen and oxygen. Carbohydrates are of three types:

- a. Monosaccharides (Simple sugars) which include glucose, fructose and galactose
- b. Disaccharides (Reducing sugars) which include maltose, sucrose and lactose.
- c. Polysaccharides (Complex sugars) e.g. starch, cellulose, chitin under the action of enzymes like ptyalin, maltase, lactase etc, and starch yields glucose as product of its digestion. Excess carbohydrate is stored in the body in form of glycogen in muscles and liver. This can be reconverted to glucose during starvation.

Importance of Carbohydrates

- a. It gives animals energy.
- b. It provides heat needed to maintain body temperature
- c. It can be used for lubrication e.g. mucus.
- d. It provides the body with a strong framework e.g. exoskeleton in insects.

PROTEINS



These are complex molecules made up of smaller units called amino acids. Protein is made up of carbon, hydrogen, oxygen, nitrogen and sometimes phosphorus and sulphur. Food like egg, meat, fish, beans etc gives you protein. Proteins are broken down into amino acids under the action of enzymes like pepsin, rennin, trypsin and erepsin.

Importance of Proteins

- Growth in young ones.
- Repair of worn-out tissues.
- Production of enzymes.
- Production of hormones.
- It supports reproduction.
- It is for tissue and all formation i.e body building.

FATS & OIL (LIPIDS)

Fats are solid lipids at room temperature while oil is the liquid. Fat and oil consist of carbon, hydrogen and little oxygen. When digested, it gives rise to fatty acids and glycerol. Foods like palm oil, groundnut, Soya beans give fat and oil. Lipids are broken down to fatty acids and glycerol when acted upon by lipase enzymes.

Importance of Fat and Oil

- It gives you energy even more than carbohydrates
- It supplies essential fatty acids to the body.
- It helps in the maintenance of body temperature
- It provides the body with fat-soluble vitamins

MINERAL SALT

These are usually taken in very small quantity in the food we eat except sodium chloride (table salt) and iron tablet, which can be taken directly by man. The lack of these salts results in nutritional deficiency. The minerals include calcium, magnesium, potassium, Phosphorus, sulphur, chlorine, iron, Iodine, fluorine, manganese, copper, cobalt and sodium.

Importance of Mineral Salts

- Regulate body metabolisms
- Components of bones and teeth
- Aids blood formation
- Control chemical reactions in the body
- Aids the formation of enzymes and pigment

VITAMINS

These are organic food substances needed by man and other animals in small quantity for normal growth and development. Lack of or inadequate supply of any of these vitamins results in nutritional deficiency.

Vitamins can be grouped into two:

- Water-soluble vitamins



b. Fat – soluble vitamins

The water-soluble vitamins include: vitamins B complex and vitamin C. Vitamin B complex include vitamin, B₂, B₃, B₅, B₆ and B₁₂

Fat-soluble vitamins include vitamins A, D, E and K.

VITAMINS, SOURCE FUNCTIONS AND DEFICIENCY SYMPTOMS

	SOURCE	FUNCTION	DEFICIENCY SYMPTOMS
Vitamin A	Liver, eggs, fish milk, palm oil, fish Vegetables	(i) Normal growth of body cells and skin (ii) Proper vision of the eye	(i) Night blindness (ii) Reduced resistance to disease
Vitamin B ₁	Yeast, milk, beans, Ground nut	(i) Normal growth (ii) Proper functioning of heart and nervous system	Beri-beri (wasting of Muscles), paralysis
Vitamin B ₂	Yeast, soya beans, egg, milk, green Vegetables	(i) Growth, proper functioning of the eye (ii) Formation of co-enzymes	(i) Slow growth (ii) Dermatitis
Vitamin B ₃	Yeast, beans, milk, Vegetables	Formation of co-enzymes for cellular respiration	Pellagra
Vitamin B ₁₂	Kidney, liver, fish Milk	Formation of red blood Cells	Pernicious Anaemia
Vitamin C	Fresh fruits and Green vegetables	(i) Aids wound healing (ii) Helps to resist infection	Scurvy
Vitamin D	Fish, milk, egg, Liver, sun's Ultraviolet rays	(i) Increases absorption Of calcium and phosphorus. (ii) Calcification and hardening Of bones	Ricket; Osteomalacia
Vitamin E	Green vegetables, Egg, butter, liver	Promotion of fertility In animals	Sterility Premature abortion
Vitamin K	Fresh green vegetables, liver	Aids blood clotting	Hemorrhage

WATER

This is of utmost importance to all organisms and it is made up of two elements, hydrogen and oxygen. Water can be got from food, river, stream, pond etc. water makes up 75% of the human body.

IMPORTANCE OF WATER

- Metabolic activities of the body of animals.
- Digestion of food.
- Maintenance of body temperature.
- It is a medium of transportation for all nutrients.
- It helps to maintain the osmotic balance in body tissues.



- f. It helps in excretion of metabolic waste from the body e.g urine.

ROUGHAGES

These are indigestible fibrous materials got from vegetables, fruit, carbohydrates and proteins. Roughages aid digestion, lack of which can lead to constipation.

EVALUATION

1. State three importance of; A. Carbohydrate B. Protein C. Lipids.
2. Mention five disease that may result from the deficiency of vitamins.

BALANCED DIET

Balanced diet is a diet containing a correct proportion of all the food substances. On a general note, a balanced diet contains 15% protein, 15% fat and oil, 10% vitamin, minerals and water and 60% carbohydrate. Once a food is taken at these proportions, there is a normal growth and development in the body.

FUNCTIONS OF BALANCED DIET

- a. It makes us healthy.
- b. It gives ability to be resistant to diseases
- c. It makes available energy needed to carry out all biological activities.
- d. It prevents malnutrition and deficiency symptoms. For examples, a diet that lacks protein results into a nutritional disease called kwashiokor in children.

The protein deficient child has the following features

- a. Retarded growth.
- b. Loss of weight.
- c. Swollen legs effect (oedema).
- d. Cracked / split stomach and thin legs e.t.c.

EVALUATION

1. State two importance each of A. protein B. carbohydrates C. vitamins
2. State three importance of balanced diet

DIGESTIVE ENZYMES

Enzymes are organic (protein) catalysts produced by living cells which help to speed up and slow down the rate of chemical reactions. Digestive enzymes aid the breaking down of complex food substances into simple, soluble and diffusible form. Enzymes have the following characteristics.

- a. Enzymes are soluble
- b. Enzymes are protein
- c. They are specific in their actions
- d. Enzymes are sensitive to temperature i. e. they work best between 35°C to 40°C
- e. Enzymes are PH specific



- f. Enzymes brings about reversible reactions
- g. Enzymes needs co-enzymes to activate them and can be inactivated by inhibitors such as mercury and cyanide

CLASSES AND FUNCTIONS OF ENZYMES

Digestive enzymes are classified based on the type of food they act upon. These include

- a. Proteases e. g. pepsin, rennin, trypsin and erepsin. They act on protein.
- b. Amylases e. g. ptyalin, lactase, maltase, sucrose. They act on carbohydrates
- c. Lipases which act on lipids (fats and oils)

EVALUATION

1. What are enzymes?
2. Outline five characteristics of enzymes

GENERAL EVALUATION/REVISIONAL QUESTIONS

1. State two food items each that supply A. Protein B. Lipids C. Mineral salts
2. List two functions each for protein and lipids.
3. State the functions of A. Chlorine B. Magnesium C. Iodine.
4. What are the diseases resulting from deficiency of: A. Sodium B. Calcium C. Iron
5. State the functions and deficiency symptoms of all the water soluble vitamins

READING ASSIGNMENT

College Biology, chapter 6, page 95 – 103

WEEKEND ASSIGNMENT

1. Vitamins are organic food substances required by animals in ____ quantity A. no B. small C. large D. high
2. The following except one are fat-soluble vitamins A. vitamin A B. Vitamin B C. Vitamin K D. Vitamin E
3. One of the following food substances is indigestible in man A. protein B. lipids C. roughages D. carbohydrates
4. The highest source of energy is from _____ A. carbohydrate B. proteins C. lipids D. vitamins
5. Rickets (poor bone formation) in children is a deficiency symptom of ____ A. potassium B. calcium C. chlorine D. manganese.

THEORY

1. Make a table of food tests showing the column of food, the test, observation & inference.
2. Make a table of important mineral elements in animals, their functions and deficiency symptoms



WEEK SIX

DATE.....

TOPIC: BASIC ECOLOGICAL CONCEPTS

CONTENT

- Definition and Branches of Ecology
- Ecological Terms (Environment, Biosphere, Habitat, Ecological Niche, Population, Community, Ecological System, Biome)
- Components of an Ecosystem

BASIC ECOLOGICAL CONCEPTS

DEFINITION OF ECOLOGY

Ecology is the study of plant and animals (as well as microorganism) in relation to their environment. As a practical science, ecological studies involve:-

- Studying the distribution of living organisms
- Finding out how living organisms depend on themselves and their non-living environment for survival.
- Measuring factors affecting the environment.

BRANCHES OF ECOLOGY

Depending on whether the organisms are studied alone or in groups, ecology is divided into two:

- AUTECOLOGY: This is the study of an individual organism or a single species of organism and its environment e.g. the study of a student and his school environment.
- SYNECOLOGY: This involves studying the inter-relationships between groups of organisms or different species of organism living together in an area e.g. study of fish, crabs, seaweeds, etc in a pond.

EVALUATION

1. Define ecology.
2. Differentiate between the two branches of ecology.

ECOLOGICAL TERMS

The various concepts closely associated with ecology include;

a. ENVIRONMENT

This includes external and internal factors, living or nonliving which affects an organism or a group of organisms. These include the habitat (with its peculiar physical conditions e.g. light, food, water, air), the animals preying on other animals or the diseases affecting the organism.

b. BIOSPHERE (ECOSPHERE)

This is the zone of the earth occupied by living organisms so as to carry out their biochemical activities.

The ecosphere consists of 3 major portions:-

- Lithosphere:- this is the solid portion (the outer-most zone) of the earth which is made up of rocks and minerals. This zone forms 30% of the earth surface and it is the basis of human settlement.



- Hydrosphere:- this is the liquid (aquatic) part of the biosphere. It covers about 70% of the earth's crust. It consist of water in various forms; solid, liquid or gas (water vapour), hydrosphere includes lakes, pools, spring, oceans, ponds, rivers, etc.
- Atmosphere: - this is the gaseous portion of the earth. It consists of three main gases; nitrogen (78%), oxygen (21%) and carbon (iv) oxide (0.03%). There are also 0.77% rare gases.

c. HABITAT

This is a place where an organism is naturally found. Habitat is always affected by environmental factors. Habitat can be divided into three:-

- Aquatic habitat: this is where plants and animals (as well as micro organisms) live in water e.g. Sea, ocean, lagoons, streams, etc.
- Terrestrial habitat: this is where the organisms live on land e.g. forests, grassland, (savanna), desert etc.
- Arboreal habitat: These include tree trunks and tree tops where some organisms (usually animals) are naturally found.

d. ECOLOGICAL NICHE

This refers to the habitat and the entire habit (behavioural, feeding, breeding) of an organism. It is the physical space occupied by an organism and its functional role in the community.

e. POPULATION

This is the total number of organisms of the same species living together in a habitat e.g. population of cockroaches in Biology laboratory.

f. COMMUNITY

This is made up of all the populations of living organisms that exists together in a habitat e.g. a community of decomposer, insects and birds on a decaying log of wood.

g. ECOLOGICAL SYSTEM (ECOSYSTEM)

This refers to the basic functional unit in nature, which consists of all living factors and their interaction with non-living factors of the environment. An ecosystem can be natural or artificial.

h. BIOMES

This is a large natural terrestrial ecosystem. It is a plant and animal community produced and maintained by the climate.

EVALUATION

1. Define the following A. Community B. Population C. Ecosystem
2. Differentiate between Biosphere and Ecosystem.

COMPONENTS OF AN ECOSYSTEM

Biosphere comprises of various ecosystems. There are two main components of the ecosystem, the abiotic and the biotic components.

ABIOTIC COMPONENTS

These are non-living components and they are basic elements and compounds of the environment in which an organism lives.



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Abiotic components include organic substances (e.g. carbohydrates, lipids, and proteins), inorganic substances (e.g. CO₂, H₂O), climatic factors (e.g. light, temperature, rainfall) as well as edaphic factors (e.g. soil types, texture, topography etc).

BIOTIC COMPONENTS

These are the living things in the ecosystem. These include the producers, the consumers and the decomposers.

- Producer:** These are autotrophs in that they synthesize their food from simple inorganic substances e. g. green plants, protophytes and chemosynthetic bacteria.
- Consumers:** These are heterotrophs which feed on the producers or one another. They may be primary, secondary or tertiary consumers e.g. non-green plants, animals protozoa and some bacteria
- Decomposers:** These are saprophytes. They break down remains of plants and animals and release usable nutrients to the soil. These nutrients are used by plants to make food e.g. fungi and some bacteria

Generally living things influence other living things in many ways such as in feeding (parasitism), shading from sunlight, pollination and dispersal of seeds, competition. Some of these factors are favourable while others are unfavourable.

GENERAL EVALUATION/REVISIONAL QUESTIONS

- Write a short note on ecosphere.
- Differentiate between a habitat and ecological niche.
- With two example each, state three subdivisions of habitat.
- What is a population?
- How is population related to the community?
- Differentiate between ecosystem and biomes.
- State the two major components of an ecosystem with two examples each.

READING ASSIGNMENT

College Biology, chapter 23, 496 – 499

WEEKEND ASSIGNMENT

- Which of the following is not classified as a terrestrial habitat? A. forest B. guinea savanna C. littoral zone D. desert
- The activities of an organism which affect the survival of another organism in a habitat can be described as A. biotic factors. B. Abiotic factors C. climatic factor D. edaphic factors.
- The number of individuals of the same species interacting in a habitat at a particular time is best described as A. community B. ecosystem C. population D. biome.
- A biotic community with its physical environment (abiotic factors) defines A. ecosystem B. population C. habitat D. biosphere.
- The most abundant gas in the atmosphere is A. oxygen B. nitrogen C. carbon dioxide D. a rare gas.



THEORY

1. Define i) Biotic community ii) habitat iii) an ecosystem
2. Write short notes on the three major portions of ecosphere.

WEEK SEVEN

DATE

TOPIC: BIOMES

CONTENT

- Biomes
- Local Biomes
- World Biomes

BIOMES

Biomes are large natural terrestrial ecosystem, identified by their dominant vegetation. They are terrestrial because plants form the bulk of the community in any ecosystem e.g. a forest biome has densely packed tall trees while grasses and few scattered shrubs are found in a savanna biome. Climatic factors determine the type of vegetation in a biome. These factors may include rainfall, relative humidity, temperature, wind and light.

EVALUATION

1. What is a biome?
2. Mention four factors that determine the vegetation of a biome.

LOCAL BIOMES

The local biomes particular to Nigeria include the following:

- mangrove swamp
- tropical rain forest
- savanna (northern and southern Guinea savanna, Sudan savanna and sahel savanna)

a. MANGROVE SWAMPS

These are found in the tropics along coastal region and river mouths. Mangrove swamps are forest of small, evergreen, broad-leaved trees growing in shallow, brackish water or wet soil. Many mangrove trees have pop roots and breathing roots called pneumatophores. The climate here is hot and wet, with total annual rain fall of above 250cm and temperature of about 26⁰c. In Nigeria, mangrove swamps are found in the delta region of Lagos, Delta, Rivers, Bayelsa and Cross rivers states.

b. TROPICAL RAIN FOREST:

This occurs in the region that is between the equator and latitude 5⁰-10⁰N and S. It has the following characteristics:

- The forest are mainly lowland.
- The climate is hot and wet.
- It consists of broad leaved trees that are mostly ever green; the leaves are gradually shed throughout the year and replaced by new ones.



- The trees form canopy strata with their interior having low light intensity, high humidity and damp floor.
- The trees possess thin bark.
- The forest is rich in epiphytes and wood climbers.
- The annual rainfall and temperature are 200cm and 27⁰c respectively.

In Nigeria, tropical rainfall is found in Edo, Delta, Ondo, Imo, Lagos, Rivers state e.t.c.

c. SAVANNA

These are tropical grassland in Africa. They are usually flat for miles at a stretch and made up mainly of grasses. The savanna region has a hot and wet seasons (29⁰c) which alternate with a cool and dry season (18⁰c). The total annual rainfall around 50cm-150cm. During the dry season, the grasses are usually dry and brown and bush fire is common occurrences.

South Guinea savanna (the largest of all the biomes in Nigeria) has tall grasses with scattered, deciduous trees. It is found in Enugu, Kogi, Benue, Kwara, Oyo, Osun, Ekiti State etc.

Northern Guinea Savanna has scattered, deciduous trees, sometimes with thorns and tick barks. Grasses are short and numerous. it is found in plateau, Kaduna, Bauchi, Niger, Kano, Adamawa states etc.

Sudan savanna has the shorter grasses fewer trees which are more scattered. It is found in Kano and parts of Borno, Sokoto, Niger, Bauchi states e.t.c

Sahel savanna has high temperature and low rainfall with short and scanty grasses as well as short and tough shrubs or trees. The plants are drought-resistant. It is found in Borno, Kastina, Sokoto, Yobe, Kano, Jigawa states etc.

EVALUATION

1. In a tabular form, distinguish between the three major biomes in Nigeria using the following
 - a. Total annual rainfall
 - b. Temperature
 - c. Regions found
2. List five characteristics of savanna.

WORLD BIOMES

Of all abiotic factors affecting ecological system, temperature and rainfall determine the world biomes. The biomes include: tropical rain forest, temperate forest, coniferous forest, temperate shrubland, savanna, temperate grassland, desert, and tundra and mountain vegetation.

a. TEMPERATE FORESTS

These are forests with the following characteristics they are

- Mainly of broad leaved deciduous trees which shed their leaves during winter.
- Possession of moderately wet climate with a dry or cold season.

b. CONIFEROUS FORESTS

These are characterized by

- Needle-leaved evergreen conifers such as pines, firs.



- Possessing few trees.
- Possessing tall tree forming upper storey.
- The forest floor being covered with a thick layer of conifer needles.
- Possessing cool temperature climate with light rainfall and snow.

c. TEMPERATE SHRUBLAND

This is forest with the following characteristics

- It consists of drought-resistant shrub plants and dwarf trees, often fire-resistant e.g. marquis.
- It has temperate climate with low rainfall.

d. TEMPERATE GRASSLAND

This is characterized by:

- perennial grasses grow on very fertile soil to support herds of grazing mammals
- It has moderately dry climate with a cold winter and a hot summer

e. SAVANNA

This is a tropical grassland with:

- scattered trees and often infertile soil
- moderately dry climate with a warm dry season and a hot rainy season

f. DESERT

This has:

- very sparse vegetation, with succulent perennials that have deep root systems.
- tropical temperate and afro-alpine regions with less than 25 cm annual rainfall.

g. TUNDRA

This is characterized by:

- treeless marshy vegetation composed mainly of dwarf shrubs, grasses, lichen and moss with very few plant trees.
- cold climate with long icy winter and very short summer with an average temperature of 10⁰c.

h. MOUNTANE VEGETATION

This has:

- evergreen rainforest on slopes of mountain, these forest are less luxuriant than the tropical rainforest.
- Afro alpine vegetation occurs at heights above 3000m on mountain, vegetation consists mainly of heath, grasses and sedges.

GENERAL EVALUATION/REVISIONAL QUESTIONS

1. What do you understand by the term biome?
2. State the local biomes found in Nigeria.
3. State the four savannas present in Nigeria.
4. What are the two factors that determine the world biomes?
5. State four of the world biomes with two characteristics each.
6. Using their characteristics, differentiate between savanna and desert.

READING ASSIGNMENT



College Biology, chapter 23, page 499 - 504

WEEKEND ASSIGNMENT

1. How is savanna plants protected from bush fires? They have A. sunken stomata B. thorn bark C. thick barks D. soft leaves
2. Which of the following limiting resources is competed for by organisms in the desert?
A. Light B. oxygen C. temperature D. water
3. Which of these is not a true characteristic of the tropical rain forest? A. Vegetation consists predominantly of tall tree with thick canopy B. forest is rich in epiphytes and climbers C. annual rainfall is less than 100 cm D. annual temperature is 27⁰c
4. Which of the following does not describe the coniferous forest? A. needle leaved evergreen conifers B. broad leaved evergreen conifers C. possessing few trees D. possessing cool temperate climate
5. Montane vegetation is described by the following except A. treeless marshy vegetation B. evergreen rainforest on slopes of mountain C. forest are less luxuriant than tropical rain forest D. afro alpine vegetation at heights above 300m on mountain

THEORY

1. Outline the properties of the savanna as a world biome.
2. State four characteristic features of vegetation found in A. savanna B. tropical rainforest C. desert.

WEEK EIGHT

DATE

TOPIC: POPULATION

CONTENT

- Population Characteristics
- Population Studies
- Factors that Affect Population
- Simple Measurement of Ecological Factors.

POPULATION CHARACTERISTICS

These include population size, density, frequency, percentage cover and distribution.

- a. Population size: - this is the number of organisms of the same species living together in a given area at a particular time.
- b. Population density: - this is the number of a particular species per unit area or volume of the habitat. Therefore
Population density = population size / area of habitat.
- c. Population frequency: - this is the number of times an organism occurs within a given area or habitat.
- d. Percentage cover: - this refers to how much space or area an organism occupies its habitat.
- e. Population growth rate: - this refers to the net result of the influence of natality (birth rate) and mortality (death rate) of organism in a given habitat.



- f. Population distribution: - this refers to the ways in which individuals of the same species are arranged in a given habitat, either randomly, evenly or clumped.

EVALUATION

1. Define the following terms: (i) Percentage cover (ii) Population size (iii) Population frequency (iv) Population density.
2. Mention two methods of determining population size.

POPULATION STUDIES

- a. Choose the habitat.
- b. Select the sampling method to be used.
- c. Collect, count and record the different types of organisms present. Sampling using a quadrant or transect using a tape can be adopted.
- d. Identify the dominant species i. e. the species that has greater influence on the other members of the community.
- e. Repeat the population studies at intervals.
- f. Determine the population characteristics.

EVALUATION

1. How do you determine the population density of insect on a piece of land?
2. How do you determine the population of grasses in a piece of land?

FACTORS AFFECTING POPULATION

- a. Natality; Ability of organisms to reproduce to increase its population
- b. Mortality; Death rate.
- c. Immigration; Movement of organisms from different habitats into a new habitat and this increases the population of the new area, decreasing the population of the former habitat.
- d. Emigration; Movement of organisms out of a habitat due to unfavourable conditions e.g. food scarcity etc. This reduces the population of the habitat.
- e. Availability of food; Animals tend to migrate to where there is plenty of food, thereby increasing the population of such places.
- f. Seasonal climatic changes; whether the change is favourable or not determines the stay or migration of organisms into or out of a habitat.
- g. Breeding season; some organisms move out of their habitats during this season (e.g. fishes); hence the population drops.
- h. Natural disasters; Like fire, drought, floods, earthquakes etc lead to a decrease in population through the death of organisms out of such habitat

MEASUREMENT OF ECOLOGICAL FACTORS

These factors can be measured using some instruments as shown below.

	INSTRUMENTS	USES
a.	Photometer	Light intensity



b.	Hydrometer	Light intensity in water
c.	Wind vane	Direction of wind
d.	Anemometer	Speed of wind
e.	Rain gauge	Amount of rainfall
f.	Hygrometer	Relative humidity
g.	Barometer	Pressure
h.	Glass thermometer	Temperature
i.	Colorimeter or pH scale	Acidity / Alkalinity
j.	Secchi disc	Turbidity
k.	Sweep insect net	Catching insects

EVALUATION

1. State three factors that: a) increase the population of a habitat b) decrease the population of a habitat.
2. Explain the effect of bush burning on the population.
3. List five ecological instruments and their uses

GENERAL EVALUATION/REVISIONAL QUESTIONS

1. State the two components of an ecosystem
2. With two examples each, discuss the various biotic components in an ecosystem
3. State three factors that: a) increase the population of a habitat b) decrease the population of a habitat.
4. State five effects of over population in a community
5. State two Abiotic factors unique to: a) aquatic habitat b) terrestrial habitat.
6. List five measurable ecological factors.
7. State the ecological instruments used in measuring the factors listed above.

READING ASSIGNMENT

College Biology, chapter 23, page 530 - 532

WEEKEND ASSIGNMENT

1. Climatic factors in an ecosystem include the following **except**
A. light B. wind C. temperature D. Oxygen.
2. Organic part of abiotic component of an ecosystem includes the following **except**
A. water B. carbohydrate C. Protein d) Lipids
3. The ratio of population size to the area of the habitat is called A. population size
B. population density C. population frequency D. population cover.
4. Habitat factors include all the following **except** A. biotic B. abiotic C. edaphic D. nature.
5. The total number of organisms of the same species in a habitat at a particular time is called A. population B. community C. census D. all of the above

THEORY

1. List five ecological instruments and state their uses.



2. State five factors affecting a population size.

WEEK NINE

DATE:

TOPIC: FUNCTIONING ECOSYSTEM

CONTENT

- Feeding Relationship
- Trophic Levels
- Food Chain and Food Web
- Energy Flow and Ecological Pyramids
- Energy Transformation in Nature
- Laws of Thermodynamics

FEEDING RELATIONSHIPS

Since all living organisms must obtain energy and nutrients from the environment in order to remain alive, they are into feeding relationships. This makes an ecosystem a functional unit. All organisms fall into one of the three major groups of biotic community, namely: producers (autotrophs), consumer (heterotrophs) and decomposers

- a. The autotrophs provide food for other organism in the habitat. In terrestrial habitat, they include grasses, trees and shrubs while aquatic autotrophs include phytoplankton, seaweeds etc
- b. The heterotrophic include: (i) herbivores (called primary consumers) feeding on plants, carnivores (called secondary consumers) feeding on primary consumers and omnivores is other animals called (tertiary consumers) that feed on secondary consumer or on both. Terrestrial heterotrophs include cow, dog, lion, man etc while water fleas, tadpoles, larvae of insect and fishes are aquatic heterotrophs
- c. Decomposers like termites, larvae of housefly (maggot), bacteria and fungi break down dead organic matter to release simple chemical compounds which can be absorb and use again.

Of all the three biotic groups, consumers have better chance of survival than any other in an ecosystem.

EVALUATION

1. State two examples each of the following in both terrestrial and aquatic habitat
A. Autotrophs B. heterotrophs C. Decomposers.
2. How do the three groups of organisms in one above relate?

TROPHIC LEVELS

In an ecosystem, energy and nutrients are transferred step by step among organisms along a feeding path way. The feeding pathway in all ecosystems follows a similar pattern which is as follows:

- a. It begins with a producer e.g green plant like grass.
- b. The producer is eaten by a primary consumer e.g Zebra , goat.
- c. The primary consumer is eaten by a secondary consumer e.g. lion.



- d. Decomposers convert the remains of dead producers and consumers into simple inorganic substance which return to the non –living environment. The difference in the feeding pathways within an ecosystem or between different ecosystems is the termination of the pathway. Some may end at the primary consumer step or may go on to secondary consumer, tertiary consumer etc.

Trophic (feeding) level: is each step along a feeding pathway. The order in which the trophic levels are arranged gives the path of energy (food) flow among the functional groups of organisms. The trophic levels are numbered in ascending order, starting from one to indicate the path of energy flow.

Trophic level 1 always consists of producers or autotrophs, trophic level 2 always consists of primary consumers. Above trophic level 2, consumers could be carnivores, parasitic organisms and scavengers. The final consumers eventually die and are fed upon by decomposers.

EVALUATION

1. Describe the pattern that feeding pathway follow in all ecosystems.
2. What do you understand by feeding level?

FOOD CHAIN FOOD WEB

This is the feeding relationship involving the transfer of energy through food from producers to consumers in a linear form.

Examples of food chain in terrestrial habitats are:

Grass → zebra → lion
(Producer) (Primary consumer) (Secondary consumer)

Guinea grass → grasshopper → toad → snake → hawk
(producer) (primary consumer) (secondary consumer) (tertiary consumer)

In aquatic habitats are:

Spirogyra → tadpoles → crabs → kingfish
(producer) (primary consumer) (secondary consumer) (tertiary consumer)

Diatoms → mosquito larva → Tilapia fish → whale
(producer) (primary consumer) (secondary consumer) (tertiary consumer)

Therefore, in a food chain, food energy is transferred from one organism to another in a linear form. Most food chains begin with producers but few of them start with dead plants or animals e.g

Humus → earthworm → domestic fowl → man

Numerous food chains present in an ecosystem produce a food web.



FOOD WEB: - is a complex feeding relationship among organisms in the same environment with two or more interrelated food chains. Food webs therefore contain more organisms than food chains. A single plant could be fed upon by more than one or two organisms. In an ecosystem, a consumer has a better chance of survival because it feeds on different types of plants or animals in a food web.



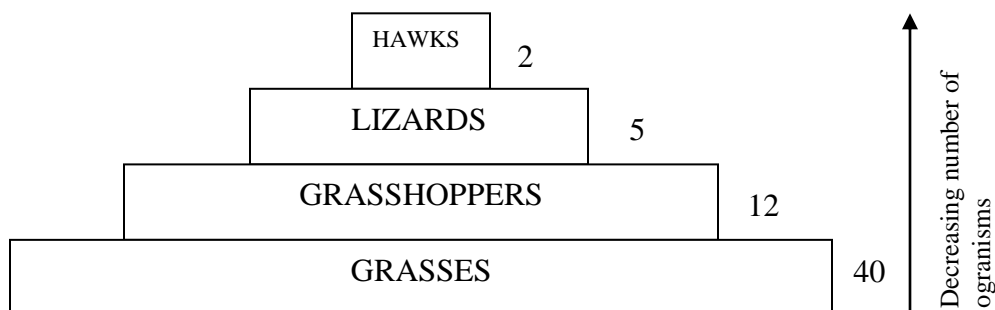
EVALUATION

1. What is a food chain?
2. Draw a food chain involving four trophic levels in a A. marine B. terrestrial habitat.

ENERGY FLOW AND ECOLOGICAL PYRAMID

Pyramids are diagrammatic representations used in ecology. They include pyramid of number, pyramid of energy and pyramid of biomass.

1. **PYRAMID OF NUMBER:** this refers to the numbers of individual organisms at each trophic level, decreasing from the first to the last level in a food chain.



Pyramid of number has the following defects: The individual organisms is given the same status, though they varied greatly in size e. g. grass and trees grouped together as producer and is not drawn to scale.



2. **PYRAMID OF ENERGY:** This is the amount of energy present in the living organisms at different trophic level of a food chain, which decreases from the first to the last i. e. from the base of the pyramid to the apex.
3. **PYRAMID OF BIOMASS:** Biomass refers to the size and numbers of living organisms. It represents the total wet or dry mass of the organisms in each trophic level. This gives a more accurate picture of the relationship between the organisms at various trophic levels in a food chain than the pyramid of numbers.

ENERGY LOSS IN THE ECOSYSTEM

Energy is the ability to do work. All living organisms obtain energy from the food they eat. The food is produced by green plants and other organisms depend on them. As energy is passed from one organism to another along the food chain, it is progressively lost due to respiration (energy used for various metabolic activities) and as heat. In most ecosystems, only about 1 - 10% of the solar energy may be available to photosynthetic producers.

EVALUATION

1. What is a pyramid? State three types of ecological pyramids.
2. State the similarities between pyramid of numbers and pyramid of energy.

LAWS OF THERMODYNAMICS

Thermodynamics simply means heat change. Heat as a form of energy that is subject to change in living organisms is governed by two laws

- a. **First law of thermodynamics** which states that energy can neither be created nor destroyed, although it can be changed from one form to another. E.g. chemical energy in food is converted to kinetic energy and heat energy in our muscles when we walk or run.
- b. **Second law of thermodynamics** which state that in any conversion of energy from one form to another, there is always a decrease in the amount of useful energy i. e. no transformation of energy from one state to another is ever 100 percent efficient.

During metabolic activities, some chemical energy is constantly lost as heat energy from the body of an organism. As energy is converted from one form to another, there will always be a loss.

FOOD CHAIN AND LAWS OF THERMODYNAMICS

- (i) Using the first law: in a food chain, energy from the sun is transferred from the producer to the final consumer and the sum total of the energy remains constant.
- (ii) Using the second law: as the energy is transformed from one trophic level to another, part of it is converted into heat it is lost, among a progressive drop in energy in successive trophic levels.

PYRAMID OF ENERGY & LAWS OF THERMODYNAMICS

- (i) Using the first law: The energy of the producers at the base of the pyramid is higher and it is gradually transformed to other trophic levels.



- (ii) Using the second law: As energy is transferred from one trophic level to another, part of the energy is converted to heat.

ENERGY FLOW AND LAWS OF THERMODYNAMICS

- (i) Using the first law: Energy flows from producers to 1⁰ consumers, then to 2⁰ consumers and finally to 3⁰ consumers in a food chain. The energy flow in a food chain is therefore in one direction only.
- (ii) Using the Second law: Energy transfer between trophic levels is not 100%. Successive levels have less useful energy and so can only support fewer organisms. Produce (green plants) have the highest amount of energy. When herbivores feed on the plants, the energy level is reduced. When carnivores consume the herbivores, the energy level is reduced.

EVALUATION

1. State the laws of thermodynamics and explain.
2. Explain pyramid of energy and food chain using the laws of thermodynamics.

GENERAL EVALUATION

1. What is a food chain?
2. Explain the role of the following in a food chain (i) Producer (ii) Consumer (iii) Decomposer.
3. A. Draw a food chain involving four trophic levels in a marine habitat.
B. Explain (i) the flow of energy through the food chain drawn in 3C
(ii) how energy in the chain is lost to the environment.

READING ASSIGNMENT

College Biology chapter 23, page 544 – 551

WEEKEND ASSIGNMENT

1. The ultimate source of energy in nature is A. green plants B. moon C. star D. sun
2. The usable form of energy in animals is A. chemical energy B. kinetic energy
C. potential energy D. ATP
3. Available to photosynthetic plants is _____ of the solar energy. A. 1-5% B. 2-5%
C. 5-15% D. 1-10%
4. The study of the relationship between heat energy and other forms of energy is called _____. A. thermodynamics B. thermocouple C. thermosetting D. all of the above
5. Energy can neither be created nor destroyed but can only be changed from one form to another This refers to the A. first law of thermodynamics B. second law of thermodynamics C. third law of thermodynamics D. none of the above

THEORY

1. State the first and second law of thermodynamics.



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2. In a tabular format, state four differences between food chain and food web.



WEEK TEN

DATE:

TOPIC: ECOLOGICAL MANAGEMENT

CONTENT

- Types of Association
- Features by organism of an association

TYPES OF ASSOCIATIONS AND THEIR FEATURES

SYMBIOSIS OR MUTUALISM (+ +)

Definition: When both population benefit and at least one of them is so dependent upon the other for some critical resource or function that it cannot survive in the given environment without the other species is referred to as mutualism or symbiosis. Symbiosis is a beneficial association and each member is called a symbiont.

Examples and features of organisms in Symbiotic Association

- Lichen:** This result from mutualistic association between an alga and a fungus. The alga carries out photosynthesis through its thallus while the fungus absorbs rain water through its tangled network of mycelia which the alga uses to photosynthesize its food. The fungus gets ready-made food from the alga.
- Protozoa in the digestive tract of termites:** The protozoa help the termite to digest the cellulose in the food while protozoa are protected by the termites.
- Nitrogen fixing bacteria in the root nodules of leguminous plants:** A bacterium called *Rhizobium leguminosarium* living in the root nodules of leguminous plant grow and multiply or reproduce there. In return, the rhizobium (bacterium) fixes nitrogen directly into the plant from the atmosphere, thereby increasing the nitrogen requirement of leguminous plants.
- Micro-organisms in the intestinal tract of ruminants:** Bacteria and other protozoa in the rumen of ruminant animal like cattle, sheep and goat help the ruminant to digest cellulose to sugars, synthesize amino acids and vitamins from other substances while the ruminant in turn provides food and shelter for the bacteria.
- Flower and insects:** Insects obtain food from flowers in the form of pollen and nectars while in return, the insects bring about cross-pollination in the plant they visit, thus enabling plants to reproduce sexually.

PROTOCOOPERATION (+ +)

Definition: Proto cooperation is an association between organisms of different species in which both are mutually benefited but they can also survive individually of each other. Unlike mutualism, the association in proto cooperation is not obligatory.

Example and features of organisms in proto cooperative association

- Sea anemone and hermit crab:** The sea anemone attaches itself to the shell of the hermit crab. The sea anemone provides camouflage protection to the hermit crab against predators while the hermit crab helps to transport the sea anemone to a feeding ground. It helps the sea anemone obtain food during its movement.



- b) **Plover and crocodile:** Plover (*Pluvianus aegyptius*), a crocodile bird, enters into the mouth of the crocodile to feed on parasitic leeches. As it obtains food from the mouth of the crocodile it also gets rid of the harmful leeches.
- c) **Cattle and egret:** The bird, egret, feeds on the parasite on the body of cattle. As the cattle benefits from the removal of parasites from its body, the egret benefits because it obtains food from the association.

COMMENSALISM (+ 0)

Definition: Commensalism is an association between two organisms living together in which only one (commensal) benefits from the association while the other neither benefits nor is harmed.

Examples and features of organisms in Commensalism

- a) **Shark and Remora fish:** The remora fish attaches itself to the body of a shark, whereas the shark is neither harmed nor benefits as a result of the presence of the remora fish.
- b) **Oyster and crabs:** The habitation of a crab is in the oyster shell in which case the crab is not protected and no harm is done to the oyster.
- c) **Man and intestinal bacteria:** Some bacteria in the large intestine of man feed on digested food there. The bacteria receive food and protection from the man whereas the man neither gains nor suffers any disadvantages from the presence of the bacteria.

EVALUATION

1. What are symbiosis and commensalism?
2. Explain two examples of symbiosis and commensalism.

AMENSALISM (- 0)

Definition: Amensalism is an association between two organisms of different species where one species is inhibited or killed and the other is unaffected. In amensalism, one does not allow the organism to live or grow near it. This relationship is also called antibiosis. The species affected is called amensal while the species causing the effect is called the inhibitor. This inhibition is done by the release of chemicals known as allochemicals or allelopathic substances.

Examples of amensalism

- a) ***Penicillium notatum* and bacteria:** *Penicillium* releases antibiotics known as penicillin which inhibits the growth of bacteria.
- b) ***Streptomyces griseus* and bacteria:** Like *Penicillium*, *Streptomyces* also secretes chemicals that inhibit the growth of bacteria.

PARASITISM (- +)

Definition: Parasitism is a close association between two organisms in which one, known as the parasite, lives in or on and feeds at the expense of the other organism which is known as the host. The parasite benefits from the association while the host usually suffers harm or may die.

Examples and Features of Organisms in Parasitism.

- a) **Man and tapeworm:** The tapeworm is a parasite that lives in the small intestine of man where it derives the benefits of a habitat, protection and food. The tapeworm attaches



itself to the small intestine of man by means of hook and sucker. In the wall of the small intestine, absorption of digested food takes place from which the tapeworm benefits. The man who is the host suffers because he loses to the tapeworm part of the food he has eaten and digested.

- b) Mistletoe and flowering plant:** The mistletoe is a plant parasite that lives on other larger flowering plants. The mistletoe benefits because it is raised up to a position from which it can receive sunlight. The parasite also absorbs water and mineral salts from the host while the host suffers harm by losing to the parasite part of the water and mineral salts that it has absorbed.

PREDATION (- +)

Definition: Predation is a type of association between two organisms in which the predator kills the other called the prey and directly feeds on it. The predator which is usually larger in size and always stronger than the prey is completely eliminated.

Examples of Predation

- a)** The hawk and chicks of domestic fowls: The hawk is the predator that catches, kills and eats the prey (young chicks) of domestic fowls. The hawk benefits while the chicks are completely eliminated.
- b)** The lion and goat: The lion is the predator that catches, kills and eats the prey (goat). The lion is stronger and bigger than the goat. The lion benefits while the goat is completely eliminated.

REVISIONAL QUESTIONS

1. Define parasitism and predation.
2. Give two examples of parasitism and predation.
3. State the differences between parasitism and amensalism.
4. Mention two growth hormones each in plants and animals.
5. Discuss the stages involved in mitotic cell division.
6. Outline four life processes involving mitosis.

READING ASSIGNMENT

College Biology by Idodo Umeh. Chapter 23, page 556

WEEKEND ASSIGNMENT

1. A ___ relationship is one in which one member of the association benefits A. parasitic B. symbiotic C. saprophytic D. mutualistic
2. Tick feeds on A. blood B. water C. skin D. body
3. The word commensal means A. sharing B. dividing C. scattering D. loving
4. Chemicals secreted by inhibitors is called ___ A. biotics B. inhibitors C. amensal D. allochemics
5. ___ consists of algae and fungi A. Lichen B. Bacteria C. Virus D. Fungi

THEORY



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1. What is A. symbiosis B. commensalism C. predation?
2. Mention three examples each of the following above.