BIOLOGY

FOR

Senior Secondary School

1

AKADALEARN

S.S.S 1

BIOLOGY

FIRST TERM

TABLE OF CONTENT

Week: 1

Topic: Biology and Living Things

Biology As An Inquiry In Science

Science is defined as a systematic process of making enquiry about the living and non-living things in our environment. It is the study of natural things around us and biology as a branch of science is derived from the Greek word bios, "life" and the suffix –*logia*, "study of." Biology is a natural science concerned with the study of life and living organisms, including their structure, function, growth, evolution, distribution, and taxonomy. Biology generally recognizes the cell as the basic unit of life, genes as the basic unit of heredity, and evolution as the engine that propels the synthesis and creation of new species. It is also understood today that all organisms survive by consuming and transforming energy and by regulating their internal environment to maintain a stable and vital condition.

Meaning Of Science

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

Definition Of Biology

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

Branches of Biology.

Biology is basically grouped into two main branches. These are:-

Zoology – The study of animals

Botany – The study of plants

Other branches include

Ecology – The study of plants and animals in relation to their environment.

Morphology – This involves the study of external features of plants and animals

Anatomy – This is the branch of biology which involves the study of the internal structures of plants and animals

Genetics – This is the scientific study of heredity and variation in living things

Physiology – This involves the study of how plants and animals function.

Scientific Approach

It involves sequences of making enquiries about an object or things under study in science. Scientific methods of science include;

Observation	Hypothesis	Classification	Experiment
Inferences	Measurement	Conclusion	Theory or Law

The starting point of scientific methods is Observation which involves the use of senses to describe what one has seen or felt about an object. The observation leads to classification, then to interference and later to measurement and identification of the existing problems.

Usefulness of Science

1. Medicine – Science has contributed greatly to the manufacture of vaccines and drugs that are used to cure various diseases of man
2. Manufacturing Industries – Various materials are combined together to manufacture many finished products
3. Construction – Roads, railways, airports have been designed and constructed as a result of the knowledge of science
4. Engineering – Ship building, skyscrapers, bridges, roads have been designed and constructed due to the knowledge of science
5. Technology – Science has helped in the development of computers, telephones, telex, fax machines have been developed with the aid of science which now makes communication easier.
6. Transportation – Aerolanes, ships, rockets have been built due to the knowledge of science

Practice Questions

1 ..... is the study of plants and animals in relation to their environment.
a) Entology
b) Ecology
c) Autology
d) Ecosystem

2 ..... is the branch of biology which involves the study of the internal structures of plants and animals.
a) Morphology
b) Entymology
c) Anatomy
d) Physiology

3 Which of this is not a usefulness of science?
a) Transportation
b) Communication
c) Medicine
d) Market

4 ..... is defined as a systematic process of making enquiry about the living and non-living things in our environment.
a) Scientific
b) Sciences
c) Science
d) Biology

5 The starting point of scientific methods is .....
a) Classification
b) Observation
c) Observer
d) Identification

6 ..... is not a branch of Biology.
a) Autelogy
b) Zoology
c) Ecology
d) Genetics

7 ..... involves the study of external features of plants and animals.
a) Autelogy
b) Zoology
c) Ecology
d) Morphology

8 ..... refers to the study of plants.
a) Autelogy
b) Botany
c) Ecology
d) Genetics

Answers

1. B
2. C
3. D
4. C
5. B
6. A
7. D
8. B

Week: 2

Topic: Living Thing and Non-living Thing

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

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

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

Characteristics of Living Things

1**. Feeding/Nutrition**: All living organisms need to take substances from their environment to obtain energy, to grow and to stay healthy. Nutrition is defined as the ability of living organisms to feed. This is to enable them carry out life processes like growth, reproduction etc

2. **Movement**: All living organisms show movement of one kind or another. All living organisms have internal movement, which means that they have the ability of moving substances from one part of their body to another. Some living organisms show external movement as well – they can move from place to place by walking, flying or swimming.

3. **Breathing or Respiration**: All living things exchange gases with their environment. Animals take in oxygen and breathe out carbon dioxide. Respiration is defined as the exchange of gases between organisms and their environment. Living organisms take in oxygen and breathe out Carbon dioxide.

4. **Excretion**: Excretion is the removal of waste from the body or the removal of metabolic waste products from the body. If this waste was allowed to remain in the body, it could be poisonous. Humans produce liquid waste called urine. We also excrete waste when we breathe out. All living things need to remove waste from their bodies.

5. **Growth**: When living things feed they gain energy. Some of this energy is used in growth. Living things become larger and more complicated as they grow. Growth is defined as an irreversible or permanent increase in size, dry mass or weight of an organism due to the addition of living proton plasmic materials.

6. **Sensitivity or Irritability**: Living things react to changes around them. We react to touch, light, heat, cold and sound, as other living things do. Irritability is defined as the ability of organisms to respond to stimuli. Stimuli include heat, light, pain, water, sound and chemical substances to which living tings respond

7. Reproduction: All living things produce young ones. Humans make babies, cats produce kittens and pigeons lay eggs. Plants also reproduce. Many make seeds which can germinate and grow into new plants. Reproduction is defined as the ability of a living thing to give birth to young ones or offspring. The purpose of reproduction is to ensure continuity of life. Types of reproduction –

Sexual reproduction: Involves two organisms coming together to produce an offspring

Asexual reproduction – One organism producing an offspring

8. Adaptation: This is the way living organisms get used to their various environments in such a manner that they would be comfortable.

9. Life span or Death: All living organisms must die because they have a definite and limited period of existence.

Differences between Plants and Animals

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

Test Questions

1. A ..... is any organism or a living form that possesses or show the characteristics of life. a) living things b) non-living thing c) living thing d) organism
2. ..... is not an example of living things a) Protozoa b) Virus c) Bacteria d) Water
3. A ..... is one that lacks or has stopped displaying the characteristics of life. a) living thing b) non – living thing c) rock d) Nonliving things
4. ..... is not a characteristic of living things. a) Growth b) Movement c) Irritation d) Irritability
5. Animals undergo photosynthesis. True or False
6. ..... is the exchange of gas with the environment. a) Reproduction b) Respiration c) Expiration d) Desperation
7. ..... is an irreversible or permanent increase in size. a) Growth b) Development c) Increment d) Reproduction

8. ..... is not an example of a stimuli. a) Pain b) Water c) Ground d) Sound
9. Excretion is the removal of ..... waste products from the body. a) catabolic b) metabolic c) anabolic d) diabolic
10. ..... is a type of reproduction in living things. a) Sexual b) Asexual c) Bisexual d) a & b

Answers

1. C
2. D
3. B
4. C
5. False
6. B
7. A
8. C
9. B
10. D

Week: 3

Topic: Classification of Living Things

In science, the practice of classifying organisms is called **taxonomy** ('Taxis' means arrangement and 'nomos' means law). The modern taxonomic system was developed by the Swedish botanist Carolus Linneaeus (1707-1788) which provides scientists and students a way to sort and group organisms for easier study. He used simple physical characteristics of organisms to identify and differentiate between different species, and is based around genetics. All living things were lumped together into two kingdoms, namely plants and animals. Animals included every living thing that moved, ate, and grew to a certain size and stopped growing. Plants included every living thing that did not move or eat and that continued to grow throughout life. It became very difficult to group some living things into one or the other, so early in the past century the two kingdoms were expanded into five kingdoms: Protista (the single-celled eukaryotes); Fungi (fungus and related organisms); Plantae (the plants); Animalia (the animals); Monera (the prokaryotes).

There are 7 major groups that are used in the classification of living things. These are Kingdom – Phylum – Class – Order – Family – Genus – Species. The basic unit of classification of living things is the species. Species is the smallest unit containing members which have the largest number of features in common and usually interbreed among themselves but a member of a species cannot interbreed with the member of another species.

The Five Kingdoms

Monera
Protista
Fungi
Plantae
Animalia

Classification of Humans/Lions

Kingdom – Animalia/Animalia

Phylum – Chordata/Chordata

Class – Mammalia/Mammalia

Order – Primates/Carnivora

Family – Hominidae/Felidae

Genus – Homo/Panthera

Species – Sapiens/Leo

Binomial System of Nomenclature

Carolus Linnaeus introduced a system of naming living tings which is popularly used today. This system is called the Binomial System of Nomenclature. Each living organism is given two names . The first name is the Generic name and it begins with a capital letter while the last name is the specific name which begins with a small letter. These names are written in italics or underlined. Examples of scientific names are

1. Man – Homo sapiens
2. Lion – Panthera leo
3. Rat – Rattus rattus
4. Orange – Citrus sinensis
5. Housefly – Musca domestica
6. Maize – Zea mays

Botanical Classification

A. Kingdom Monera

Characteristics

- they are unicellular or single celled
- the cells are prokaryotic
- the cells have no definite nucleus with nuclear membrane
- they do not have complex chromosomes
- the cells have no mitochondria
- the cell wall does not contain cellulose but polysaccharides and amino acids
- there is no sexual reproduction

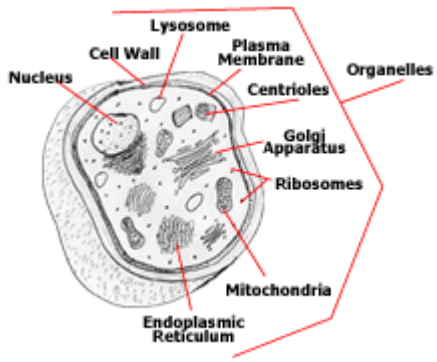
Monera is divided into two namely: Schizophyta and Cyanophyta

i) Schizophyta

Characteristics

- These are simple living things that belong to monera
- They have procaryotic cells with no definite nucleus
- They are microscopic and non-green plants
- They reproduce by asexual means (binary fission).

– They are unicellular organisms
Examples of Schizophyta are Bacteria, Viruses.



ii) Cyanophyta

Characteristics

- they are microscopic in nature
- they do not have cilia, flagella or locomotive organelles
- they reproduce by cell division
- Some are unicellular, others are filamentous
- their cells contain cholorophyll but not in choloroplast
- their cell walls do not contain cellulose

Examples are blue-green algae

B. Kingdom Protista

Characteristics

- they are unicellular organisms
- they are all eukaryotic
- some members are motile while others are non-motile
- they move either by cilia, flagella or amoeboid by nature
- some of the protista are heterotrophic while some are both heterotrophic and photosynthetic
- asexual and sexual reproduction are exhibited by some members

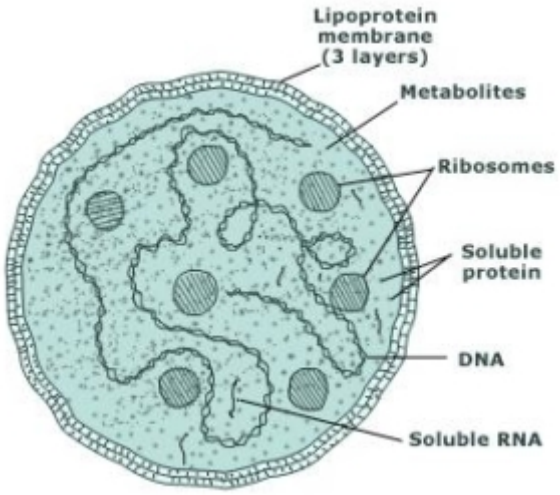
There are four phyla in this kingdom

a. protozoa b. euglenophyta c. chrysophyta d. pyrrophyta

i. Protozoa

Characteristics

- they are microscopic organisms
- they have eucaryotic cells
- they reproduce asexually by binary fission
- they are unicellular motile organism
- they are mainly aquatic organisms while few are parasitic
- organisms in this group are Amoeba(move by pseudopodia), Paramecium (move of cilia), Plasmodium



Blue Green Algae

ii Euglenophyta

Euglena

Euglena viridis is a protist that exhibits characteristics of plants and animals.

Animal Characteristics

- possession of flagellum for movement
- possession of gullet for passage of food
- possession of contractile vacuole used for osmo-regulation

- presence of eye spot to enable it to respond to light
- possession of pellicle which makes its body flexible

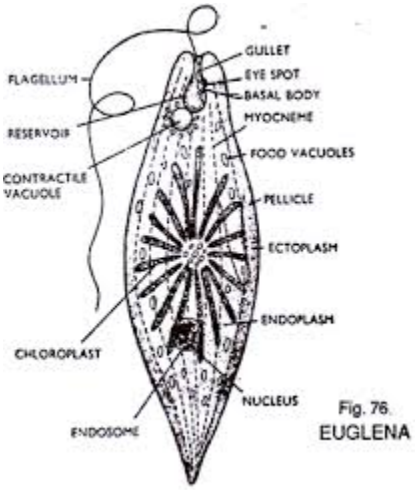


Fig. 76.
EUGLENA

Plant Characteristics

- possession of choloroplast for photosynthesis
- possession of pyrenoids where starch is stored
- holophytic mode of nutrition

C. Kingdom Fungi

The fungi were for a long time classified with the plants. They however differ from plants in the composition of their cell walls.

Characteristics

- they are eucaryotes
- some are unicellular e.g yeast, others are multicellular e.g mushrooms
- they are mainly non-motile organisms
- they have no true roots, stems and leaves
- they are non-green plants i.e they lack cholorophyll
- they store excess food in form of glycogen
- their cell walls are made of chitin instead of cellulose
- they reproduce asexually by formation of spores and some sexually by conjugation
- they are mainly found in moist emvironments

- examples of fungi are bread moulds, Rhizopus, mushroom, mucor, yeast and toad stools

D. Kingdom Plantae

Characteristics

- they are eukaryotes
- they are many celled
- they are non – motile organisms
- they possess cholorophyll whic enable them to carry out photosynthesis
- The plant kingdom consist of 3 main divisions:- Thallophyta, Bryophyta and Tracheopyta

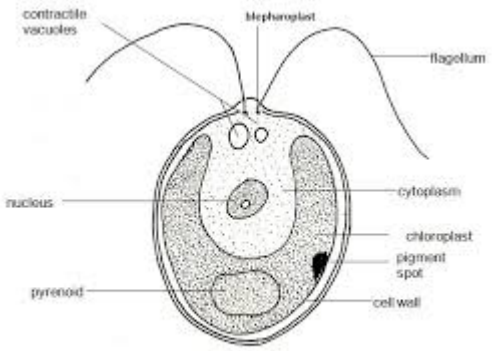
i) Thallophyta

They are simple plants with definite shape. Members of thallophyta are the fungi, algae and lichens. (Note lichens are formed when algae and fungi exist together. they grow on rocks and tree trunks). They can further be subdivided into – Rhodophyta (Red algae), Cholorphyta (green algae) and Phaecophyta (Brown algae).

Characteristics

- they are simple microscopic plants
- some are unicellular e.g chlamydomonas while some are multi cellular e.g spirogyra

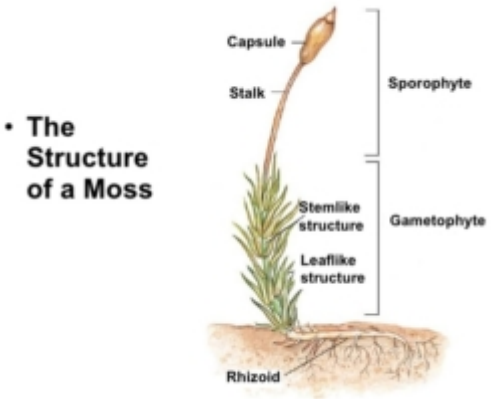
- they are simple aquatic organisms
- they have cellular cell walls
- they are filamentous and cells are not differentiated
- they have no specialised reproductive organs
- examples include algae like chlamydomonas, volvox and spirogyra.



Chlamydomonas

iii) Bryophyta

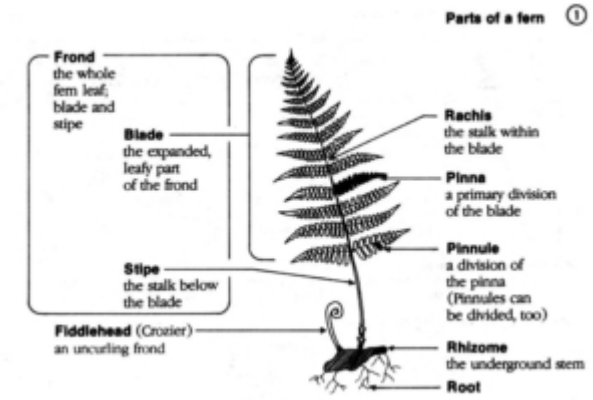
– They are complex, multicellular green plants
– Their cells are differentiated into tissues
– They lack true roots, stems and leaves but have structures resembling roots, stems and leaves.
– They are non-vascular plants
– They are usually found growing in moist places
– Some bryophytes are terrestrial while other are aquatic.
– They exhibit asexual reproduction by spores in which there is alteration of generation.
Examples of Bryophytes are Mosses and Liverworts.



ii) Pteridophyta

- They are multicellular and vascular green plants
- They are non flowering plants
- They have true roots, stems and leaves
- They are mainly terrestrial plants while few are aquatic
- They are non-speed producing plants
- They reproduce sexually by gametes and asexually by spores

Example is the ferns and it includes – dryopteris, felimas and water ferns



iii) Tracheopyta

They are divided into Pteridophyta and Spermatophyta

a. Spermatophyta

- They are multicellular, seed producing flowering plants
- They are vascular plants and have well developed vascular tissues
- They have roots , stems and leaves.
- They reproduce sexually and do not need water for population.
- They are mainly terrestrial green plants.

Spermatophyta can be divided into two main classes: Gymnosperms and Angiosperms

b. Pteridophyta

- they are multicellular and vascular plants
- they are non flowering plants
- they are mainly terrestial
- thye have true roots, stems and leaves
- they are non-seed producing plants
- they reproduce sexually by spores

Example is the ferns

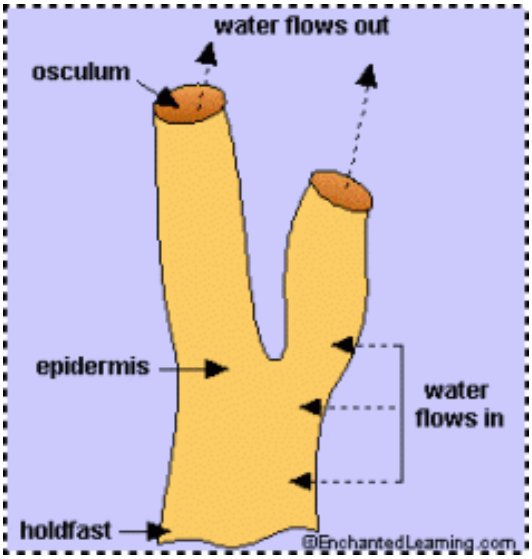
E. Kingdom Animalia

The first eight phyla of the animal kingdom belongs to the sub-phylum invertebratae (animal without backbone) while some phylum cordata belongs to pylum vertebrata (animals with backbone and internal skeleton)

1. Porifera

Characteristics

- simple aquatic invertebrates
- they do not move but are attached to rocks and shells
- they live in colonies
- their larval stage is motile
- they are primitive multicellular animals
- they have asymmetrical bodies
- they lack specialised tissues
- examples are sponges

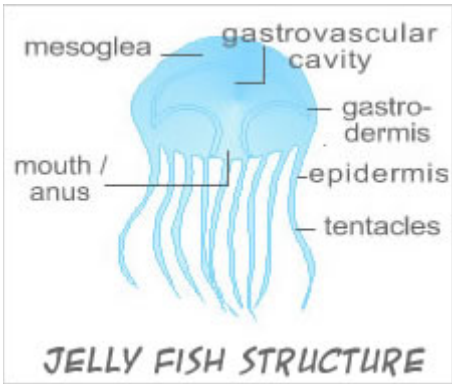


2. Coelentrata

Characteristics

- they are multicellular organisms
- the body is made up of two layers

- they are mainly aquatic organisms
- they reproduce asexually by budding
- they have tentacles and stinging cells used for capturing prey
- tey have soft jelly like bodies
- they possess radial symmetry



3. Platyhelminthes

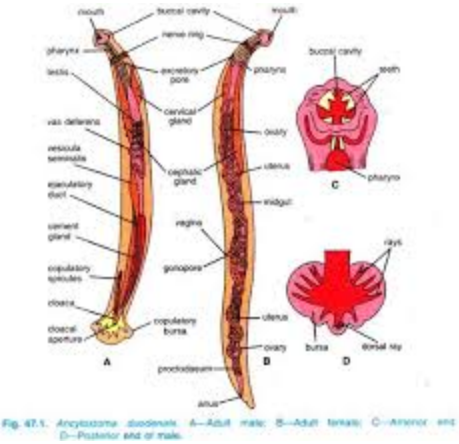
Characteristics

- they are multicellular flatworms
- they are bilaterally symmetrical
- they do not have body cavity or lumen
- their body is made up of three layers – ectoderm, mesoderm and endoderm
- most flatworms are hermaphrodites
- examples are tapeworm, liverfluke, planaria

4. Nematoda

Characteristics

- they have round and cylindrical bodies
- they lack body cavity
- they are bilaterally symmetrical
- body has three layers
- some are hermaphrodites and some reproduce sexually
- examples are hookworms, guinea worms, filaria worms, thread worms.

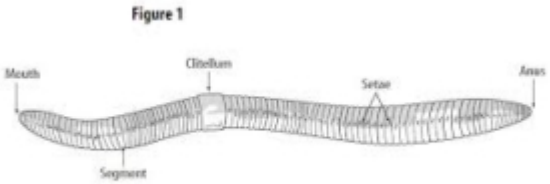


5. Annelida

Characteristics

- they have internal and external segmented bodies
- the body is long and cylindrical

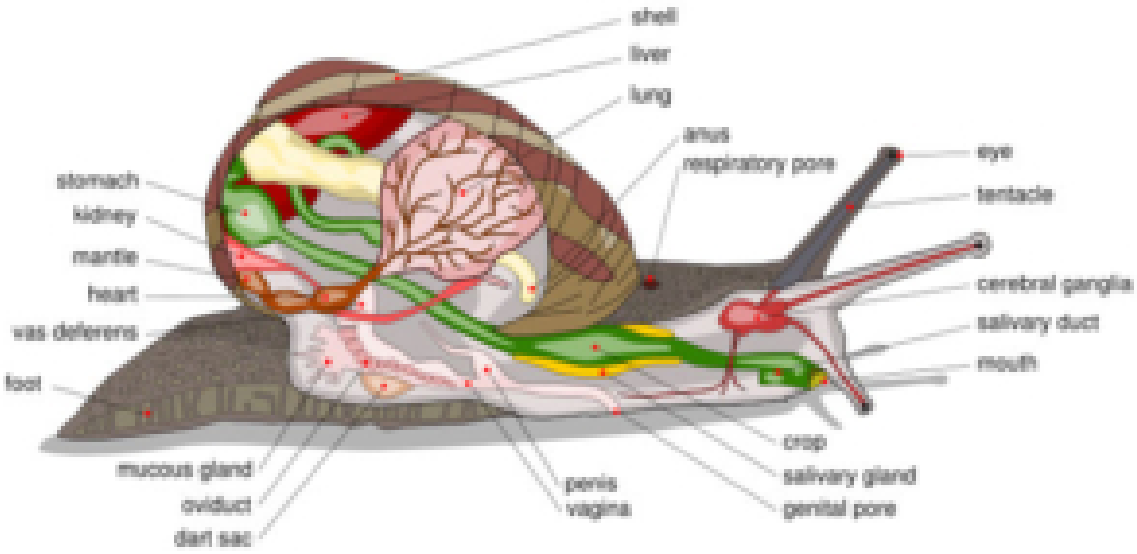
- they have true body cavity
- the alimentary canal has two openings – the mouth and anus
- they reproduce sexually
- their bodies are made up of three thick layers
- examples are earthworms, leeches, tubeworms



6. Mollusca

Characteristics

- they have soft unsegmented bodies
- they ave tentacles on their heads
- they possess muscular foot adapted for crawling and burrowing
- the body is covered in soft tissue called mantle
- some have calcerous shells e.g snail, others no shell e.g slug and octopus
- their eyes and tentacles are used for sensitivity
- examples are squid, periwinkles, snails, oysters, octopus



Test Questions

1. The pratice of classifying living things is called.....? a) Taxinomy b) Taxonomy c) Kingdom d) Classification
2. The basic unit of classification of living things is the ..... a) Class b) Order c) Kingdom d) Species
3. The member of a species cannot interbreed with the member of another species. True of False
4. The first name of the Binomial System of Nomenclature is called the ..... name. a) Specific b) Generic c) Genetic d) Special
5. The botanical name for Maize is called ..... a) Zea mays b) *Zea Mays* c) Zea mays d) Zea Mays

Answers

1. B
2. D

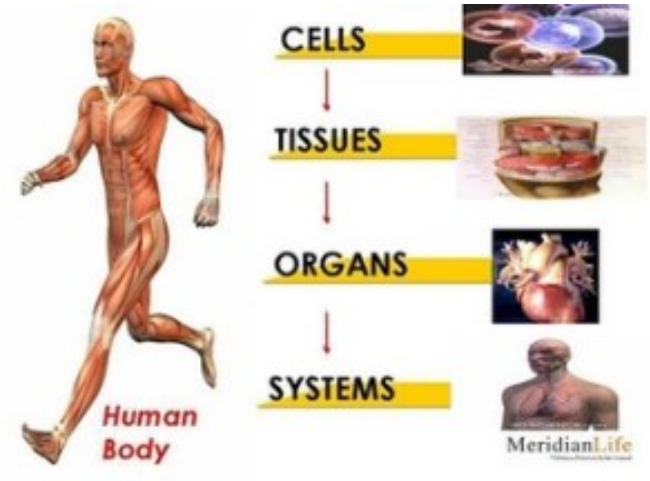
3. True
4. B
5. C

Week: 4

Topic: Organization of Life

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

Levels of Organization



A complex multicellular living organism evolved from non-living atoms and molecules in several steps. Biologists study living organisms at any of these levels. Molecular biologists, for instance, go beyond the cell to study life at non-living molecular level. Every living thing is made up of a cell or a number of cells. A single celled organism is called Unicellular Organism, while those made up of many cells are called Multicellular Organism.

In unicellular organisms, the single cell performs all life functions. It functions independently. Examples are Amoeba, Paramecium, Euglena, Chlamydomonas, etc.

Multicellular organisms have various levels of organization within them. Individual cells may perform specific functions and also work together for the good of the entire organism. The cells become dependent on one another. Multicellular organisms have the following 5 levels of organization ranging from simplest to most complex:

Cell level

Cells are the basic unit of structure and function in living things and this may serve a specific function within the organism. Examples are blood cells, nerve cells, bone cells, muscle cells,

etc. There are some organisms at the cellular level (i.e. with single cell performs all life functions). Examples are Amoeba, Paramecium, Euglena, Chlamydomonas, etc.

Tissue level

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

Types of Tissue in Man and their Function

1. Epithelial Tissues: They line and protect the body surface. They help in the formation of skin.

2. Blood Tissues: They transport food and oxygen round the body.

3. Skeletal Tissues: They support the body and aid movement

4. Connective Tissues: They bind other tissue together.

5. Nerve Tissues: They coordinate and transmit nerve impulses.

6. Muscle Tissues: It is for movement for the parts of the body.

Types of Tissue in Plant

1. Vascular Tissues: For transport of food and water in plant. They include phloem and xylem.

2. Strengthening Tissues: They give strength and support to the plants body. They include sclerenchyma, collenchyma and parenchyma.

3. Epithelial Tissues: They line and protect the plants surface.

Organ Level

An organ is made up of tissues that work together to perform a specific activity. Examples are heart, brain, skin etc.

System Level

System is a group of two or more organs that work together to perform a specific function for the organism. Examples are circulatory system, nervous system, skeletal system, etc. The human body has 11 organ systems which are the circulatory, digestive, endocrine, excretory (urinary), immune (lymphatic), integumentary, muscular, nervous, reproductive, respiratory, and skeletal.

Organism Level

These are entire living things that can carry out all basic life processes. Meaning they can take in materials, release energy from food, release wastes, grow, respond to the environment, and reproduce. Usually made up of organ systems, but an organism may be made up of only one cell such as bacteria or protist. Examples are bacteria, amoeba, mushroom, sunflower, dog, human etc.

Complexity of Organisms

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

Advantages of Complexity in Organization

1. There is internal structural specialization of various cells.

2. Specialization leads to division of labour.

3. There is efficiency.

4. One body function does not adversely affect other body functions.

5. Mutual interdependence between component cells

6. It increases adaptation to environment

Disadvantages of Complexity in Organization

1. Individual cells are not capable of existing independently and therefore depend on one another's activity to exist.

2. Due to complexity, organisms must obtain enough food and oxygen to activate them and avoid risk of death.

3. More effort is needed to eliminate toxic wastes.
4. Energy and time are wasted.
5. Decrease in ability to regenerate

Test Questions

1. ..... is defined as the smallest unit of living organism. a) tissue b) cell c) unicellular d) multicellular
2. Which of the following is the third level of organisation of life. a) Organ b) tissue c) cell d) system
3. ..... is two or more organs that work together to perform a specific role. a) System b) Organ c) Cell d) Tissue
4. The following tissues are found in plants except ..... a) Epithelial b) Vascular c) Strenthening d) Support
5. One of the following is not a tissue in Man. a) Blood b) Water c) Skeletal d) Connective
6. Give two advantages of complexity in an Organisation

Answers

1. B
2. A
3. A
4. D
5. B

Week: 5

Topic: Plant Nutrition

One of the main characteristics of living things is their ability to feed. This is called nutrition. Both plants and animals feed. While some organisms called **autotrophs** can manufacture their own food, other organisms called **heterotrophs** cannot. Therefore, most autotrophs can manufacture their own foods through a process called photosynthesis.

Photosynthesis

Photosynthesis is defined as the process by which green plants manufacture their own food (organic compounds) making use of carbon dioxide and water in the presence of sunlight.

Materials and Conditions Necessary for Photosynthesis

1. Carbon (iv) oxide – This is derived from the atmosphere and it diffuses into the intercellular spaces through the stomata of the leaves. From the intercellular spaces, it diffuses furter into the mesophyll cells containing chloroplasts.
2. Water and Mineral Salts – Water and mineral salts are derived from the soil. They pass into the roots of plants through the root hairs by a process called osmosis. Water and dissolved mineral salts are conducted by the xylem from the roots through the system;;
3. Sunlight – This is obtained from solar energy. The light from the sun is trapped by the cholorophyll of the leaves. The sunlight is used to split water into hydrogen ions and hydroxyl ions in a process called photolysis
4. Optimum Temperature – This is derived partly from Solar energy and partly from chemical reactions witin the leaves during which heat is generated.
5. Chlorophyll – Green coloring found in pallisade and spongy mesophyll of the leaves where food is synthesized within the plant.

Experiments in Photosynthesis in Plant

Experiment to Test For Starch in A Fresh Green Leaf

Aim: to test for the presence of starch in the leaf.

Materials required: fresh green leaves from outdoor plants, beakers, burner, boiling tubes, dropping tube, white tiles and iodine solution.

Method: Firstly, boil the leaf in water for 4-6 minutes so as to kill the cells, inactivate the enzymes and burst starch grains present. Then dip the test tube containing 70% alcohol to decolourize the leaf. After that, the decolourized leaf is dipped into a beaker containing hot water to soften it. Finally, place the leaf in a white tile and pour few drops of iodine solution on the leaf. In a control experiment, a leaf from plant kept in the dark cupboard is plucked and tested for starch.

Observation: It is seen that the leaf that was plucked from the potted plant outside turned blue-black with iodine solution while the other leaf (control experiment) remained colourless.

Conclusion: Since the leaf in the real experiment turned blue-black with iodine solution, it shows that photosynthesis has taken place or starch is formed by the leaf.

Experiment to Show That Light Is Necessary For Photosynthesis

Aim: To show that sunlight is necessary for photosynthesis

Materials: A potted plant, strip of black paper, clips, cupboard.

Method: The potted plant is first de-starched by putting it in dark cupboard for 1 – 2 days. This is to remove all traces of starch formed in the leaves. After this, the middle of one of the leaves is covered by a strip of black paper, both at the front and back with the aid of clips. The whole plant is then placed in sunlight. After about 3 – 5 hours, the paper is removed. The leaf is then tested for starch.

Observation: Only the exposed parts, i.e., the top and bottom of the leaf turned blue-black with the iodine solution which shows the presence of starch while the area that was covered with black paper will remain colourless, indicating that starch is absent.

Conclusion: The experiment shows that sunlight is necessary for photosynthesis.

Experiment to Show That Carbon Dioxide Is Necessary For Photosynthesis

Aim: To show that carbon (IV) oxide is necessary for photosynthesis

Materials required: A potted plant, Vaseline, conical flask, split cork, retort stand and caustic soda (sodium hydroxide) solution.

Method: Use a leaf attached to a potted plant. The leaf is enclosed in the flask containing caustic soda solution. This solution absorbs the carbon (IV) oxide inside the flask. The flask mouth is corked and smeared with Vaseline at the neck to make it air tight. The whole experiment is now exposed to sunlight for several hours. Two leaves (one inside the flask) and the other outside the flask (control experiment) are plucked and tested for starch.

Observation: At the end of the test for starch, the leaf inside the flask did not show blue-black colour, indicating absence of starch formation because of lack of carbon (IV) oxide inside the flask while the leaf outside the flask shows blue-black colour, indicating the presence of starch.

Conclusion: This experiment shows that carbon (IV) oxide is necessary for photosynthesis to take place.

Experiment to Show That Chlorophyll Is Necessary For Photosynthesis

Aim: To show that chlorophyll is necessary for photosynthesis

Materials required: A variegated plant is needed. A variegated plant has green and white patches on the leaves.

Method: the potted variegated plant is exposed to sunlight for about 3-5 hours, after which a variegated leaf is plucked fresh from the plant during the day time when there is sunlight. Make a drawing of the leaf and map out the green and white patches. The variegated leaf is then tested for starch.

Observation: It will be noticed that the green parts of the variegated leaf are stained blue-black with iodine solution while the white part remain colourless.

Conclusion: This experiment shows that chlorophyll is necessary for photosynthesis to take place.

Experiment to Show That Oxygen Is Given Off During Photosynthesis

Aim: To show that oxygen is given out as a by-product during photosynthesis

Materials required: A water plants e.g. Elodea, glass funnel, beaker, water, test tube, and splinter.

Method: Fill up the beaker with water. Then place the water plant (e.g. Elodea) at the bottom of the beaker. This is followed by the filling of the test tube with water and then inverts it over the stem of the funnel. The whole set-up is then placed in the sunlight for several hours. Tiny bubbles of gas will start to appear on the surface of the leaves and these break off and accumulate at the top of the test tube.

Observation: It is seen that the gas formed at the top of the test tube rekindles a glowing splinter showing the presence of oxygen.

Conclusion: This experiment shows that oxygen is given off as a by-product during photosynthesis.

Chemosynthesis

Chemosynthesis is the process by which some organisms, such as certain bacteria, use chemical Energy to produce carbohydrates.

Questions

1. ..... are plants that can manufacture their own foods a) Hetetrophs b) Autotrophs c) Carnivores d) Omnivores
2. Plants that cannot manufacture their foods are called ..... a) Hetetrophs b) Organotrophs c) Herbivores d) Heterotrophs
3. ..... is defined as the process by which green plants manufacture their own food. a) Chemosynthesis b) Photosynthesis d) Autotrophism c) Heterotrophism
4. ..... is the green coloring found in pallisade and spongy mesophyll of the leaves where food is synthesized within the plant. a) Chlorophyll b) Chlorofoam c) Chloraphenicol d) Cholorophyll
5. ..... is the process by which some organisms, such as certain bacteria, use chemical Energy to produce carbohydrates. a) Carbon dioxide b) Chemical Reaction c) Carbolic reaction d) Chemosynthesis

Answers

1. B
2. D
3. B
4. A
5. D

Week: 6

Topic: Nutrient Cycling In Nature

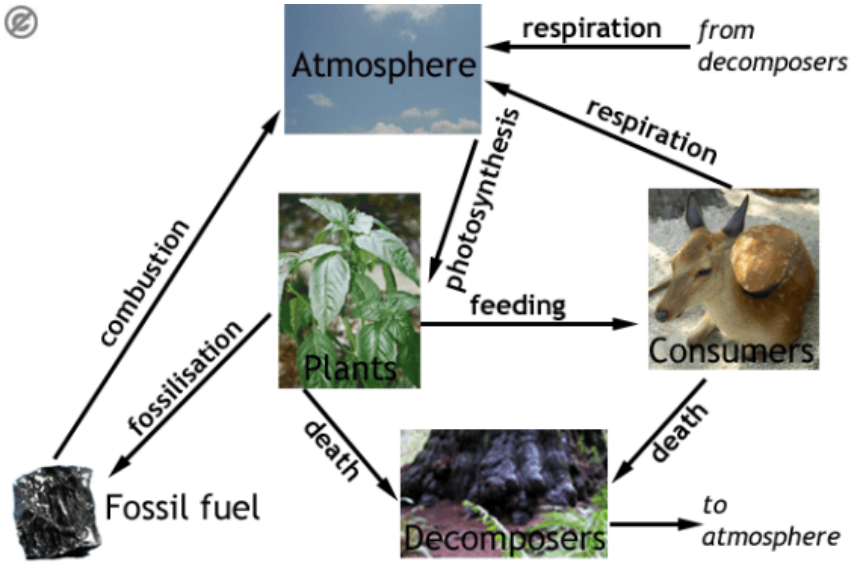
Definition

Nutrient Cycle is the movement and exchange of organic and inorganic matter back into the production of living matter. Nutrient cycles look at how important molecules in an ecosystem are transferred. Like energy, these nutrients are never lost from the cycle, merely stored in a different form – be it fossil fuels, living organisms or CO_2. A very important role played by microorganisms is that they feed on dead material by saprotrophic nutrition, and convert complex organic molecules to simple ones.

The Carbon Cycle

All life is based on carbon; it is contained in proteins, carbohydrates; indeed all organic molecules contain carbon. So it is the most important nutrient in an ecosystem. The carbon cycle involves several stages of carbon being **fixed** (incorporated as part of) by plants from the atmosphere. This carbon is transferred to consumers by eating, or it becomes fossil fuel in fossilisation.

Below is an example of a carbon cycle. They cycles can be represented a number of ways, and this is just one example.



Although much is said about rising carbon dioxide in the atmosphere, only 0.04% of air is CO2, indeed most is in the ocean as hydrogen carbonate (HCO_3^-), and this is where most

photosynthesis occurs. That isn't to say carbon dioxide rising in the atmosphere isn't a very important global problem, just that it only comprises a small aspect of our atmosphere.

The Process of Carbon Cycle

The atmospheric carbon dioxide is virtually the only source of carbon which is the basic constituent of all the organic compounds.

This gas is used by all plants in photosynthesis and the end products (organic substances) of this complex process are used in two ways.

One fraction is used in the construction of more living matter. The carbon and oxygen so supplied by CO_2 remain in living matter until death.

Decay subsequently returns CO_2 to the atmosphere, and this completes one possible carbon cycle. Another fraction of the organic substances is used as fuel in respiration by both plants and animals.

This process releases CO_2 as a by-product. Such CO_2 may now be used in photosynthesis again, or it may return to the environment, completing the second possible carbon cycle (Fig. 5.6). Thus, photosynthesis and respiration are the two major processes that drive the global Carbon Cycle, with CO_2 as the main vehicle of flux between atmosphere, hydrosphere and biota.

The CO_2 content of the atmosphere is replenished not only through biological oxidation (respiration), but also through non-living combustion i.e., forest fires and burning of industrial fuels release CO_2 into the air. Occasionally volcanic eruptions also add CO_2 to the atmosphere.

It is clear that terrestrial plants utilize atmospheric CO_2 as their carbon source for photosynthesis, whereas aquatic plants use hydrosphere carbon i.e., dissolved carbonates.

Oxygen Cycle

The oxygen cycle elaborates how oxygen circulates in various forms through nature. Oxygen occurs freely in the air, trapped in the earth crust as chemical compounds, or dissolved in water. Oxygen in the atmosphere is about 21%, and it is the second most abundant gas after nitrogen. It is mostly utilized by living organisms, especially man and animals in respiration. Oxygen is also the most common element of human body.

Oxygen is also used during combustion, decomposition, and oxidation. The circulation of oxygen is through three main flow systems including the (air) atmosphere, the biosphere, and the earth's crust. In the oxygen cycle, the main driving factor is photosynthesis which is the process whereby green plants and algae make their own food by use of solar energy, water, and carbon dioxide to gives off oxygen as a by-product.

Hence, for oxygen to remain in the atmosphere, it has to circulate through various forms of nature which is essentially termed as the oxygen cycle. The circulation depends on the various activities on Earth.

Process of Oxygen Cycle

The Atmosphere (air)

The atmosphere carries a small quantity of all oxygen, only about 0.35% of the entire earth's oxygen. In the atmosphere, oxygen is released by the process known as photolysis. Photolysis happens when the ultraviolet radiation of sunlight breaks apart oxygen-containing molecules such as nitrous oxide and atmospheric water to release free oxygen. The surplus oxygen recombines with other oxygen molecules to form ozone while the rest is freed into the atmosphere. Ozone is the layer that helps to shield the Earth from the dangerous ultra violet rays.

Biosphere

The biosphere carries the smallest quantity of all earth's oxygen, about 0.01%. In the biosphere, the major oxygen cycles are photosynthesis and respiration. In these two processes of the oxygen cycle, it is interconnected with the carbon cycle and the water cycle. During photosynthesis, plants and planktons use sunlight energy, water, and carbon dioxide to make food (carbohydrates) and release oxygen as a by-product. As such, plants and planktons are the main producers of oxygen in the ecosystem. They take in carbon dioxide and give out oxygen. Plants are estimated to replace about 99% of all the oxygen used.

On the other hand, respiration happens when humans and animals breathe in oxygen which is used during metabolism to break down carbohydrates and exhale carbon dioxide as a by-product. Such free carbon dioxide is then released into the environment and is used by plants and planktons during photosynthesis to give out molecular atmospheric oxygen, thus completing the oxygen cycle. Therefore, suffice is to say that oxygen enters organisms in the biosphere through respiration and is expelled through photosynthesis in a process that is interconnected with the carbon cycle plus the water cycle.

However, the continued release of carbon dioxide into the atmosphere by burning fossil fuels and automobile pollution affects the oxygen cycle.

The Lithosphere (Earth's Crust)

The lithosphere carries the largest quantity of all earth's oxygen, about 99.5%, because it is a constituent of the earth's lands, soils, organic matter, biomass, water, and rocks. Mostly, these constituents of the earth fix oxygen in mineral chemicals compounds such as oxides and silicates. The process is natural and happens automatically as the pure mineral elements absorb or react with the free oxygen. It happens similar to the manner in which iron picks up oxygen from the air, resulting in the formation of rust (iron oxides).

As such, during chemical reactions and some weathering processes, a portion of the trapped oxygen in the minerals is released into the atmosphere. Also, as animals and plants draw nutrient minerals from rocks, organic matter, or biomass, some of the trapped oxygen is freed in the process. Dissolved oxygen is also present in water system which is essential for the survival of aquatic life forms. As a result, these processes combined gives rise to oxygen cycle in the biosphere and lithosphere.

Processes that Use Oxygen

1. **Respiration:** When we breather, we use oxygen and release carbon dioxide. Similarly, animals and plants also use oxygen when they breathe.
2. **Combustion:** When you burn something let's say a paper, you need three things for combustion to take place i.e. oxygen, fuel and heat. So, when you burn a paper, it uses oxygen and releases carbon dioxide and may be some other gases.
3. **Decomposition:** Decomposition occurs when plants and animals die. When this happens, they decompose and such process uses oxygen and releases carbon dioxide.
4. **Rusting:** When things rust, they use oxygen. This is also called as oxidation.

Processes that Produce Oxygen

1. **Plants:** Plants produce oxygen during the process of photosynthesis. During the process of photosynthesis,

plants use carbon dioxide, sunlight, and water to create energy.

2. **Sunlight:** Some oxygen also gets produced when sunlight reacts with water vapor in the atmosphere.

Water Cycle

The water cycle explains the continuous movement of water on, above, and below the surface of the earth. It is also referred to as the Hydrological Cycle. The cycle describes the properties of water that make it undergo the various movements on the planet. The water cycle has nine main physical processes that create a continuous water movement on the planet.

Intricate sequences include the transition of water from the gaseous composition of the atmosphere; through the water bodies such as oceans, lakes, rivers; passage through the soil, rocks and underground waters; and later returns into the atmosphere. Simply put, the hydrological cycle has neither a beginning nor an end, it's an incessant process.

Process Of Water Cycle

The water cycle processes involve evaporation, condensation, precipitation, interception, infiltration, percolation, transpiration, runoff, and storage.

1. **Evaporation**

Evaporation takes place when water changes from its liquid state to vapor or gaseous state. A substantial heat amount is exchanged during the process, roughly 600 calories of energy per gram of water. In most cases, the solar radiation and additional causes such as the wind, vapor pressure, atmospheric pressure, and air temperature influence the amount of natural evaporation in different geographical regions.

Evaporation occurs over the surfaces of the water bodies such as oceans, streams, and lakes. It can also occur on raindrops, rocks, snow, soil or vegetation. When evaporation happens, anything present in the water such as salts and minerals is left behind. Thus, evaporation purifies the water. The evaporated moisture then rises into the atmosphere from the evaporation sources as water vapor or in a gaseous state. At any particular moment, some water vapor is present in the atmosphere.

2. **Condensation**

Condensation is the process whereby the water vapor changes from its gaseous physical state to liquid or crystal solid. The water vapor condenses on minute air particles due to the cooling of the air, freezing temperatures, or increased vapor amounts to the point of saturation in the upper stratospheres.

The condensed vapor then forms fog, dew or clouds. When the condensed clouds, dew, and fogs become too large and heavy to remain suspended in the atmosphere, they fall back on earth as precipitation due to gravity. The 600 calories of energy per gram of water needed during evaporations are released into the environment.

3. **Precipitation**

Precipitation takes place whenever any or all forms of water particles fall from the atmosphere and reach the earth surface. Precipitation occurs when the liquid or solid particles in the clouds, dew, and fog drops to the ground because of frictional drag and gravity.

One falling particle leaves behind a turbulent wake, causing faster and continued drops. The crystallized ice may reach the ground as ice pellets or snow or may melt and change into raindrops before reaching the surface of the earth depending on the atmospheric temperatures.

Precipitation falls on water bodies or on ground surface where it disperses in various ways. For sometime, precipitation can remain on the surface as runoff or overland flow. It may be

carried into waterways, intercepted by plants, or infiltrate into the soil. A good percentage of precipitation goes back to the atmosphere as evaporation.

4. **Interception**

Interception is whereby the water movement is interrupted in the various paths during transportation events over the land surface. Interception takes place when the water is absorbed by vegetation cover and trees, absorbed into the ground, or stored in puddles and land formations such as furrows and streamlets. These waters can either infiltrate into the soil or return to the atmosphere through evapotranspiration or evaporation.

5. **Infiltration**

Infiltration is the physical process involving the slow passage of water through the soil. This phenomenon is influenced by the soil surface conditions such as permeability and porosity of the soil profile. Other factors include soil texture, soil moisture content, and soil structure. The infiltrated water is stored in the soil and can later return to the atmosphere via evapotranspiration.

6. **Percolation**

Percolation is the flow of water through the soil and rocks by the influence of capillary and gravity forces. All water on the earth's surface move by the forces of gravity and capillarity to rest beneath the earth as groundwater. Once beneath the earth, below the water table, the water mostly moves horizontally rather than downwards based on the geologic boundary formations.

This area normally acts as reservoirs for storing water. Some geologic formations may conduct this water back to the surface such as springs.

7. **Transpiration**

Transpiration is a process in all plants that normally takes place during the day, giving off water vapor from the leaves openings. Plants transpire to move nutrients to the upper sections of the plant and to cool the plants. Most of the water absorbed by the plants are transpired into the atmosphere until a water deficit point is reached whereby the plant resorts to releasing water vapor at a much slower rate. Transpiration is important in the water cycle because plants absorb the moisture from the soil and releases it into the atmosphere as water vapor.

8. **Runoff**

Runoff is the occurrence of excess water from watershed or drainage basin that flows on the surface. The flow is as a result of precipitation above waterways, groundwater runoff from deep percolations, subsurface runoff that infiltrates the surface soils, and surface runoff that flows on the land surface. As the water flows, it can be used for agricultural and domestic

purposes, it may seep into the ground, stored in reservoirs or water bodies, or evaporate into the atmosphere.

9. **Storage**

Storage refers to the various water reservoirs in the planetary water or hydrological cycle. The water is primarily stored in the atmosphere, the surface of the earth, and in the ground. Storage in the atmosphere is in the form of water vapor. Storage on the surface of the earth includes lakes, oceans, rivers, glaciers, and reservoirs. Storage in the ground pertains to the soils, rock formations, and aquifers.

Test Questions

1. One of the following is a process that uses oxygen except ..... a) Combustion b) Crusting c) Respiration d) Decomposition
2. Evaporation, Transpiration, Percolation are all processes of ..... a) Carbon cycle b) Nutrient cycle c) Water cycle d) Plant cycle
3. ..... is the physical process involving the slow passage of water through the soil a) Infiltration b) Percolation c) Evaporation d) Transpiration
4. The ..... is virtually the only source of carbon which is the basic constituent of all the organic compounds a) carbon dioxide b) carbon monoxide c) atmospheric carbon dioxide d) carbon (iv) oxide
5. ..... refers to the various water reservoirs in the planetary water or hydrological cycle a) Storage b) Pottage c) Percolation d) Evaporation
6. Oxygen in the atmosphere is about ..... a) 20% b) 22% c) 23% d) 21%
7. The flow of water through the soil and rocks by the influence of capillary and gravity forces a) Perforation b) Percolation c) Permutation d) Photosynthesis
8. ..... is the occurrence of excess water from watershed or drainage basin that flows on the surface. a) Dry off b) Drain c) Run off d) Rain
9. ..... carries the smallest quantity of all earth's oxygen, about 0.01%. a) Biosphere b) Lithosphere c) Atmosphere d) Autosphere
10. ..... is the process whereby the water vapor changes from its gaseous physical state to liquid or crystal solid. a) Conservation b) Nitrification c) Interception d) Condensation

Answers

1. B
2. C
3. A
4. C
5. A
6. D
7. B
8. C
9. A
10. D

Week: 7

Topic: Nutrition In Animals

All living organisms need food for their survival and daily activities. Plants can manufacture their own food through a process called photosynthesis, hence they are called autotrophs. On the other hand, animals cannot manufacture their own food as they depend on plants directly or indirectly for their food, hence they are called **heterotrophs.**

Animals sometimes are classified according to the type of food they eat. On this basis, they are classified into three groups, namely:

1. **Carnivorous animals:** These animals feed only on flesh or other animals, e.g dog, lion, lizard, snake, cat, etc.
2. **Herbivorous animals:** These animals feed on plants, e.g. goat, sheep, rabbit, etc.
3. **Omnivorous animals**: These animals feed on both plants and animals, e.g. man, pig, etc.

Classes And Sources Of Food

There are seven major classes of nutrients –

Carbohydrates, Fats, Fibre, Minerals, Protein, Vitamin, and Water.

The macronutrients (excluding fiber and water) provide structural material (amino acids from which proteins are built, and lipids from which cell membranes and some signaling molecules are built) and energy. Some of the structural material can be used to generate energy internally, and in either case it is measured in joules or calories (sometimes called “kilocalories” and on monomers bound to glycerol backbone. Some fatty acids, but not all, are essential in the diet: they cannot be synthesized in the body. Protein molecules contain nitrogen atoms in addition to carbon, oxygen, and hydrogen. The fundamental components of protein are nitrogen-containing amino acids, some of which are essential in the sense that humans cannot make them internally. Some of the amino acids are convertible (with the expenditure of energy) to glucose and can be used for energy production just as ordinary glucose. By breaking down existing protein, some glucose can be produced internally; the remaining amino acids are discarded, primarily as urea in urine. This occurs normally only during prolonged starvation.

Other micronutrients include antioxidants and phytochemicals which are said to influence (or protect) some body systems. Their necessity is not as well established as in the case of, for instance, vitamins.

Most foods contain a mix of some or all of the nutrient classes, together with other substances such as toxins or various sorts. Some nutrients can be stored internally (e.g., the fat soluble vitamins), while others are required more or less continuously. Poor health can be caused by a lack of required nutrients or, in extreme cases, too much of a required nutrient. For example, both salt and water (both absolutely required) will cause illness or even death in too large amounts.

other rare occasions written with a capital C to distinguish them from little 'c' calories). Carbohydrates and proteins provide 17 kJ approximately (4 kcal) of energy per gram, while fats provide 37 kJ (9 kcal) per gram.though the net energy from either depends on such factors as absorption and digestive effort, which vary substantially from instance to instance. Vitamins, minerals, fiber, and water do not provide energy, but are required for other reasons. A third class dietary material, fiber (i.e., non-digestible material such as cellulose), seems also to be required, for both mechanical and biochemical reasons, though the exact reasons remain unclear.

Molecules of carbohydrates and fats consist of carbon, hydrogen, and oxygen atoms. Carbohydrates range from simple monosaccharides (glucose, fructose, galactose) to complex polysaccharides (starch). Fats are triglycerides, made of assorted fatty acid

Carbohydrates

- Carbohydrates may be classified as monosaccharides, disaccharides, or polysaccharides depending on the number of monomer (sugar) units they contain.
- They constitute a large part of foods such as rice, noodles, bread, and other grain-based products. Monosaccharides – one sugar unit, disaccharides – two sugar units, and polysaccharides three or more units.
- Polysaccharides are often referred to as complex carbohydrates because they are typically long multiple branched chains of sugar units.
- The difference is that complex carbohydrates take longer to digest and absorb since their sugar units must be separated from the chain before absorption.
- The spike in blood glucose levels after ingestion of simple sugars is thought to be related to some of the heart and vascular diseases which have become more frequent in recent times.
- Simple sugars form a greater part of modern diets than formerly, perhaps leading to more cardiovascular disease. The degree of causation is still not clear, however.

Fat

- A molecule of dietary fat typically consists of several fatty acids (containing long chains of carbon and hydrogen atoms), bonded to a glycerol.

- They are typically found as triglycerides (three fatty acids attached to one glycerol backbone). Fats may be classified as saturated or unsaturated depending on the detailed structure of the fatty acids involved.
- Saturated fats have all of the carbon atoms in their fatty acid chains bonded to hydrogen atoms, whereas unsaturated fats have some of these carbon atoms double-bonded, so their molecules have relatively fewer hydrogen atoms than a saturated fatty acid of the same length.
- Unsaturated fats may be further classified as monounsaturated (one double-bond) or polyunsaturated (many double-bonds).
- Furthermore, depending on the location of the double-bond in the fatty acid chain, unsaturated fatty acids are classified as omega-3 or omega-6 fatty acids.
- Trans fats are a type of unsaturated fat with trans-isomer bonds; these are rare in nature and in foods from natural sources; they are typically created in an industrial process called (partial) hydrogenation.

Fiber

- Dietary fiber is a carbohydrate (or a polysaccharide) that is incompletely absorbed in humans and in some animals.
- When metabolized it can produce four calories (kilocalories) of energy per gram. But in most circumstances it accounts for less than that because of its limited absorption and digestibility.
- Dietary fiber consists mainly of cellulose, a large carbohydrate polymer that is indigestible because humans do not have the required enzymes to disassemble it. There are two subcategories: soluble and insoluble fibre. Whole grains, fruits (especially plums, prunes, and figs), and vegetables are good sources of dietary fibre.
- Fibre is important to digestive health and is thought to reduce the risk of colon cancer.[citation needed] For mechanical reasons it can help in alleviating both constipation and diarrhea.
- Fiber provides bulk to the intestinal contents, and insoluble fiber especially stimulates peristalsis—the rhythmic muscular contractions of the intestines which moves along the digestive tract.
- Some soluble fibers produce a solution of high viscosity; this is essentially a gel, which slows the movement of food through the intestines.
- Additionally, fiber, perhaps especially that from whole grains, may help lessen insulin spikes and reduce the risk of type 2 diabetes.

Protein

- Most meats such as chicken contain all the essential amino acids needed for humans**.**
- Proteins are the basis of many animal body structures (e.g. muscles, skin, and hair). They also form the enyzmes which control chemical reactions throughout the body.
- Each molecule is composed of amino acids which are characterized by inclusion of nitrogen and sometimes sulphur (these components are responsible for the distinctive smell of burning protein, such as the keratin in hair).
- The body requires amino acids to produce new proteins (protein retention) and to replace damaged proteins (maintenance).
- As there is no protein or amino acid storage provision, amino acids must be present in the diet. Excess amino acids are discarded, typically in the urine.
- For all animals, some amino acids are essential (an animal cannot produce them internally) and some are non-essential (the animal can produce them from other nitrogen-containing compounds).
- About twenty amino acids are found in the human body, and about ten of these are essential, and therefore must be included in the diet.
- A diet that contains adequate amounts of amino acids (especially those that are essential) is particularly important in some situations: during early development and maturation, pregnancy, lactation, or injury (a burn, for instance).
- A complete protein source contains all the essential amino acids; an incomplete protein source lacks one or more of the essential amino acids.

Minerals

- Dietary minerals are the chemical elements required by living organisms, other than the four elements carbon, hydrogen, nitrogen, and oxygen that are present in nearly all organic molecules.
- The term “mineral” is archaic, since the intent is to describe simply the less common elements in the diet. Some are heavier than the four just mentioned—including several metals, which often occur as ions in the body.
- Some dietitians recommend that these be supplied from foods in which they occur naturally, or at least as complex compounds, or sometimes even from natural inorganic sources (such as calcium carbonate from ground oyster shells).
- Some are absorbed much more readily in the ionic forms found in such sources.

- On the other hand, minerals are often artificially added to the diet as supplements; the most famous is likely iodine in iodized salt which prevents goiter

Vitamins

- Some vitamins are recognized as essential nutrients, necessary in the diet for good health. (Vitamin D is the exception: it can alternatively be synthesized in the skin, in the presence of UVB radiation.)
- Certain vitamin-like compounds that are recommended in the diet, such as carnitine, are thought useful for survival and health, but these are not "essential" dietary nutrients because the human body has some capacity to produce them from other compounds.
- Thousands of different phytochemicals have recently been discovered in food (particularly in fresh vegetables), which may have desirable properties including antioxidant activity (see below); experimental demonstration has been suggestive but inconclusive.
- Other essential nutrients not classed as vitamins include essential amino acids (see above), choline, essential fatty acids (see above), and the minerals discussed in the preceding section.
- Vitamin deficiencies may result in disease conditions: goitre, scurvy, osteoporosis, impaired immune system, disorders of cell metabolism, certain forms of cancer, symptoms of premature aging, and poor psychological health (including eating disorders), among many others.
- Excess of some vitamins is also dangerous to health (notably vitamin A), and for at least one vitamin, B6, toxicity begins at levels not far above the required amount.
- Deficiency or excess of minerals can also have serious health consequences.

Water

- About 70% of the non-fat mass of the human body is made of water. Analysis of Adipose Tissue in Relation to Body Weight Loss in Man.
- To function properly, the body requires between one and seven liters of water per day to avoid dehydration; the precise amount depends on the level of activity, temperature, humidity, and other factors.
- With physical exertion and heat exposure, water loss increases and daily fluid needs will eventually increase as well.

- It is not fully clear how much water intake is needed by healthy people, although some experts assert that 8–10 glasses of water (approximately 2 liters) daily is the minimum to maintain proper hydration.
- The notion that a person should consume eight glasses of water per day cannot be traced to a credible scientific source. The effect of, greater or lesser, water intake on weight loss and on constipation is also still unclear.
- Water aids digestion and is needed by the body to also wash away toxic materials.

Balanced Diet

Balanced diet is a diet containing the correct proportion or the right amount of all the six food substances required by an organism or man. The balanced diet must contain the six food substances such as carbohydrates, proteins, fats and oil, minerals, vitamins and water.

Importance of Balanced Diet:

Balanced diet is important to the body in the following ways:

1. Balanced diet makes us healthy and by so doing, makes us to be resistance to diseases.
2. It encourages growth and normal development of the body.
3. It also provides energy required for normal activities.
4. Balanced diet prevents malnutrition, deficiency or diseases. Lack of some food substances, e.g protein in a diet can cause a nutritional disease called **kwashiokor** in children which is characterised by a very big head, narrow neck, big, swollen and shiny stomach, flat buttock, and very slender and narrow legs.

Digestive Enzymes

An enzyme is an organic catalyst usually proteinous in nature, which promotes or speeds up chemical changes in living cells but are not themselves used up in the process.

Enzymes accelerate metabolic reactions without changing their composition in the process.

Characteristics

1. All enzymes are proteins in nature.
2. Enzymes are usually involved in reversible reactions.
3. Enzymes are affected by the pH (acidity or alkalinity) of their surrounding. They are destroyed by strong acids or alkali.

4. Enzymes accelerate the rate of chemical reaction.
5. Each enzyme is specific in action, i.e., an enzyme or a group of enzymes deals with only one process.

Classes of Enzymes

The new method of classifying enzymes is based on the nature of chemical changes brought about on a substrate. Such changes may involve oxidation in which case the enzyme will be called an oxidase.

It is important to note that the earlier classification based on the substrate enzyme works on, e.g. amylases for maltose, proteases for protein or lipases for lipids are no longer correct or biochemically acceptable.

From the above classification, it is clear that all digestive enzymes belong to the class called **hydrolases.** the class, hydrolases generally refer to enzymes that break up various bonds (i.e. breaking large molecules into smaller particles) in the presence of water.

Test Questions

1. Plants can manufacture their own food through a process called photosynthesis are called ..... a) heterotrophs b) autotrophs c) autetrophs d) heterotrophic plants
2. Animals that cannot manufacture their own food who depend on plants directly or indirectly for their food, are called **.....** a) heterotrophs b) autrophs c) autotrophs d) canivores
3. ..... are animals that feed on flesh or other animals a) Herbivores b) Carnivores c) Omnivores d) Autovores
4. ..... are animals that feed on both flesh and plants a) Herbivors b) Carnivores c) Rativores d) Omnivores
5. ..... is a diet containing the correct proportion or the right amount of all the six food substances required by an organism or man. a) Balance diet b) Complete diet c) Balanced diet d) Missing diet
6. All digestive enzymes belong to the class called ..... a) Hydrolase b) Oxidase c) Peptolase d) Hydralase
7. One of these is not a characteristic of enzymes
   a) Enzymes are specific in action
   b) Enzymes are affected by the pH
   c) Enzymes reduce the rate of chemical reaction
   d) Enzymes are proteins in nature

8. Carbohydrates may be classified as monosaccharides, disaccharides, or ..... depending on the number of monomer (sugar) units they contain. a) starch b) peptosaccharides c) cellulose d) polysaccharides

9. Lack of some food substances, e.g protein in a diet can cause a nutritional disease called ..... a) kwashiokor b) beriberi c) scurvy d) polio

10. List the classes of food and give one function each

Answers

1. B
2. A
3. B
4. D
5. C
6. A
7. C
8. D
9. A
10. Water – aids digestion
    Protein – for production of hormones
    Vitamins – e.g vitamin B required for normal growth
    Carbohydrates – provides energy for the body
    Fats and Oils – maintenance of body temperature
    Minerals – e.g calcium for bone and teeth formation

Week: 8

Topic: Modes Of Nutrition

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

Autotrophic Nutrition

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

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

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

The green plants derive their energy for making this food from the sunlight. This energy is usually trapped by chlorophyll.

Popular examples of organisms that carry out or exhibit photosynthetic nutrition are all green plants such as flowering plants, Spirogyra, Euglena, blue-green alga (nostoc) etc.

ii. Chemosynthetic Nutrition: Chemosynthetic nutrition is another is another mode of nutrition in which certain bacteria are able to synthesise organic compounds from simple inorganic materials such as carbon (iv) oxide. ammonia, water or nitrite to manufacture their food. The energy used for the synthesis comes from the oxidation of the inorganic materials or chemicals, hence the process is called **chemosynthesis.** Examples of the organisms or bacteria that exhibit chemosynthetic nutrition are:

a. Nitrosomonas which converts ammonia to nitrate.

b. Nitrobacter which converts nitrites to nitrate.

Heterotrophic Nutrition:

Thus is the type of nutrition in which organisms cannot manufacture their food but depend directly or indirectly on plants (autotrophs) for their food.

Organisms which cannot manufacture their own food are called **heterotrophs**. Most animals, fungi, protozoa and some bacteria belong to this group.

Heterotrophic nutrition is also sub-divided into the following groups or types:

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

The organisms ingest, digest and assimilate these food into their bodies. Examples of organisms that exhibit holozoic mode of nutrition are:

(a). Carnivores like cats, dogs, lions etc that feed on flesh.

(b). Herbivores like sheep, goat, rabbits, etc that feed on plants.

(c). Omnivores like man, pig etc that feed on both flesh and vegetables or plants.

(d.) Scavengers like vulture that feed on dead animals.

2) Parasitic Nutrition: This is the type of nutrition in which certain organisms feed on another organism in order to derive nourishment from it. This mode of nutrition is called parasitic nutrition while the association is called **parasitism**. Parasitism is an association between two organisms, usually of different species in which one called the **parasite** gains from the association while the other called the **host** is harmed or suffer losses. Examples if parasites are:

(a.) Animal Parasites like Tapeworm (Taenia Solium), plasmodium, roundworms, liver flukes, ticks, fleas, bugs, leeches, Aphids, body louse, guinea worm, hookworm, etc.

(b.) Plant Parasites like Doder (Cassytha filiformis) and mistletoe. Animal parasites are classified as endoparasites and ectoparasites.

i.) Ectoparasites: These are parasites which live on the body of their hosts. In other words, they live outside the body of the host where they derive food and shelter from, e.g. flea, body louse, bed bug, Aphid and tick. Ticks are usually found in cattle and sheep. Ticks and fleas may be found on dogs, chickens and rats also carry lic on their bodies. Aphids and cotton stainers are ectoparasites on plants.

ii). Endoparasites: These are parasites which live inside the body of their hosts such as man and other animals. Examples include:

a). Tapeworm (Taenia Solium): Tapeworm is associated with pigs which are the secondary host and man which is the primary host. It has a flattened tape-like body. It has a head called scolex on which are found rostellum, hook and sucker which enable it to fasten itself to the lining of the host's intestine. It also has a body cuticle which resists digestive enzymes of the host. Tapeworm has a flat body surface which ensures a large surface area for absorption of already digested food. The entire body consists of numerous proglottids which aids the absorption of digested food from its host.

b.) Liver Fluke (Fasciola hepatica): This is a small endoparasitic associated with sheep. It is common with the liver of the sheep.

c.) Filaria worm (Wucheraria bancrofti): This is another endoparasite associated with cattle, sheep and goat. It causes elephantiasis.

d.) Roundworm (Ascaris lumbricoides): This is another endoparasite commonly found in the alimentary canal of human beings and pigs. It deprives its host of the food which it eats.

e.) Guinea worm (Dracunculus medinensis): This is an endoparasite commonly found in the subcutaneous tissues from which it pushes out its head through a blister caused by it on the foot or leg of its host.

3.) Saprophytic Nutrition: This is the type of nutrition in which certain organisms called, the **saprophytes** feed on dead and decaying organic materials. This type of nutrition is called **saprophytism**. The saprophytes, generally, can secrete enzymes into the substrate of dead and decaying organic materials on which they grow. The enzymes so secreted are able to digest some portions of the substrate outside the body of the saprophyte by a process called **extracellular digestion**. The digested food material on the substance is then absorbed into the body through the rhizoids. Examples of organisms which exhibit saprophytic mode of nutrition are the fungi such as rhizopus, mushroom, mucor, toad stool and penicillium.

4.) Symbiotic Nutrition: This is the type of nutrition in which two organisms of different species called **symbionts** live together and derive nutrients or food from each other. In this case, both organisms gain from such association and none is harmed. This type of nutrition is called symbiotic nutrition while the association between the two organisms in which both derive benefits is called **symbiosis**. Apart from nutritional benefits, the symbionts can derive other benefits like protection, shelter and reproduction during such association.

Examples of organisms that exhibit symbiotic nutrition are:

a.) Nitrogen fixing bacteria and root nodules of leguminous plants: An example of a symbiotic association is the one between the nitrogen fixing bacteria, Rhizobium spp and the root nodules of leguminous plant. The bacteria is able to fix atmospheric nitrogen directly into the plant while the plant in turn provides shelter and food for the bacteria.

b.) Algae and fungi in a lichen: A lichen is usually made up of two organisms, a fungus and a unicellular alga, living closely together. The thallus or plant body of a lichen consists mostly of fungal hyphae, with alga cells embedded in them. The alga cells are arranged in a definite layer. The green alga manufactures food for both plants, while the fungus protects the alga and absorbs water from the surroundings.

c.) Sea anemones and hermit crabs: The sea anemone is known to attach itself to the empty shell in which the hermit crab is found. Pieces of food left by the crab are eaten by the sea anemone while the crab obtains its benefit by way of protection against predators that would have attacked or eaten it as the sting of the sea anemone keep them away from the hermit crab.

d.) Termites and protozoa living in the gut: This is another example of symbiotic nutrition. In this case, the protozoa in the gut of termite helps the termite to digest cellulose while the termite provides protection and food for the protozoa.

5. Carnivorous or Insectivorous plants: Carnivorous or insectivorous plants are equipped with devices for trapping, digesting and absorbing nutritive compounds from the bodies of insects and other small organisms. They have green leaves to help them carry out photosynthetic nutrition.

Carnivorous plants usually grow in places with little nitrogenous salts and they then use insects or other smaller animals as their sources of nitrogen.

Examples of carnivorous or insectivorous plants are:

a.) Sundew (Drosera): The Drosera plant possesses leaves capable of forming an organ to trap and digest insects. The upper surface of the leaf has a number of glandular hairs or tentacles. The leaf surface is sticky as a result of digestive gland in the plant. The ends of the tentacles secrete enzymes capable of digesting insects caught. The presence of an insect on the leaf stimulates the leaf to fold over and turn all the tentacles inwards. The insect gests enmeshed and caught. Secretions from the glands then pour out and cover the insect.

b.) Bladderwort (Utricularia): These are aquatic plants without roots. Some of the leaves are modified to form hair-like bladders. Each bladder has a trap door hinged on only one edge, so that it can only open inward and tends to remain closed. In this arrangement, a trapped insect finds it difficult to escape. The captured insect eventually dies of starvation and its nutrients are then absorbed by the plant.

c.) Pitcher-plant of the Nepenthes and Sarracenia: The pitcher is formed from the modified leaf while the whole leaf of Serracenia is modified into the pitcher plant, only the terminal leaf of Nepenthes forms the pitcher plant.

The pitcher of Nepenthes contains a watery fluid secreted by glands in the lower half. The wall of the rest of the pitcher above this secretion is smooth, being covered by little waxy scales. The pitcher has a lid, whose sugary secretion attracts insects. Once at the lid, the insect falls over the rim of the pitcher into the fluid at the bottom. Enzymes secreted by the pitcher aid the digestion after which the required nutrients are absorbed by the plant.

Other examples of **Carnivorous plants are:**

d.) Venus-fly trap (Dionaea muscipula)

e.) The butterwort (Pinguicula).

Test Questions

1. **……. is the type if nutrition in which all green plants are able to manufacture their own food making use of of carbon dioxide and water in the presence of sunlight. a) Parasitic b) Chemophytic c) Holophytic c) Therapeutic**
2. **…… is the type of nutrition in which two organisms of different species live together and derive nutrients or food from each other a) Symbiotic nutrition b) Symbionts c) Chemosynthesis d) Parasitic**
3. **……. is the type of nutrition in which certain organisms feed on dead and decaying organic materials a) Symbiotic nutrition b) Saprophytic nutrition c) Holophytic nutrition d) Parasitic nutrition**
4. **The relationship between Tape worm and the intestine of man is …… a) Symbiotic b) Holophytic c) Saprophytic d) Parasitic**
5. **…… nutrition involves the feeding on other organisms or solid organic substances synthesised by green plants. a) Holophytic b) Holozoic c) Parasitic d) Saprophytic**
6. **Parasites which live in the bodies of their host are called …… parasites a) endo b) ecto c) inner d) filio**
7. **……. is an example of a scavenger a) lion b) tiger c) vulture d) snake**
8. **The energy used for the synthesis comes from the oxidation of the inorganic materials or chemicals, hence the process is called …… a) photosythesis b) holophytic c) autotrophism d) chemosythesis**

9. **All these are examples of endo parasites except ..... a) tape worm b) guinea worm c) pig worm d) liver fluke**
10. **..... converts nitrites to nitrates a) Nitrosomonas b) Nitrobacter c) Denitrifying bacteria d) Nitrogen fixing bacteria**

Answers

1. C
2. A
3. B
4. D
5. B
6. A
7. C
8. D
9. C
10. B

Week: 9

Topic: Basic Ecological Concept

Introduction

The ecological system comprises scientific study of the processes influencing the distribution and abundance of organisms, the interactions among organisms, and the interactions between organisms and the transformation and flux of energy and matter.

What Is Ecology?

Ecology is the study of the relationships of living organisms to each other and their surroundings. It provides the foundations of our understanding of agriculture, forestry and fisheries. Biologists who study ecology are called ecologists. Ecology is also known as environmental biology.

Ecology is a practical science involving;

– The measurement of factors affecting the environment

– Studying the distribution of living organisms, and

– Finding out how living organisms depend on one another and their non-living environment for their survival.

In other word, ecology is the branch of biology dealing with the relations and interactions between organisms and their environment, including other organisms.

Ecology is divided into two main branches:

Autecology: Autecology is concerned with the study of an individual organism or a single species of organism and its environment. For example, the study of a single rat and its environment.

Synecology: Synecology is concerned with the study of the inter-relationships between groups of organisms or species of organisms living together in an area. For example, the study of different organisms in a river in relation to their aquatic environment.

Ecological Concepts

There are some important concepts commonly used in the study of ecology which enable one to understand ecology. Some of these ecological concepts are:

1. Environment: This includes all the factors external and internal, living and non-living factors which affect an organism.
2. Biosphere or Ecosphere: The biosphere or ecosphere is the zone of the earth occupied by living organisms. It is a layer of life which exists on the earth surface. The biosphere is a narrow zone where complex biological and chemical activities occur. It can be found on land, soil, water and air. It provides habitat for organisms like animals, plants and micro-organism.
3. Lithosphere: It is the part of the earth occupied by land
4. Hydrosphere: part of the earth occupied by water
5. Atmosphere: It is part the earth occupied by air.
6. Habitat: It is defined as an area occupied by a biotic community. In other word, habitat is any environment in which an organism lives naturally. for example, the habitat of fish is water.
7. Biotic Community or Biome: A biotic community is any naturally occurring group of different organisms living together and interacting in the same environment. A biome is the largest community of organisms, e.g. rain forest, Guinea savanna, etc.
8. Ecological Niche: This refers to the specific portion of a habitat which is occupied by a particular species or organism. It is the functional position of an organism within the community. For example, a caterpillar and an Aphid which live on the same plant occupy different positions or ecological niches on the leaves and feeds on them while the Aphid lives on the young shoot and sucks sap from it. Although both organisms live on the same habitat, each has its own living space and source of food.
9. Population: Population is defined as the total number of organisms of the same species living together in a given area. For example, the total number of tilapia fish in a pond constitutes the population of Tilapia fish in that habitat.
10. Ecosystem: An ecosystem refers to a community of plants and animals functioning together with their non-living environment. In other words, ecosystem consists of the living factors (plants and animals) interacting with the non-living factors in an environment.

Components of an Ecosystem

The ecosystem is made up of two main components. These are the biotic (living) components and the abiotic (non-living) components.

Biotic Components

The biotic components include the living things (plants and animals) which can be grouped into producers, consumers and decomposers.

- Producers: Producers are autotrophs (green plants and some micro-organisms) which can manufacture their own food from simple inorganic materials during the process of photosynthesis and chemosynthesis.
- Consumers: Consumers are the heterotrophs (animals and some plants) which cannot manufacture their own food but depend on plants directly or indirectly for their own food. They may be primary, secondary or tertiary consumers
- Decomposers: decomposers are bacteria and some fungi which break down dead plants and animals in order to feed on them and in the process, nutrients are released to the soil for use by the producers.

Abiotic Components

The abiotic components of an ecosystem include the non-living things which include:

- Climatic factors like temperature, wind, humidity, sunlight and rainfall.
- Inorganic materials and nutrients such as carbon (iv) oxide, oxygen, nitrogen, calcium, phosphorus, etc.
- Edaphic factors like soils, rocks, topography, etc.
- Other factors like dust, storm, fire and water.

Interactions Among the Components of Ecosystem

There is a unique interaction among the various components of an ecosystem. Green plants use carbon (iv) oxide, water and chlorophyll in the presence of sunlight to produce carbohydrate or starch. Animals feed on these carbohydrates or plants and release carbon (iv) oxide for plants to take in. Micro-organisms and other decomposers break down dead plants and other organisms to release nutrients to the soil. These nutrients are absorbed by plants for use in food production. Plant gives out oxygen during photosynthesis which is used by animals for their normal respiration.

Test Questions

1. ..... is the study of the relationships of living organisms to each other and their surroundings. a) Floriculture b) Ecology c) Biology d) Autecology
2. The abiotic components of an ecosystem include the non-living things. All of these is an example except a) temperature b) soil c) fungi d) water

3. ..... are autotrophs (green plants and some micro-organisms) which can manufacture their own food from simple inorganic materials. a) Producers b) Decomposers c) Consumers d) Customers
4. An ..... refers to a community of plants and animals functioning together with their non-living environment. a) Ecology b) Ecosystem c) Biosystem d) Ecological management
5. ..... is defined as the total number of organisms of the same species living together in a given area. a) Species b) Niche c) Habitat d) Population
6. ..... is concerned with the study of the inter-relationships between groups of organisms or species of organisms living together in an area. a) Synecology b) Autecology c) Ecology d) Biology
7. A/An ..... community is any naturally occurring group of different organisms living together and interacting in the same environment. a) biome b) abiotic c) biotic d) ecological
8. ..... is the zone of the earth occupied by living organisms. a) Environment b) Ecosphere c) Atmosphere d) Lithosphere
9. ..... is the part of the earth occupied by water. a) Atmosphere b) Hydrosphere c) Lithosphere d) Biosphere
10. Ecological ..... refers to the specific portion of a habitat which is occupied by a particular species or organism. a) fauna b) zone c) biome d) niche

Answers

1. B
2. C
3. A
4. B
5. D
6. A
7. C
8. B
9. B
10. D

Week: 10

Topic: Growth

Introduction

Growth is a permanent increase in size and complexity of an organism during development from embryo to maturity, as a result of cell division. Growth is an anabolic process. For it to occur, the cell needs plenty of food to provide the necessary energy and materials for building up new protoplasm.

In a unicellular organism, the young organism grows until it reaches its maximum size, then it reproduces to give rise to young individual. This usually happens by simple division of the adult cell into two daughter cells as in the amoeba. All multicellular organisms begin life as a single fertilized cell. This cell divides into two, then into four and so on.

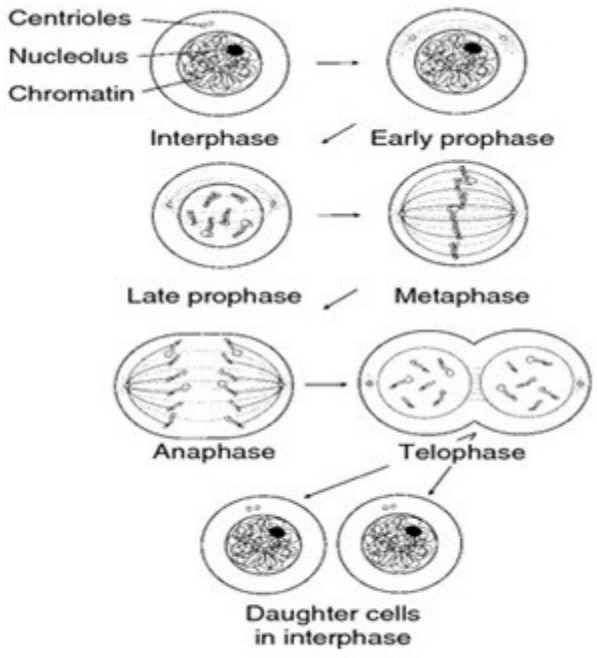
BASIS OF GROWTH

- **Cell Division**: For an embryo to grow or a tissue to regenerate, its cells must divide. There are two types of cell division – mitosis and meiosis.

1. **Meiosis**: It is a form of division which brings about a halving of the chromosome number as well as interchange of genetic material between homologous chromosomes. In animals meiosis takes place at the formation of gametes and in diploid plants at the formation of pores.

2. **Mitosis(*karyokinesis)***: is the process in cell division by which the nucleus divides, typically consisting of four stages and normally resulting in two new identical daughter cell, each of which contains a complete copy of the parental chromosomes. **Tissue repair and binary fission (asexual reproduction) are all mitotic divisions.** The period between mitotic divisions is called *interphase (resting period),* and mitosis itself occurs in four phases: *prophase, metaphase, anaphase,* and telophase.During *interphase* the chromosomes are extended long threads that cannot be visibly identified. The DNA of the chromosomes is replicated during this phase, resulting in duplication of the genetic material. During *prophase* the chromosomes coil up and contract, becoming short rods. Each chromosome consists of a pair of strands, called *chromatids,* held together at the centromere. At the same time the nuclear envelope disappears, and the centriole divides and the two daughter centrioles move toward opposite poles of the cell. During *metaphase* the chromosomes move so that their centromeres are aligned in the equatorial plane of the cell (the metaphase plate), and the mitotic spindle forms. The mitotic spindle is formed of fibers composed of microtubules, which extend from the centrioles to the metaphase plate and to the centromeres of the chromosomes. During *anaphase* the chromatids of each chromosome separate, becoming new daughter chromosomes,

which are drawn to opposite poles of the cell by the spindle fibers.During *telophase* the daughter chromosomes arrive at the poles of the cell, where they are surrounded by two new nuclear envelopes as they begin to uncoil and extend. During this phase, *cytokinesis,* division of the cytoplasm, occurs. A furrow forms around the cell in the equatorial plane and deepens until the two daughter cells are separated.



MITOSIS

DIFFERENCES BETWEEN MEIOSIS AND MITOSIS

MEIOSIS	MITOSIS
• Haploid number of chromosomes result after division	Diploid number of chromosomes are formed after division
• Two stages of division	Only a stage of division
• Four daughter cells are formed	Two daughter cells are formed
• Occurs only in sex cells	Occurs in body or somatic cells
• Exchange of genetic materials is due to crossing over	No crossing over as well as exchange of materials

Cell Enlargement: After the formation of new daughter cells, there is tendency for them to increase in size.

Cell Differentiation: In the process of growth, the formerly undifferentiated cells begin to grow to the extent that they start becoming specialized for a particular function due to structural changes. Examples are organs like xylem which initial function is to transport mineral salts and water, it start to grow lignin on its walls. Making it to play the role of strengthening of the stem.

REGULATION OF GROWTH BY HORMONE

Organisms produce growth hormones in small quantities which have profound effects on other parts of their body where they are needed for some form of growth.

Examples are plant hormones like auxins, gibberellins, cytokinin, abscisic acid and florigens which help the plants in the following:

PLANT HORMONES	**FUNCTION**
• Auxin	Cell elongation, apical dominance, tropism, lateral bud development, lateral root initiation, fruit growth, leaf abscission and control of cell differentiation.
• Gibberellin	Cell elongation, apical dominance, apical division, flower buds, flower sex, fruit growth, tropism and seed germination.
• Cytokinin	Apical division and protein synthesis, fruit growth and control of cell differentiation in culture.
• Florigens	Flower buds growth
• Abscisic acid	Apical division and protein synthesis

Animal hormones include adrenalin, insulin, thyroxine, pituitrin, testosterone, oestrogen, progesterone and are secreted for the following:

- During fright
- For body metabolism
- In reproductive functions
- Growth of long bones etc.

EXERCISES

Lets see how much you've learnt, attach the following **Answers** to the comment below

1. One of the following is not a plant hormone (a) cytochrome (b) cytokinin (c) Auxin (d) gibberellins
2. Auxin _____. (a) Promotes fruit growth (b) stimulates positive phototropism (c) causes roots to develop (d) all of the above
3. Apical dominance is caused by the production of _____ by the apical meristem. (a) ethylene (b) gibberellin (c) abscisic acid (d) Auxin
4. The following are basis of growth except (a) cell enlargement (b) increase in size (c) cell division (d) cell differentiation
5. _____ is referred to as the resting period between the mitotic phase. (a) anaphase (b) interphase (c) metaphase (d) prophase
6. _____ is the process in cell division by which the nucleus divides, typically consisting of four stages and normally resulting in two new identical daughter cell, each of which contains a complete copy of the parental chromosomes. (a) Chemokinesis (b) Photosynthesis (c) Karyokinesis (d) Growth
7. One of these is not an example of plant hormone. (a) Auxin (b) Giberellin (c) Cytokinin (d) Cytokinesis
8. One of the following is an example of animal hormone (a) Adrenalin (b) Florigen (c) Abscisic acid (d) Auxin

Answers

1. A
2. D
3. D
4. B
5. B
6. C
7. D
8. A

S.S.S 1

BIOLOGY

SECOND TERM

TABLE OF CONTENT

Week: 1

Topic: Basic Ecological Concept

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Biotic components

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- Decomposers: decomposers are bacteria and some fungi which break down dead plants and animals in order to feed on them and in the process, nutrients are released to the soil for use by the producers.

Abiotic Components

The abiotic components of an ecosystem include the non-living things which include:

- Climatic factors like temperature, wind, humidity, sunlight and rainfall.
- Inorganic materials and nutrients such as carbon (iv) oxide, oxygen, nitrogen, calcium, phosphorus, etc.
- Edaphic factors like soils, rocks, topography, etc.
- Other factors like dust, storm, fire and water.

Interactions among the Components of Ecosystem

There is a unique interaction among the various components of an ecosystem. Green plants use carbon (iv) oxide, water and chlorophyll in the presence of sunlight to produce carbohydrate or starch. Animals feed on these carbohydrates or plants and release carbon (iv) oxide for plants to take in. Micro-organisms and other decomposers break down dead plants and other organisms to release nutrients to the soil. These nutrients are absorbed by plants for use in food production. Plant gives out oxygen during photosynthesis which is used by animals for their normal respiration.

BIOMES

Large biotic communities corresponding to vegetation belts or zones are called biomes. Biomes are described as any large natural terrestrial ecosystem. The type of any biome is largely determined by climatic factors, especially rainfall and temperature. Thus, regions of the world with similar climates have similar biomes.

The local biomes in Nigeria can be divided into:

– Forest zone: The forest zone is made up of vegetation having mainly trees and consists of the following local biotic communities:

- Mangrove swamp forest (salt and fresh water swamp)

- Tropical rain forest

– Savanna Zone: The savanna zone is made up of mainly grasses and is further sub-divided into three savanna belts or biotic communities which are:

- Southern guinea savanna
- Northern guinea savanna
- Sahel savanna
- Sudan savanna

However, the most important factors that determine the distribution of forest and savanna are climatic factors. These are the;

- Mean annual rainfall
- Length and severity of the dry season;
- Minimum relative humidity in the driest months

Diagnostic Features Of Nigeria's Biomes

Mangrove Swamps: These are found in the tropics, along coastal regions and river months. In Nigeria, mangrove swamps are found in the delta regions of Lagos, Delta, Edo, Rivers, Ondo and Cross Rivers States.

- The climate is hot and wet throughout the year.
- The total annual rainfall is heavy, usually above 2500mm, and the average monthly temperature is around 26°C for nearly all months of the year.
- They are forests of small, evergreen, broadleaved trees growing in shallow, brackish waters or wet soils. Many mangrove trees have prop roots and breathing roots. These features enable them to grow well in the soft swampy areas of this region of Nigeria. However, evaporation from rivers in the fresh water swamp forests is low.
- Shrubs and climbers form clumps of thick bush. The floating plants in standing waters include species of water lettuce, Lemna and Salvina. Trees occurring near the waters include Alstonia and Spondiathus.

Tropical Rainforest

- These occur in regions that lie between the equator and latitude 5 – 10°N and S. The forests areas are mainly in the lowlands and they also extend up hill slopes to a height of 600 or 1000 metres.

- In Nigeria, rainforest regions are hot and wet throughout the year. The mean annual temperature is 27°C while the mean total annual rainfall is 2000mm. Relative humidity is atleast 70%. Rainy season is long and the dry season is short and very severe.
- The tropical rainforest is dense and made up of many types of broad-leaved trees that are mostly evergreen i.e. the trees drop their leaves gradually throughout the year, and new leaves grow continuously to replace them.
- The trees form three layers; the tree tops form a thick canopy that prevents sunlight from reaching the forest floor. As a result, the vegetation on the forest floor is sparse. It is also possible to identify five layers, called strata, forming stratification, in a forest.
- Epiphytic plants and woody climbers (Lianas) are common features of these forests. The animal species found here are diverse and. Examples include monkeys, gorillas, chimpanzees, leopards, bats, beetles, bees, ants, termites, spiders, cobras, squirrels, lizards, birds, frogs, insects and scorpions.

Savanna: Tropical grasslands are often called savanna. The savanna is usually flat for miles at a stretch. The main savanna region is in Africa. It occurs in tropical and subtropical regions. It contains scattered trees and shrubs. The West African savanna has three belts (Guinea savanna, bordering the rainforest, the Sudan and Sahel savannas, bordering the desert). The savanna regions have hot, wet season, which alternates with cool, dry season. The average monthly temperatures are around 29°C during the hot season and around 18°C during the cold season. The total annual rainfall varies a great deal from around 500mm in regions on the semi desert fringes to about 1500mm in regions bordering the rainforest. Most of the rain falls during the hot season, i.e. from May to October in the West African savanna regions. The rainfall of the savanna is sufficient to support a rich growth of trees but is enough to prevent deserts from forming. Thus, perennial grasses with chimps of trees mostly dominate the savanna. In the moist Guinea savanna, the grasses grow tall during the rainy season. Trees occur quite close together especially along the rainforest fringe.

Southern Guinea Savanna: Southern Guinea Savanna occurs in parts of Oyo, Ondo, Osun and Kwara states.

- The mean rainfall is above 500mm.
- Dry season is shorter and less intense than in the northern Guinea savanna.
- The vegetation is an open savanna wood land type, with tall grasses up to 3 meters high.
- The trees have short, large and broad leaves.
- Major characteristics of the savanna are the common occurrence of fires in the dry season. Several of the trees are adapted to fires by the possession of thick, fore resistant barks. Trees include Daniellia oliveri; Hypmemocardia, alida, vitex doniana

and Afzelia Africana. Species of grasses include Andropogan, Hypharrenia and Pennisetum.

- The animal forms include guinea fowl, deer, rats, grasshoppers and snakes.

Northern Guinea Savanna: In Nigeria, Northern Guinea Savanna is found in parts of Kaduna, Kwara, Benue and Kogi states.

- Grasses with scattered trees and shrubs dominate the vegetation.
- Trees are shorter and thorny and are fewer in numbers than in the southern Guinea savanna. Tree species found in the Northern Guinea Savanna include Isoberlina doka, Uapola somon and Monotes kerstingii.

Sudan Savanna: The Sudan savanna is found in Kano and parts of Borno, Yobe, Sokoto, Kebbi, Zamfara, Niger, Taraba, Adamawa, Bauchi and Gombe states. In the drier Sudan savanna, the grasses are shorter and the trees are fewer and more scattered.

Sahel Savanna: The Sahel savanna is found around Lake Chad. It extends across West Africa from Senegal in the West to Chad in the east and from Sahara in the north to the Northern Guinea Savanna belt in the south. In Nigeria, it occurs only at the northeast corner, in Borno and Yobe states near Lake Chad. Rainfall is very variable. The mean annual rainfall is 629mm. The zone is arid.

- Typical vegetation is an open thorn savanna, with trees up to 10 metres tall, having small leaves and thorns. In the Sahel, there are clumps of short grasses and a few isolated shrubs and trees. During the dry season, the grasses are usually dry and brown, and bush fires are often are of common occurrence.
- The underground parts of the grasses survive the dry season and fires, and grow again when the rain comes. Common grasses are; Pennisetum, Andropogan, Panicum, Aristida, Stipoides etc. While common trees include Afzelia, Acalia, Balanites, Leptodenia, date palsete.
- The fauna include gazelle, antelope, buffalo, giraffe, elephant, zebra, eland, bush cow, lion, hyena etc.

Major Biomes of the World

Tropical Rain Forest

Tropical rain forests are home to more species than all other land biomes combined. The leafy tops of tall trees – extending up to 70 meters above the forest floor – form a dense covering called a canopy. In the shade below the canopy, a second layer of shorter trees and

vines forms an understory. Organic matter that falls to the forest floor quickly decomposes and the nutrients are recycled.

Abiotic factors: hot and wet year-round; thin, nutrient-poor soils

Dominant plants: broad-leaved evergreen trees; ferns; large woody vines and climbing plants; orchids and bromeliads

Dominant wildlife: herbivores such as sloths, tapirs, and capybaras; predators such as jaguars; anteaters; monkeys; birds such as toucans, parrots, and parakeets; insects such as butterflies, ants, and beetles; piranhas and other freshwater fishes; reptiles such as frogs, caymans, boa constrictors, and anacondas

Geographic distribution: parts of South and Central America, Southeast Asia, parts of Africa, southern India, and northeastern Australia

Tropical Savanna

Receiving more seasonal rainfall than deserts but less than tropical dry forests, tropical savannas, or grasslands, are characterized by a cover of grasses. Savannas are spotted with isolated trees and small groves of trees and shrubs. Compact soils, fairly frequent fires, and the action of large animals such as rhinoceros prevent some savanna areas from turning into dry forest.

Abiotic factors: warm temperatures; seasonal rainfall; compact soil; frequent fires set by lightning

Dominant plants: tall, perennial grasses; sometimes drought-tolerant and fire resistant trees or shrubs

Dominant wildlife: predators such as lions, leopards, cheetahs, hyenas, and jackals; aardvarks; herbivores such as elephants, giraffes, antelopes, and zebras; baboons; birds such as eagles, ostriches, weaver birds, and storks; insects such as termites

Geographic distribution: large parts of eastern Africa, southern Brazil, northern Australia

Temperate Grassland

Characterized by a rich mix of grasses and underlaid by some of the world's most fertile soils, temperate grasslands – such as plains and prairies – once covered vast areas of the Midwestern United States. Since the development of the steel plow, however, most have been converted to agricultural fields. Periodic fires and heavy grazing by large herbivores maintain the characteristic plant community.

Abiotic factors: warm to hot summers; cold winters; moderate, seasonal precipitation; fertile soils; occasional fires

Dominant plants: lush, perennial grasses and herbs; most are resistant to drought, fire, and cold

Dominant wildlife: predators such as coyotes and badgers — historically included wolves and grizzly bears; herbivores such as mule deer, pronghorn antelope, rabbits, prairie dogs, and introduced cattle — historically included bison; birds such as hawks, owls, bobwhite, prairie chicken, mountain plover; reptiles such as snakes; insects such as ants and grasshoppers

Geographic distribution: central Asia, North America, Australia, central Europe, and upland plateaus of South America

Desert

All deserts are dry; in fact, a desert biome is defined as having annual precipitation of less than 25 centimeters. Beyond that, deserts vary greatly, depending on elevation and latitude. Many undergo extreme temperature changes during the course of a day, alternating between hot and cold. The organisms in this biome can tolerate the extreme conditions.

Abiotic factors: low precipitation, variable temperatures; soils rich in minerals but poor in organic material

Dominant plants: cacti and other succulents; creosote bush and other plants with short growth cycles

Dominant wildlife: predators such as mountain lions, gray foxes, and bobcats; herbivores such as mule deer, pronghorn antelope, desert bighorn sheep, and kangaroo rats; bats; birds such as owls, hawks, and roadrunners; insects such as ants, beetles, butterflies, flies, and wasps; reptiles such as tortoises, rattlesnakes, and lizards

Geographic distribution: Africa, Asia, the Middle East, United States, Mexico, South America, and Australia

Temperate Woodland and Shrubland

This biome is characterized by a semiarid climate and a mix of shrub communities and open woodlands. In the open woodlands, large areas of grasses and wildflowers such as poppies are interspersed with oak trees. Communities that are dominated by shrubs are also known as chaparral. The growth of dense, low plants that contain flammable oils makes fires a constant threat.

Abiotic factors: hot, dry summers; cool, moist winters; thin, nutrient-poor soils; periodic fires

Dominant plants: woody evergreen shrubs with small, leathery leaves; fragrant, oily herbs that grow during winter and die in summer

Dominant wildlife: predators such as coyotes, foxes, bobcats, and mountain lions; herbivores such as blacktailed deer, rabbits, squirrels, and mice; birds such as hawks, California quail,

western scrub jay, warblers and other songbirds; reptiles such as lizards and snakes; butterflies; spiders

Geographic distribution: western coasts of North and South America, areas around the Mediterranean Sea, South Africa, and Australia.

Test Questions

1. ..... is the study of the relationships of living organisms to each other and their surroundings. a) Floriculture b) Ecology c) Biology d) Autecology
2. The abiotic components of an ecosystem include the non-living things. All of these is an example except a) temperature b) soil c) fungi d) water
3. ..... are autotrophs (green plants and some micro-organisms) which can manufacture their own food from simple inorganic materials. a) Producers b) Decomposers c) Consumers d) Customers
4. An ..... refers to a community of plants and animals functioning together with their non-living environment. a) Ecology b) Ecosystem c) Biosystem d) Ecological management
5. ..... is defined as the total number of organisms of the same species living together in a given area. a) Species b) Niche c) Habitat d) Population
6. ..... is concerned with the study of the inter-relationships between groups of organisms or species of organisms living together in an area. a) Synecology b) Autecology c) Ecology d) Biology
7. A/An ..... community is any naturally occurring group of different organisms living together and interacting in the same environment. a) biome b) abiotic c) biotic d) ecological
8. ..... is the zone of the earth occupied by living organisms. a) Environment b) Ecosphere c) Atmosphere d) Lithosphere
9. ..... is the part of the earth occupied by water. a) Atmosphere b) Hydrosphere c) Lithosphere d) Biosphere
10. Ecological ..... refers to the specific portion of a habitat which is occupied by a particular species or organism. a) fauna b) zone c) biome d) niche

Answers

1. B
2. C

3. A
4. B
5. D
6. A
7. C
8. B
9. B
10. D

Week: 2

Topic: Ecological Management

Introduction

Living organisms establish different living associations with others in order to obtain food or protection. Some of these living associations are beneficial to one or both organisms in the relationship. This is called biological associations and these biological associations are beneficial, some are neutral while others are harmful.

Types of Association

Symbiosis

The word symbiosis literally means 'living together,' but when we use the word symbiosis in biology, what we're really talking about is a close, long-term interaction between two different species. There are many different types of symbiotic relationships that occur in nature.

In many cases, both species benefit from the interaction. This type of symbiosis is called mutualism.

Mutualism: Is a biological interaction between two organisms, in which both species benefit from the interaction. Most mutualisms are facultative, meaning the partners can successfully live apart. However, some mutualisms are so intimate that the interacting species can no longer live without each other; they have a mutually obligate interdependence.

An example of mutualism is the relationship between bullhorn acacia trees and certain species of ants. Each bullhorn acacia tree is home to a colony of stinging ants. The tree has very large thorns that look like bull's horns. The ants hollow out the thorns and use them as shelter. In addition to providing shelter, the acacia tree also provides the ants with two food sources. One food source is very sweet nectar that oozes from the tree at specialized structures called nectaries. The second food source is in the form of food nodules called beltian bodies that grow on the tips of the leaves. Between the nectar and the beltian bodies, the ants have all of the food they need. So, the ants get food and shelter.

But the ants are very territorial and aggressive. They will attack anything and everything that touches the tree – from grasshoppers and caterpillars to deer and humans. They will even climb onto neighboring trees that touch their tree and kill the whole branch and clear all vegetation in a perimeter around their tree's trunk, as well. The ants protect the tree from herbivores and remove competing vegetation, so the acacia gains a big advantage from the relationship. In this case, the acacia is considered a host because it is the larger organism in a symbiotic relationship upon or inside of which the smaller organism lives, and the ant is

considered to be a symbiont, which is the term for the smaller organism in a symbiotic relationship that lives in or on the host.

Image of the relationship between bullhorn acacia trees and certain species of ants.

Other mutualistic relationships include:

Termites are only able to eat wood because they have mutualistic protozoans and bacteria in their gut that helps them digest cellulose.

1. Coli is one of the normal bacteria found in all human large intestines. Humans provide E. coli with food and a place to live. In return, the E. coli produce vitamin K and make it harder for pathogenic bacteria to establish themselves in our large intestine.

Parasitism

Parasitism is an association between two different species where the symbiont (parasite) benefits and the host is harmed. In other word, parasitism is a relationship wherein an organism gets the benefit and the other is harmed. Fleas, ticks, lice, leeches, and any bacteria or viruses that cause disease, are considered to be parasitic.

In this relationship, the host may become weak but does not usually die. If the host dies, the parasites may also die.

- Parasites are organisms that live inside or outside the body of another organisms and feed on it.
- Host is the provider of food and shelter for the parasite.
- Ectoparasites are parasites that live outside the body of the host.
- Endoparasites are parasites that live inside the body of the host.

Not all parasites have to cause disease. Lice, ticks, fleas, and leeches are all examples of parasites that don't usually cause disease directly, but they do suck blood from their host, and that is causing some harm, not to mention discomfort to their host. Parasites can also act as vectors or organisms that transmit disease-causing pathogens to other species of animals.

Examples:

- Fleas and dog – fleas are insects that suck blood from the body of the dog. They also live on the body of the dog.
- Mosquito bites human to suck blood.
- Hook worms or round worms on human digestive tract.

Commensalism

Commensalism is an association between two different species where one species enjoys a benefit, and the other is not significantly affected. In other word, Commensalism is a relationship wherein one participating organisms is benefited while the other is neither helped nor harmed.

Commensalism is sometimes hard to prove because in any symbiotic relationship, the likelihood that a very closely associated organism has no effect whatsoever on the other organism is pretty unlikely. But, there are a few examples where commensalism does appear to exist. For example, the cattle egret follows cattle, water buffalo, and other large herbivores as they graze. The herbivores flush insects from the vegetation as they move, and the egrets catch and eat the insects when they leave the vegetation. In this relationship the egret benefits greatly, but there is no apparent effect on the herbivore.

Other Examples are:

- Orchids and some kinds of fern are aerial plants. They usually grow on trunks or branches of trees. These plants get moisture and nutrients from the bark of the tree. They also use the tree for support because they do not have stems. The orchids or ferns do not seem to harm or help the tree.
- The barnacles are shelled animals that cannot move on their own. They attached themselves to other animals like crabs or whales. The barnacles get transportation and a steady supply of food as the whale moves through the ocean. The whale on the other hand, is generally not affected by this kind of interaction.

Predation

Predation is a relationship wherein a smaller animal is killed and eaten by a bigger animal.

- Predator – the animal that feeds on another animal.
- Prey – the animal that is eaten.

Examples:

- The hawk catches the fish for food.
- Frogs feed on insects.
- Lion hunt deer for food.

Competition

Competition is a relationship wherein two or more organisms need the same thing in order to survive. It may exist among organisms of the same kind or of different kinds. In this kind of

interaction, the organisms fight for a common resource in order to survive. The common resources could be food, water, sunlight, shelter or space, and other things.

Examples:

In a rice field, rice plants compete with each other for water, minerals, space, and sunlight. At the same time, the rice plants compete for the same resources with the weeds that grow among them.

- Both vegetable plants and the weeds need sunlight, water, and minerals in order to survive.
- Dogs and cats need same kind of food and may fight over it.

Tolerance

Tolerance is the ability of living organisms to withstand or tolerate little unfavourable changes in the environment which affect their survival.

Living organisms can only live in a particular habitat if they can tolerate the ranges of the abiotic factors that operate in it. Due to changes in environmental factors, some of these conditions are sometimes unfavourable. Too little or too much of certain environmental factors such as light, heat, cold, acidity and alkalinity might produce unfavourable conditions.

Tolerance Range

Tolerance range is defined as the range between the minimum and maximum limits to which organisms can tolerate certain changes in their environment so as to survive. Organisms can only live within certain minimum and maximum limits for each abiotic factor. Death occurs beyond this range. For example, for most animals, the minimum temperature limit is 0°C while the maximum limit is 42°C. Their tolerance range is 0 – 42°C. Below 0°C or above 42°C, the organisms may die.

Geographic Range

Geographic range refers to the areas where a species of organism can only be found within the minimum and maximum limits of its tolerance.

Different abiotic factors like rainfall, temperature, light intensity, availability of food, relative humidity, day length, wind, etc. are often responsible for the geographical boundaries of species of organisms. For example, the geographical range of the tropical rainforest is within the equator as a result of high rainfall and high temperatures, whereas tropical rainforest cannot be found at the Northern and Southern poles because of low rainfall and temperature.

Practice Questions

1. _____ is a biological interaction between two organisms, in which both species benefit from the interaction. a) Mutualism b) Parasitism c) Symbiosis d) Autotrophism
2. Predation is a relationship wherein a prey (smaller animal) is killed and eaten by a ____(bigger animal) a) Predate b) victim c) Predator d) Lion
3. The difference in range between the minimum and maximum limits to which organisms can tolerate certain changes in their environment so as to survive is called _____? a) Tolerance b) Endurance c) Tolerance Range d) Difference Range
4. _____ is the ability of living organisms to withstand or tolerate little unfavourable changes in the environment which affect their survival. a) Adaptability b) Change c) Movement d) Tolerance
5. The hawk catches the fish for food is an example of a) Competition b) Predation c) Tolerance d) Feeding Habit
6. “Dogs and cats need same kind of food and may fight over it” is an example of a) Competition b) Survival c) Survival of the fittest d) Struggling for food
7. The word “**Symbiosis**” literally means a) eating together b) living together c) competing d) having fun
8. _____ is an association between two different species where one species enjoys a benefit, and the other is not significantly affected. a) Parasitism b) Symbiosis c) Commensalism d) Competition
9. All these except one is part of a parasitic relationship. a) Host b) Endo parasites c) Ecto parasites d) Prey
10. _____ refers to the areas where a species of organism can only be found within the minimum and maximum limits of its tolerance. a) Geography b) Tolerance range c) Geographic range d) Range

Answers

1. A
2. C
3. C
4. D
5. B

6. A
7. B
8. C
9. D
10. C

Week: 3

Topic: Tolerance

Introduction

Tolerance is the ability of living organisms to withstand or tolerate little unfavourable changes in the environment which affect their survival.

Living organisms can only live in a particular habitat if they can tolerate the ranges of the abiotic factors that operate in it. Due to changes in environmental factors, some of these conditions are sometimes unfavourable. Too little or too much of certain environmental factors such as light, heat, cod, acidity and alkalinity might produce unfavourable conditions.

Tolerance Range

Tolerance range is defined as the range between the minimum and maximum limits to which organisms can tolerate certain changes in their environment so as to survive. Organisms can only live within certain minimum and maximum limits for each abiotic factors. Death occurs beyond this range. For example, for most animals, the minimum temperature, limit is $0^{o}C$ while the maximum limits is $42^{o}C$. Their tolerance range is $0 - 42^{o}C$. Below $00C$ or above $42^{o}C$, the organisms may die.

Also one factor may affect the tolerance range than other factors. For example, when the oxygen level of water is low, lobsters can only tolerate temperature up to $29^{o}C$ but at a higher oxygen level, they can tolerate temperature up to $32^{o}C$. Also, while some plants can withstand long period of drought, many others cannot.

Geographical Range

Geographical range refers to the areas where a species of organism can only be found within the minimum and maximum limits of its tolerance.

Different abiotic factors like rainfall, temperature, light intensity, availability of food, relative humidity, day length, wind, etc are often responsible for the geographical boundaries of species of organisms. For example, the geographic range of the rain forest is within the equator as a result of high rainfall and high temperatures, whereas tropical rainforest cannot be found at the Northern and Southern poles because of low rainfall and temperature.

Practice Questions

1. _____ is the ability of living organisms to withstand or tolerate little unfavourable changes in the environment which affect their survival.
   a) Tolerance
   b) Adaptation
   c) Competition
   d) Survival

2. _____ refers to the areas where a species of organism can only be found within the minimum and maximum limits of its tolerance.
   a) Adaptive ability
   b) Geographical Range
   c) Tolerance
   d) Competition

3. Living organisms can only live in a particular habitat if they can tolerate the ranges of the _____ that operate in it.
   a) biotic factors
   b) abiotic factors
   c) edaphic factors
   d) ecosystem

4. What is the minimum temperature tolerance for animals
   a) 30^{o}
   b) 100^{o}
   c) 25^{o}
   d) 0^{o}

5. One of the following factors affects tolerance range
   a) drought
   b) sunshine
   c) low oxygen level of water
   d) temperature

Answers

1. A
2. B
3. B
4. D
5. C

Week 4 & 5

Topic: Adaptation

Introduction

Adaptation is defined as the ability of an organism to live successfully in a particular habitat as a result of its structure, appearance and behaviour. In other words, adaptation is the change in structure, function and behaviour of an organism in order to adjust or survive in its environment.

It is expected that every organism must adapt to its environment in order to survive. Plants and animals possess certain features which enable them to adapt to either aquatic or terrestrial habitats.

Plants Adaptation

Xerophytes

These are plants that survive extremely dry places. They possess the following adaptive features:

- Well developed root system which absorbs water from deep level.
- Special water storage tissues
- Small leaves to reduce rate of transpiration
- Possession of succulent leaves
- Thick back, stem to avoid excessive loss of water from lenticels
- Leaves are waxy, hairy, spiny to reduce transpiration

Examples are Acacias, baobab, mango, cacti, bryophyllum, cassia spp, etc.

Mesophytes

They are plants found where conditions are not extremes. They possess the following characteristics:

- Broad leaves for faster rate of transpiration
- Well-developed root system
- No special protective for stomata

Examples are maize, cowpea, hibiscus, etc.

Hydrophytes

They are plants that survive in water. They are adapted in the following ways:

- Ability of the leaves to float e.g. water lettuce
- A poorly developed root system
- Well-developed stomata and cuticles on the upper surface only
- Submerged plants have air space for buoyancy e.g. ceratophyllum
- Presence of adventitious roots e.g. water lily
- Presence of long stem or stalk for photosynthesis and pollination.

Animal Adaptation

Terrestrial Animals

- Possession of thick, tough skin or hairs or furs, feathers as protective measures, as well as temperature regulation.
- Lungs for respiration
- Kidneys for excretion
- Limbs for support and locomotion
- Sweat gland for cooling and excretion
- Giving birth to few young ones e.g. elephants

Aboreal Animals

- Possession of bright colours, as well as camouflage e.g. chameleon
- Possession of wings for flight
- Presence of hollow bones to make room for lightness
- Possession of strong flight muscles and tendon
- Possession of powerful limbs, claws and tails for climbing and piercing e.g. birds, monkeys and barboons
- The aves feed mostly on concentrated food (grains) in other to have enough energy to fly long distance

- Possession of streamlined body for easy flight

Aquatic Animals

- Possession of streamlined body for easy movement
- Some have dark upper parts, while their lower parts are lighter in order to blend with the sky (camouflage) when viewed from below.
- Possession of slimy body for easy movement as well as a protective measure
- Possession of gills or respiratory trumpets for respiration
- Presence lateral lines to detect vibration
- Possession of fins and webs for easy movement
- Presence of suckers or hairs for attachment

Adaptation of Parasites – Endoparasites

- Presence of suckers and hooks for attachment
- They shield themselves inside their hosts intestine with anti-enzymes in order to avoid being digested
- They possess very thin membrane which enhances the diffusion of already digested food from their host into their own system.
- Some like the tapeworms are hermaphrodites and do not need opposite sex before fertilization

Image of Tapeworm

- They lay numerous eggs to make sure their new host is reached.
- Some have intermediate hosts which contribute to their confirmed existence

Halophytes

These are salt-resistant organisms. They may be plants or animals. Examples of plants are white mangrove and red mangrove. Examples of animals are all marine animals like sharks, whales, etc.

Animal Adaptation

A. To Aquatic Environment

1. possession of streamlined body for easy movement in water e.g tilapia fish, toad
2. possession of swim bladder for the purpose of buoyancy in water e.g tilapia fish
3. possession of fins for movement as in the case of fish and webbed toes in toad
4. possession of gills for gaseous exchange
5. possession of tail for swimming e.g tad poles
6. possession of sticky under-surface for attachment of surfaces of objects e.g snails
7. possession of suckers or hairs for attachment to vegetation so as to avoid being swept away by current water e.g leeches

B. To Terrestial

1. possession of powerful limbs for movement e.g mammals
2. possession of lungs for gaseous exchange e.g birds, reptiles
3. possession of sweat glands for excretion and cooling
4. possession of skin as in mammals and cuticle by insects to protect and prevent drying up and injury
5. possession of hairs as in mammals and that of feathers as in birds.

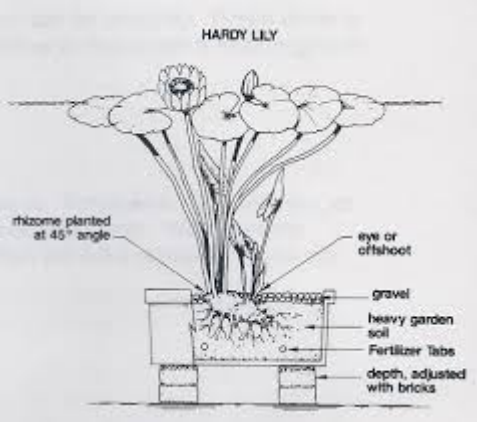
C. To Aboreal Habitat

1. Possession of wings and streamlined bodies for flight e.g birds
2. possession of bright colour as well as camouflage e.g. chameleon
3. possession of powerful limbs, claws and tails for climbing and piercing e.g. monkeys
4. possession of hollow bones to make them light e.g birds
5. possession of strong muscles and tendons to ease flight e.g. birds

Plants Adaptation

A. To Aquatic Habitat

1. Possession of waxy cuticles on leaves to prevent wetting e.g. watter lettuce
2. possession of air float in leaves and stems for buoyancy e.g. water hyacinth
3. possession of air spaces in the tissues for buoyancy
4. possession of long stem and flower stalk to expose the flowers and leaves
5. possession of breathing roots for gaseous exchange



B. To Terrestial Habitat

1. possession of extensive root for anchorage and water absorption
2. possession of thick, waxy cuticles on leaves to prevent water loss
3. possession of succulent stem by desert plants to enable them store excess water
4. possession of thick barks on the stems to protect internal tissues
5. possession of tiny and scanty leaves by desert plants to reduce water loss through transpiration

6. possession of numerous leaves to enhance potosynthesis

Practice Questions

1. One of this is **not** an adaptation of animals for aquatic environment.
   a) possession of streamlined body
   b) possession of gills for gaseous exchange
   c) possession of suckers or hairs for attachment to vegetation
   d) possession of eyes to see

2. One of this is **not** an adaptation of animals for aboreal environment.
   a) possession of hollow bones to make them light
   b) possession of feathers
   c) possession of bright colour as well as camouflage
   d) possession of strong muscles and tendons to ease flight

3. One of this is **an** adaptation of animals for aquatic environment.
   a) possession of breathing roots for gaseous exchange
   b) possession of wings for flight
   c) possession of gills
   d) possession of skin

4. _____ is defined as the ability of an organism to live successfully in a particular habitat as a result of its structure, appearance and behaviour.
   a) Animal adaptation
   b) Plants adaptation
   c) Adaptation
   d) Competition

5. _____ are plants that survive extremely dry places.
   a) Zerophytes
   b) Xeropytes
   c) Thalophytes
   d) halophytes

6. _____ are salt resistant organisms
   a) sporopytes
   b) thalophytes
   c) halophytes
   d) spermatophytes

7. Hydropytes are plants that can survive in _____
   a) fire

b) land
c) rain
d) water

8. One of the following is not an adaptive feature of Xerophytes
   a) Well developed root system which absorbs water from deep level.
   b) Special water storage tissues
   c) Small leaves to reduce rate of transpiration
   d) Possession of scaly leaves

Answers

1. D
2. B
3. A
4. C
5. B
6. C
7. D
8. D

Week: 6 & 7

Topic: Pollution

Introduction

Pollution is the introduction of a contaminant into a natural environment, usually by humans. In other words, Pollution is the addition to the ecosystem of something which has a detrimental effect on it. One of the most important causes of pollution is the high rate of energy usage by modern, growing populations.

When some physical, chemical or biological changes occur in our physical environment it is known as pollution and the substances which brings these changes are known as pollutants. The sources for the pollution can be natural or man made.

Different kinds of pollution are found, but we will discuss the following:

1. Air Pollution.
2. Water Pollution.
3. Land Pollution.

Air Pollution

Air pollution is the accumulation in the atmosphere of substances that, in sufficient concentrations, endanger human health or produce other measured effects on living matter and other materials. In other words, Air pollution is defined as any contamination of the atmosphere that disturbs the natural composition and chemistry of the air. This can be in the form of particulate matter such as dust or excessive gases like carbon dioxide or other

vapours that cannot be effectively removed through natural cycles, such as the carbon cycle or the nitrogen cycle.

Among the major sources of pollution are power and heat generation, the burning of solid wastes, industrial processes, and, especially, transportation. The six major types of pollutants are carbon monoxide, hydrocarbons, nitrogen oxides, particulates, sulphur dioxide, and photochemical oxidants.

Air pollution comes from a wide variety of sources. Some of the most excessive sources include:

- Vehicle or manufacturing exhaust
- Forest fires, volcanic eruptions, dry soil erosion, and other natural sources
- Building construction or demolition

Depending on the concentration of air pollutants, several effects can be noticed. Smog increases, higher rain acidity, crop depletion from inadequate oxygen, and higher rates of asthma. Many scientists believe that global warming is also related to increased air pollution.

Examples of Air Pollution

- Noise Pollution
  Noise pollution or unwanted sounds that are carried by the air, have an irritating and detrimental effect on humans and other animals. Careful planning of streets and buildings in towns and better control over noisy vehicles may add to the control of noise pollution.

- Tobacco Smoke
  Tobacco smoke is one of the major forms of pollution in buildings. It is not only the smoker who is infected, but everyone who inhales the polluted air. There is a very strong connection between smoking and lung cancer. Bronchitis is common among smokers and unborn babies of mothers who smoke also suffer from the harmful effects of smoking.

- Exhaust Gases of Vehicles
  Pollution from exhaust gases of vehicles is reponsible for 60% of all air pollution and in cities up to 80%. There is a large variety of harmful chemicals present in these gases, with lead being one of the most dangerous.

- Combustion of Coal
  The combustion of caol without special precautions can have serious consequences. If winds do not blow away the poisonous gases, they can have fatal effects and may lead to death.

- Acid rain
  Acid rain is the term for pollution caused when sulfur and nitrogen dioxides combine with atmospheric moisture to produce highly acidic rain, snow, hail, or fog. The acid eats into the stone, brick and metal articles and pollutes water sources. Coal in South Africa is rich in sulphur and the power stations in the Mpumalanga Province could be reponsible for acid rain over other areas of our country.

Control Measures

Although individual people can help to combat air pollution in their own immediate environment, efficient control can be best achieved by legislation. Some commonly enforced control measures include

- The establishment of more smokeless zones;
- Control over the kinds of fuel used in cars, aeroplanes, power stations, etc.

Water Pollution

Water pollution is the introduction into fresh or ocean waters of chemical, physical, or biological material that degrades the quality of the water and affects the organisms living in it. In other words, Water pollution involves any contaminated water, whether from chemical, particulate, or bacterial matter that degrades the water's quality and purity. Water pollution can occur in oceans, rivers, lakes, and underground reservoirs, and as different water sources flow together the pollution can spread.

This process ranges from simple addition of dissolved or suspended solids to discharge of the most insidious and persistent toxic pollutants (such as pesticides, heavy metals, and non-degradable, bioaccumulative, chemical compounds).

Causes of water pollution include:

- Increased sediment from soil erosion
- Improper waste disposal and littering
- Leaching of soil pollution into water supplies
- Organic material decay in water supplies

The effects of water pollution include decreasing the quantity of drinkable water available, lowering water supplies for crop irrigation, and impacting fish and wildlife populations that require water of a certain purity for survival.

Examples of Water Pollution

- Industrial affluents
  Water is discharged from after having been used in production processes. This waste water may contain acids, alkalis, salts, poisons, oils and in some cases harmful bacteria.
- Mining and Agricultural Wastes
  Mines, especially gold and coal mines, are responsible for large quantities of acid water. Agricultural pesticides, fertilizers and herbicides may wash into rivers and stagnant water bodies.
- Sewage Disposal and Domestic Wastes
  Sewage as well as domestic and farm wastes were often allowed to pollute rivers and dams.

Control Measures

The following measures can be used to stop water pollution:

- Every intelligent people should be wise enough not to pollute water in any way;
- By research and legislation the pollution of water bodies, even though not entirely prevented, must be effectively controlled.

Land Pollution

Land pollution is the degradation of the Earth's land surface through misuse of the soil by poor agricultural practices, mineral exploitation, industrial waste dumping, and indiscriminate disposal of urban wastes. It includes visible waste and litter as well as pollution of the soil itself.

Examples of Land Pollution

- Soil Pollution
  Soil pollution is mainly due to chemicals in herbicides (weed killers) and pesticides (poisons which kill insects and other invertebrate pests). Litter is waste material dumped in public places such as streets, parks, picnic areas, at bus stops and near shops.

- Waste Disposal
  The accumulation of waste threatens the health of people in residential areas. Waste decays, encourages household pests and turns urban areas into unsightly, dirty and unhealthy places to live in.

Control Measures

The following measures can be used to control land pollution:

- anti-litter campaigns can educate people against littering;
- organic waste can be dumped in places far from residential areas;
- inorganic materials such as metals, glass and plastic, but also paper, can be reclaimed and recycled.

Ozone Layer Depletion: Effects and Causes of Ozone Depletion

The ozone layer is responsible for absorbing harmful ultraviolet rays, and preventing them from entering the Earth's atmosphere. However, various factors have led to the depletion and damage of this protective layer.
Ozone is a colourless gas found in the upper atmosphere of the Earth. It is formed when oxygen molecules absorb ultraviolet photons, and undergo a chemical reaction known as photo dissociation or photolysis. In this process, a single molecule of oxygen breaks down into two oxygen atoms. The free oxygen atom (O), then combines with an oxygen molecule (O_2), and forms a molecule of ozone (O_3). The ozone molecules, in turn absorb ultraviolet rays between 310 to 200 nm (nanometers) wavelength, and thereby prevent these harmful radiations from entering the Earth's atmosphere. The process of absorption of harmful radiation occurs when ozone molecules split up into a molecule of oxygen, and an oxygen atom. The oxygen atom (O), again combines with the oxygen molecule (O_2) to regenerate an ozone (O_3) molecule. Thus, the total amount of ozone is maintained by this continuous process of destruction, and regeneration.

Causes of Ozone Depletion
Ozone is a triatomic form of oxygen (O_3), found in the Earth's atmosphere. A combination of low temperatures, elevated chlorine and bromine concentrations in the upper stratosphere are responsible for the destruction of ozone. The production and emission of chlorofluorocarbons (CFCs), is the leading cause of ozone layer depletion. CFC's accounts for almost 80% of the total depletion of ozone.

Other ozone-depleting substances (ODS), include hydrochlorofluorocarbons (HCFCs), and volatile organic compounds (VOCs). These are often found in vehicle emissions, byproducts of industrial processes, refrigerants, and aerosols. ODS are relatively stable in the lower atmosphere of the Earth, but in the stratosphere, they are exposed to ultraviolet radiation and thus, they break down to release a free chlorine atom.

This free chlorine atom reacts with an ozone molecule (O_3), and forms chlorine monoxide (ClO), and a molecule of oxygen. Now, ClO reacts with an ozone molecule to form a chlorine atom, and two molecules of oxygen. The free chlorine molecule again reacts with ozone to form chlorine monoxide. The process continues, and this results in the depletion of the ozone layer.

Possible Effects of Ozone Depletion

As ozone depletes in the stratosphere, it forms a 'hole' in the layer. This hole enables harmful ultraviolet rays to enter the Earth's atmosphere. Ultraviolet rays of the Sun are associated with a number of health-related, and environmental issues.

Impact on Humans

Skin cancer: Exposure to ultraviolet rays poses an increased risk of developing several types of skin cancers, including malignant melanoma, basal and squamous cell carcinoma.
Eye damage: Direct exposure to UV radiations can result in photokeratitis (snow blindness),

and cataracts.
Immune system damage: Effects of UV rays include impairment of the immune system. Increased exposure to UV rays weakens the response of the immune system.
Accelerated aging of skin: Constant exposure to UV radiation can cause photo allergy, which results in the outbreak of rash in fair-skinned people.
Other effects: Ozone chemicals can cause difficulty in breathing, chest pain, throat irritation, and hamper lung functioning.

Effects on Amphibians
Ozone depletion is listed as one of the causes for the declining numbers of amphibian species. Ozone depletion affects many species of amphibians at every stage of their life cycle.

Some of the effects are mentioned below:

Hampers growth and development in larvae
Changes behaviour and habits
Causes deformities in some species
Decreases immunity. Some species have become more vulnerable to diseases and death
Retinal damage and blindness in some species

Effects on Marine Ecosystems
In particular, plankton (phytoplankton and bacterioplankton) are threatened by increased UV radiation. Marine phytoplankton play a fundamental role in both the food chain as well as the oceanic carbon cycle. Plankton play an important role in converting atmospheric carbon dioxide into oxygen. Ultraviolet rays can influence the survival rates of these microscopic organisms, by affecting their orientation and mobility. This eventually disturbs and affects the entire ecosystem.

Impact on Plants

In some species of plants, UV radiation can alter the time of flowering, as well as the number of flowers.
Plant growth can be directly affected by UV-B radiation. Despite mechanisms to reduce or repair these effects, physiological and developmental processes of plants are affected.

Another observation is an increase in the ozone present in the lower atmosphere due to the decrease in the ozone in the stratosphere. Ozone present in the lower atmosphere is mainly regarded as a pollutant and a greenhouse gas, that can contribute to global warming and climate change. However, studies have pointed out that the lifespan of lower atmospheric ozone is quite less, compared to stratospheric ozone. At the same time, increase in the level of ozone in the lower atmosphere can enhance the ability of sunlight to synthesize vitamin D, which can be regarded as an important beneficial effect of ozone layer depletion.

Practice Questions

1. Pollution is the introduction of a _____ into a natural environment, usually by humans.
   a) contamination
   b) contaminant
   c) pollutes
   d) dirts

2. Ozone is a _____ form of oxygen (O_3), found in the Earth's atmosphere
   a) diatomic
   b) monoatomic
   c) triatomic
   d) hexatomic

3. One of the following is not a cause of water pollution
   a) Increased sediment from soil erosion
   b) smoke from chimney
   c) Improper waste disposal and littering
   d) Leaching of soil pollution into water supplies

4. One of the following is not an impact of ozone depletion on humans
   a) hampering of growth
   b) skin cancer
   c) eye damage
   d) aging of skin

5. As ozone depletes in the stratosphere, it forms a _____ in the layer
   a) hole
   b) space
   c) base
   d) line

6. One of the following is not a cause of air pollution.
   a) Exhaust Gases of Vehicles
   b) Smoke from chimney
   c) Acid rain
   d) Sewage

7. _____ are unwanted sounds that are carried by the air, have an irritating and detrimental effect on humans and other animals.
   a) air pollution
   b) pollutants
   c) smoke
   d) noise pollution

8. One of the following is not a control measure for pollution
   a) anti-litter campaigns can educate people against littering

b) organic waste can be dumped in places far from residential areas
c) littering of the streets with dirts
d) inorganic materials such as metals, glass and plastic, but also paper, can be reclaimed and recycled.

9. _____ is the degradation of the Earth's land surface through misuse of the soil by poor agricultural practices, mineral exploitation, industrial waste dumping, and indiscriminate disposal of urban wastes.
   a) Land pollution
   b) Soil pollution
   c) Water disposal
   d) Air pollution

10. _____ is the introduction into fresh or ocean waters of chemical, physical, or biological material that degrades the quality of the water and affects the organisms living in it.
    a) Rain pollution
    b) Sea pollution
    c) Water pollution
    d) Pollution

Answers

1. B
2. C
3. B
4. A
5. A
6. D
7. D
8. C
9. A
10. B

Week: 8

Topic: Conservation of Natural Resources

Introduction

Conservation is the planning and management of natural resources in order to secure their wise use and continuity of supply while maintaining and enhancing their quality, value and diversity. In other words, conservation is defined as the planned or controlled exploitation or judicious use of natural resources to ensure their continuous availability and to preserve the quality or original nature of the environment.

Natural resources can be:

1. Renewable: These include those that are recoverable. Examples are rain, animals, plants, water, air, food and soil.
2. Non-renewable: These include those materials that are fixed and can easily be depleted. Examples are naturally occurring materials such as minerals, oil, coal, petroleum, bauxite, tin, gas, copper, etc.

Need or Reasons for Conservation

1. To prevent destruction of natural environment or to allow for continued use of natural resources for man's benefits
2. To preserve rare and valuable species of plants and animals for the future generation or to save them from extinction or permanent destruction
3. To preserve naturally beautiful sceneries for their aesthetic values
4. To promote the recycling of some scarce mineral resources, e.g. water
5. To prevent the destruction of natural ecosystem; this will allow the organisms in the ecosystem to survive
6. Forest which provides medicinal materials must be conserved to ensure easy availability and continued existence
7. Natural resources, e.g. wild life, forest, minerals, etc provide basis for research purposes

Natural Resources that Need to be Conserved

Natural resources that need to be conserved include wildlife, water, forest, soil, air and mineral resources

Methods of Conservation of Natural Resources

Water Conservation Methods:

1. By irrigation to reactivate especially areas that lack adequate water
2. Construction of dams and reservoirs to obstruct flood, use available water for irrigation and generation of hydroelectricity.
3. Adequate control and use of ground water
4. Control of water pollution by government enacting laws
5. Water should not be allowed to spill all over the towns. For example is burst of water pipes
6. Research centres should be encouraged on adequate form of recycling water and sewages
7. Tree planting which provides vegetation cover and reduces evaporation and promotes water retention

Soil Conservation Methods:

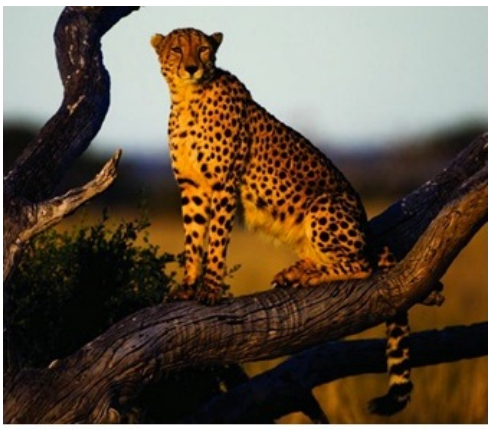
1. The control of erosion using methods ranging from contouring, protective vegetation, terracing, strip cropping, planting of cover crops, preventing over-grazing, the use of mulching and breaking of wind to avoid wind erosion of the soil
2. The soil fertility must be maintained by the following methods: fertilizer application, manure application and the use of cover crops.
3. Trees should be planted in order to check erosion as well as desertification
4. Government should enact laws to control soil erosion

Forest Conservation Methods:

1. Through reforestation, people are made to plant two trees where one is cut
2. Adequate forest management approach should be encouraged
3. Maintenance of forest reserves
4. Having strict laws guiding forest management
5. Consistent soil conservation to encourage adequate forestation

6. Encouraging industries to use other materials aside from wood in furniture making

Wild-life Conservation Methods:



1. Hunting is to be limited
2. There should be strict laws governing wild life
3. More national parks should be established
4. There should be provisions for artificial stocks
5. Game farming must be adopted

Fisheries Conservation Methods:

1. Water pollution must be avoided
2. Fingerlings should be stocked artificially
3. Dams, reservoirs and ponds are constructed
4. Construction of fingerlings multiplication centres

Conversation Agencies

1. National Electric Power Authority (NEPA)
2. River Basin Development Authorities (RBDA)
3. Ministry of Agriculture:
4. Department of fisheries
5. Department of wild life conversation
6. Department of forestry
7. Environmental Sanitation Authority
8. Nigerian Conservation Foundation

Importance of conservation

Forest Conservation:

1. It encourages rainfall
2. Natural species are preserved
3. It checks desert encroachment
4. Timber products are preserved
5. It checks erosion as well as preserves the soil
6. Forests can serve as centres of tourism
7. Forests can also serve as wind break
8. Forests provide medicinal herbs
9. Forests provide employment for some people, e.g. forest guards, lumbermen and hunters

Wild-life Conservation:

1. It is a source of protein
2. It provides raw materials for industries e.g. hides, bones and skins
3. Natural species are stopped from going into extinction
4. Tourism and recreation are encouraged

5. It generates revenue for government
6. It provides research work for scientists
7. It can generate employment for some people

Water Conservation:

1. It provides food and protein
2. It provides water for agriculture and irrigation
3. Water is made available for domestic use
4. It provides means of transportation
5. A source of generating electricity. It is used for Hydro-Electric Power (H.E.P) generation which provides electricity, e.g. Kainji dam
6. Provides recreation e.g. games like swimming

Mineral Resources Conservation

1. Energy is made available
2. Raw materials are made available for industries
3. Foreign exchange reserve is generated
4. It is a source of spice e.g. common salt
5. Air is the habitat of most organisms, e.g. birds, insects, etc.

Soil Conservation:

1. It maintains its fertility
2. It provides raw materials for industries e.g. limestone, clay, etc.
3. Provides nutrient to plants
4. It harbours organisms
5. It is a base for plants' growth

Problems encountered in conservation

1. Poor public education and management
2. Subsistence farming methods e.g. bush burning

3. Inadequate finance
4. Overgrazing constant cropping and fishing
5. Short supply of land

Some game reserves in Nigeria include:

1. Yankari game reserve in Bauchi State
2. Borgu game reserve in Niger State
3. Shasha river forest in Ogun State
4. Olomu forest reserve in Kwara State
5. Mamu river forest reserve in Anambra State
6. Zamfara forest reserve in Zamfara State

ASSESSMENT

1. What is conservation?
2. List 5 problems encountered in conservation
3. What are the importance of conservation?
4. List 4 conservation agencies
5. What are the reasons for conservation?

Week: 9 & 10

Topic: Reproduction

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

Sexual Reproduction

Sexual reproduction involving the fusion of female gamete (ovum) and male gamete (spermatozoon), which forms a zygote that potentially develops into genetically distinct offspring.

The process of sexual reproduction involves two parents. Both parents normally contribute one gamete or sex cell to the process. This process assures that the genetic information given to the offspring will be obtained equally from each parent. The female gamete is called the egg or the ovum and the male gamete is called a sperm. These gametes are formed in specialized reproductive structures called gonads. The sperm is much smaller than the egg, but is capable of moving on its own power using a whip-like tail called a flagellum.

The sperm and egg unite in a process called fertilization. This process forms a single celled structure called a zygote which contains the complete genetic information to develop into a complete new organism having characteristics of both parents.

Types of Sexual Reproduction

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

Conjugation: This is a simple type sexual reproduction which occurs in some lower organisms such as Mucor, Rhizopus, Paramecium and Spirogyra. Conjugation is the process by which nuclear materials is passed from one cell to another.

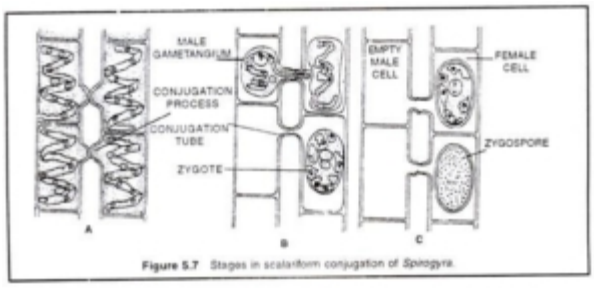


Figure 5.7 Stages in scalariform conjugation of *Spirogyra*.

CONJUGATION IN SPIROGYRA

1. Fusion of Gametes: Fusion of gametes is the union of the haploid male and female gametes to produce diploid organisms called zygote. It usually entails processes such as meiosis and fertilization. Meiosis is an important process to generate gametes that are haploid and genetically different so that during fertilization, the newly formed zygote will contain the original number of chromosomes but with a genome that is different from either parent. Examples are found in higher plants and animals.

Types of Fertilization: There are two mechanisms by which fertilization can take place.

- **The first is external (the eggs are fertilized outside of the body).**
- **The second is internal (the eggs are fertilized within the female reproductive tract).**

MEIOSIS

Meiosis is a two successive cell division with only one duplication of chromosome. Four daughter cells are produced in meiosis. Meiosis takes place in reproductive cells i.e. ovules and pollen grains in plants, ovaries and testes in animals. In animals, meiosis occurs in the formation of gametes (sex cells such as eggs and spermatozoa). The process of gametes formation is called gametogenesis. The process involved in the production of spermatozoa by testes is called spermatogenesis while that of eggs or ova production by the ovaries is called oogenesis.

Stages of Meiosis

Interphase: This is the resting stage of the cell division. At this stage, the chromosomes are not seen.

Meiosis consists of two successive divisions:

1st meiotic division – This is when the parent cell splits into two. It is divided into four stages:

Prophase I

Just like in mitosis, during prophase, DNA condensation occurs, the nuclear envelope and nucleoli disappear, and the spindle starts to form.

As DNA condensation proceeds and the chromosomes first become visible, they are visible as **tetrads**. So, tetrads become visible during prophase.

Metaphase I

Tetrads line up at the equator. The spindle has completely formed. It is during prophase I and metaphase I that **genetic recombination** is occurring.

Anaphase I

Tetrads pull apart and chromosomes with two chromatids move toward the poles.

Telophase I

Chromosomes with two chromatids decondense and a nuclear envelope reforms around them. Each nucleus is now haploid.

2nd meiotic division – The two daughter cells then divide again giving a total of four daughter cells. It is made of four stages:

Prophase II

Chromosomes with two chromatids become visible as they condense (and the nuclear envelope and nucleoli disappear, and the spindle is forming).

Metaphase II

Chromosomes with two chromatids line up at the equator. The spindle is fully formed.

Anaphase II

Chromosomes split, so that a chromosome with only one chromatid heads toward each pole.

Telophase II

Chromosomes with only one chromatid decondense and get surrounded by new nuclear envelopes. The four daughter cells are now all haploid and have the right amount of DNA. They are ready to develop into sperm or eggs now.

Stages of Meiosis

Differences between Sexual and Asexual Reproduction

	Sexual Reproduction	**Asexual Reproduction**
1.	Gametes are formed.	No gametes are formed.
2.	It involves the male and female gametes.	No fusion of gametes.
3.	Zygote is formed.	Zygote is not formed.
4.	Often, two parents are needed.	Only one parent is required.
5.	Offspring show new variation.	Offspring are identical.

Structure and Function of the Male and Female Gametes

The reproductive sex cells are also known as gametes. The formation of gametes called gametogenesis takes place in the gonads (Testes and Ovaries)

Male Gametes or Sex Cells called sperms are produced in the testes by a process called spermatogenesis. The gamete is unicellular in nature. The sperm consists of a head which contains the nucleus, a middle piece and a whip-like tail or flagellum.

Parts and function of sperm cell

1. Acrosome: It is located at the posterior end of the head which contain lytic enzymes used to dissolve the egg membrane and enhances the penetration of the egg during fertilization.
2. Middle piece: It contains numerous mitochondria which generate the energy used by the sperm to swim towards the egg.
3. Nucleus: It is found in the head of the sperm cell and contains the genetic materials which fuse with the nucleus of the egg or ovum.
4. Long whip-like tail or flagellum: It helps to move the sperm cell.

Female Sex Cells or Gametes: Also called the eggs or ova, are produced in the ovaries by a process called oogenesis. The human female gametes are larger than the sperm. It consists of the cytoplasm, a nucleus in the centre, granules and yolk droplet. The yolk provides a source of nourishment for the embryo, especially at the early stages of development. The nuclei of the sperm and ovum contain chromosomes (thread-like materials) which carries the genes. The genes are the transmittable character from parents to offspring.

EXCRETION

Excretion is defined as the process by which organisms get rid of waste products during its metabolism. The reason for excretion by all living things is to get rid of metabolic wastes which are poisonous or toxic to the body system when they are not removed. Different organisms use different means of removing waste products from their body systems. The table below shows the excretory organs/ organelles and waste products of some organisms.

Practice Questions

1. _____ is defined as the process by which organisms get rid of waste products during its metabolism.
   a) Excretion
   d) Egestion

c) Ingestion
d) Digestion

2. _____ is defined as the ability of living organisms to give rise to new individuals of the same species
   a) Production
   b) Sexual reproduction
   c) Reproduction
   d) Asexual reproduction

3. _____ is the process by which nuclear materials is passed from one cell to another.
   a) Conjugation
   b) Sexual reproduction
   c) Asexual reproduction
   d) Bisexual reproduction

4. Acrosome, middle piece and nucleus are all part of a _____
   a) animal cell
   b) plant cell
   c) sperm cell
   d) uterus

5. Male Gametes or Sex Cells called sperms are produced in the testes by a process called _____
   a) spermatoexodus
   b) spermatogenesis
   c) cytokinesis
   d) ovaries

6. The reproductive sex cells are also known as
   a) gonads
   b) gametes
   c) zygotes
   d) foetus

7. _____ is not a stage of meiosis
   a) anaphase
   b) interphase
   c) metaphase
   d) dataphase

8. There are two types of fertilization and these are _____
   a) external and internal
   b) inside and outside

c) sexual and asexual
d) single and double

9. _____ is located at the posterior end of the head which contain lytic enzymes used to dissolve the egg membrane and enhances the penetration of the egg during fertilization.
10. _____ is the resting stage of the cell division.

Answers

1. A
2. C
3. A
4. C
5. B
6. B
7. D
8. A
9. Acrosome
10. Interphase

S.S.S 1

BIOLOGY

THIRD TERM

TABLE OF CONTENT

Week: 1

Topic: Micro-Organisms Around Us

Introduction

Micro-organisms make up a large part of the planet's living material and play a major role in maintaining the Earth's ecosystem.

Micro-organisms or microbes are microscopic organisms that exist as unicellular, multicellular, or cell clusters. Micro-organisms are widespread in nature and are beneficial to life, but some can cause serious harm.

Micro-organisms found in Air and Water

Air: The air harbour micro-organisms like fungi (Rhizopus, Yeast, Mucor, Aspergillus and Penicillium spores); bacteria like Mycobacterium spp, micrococci, sarcina and finally viruses like Rhino virus (which causes common cold), pox virus, measles virus, etc.

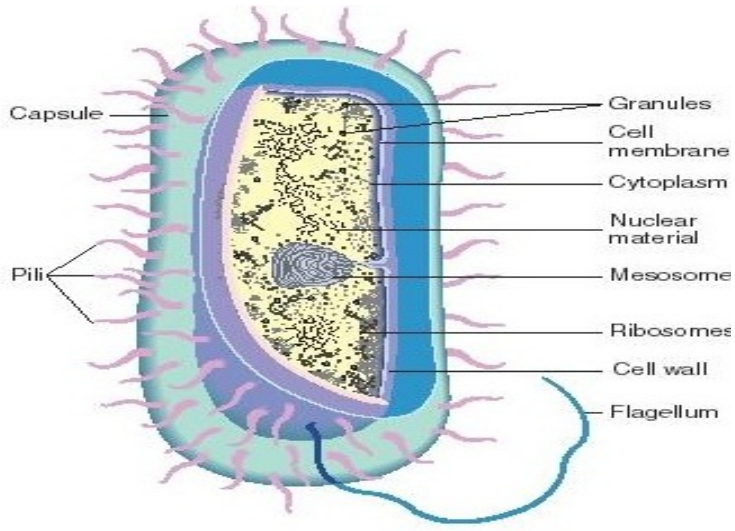
Water: Bacteria like Salmonella, Mycobacteria, Escherichia Proteus, and Pseudomonas are known to live in water. Others are phytoplanktons, blue-green algae, fungi like Aspergillus, Rhizopus, moulds, oscillatory, spirogyra and ulothrix. The protozoa include Amoeba and Paramecium

Microorganisms are divided into five types: bacteria, protozoa, algae, fungi, and viruses. Each type has a characteristic cellular composition, morphology, mean of locomotion, and reproduction.

Microorganisms are beneficial in producing oxygen, decomposing organic material, providing nutrients for plants, and maintaining human health, but some can be pathogenic and cause diseases in plants and humans.

Bacteria

All bacteria are unicellular prokaryotes, meaning they do not have a defined cellular nucleus. Their genetic information is in their nucleoid, – single, circular tightly- packed DNA molecule.



According to their shape, all bacteria are divided into four groups:

- spirilla (with a spiral body shape);
- cocci (with a spherical body shape);
- bacillus (with a rod (stick) shaped body)
- vibrio (curved shape).

Some types of bacteria live on their own and others form colonies. Some bacteria are quite mobile and others 'stay put' for their whole life. Bacteria move using their cytoplasmic tail – flagella, or by secreting slimy substances that allow them to slide along surfaces.

The cell walls of most bacteria contain a polysaccharide called peptidoglycan. Differences in their cell wall structure is a major feature used in classifying these organisms. The staining abilities of bacteria are also based on their cell wall structure. According to the way they stain, bacteria can be classified as either Gram – positive or Gram – negative.

Based on their response to gaseous oxygen, all bacteria can be divided into the following groups:

- Aerobic – living in the presence of oxygen;
- Anaerobic – living without oxygen;
- Facultative anaerobes – can live in both environments.

According to the way they obtain energy, bacteria are classified as heterotrophs or autotrophs. Autotrophs make their own food by using the energy of sunlight or chemical reactions, in which case they are called chemoautotrophs. Heterotrophs obtain their energy by consuming other organisms. Bacteria that use decaying life forms as a source of energy are called saprophytes.

Protozoa

Protozoa is a subkingdom of unicellular, mostly aerobic, eukaryotic organisms. Sometimes they are also called protists. They are neither plants nor animals. They make up the largest group of organisms in the world in terms of numbers and biomass. Protozoa have been traditionally divided based on their mode of locomotion:

- Flagellates produce their own food and use their whip-like structure to propel forward, e.g. Euglena
- Ciliates have tiny hair that beat to produce movement, e.g. Paramecium
- Amoeboids have false feet or pseudopodia used for feeding and locomotion, e.g. Amoeba
- Sporozoans are non-motile e.g. Plasmodium

They also have different means of nutrition, which groups them as autotrophs or heterotrophs.

Some protozoans, like Euglena, have chloroplasts like plants and make their own food, which makes them autotrophs. Others, like amoeba, are heterotrophs. Protozoans can be free-living or parasitic, unicellular or colonial. Some parasitic protozoans can cause diseases in humans.

Because heterotrophic protozans consume bacteria, they play a very important role in controlling biomass. Biomass is the total weight of living organimsms in a given area.

Fungi

Fungi are saprophytic (feed on decaying organic matter) and parasitic organisms. Fungi include moulds, rusts, mildews, smuts, mushrooms and yeast. By breaking down dead organic material, they continue the cycle of nutrients through ecosystems. Some plants have a symbiotic relationship with fungi. Symbiosis is a mutually beneficial co-existence of dissimilar organisms. For example, there are mushrooms that live near tree roots and supply them with essential nutrients.

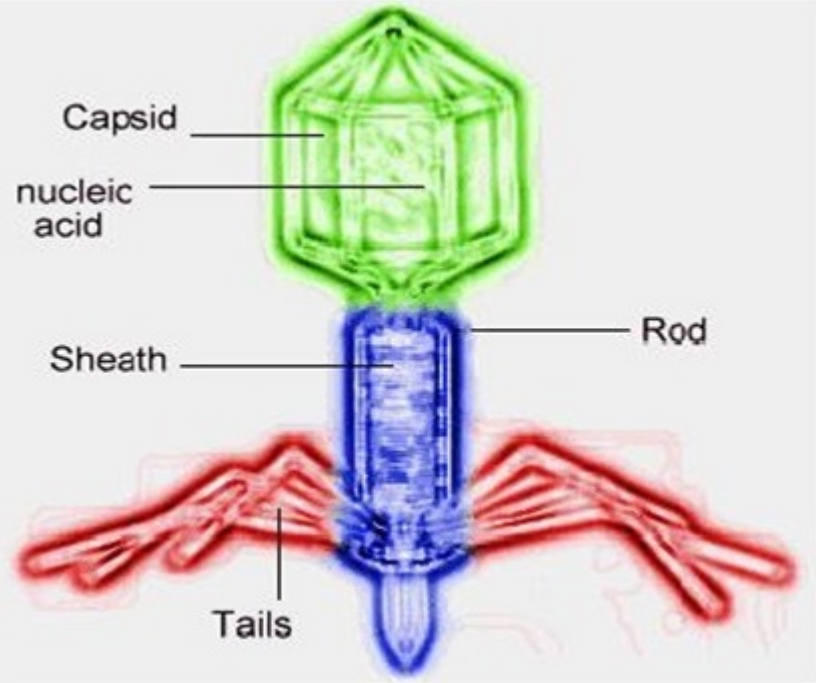
All fungi are made of eukaryotic cells. Fungi can be unicellular (single-celled) or multicellular (with cells arranged in filaments called hyphae) and their cell wall is composed of chitin. Yeasts are unicellular fungi. Masses of hyphae are called mycelia. Mycelia can be well structured, as in a mushroom, or tangled and unstructured, as in moulds. Some fungi can exist in the form of yeast and hyphae. These types of fungi are called dimorphic.

All fungi are heterotrophic, meaning that they obtain their energy and carbon compounds from organic nutrients. None of the fungi are photosynthetic. Some fungi are parasites and can cause diseases in humans, animals and plants. . Fungi reproduce by releasing spores. Some fungi are used in the food industry and pharmaceutics (antibiotic production).

Viruses

Although viruses are not considered living organisms, they are sometimes classified as microorganisms. Viruses are much smaller than common microbes. They are made of a DNA molecule covered with a protein shell called a capsid. Retroviruses are made of an RNA molecule covered with a capsid. Capsids can take many shapes. Viruses cannot reproduce outside the host cell, but they cannot be called parasites either. Scientists still argue today about whether viruses are true living forms because they are not cells and they cannot metabolise on their own.

Viruses can infest prokaryotic and eukaryotic cells, often causing diseases in organisms. A virus that infects bacteria is known as a bacteriophage.



Algae

Algae, also called cyanobacteria or blue-green algae, are unicellular or multicellular eukaryotes that obtain nourishment by photosynthesis. They live in water, damp soil, and rocks and produce oxygen and carbohydrates used by other organisms. It is believed that cyanobacteria are the origins of green land plants.

Test Questions

1. Microorganisms are divided into _____ types
   a) 2

b) 5
c) 3
d) 4

2. They are made of a DNA molecule covered with a protein shell called a ____
   a) capsid
   b) capsule
   c) cocci
   d) spirilla

3. Fungi are _____ and parasitic organisms
   a) saprophytic
   b) symbiotic
   c) holophytic
   d) holozoic

4. All these are examples of protozoa except ___
   a) Flagellates
   b) Ciliates have tiny hair that beat to produce movement, e.g. Paramecium
   c) Amoeboids
   d) Virus

5. All bacteria are _____ prokaryotes
   a) multicellular
   b) bicellular
   c) unicellular
   d) a & c

6. One of the following is not a group of bacteria
   a) Aerobic
   b) Propylactic
   c) Anaerobic
   d) Facultative anaerobes

7. One of the following is not a shape category of bacteria
   a) spirilla
   b) cocci
   c) vibralto
   d) bacillus

8. All fungi are heterotrophic. True or False

9. All fungi are photosynthetic. True or False

10. Protozoans can be free-living or parasitic, unicellular or _____
    a) colonial

b) colony
c) free
d) grouped

Answers

1. B
2. A
3. A
4. D
5. C
6. B
7. C
8. True
9. False
10. A

Week: 2

Topic: Concept Of Culturing

Culturing simply involves the techniques of growing micro-organisms in special media in the laboratory. It involves the making of sterile medium, inoculating, incubating and examining micro-organisms. By this means, micro-organism characteristics such as colour, pattern of growth and appearance can be seen. Culture of micro-organisms can be grown from water, air, animals, plants and various parts of human body.

Preparation of Culture Solution

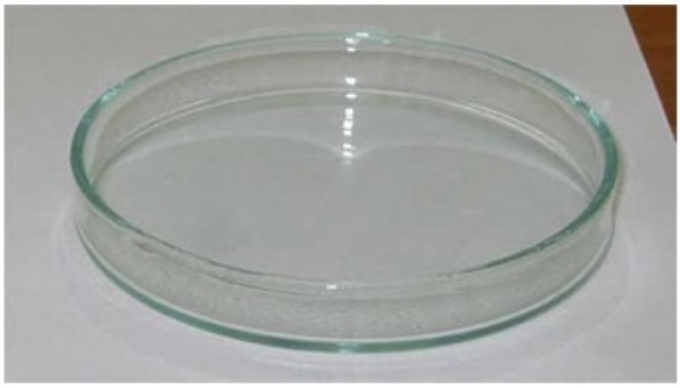
- The culture solution called Agar is prepared under sterile conditions
- Then boil and pour it into sterile petri-dish
- Allow it to cool and set in the petri-dish
- A heat sterilizer may be used to kill micro-organisms in the petri-dish
- The material is then introduced into the agar medium and covered immediately
- Place the petri-dish in warm but dark compartment or an incubator
- Observe and record what you have seen for 2-3 days

Instruments Required for the Preparation of Culture Solution

Major instruments required for the preparation of culture solution are:

- Microscope

- Petri-dishes



- Test tubes or test tube holder

- Hand lens

- Slides
- Cover slips

- Inoculating needles or loops
- Inoculating chamber if available

Precautions to be Taken During Preparation of Culture Solution

1. Wash hands with soap before and after the preparation of agar solution
2. Open petri-dish only slightly and cover at once
3. Close petri-dish firmly with adhesive tape
4. Sick person should not be permitted to take part in culturing experiments
5. Avoid talking, coughing, sneezing and touching of infected jelly
6. Unused agar should be sterilized by washing with antiseptic soap and disinfectant, e.g. 40% folmadehyde. Heat can also be used to sterilize
7. All instruments should also be sterilized before the beginning of culture solution preparation.

Identification of Micro-organisms

Micro-organisms can be identified in the air, pond water, river and stream by preparing a culture medium. The following procedures should be followed:

1. Five petri-dishes with culture medium labelled K, L, M, N and O respectively
2. Expose petri-dish K to air for about 10-15 minutes and then cover it.
3. Put in petri-dish L a few drops of pond water and cover it
4. Put in petri-dish M a few drops of river water and cover it
5. Put in petri-dish N a few drops of stream water and cover it
6. Allow petri-dish O to serve as control, i.e. do not introduce anything into it
7. Leave all the petri-dishes in the laboratory for 3-4 days
8. Observe all the petri-dishes for any development and note any difference in each of the petri-dishes
9. Record the characteristics (colour, pattern of growth, appearance) of colonies of micro-organisms in each petri-dish

Practice Questions

1. All these instruments are used for culturing except _____
   a) slides
   b) cover slips
   c) needles
   d) innoculating chamber

2. _____ simply involves the techniques of growing micro-organisms in special media in the laboratory.
   a) Culturing
   b) Culture
   c) Innocluation
   d) Separation

3. One of the following is not part of a culturing method
   a) sterile medium
   b) inoculation
   c) incubation
   d) ejaculation

4. _____ is the name of the white transparent plate used to culture medium
   a) Petri dish
   b) Metric dish
   c) White dish
   d) Experimental dish

5. Micro-organisms can be identified in the air, pond water, river and stream by preparing a _____ medium
   a) cultural
   b) innoculating
   c) culture
   d) sterile

Answers

1. C
2. A
3. D
4. A

5. C

Week 3

Topic: Micro-Organisms in Action

Introduction

Growth of micro-organisms, like all living things, do increase in size and multiply in number of cells using either the culture medium provided or any suitable surface such as moist bread as source of food. Micro-organisms can also increase in mass. Such an increase in size, mass or number of cells is regarded as growth in micro-organisms.

If environmental conditions of growth such as food, adequate temperature and humidity are favourable, such an increase in mass, size and number of cells of the colony is an index of growth of micro-organisms.

Ways of Measuring Growth in Micro-organisms

There are two major ways of measuring growth in micro-organisms. These are:

First method: A bacterial sample is inoculated into a nutrient agar (a clear liquid culture medium). As the bacterial population increases, the clear liquid medium becomes cloudy and turbid. Progressive increase in turbidity indicates a related increase in the number of bacterial cells. This property is used to measure bacterial growth.

In the laboratory, turbidity can be measured with a spectrophotometer. This instrument measures the amount of light that can pass through a liquid medium.

Second method: In this method, small samples of bacteria are taken from the nutrient agar at regular interval of time. Each sample is diluted several times. Each diluted sample is innoculated on to a nutrient agar medium in a petri-dish and incubated. The number of colonies formed in each petri-dish is counted. As each colony is formed by the multiplication of a single bacterium, the number of colonies indicate the number of living bacterial cells in the diluted sample. From this, the actual number of bacteria in the original sample can be calculated.

Beneficial Effects of Micro-Organisms

Some micro-organisms especially bacteria and fungi are beneficial to man in three major ways: in nature, medicine and in industries

In Nature

Compost formation: Micro-organisms especially bacteria aid compost formation through the decay of dead organisms and humus

Nitrogen fixation: Certain bacteria (Rhizobium leguminosarium) aid nitrogen fixation into plants through the root nodules of leguminous plants.

Maintenance of soil fertility: Most saprophytic bacteria, due to their decomposition activities, release nutrients into the soil which aid its fertility through nitrogen cycle

Digestion of cellulose: Some bacteria living in the rumen of ruminant animals like cattle, sheep and goat help such animals to digest cellulose in the rumen

Decomposition: Micro-organisms, especially saprophytic bacteria also aid the decomposition of dead of dead plants and animals thereby releasing nutrients to the soil

Silage making: Some bacteria are also useful in silage making which involves the preservation of pasture crops for future use.

Sewage treatment: Bacteria are also involved in the decomposition of sewage into harmless substance

In Medicine

Manufacturing of drugs/ vaccines: Micro-organisms are used in medicine for the manufacturing of drugs, vaccines and antibiotic which help in curing many human diseases, e.g. penicillin (an antibiotic) is obtained from Penicilium notatun (a fungus) and streptomycin, another antibiotic, is obtained from a bacterium called Streptomyces griseus

Sources of vitamin B: Yeast and certain bacteria are rich sources of vitamin B complex.

Sources of enzymes: Certain yeast and bacteria are also rich sources of enzymes like amylase and invertase

In Industries

For baking: Yeast (fungus) is useful in baking industries as it causes dough to rise in bread and other allied food processing

Preparation of alcoholic drinks: Yeast is also useful in brewing industries as it is used for the fermentation of sugar to produce alcohol

Making of cheese / yoghurt: Certain bacteria are used in food processing such as cheese, vinegar and yoghurt

Retting of jute: Certain bacterial action are used in the retting of jute to obtain sack fibres from flax plants

Curing of tobacco: Bacteria are useful in the curing or ripening of tobacco leaves

Tanning of hides and skins: The action of bacteria is useful in the conversion of hides and skin to leather during the tanning process

Harmful Effects of Some Micro-Organisms

Cause of disease: Micro-organisms are responsible for various diseases in plants and animals

Spoilage of food: micro-organisms are generally known to cause food spoilage

Deterioration of materials: Micro-organisms are also responsible for the deterioration of materials like wood, cotton, paper, leather, etc.

Causes of death: Micro-organisms can also cause the death of plants and animals

Types of Disease-Causing Micro-organisms

Organisms that cause disease are called pathogens. They are also parasites, living off their host, which does not benefit as a result.

There are 4 types of microbes (micro-organisms) that cause disease;

- Viruses
- Bacteria
- Fungi

Protozoa (also known as protoctista).

Virus: Viruses are inactive when outside of a living cell, but once their nucleic acid is inside they take over the cell's activities. Usually they make many copies of themselves inside the cell, then break out of the cell and infect others. Viruses cannot be killed by antibiotics such as penicillin.

Examples of diseases caused by viruses: flu (influenza), common cold, measles, mumps, german measles (Rubella), smallpox, cowpox, chicken pox, HIV (can lead to AIDS), rabies

Bacteria: Not all bacteria cause disease; some are very useful "in nature". When bacteria infect the body, they can reproduce quite fast. Often they produce chemicals called toxins which have the actual effect which causes an illness. Bacteria can usually be killed by antibiotics such as penicillin.

Examples of diseases caused by bacteria: cholera, tuberculosis (TB), septicaemia ("blood poisoning"), anthrax.

Fungi: Not all fungi cause disease; some are very useful "in nature".

Examples of diseases caused by fungi: Athlete's foot (not only caught by athletes, or confined to the foot!), ringworm (not a worm), thrush (not a bird)

Protozoa: Are generally single celled organisms with true nuclei and a cell membrane, so they are quite like our body cells.

Examples of diseases caused by protozoa/protoctista: Malaria, sleeping sickness, dysentery

Spread of Disease-Causing Micro-organisms

Micro-organisms can spread or transmit diseases through the following ways:

- Air, i.e. air-borne pathogens
- Water, I.e. water-borne pathogens
- Food, i.e. food-borne pathogens
- Animal vectors or carriers

Personal or direct skin contact

Certain diseases known as contagious diseases can be controlled by direct contact with an infected person, e.g. leprosy, measles, tuberculosis and sexually transmitted disease (STD) such as gonorrhea, syphilis and AIDS.

<TABLE>

Names of some diseases, causative micro-organisms, mode of transmission, host and major symptoms are stated in the table below

Food and Water-Borne Diseases

Diseases	Causative organisms	Mode of transmission	Host	Major symptoms

Infective headache and jaundice	Virus hepatitis	Water	Man (female and male of all ages)	Swollen liver, fever,
Typhoid	Bacteria (Salmonella typhi)	Food and water	Man (female and men of all ages	High temperature with diarrhoea, or constipation
Cholera	Bacterium (Vibro cholera)	Drinking water	Man (female and male of all ages)	Serious diarrhea with vomiting, high temperature and abdominal pain
Polio	myelitis (infant paralysis) Virus	Water	Children	High fever, headache, stiffness of limbs due to nervous disorder that result from attack on muscle nerves
Amoebic dysentery	Protozoan (Entamoeba histolytica)	Food and water	Man	Abdominal pain, heavy vomiting and diarrhoea
Bacillic dysentery	Bacterium (shigella dysenteriae)	Water and food	Man	Fever, abdominal pain and diarrhoea
Food poisoning	Bacteria (Salmonella spp.)	Infected food	Man	Headache, restlessless, abdominal pain and vomiting
Para-typhoid	Bacterium (Salmonella para-typhi)	Water and food	Man	High fever, constipation or diarrhea

Air-Borne Diseases

Diseases	Causative organism	Mode of transmission	Host	Major symptoms
Tuberculosis	Bacterium (Mycobacterium tuberculosis)	Airborne and food	Man and cow	Persistent dry cough and profuse sweating at night, high temperature, loss of weight and blood in sputum
Measles	Virus contact	Air and body	Man and children	High fever, skin rashes, headache, cold, cough and body pain
Pneumonia	Bacteria	Air	Man, pig, birds and cows	High fever, difficult breathing and cough
Meningitis (cerebrospinal fever)	Bacteria (Meningococcus)	Airborne	Children and young adults	High fever, headache, vomiting and stiffness of the neck
Small pox	Virus	Airborne	Man	High fever, skin rashes and small blister
Common cold	Virus	Airborne	Man	High fever, headache and runny nose
Influenza	Virus	Airborne	Man	High fever, headache, body pain and shivering
German measles	Virus	Airborne	Man	Rashes on the face and swollen glands on the neck

Whooping cough	Bacteria	Airborne	Man	of all ages Cold, high fever, cough and vomiting
Chicken pox	Virus	Airborne	Man of all age	Itchy skin rash

Diseases Spread by Vectors

A vector is an animal which transmits a disease-causing organism (pathogen) from the person suffering from the disease to another person. The table below shows the vectors, micro-organisms, and the diseases they transmit.

Disease	Causative organism	Vector/ mode of transmission	Host	Main symptoms
Malaria	Plasmodium spp (protozoan)	Female anopheles mosquito bite	Man	High fever associated with shivering and sweating
Sleeping sickness (Trypanosomiasis)	Trypanosomes (protozoan)	Tse-tse fly bite	Man	Regular and uncontrollable sleepiness, fever and headache, sluggishness and drownsiness
Plague	Bacterium	Rat flea	Man	Shivering, fever, cough and difficult breathing
Typhus fever	Rickettsia	Body louse	Man	High fever, severe pains in the muscle

Dengue fever	Virus	Female Aedes mosquito bite	Man and monkey	High fever, severe pains in the joints, back and head, nausea and vomiting
Yellow fever	Virus	Aedes mosquito bite	Man	High fever, headache and backache, temperature falls and virus enter the liver and kidneys, jaundice develops
River blindness	(Onchocerciasis) Protozoan	Blackfly	Man	Severe headache, high fever and gradual blindnesss

Diseases Spread Through Sexual Contact

Diseases which are transmitted by sexual contact are known as venereal diseases (VD) or sexually transmitted diseases (STD).

Some sexually transmitted diseases, causative organisms, mode of transmission, their hosts and symptoms are outlined in the table below:

Disease	Causative organism	Vector/ mode of transmission	Host	Main symptoms
Gonorrhea	Bacterium (Neisseria gonorrhea)	Sexual intercourse	Man	Inflamed urethra, burning sensation during urination, and a thick, yellowish discharge in male. In female,

				redness around the urinary opening, vaginal discharge or swelling of the vulva. It may cause blindness to babies during pregnancy
Syphilis	Bacterium (Treponema pallidum)	Sexual intercourse	Man	A small painless sore or chancre appears on the penis or vulva. A mild fever, skin rashes, mouth ulcers and aching pains in the lymph node regions. It may lead to abortions, attack the brain and cause blindness, insanity or loss of control of movement
AIDS	Virus (Human Immuno virus (HIV)	Sexual intercourse, blood transfusion, injection needle	Man, Woman	Infected person High fever, loss of weight, chronic diarrhoea, skin rashes, wasting away of muscles and finally death
Staphylococcus	Bacterium	Sexual intercourse	Man	Itching around private parts, burning sensations around waist in male. In females, there are itching around private parts, burning sensation in

				waist and stomach, vaginal discharge, irregular menstruation and inability to get pregnant

Practice Questions

Staphylococcus can be transmitted by one of the following ways _____

a) blood transfusion

b) sexual intercourse

c) mating

d) injection

Microorganisms are harmful but they are also beneficial to man. True or False

The causative organism for syphilis is _____

a) bacterium

b) virus

c) fungi

d) animal

Diseases which are transmitted by sexual contact are known as _____ diseases

a) sexual

b) venereal

c) blood

d) a & b

What is the meaning of AIDS?

a) Acquired Immune Deficient Syndrome

b) Acquire Immunization Deficiencey Syndrome

c) Acquired Immune Deficiency Symptom

d) Acquired Immune Deficiency Syndrome

A _____ is an animal which transmits a disease-causing organism from the person suffering from the disease to another person

a) Scalar

b) Predator

c) Vector

d) Pathogen

_____ is the name of the vector that transmitts Malaria

a) Plasmodium spp

b) Male Aedes Mosquito

c) Female anopheles mosquito

d) Protozoan

Micro-organisms can spread or transmit diseases through the following ways except

a) air

b) water

c) direct contact

d) body louse

All these are airborne diseases except ____

a) measles

b) sleeping sickness

c) tuberculosis

d) pneumonia

All these diseases are transmitted by vectors except ____

a) Syphilis

b) Yellow fever

c) Malaria

d) River blindness

Answers

1. B
2. True
3. A
4. B
5. D
6. C
7. C
8. D
9. B
10. D

Week 4

Topic: Sexually Transmitted Infections (STIs)

Introduction

Sexually transmitted infections (STIs) are infections that are spread primarily through person-to-person sexual contact. There are more than 30 different sexually transmissible bacteria, viruses and parasites.

The most common conditions they cause are gonorrhoea, chlamydial infection, syphilis, trichomoniasis, chancroid, genital herpes, genital warts, human immunodeficiency virus (HIV) infection and hepatitis B infection.

Several, in particular HIV and syphilis, can also be transmitted from mother to child during pregnancy and childbirth, and through blood products and tissue transfer.

What is a sexually transmitted infection (STI)?

It is an infection passed from person to person through intimate sexual contact. STIs are also called sexually transmitted diseases, or STDs.

Major Sources of STI Transmissions

You can get an STI by having intimate sexual contact with someone who already has the infection. You can't tell if a person is infected because many STIs have no symptoms. But STIs can still be passed from person to person even if there are no symptoms. STIs are spread during vaginal, anal, or oral sex or during genital touching. So it's possible to get some STIs without having intercourse. Not all STIs are spread the same way.

Signs and Symptoms of STI

Many STIs have only mild or no symptoms at all. When symptoms do develop, they often are mistaken for something else, such as urinary tract infection or yeast infection. This is why screening for STIs is so important. The STIs listed here are among the most common or harmful to women.

Symptoms of sexually transmitted infections

STI	**Symptoms**
Bacterial vaginosis (BV)	Most women have no symptoms. Women with symptoms may have: • Vaginal itching • Pain when urinating • Discharge with a fishy odour
Chlamydia	Most women have no symptoms. Women with symptoms may have: • Abnormal vaginal discharge • Burning when urinating • Bleeding between periods Infections that are not treated, even if there are no symptoms, can lead to: • Lower abdominal pain • Low back pain • Nausea • Fever • Pain during sex
Genital herpes	Some people may have no symptoms. During an "outbreak," the symptoms are clear: • Small red bumps, blisters, or open sores where the virus entered the body, such as on the penis, vagina, or mouth • Vaginal discharge • Fever • Headache • Muscle aches • Pain when urinating • Itching, burning, or swollen glands in genital area

	• Pain in legs, buttocks, or genital area Symptoms may go away and then come back. Sores heal after 2 to 4 weeks.
Gonorrhea	Symptoms are often mild, but most women have no symptoms. If symptoms are present, they most often appear within 10 days of becoming infected. Symptoms are: • Pain or burning when urinating • Yellowish and sometimes bloody vaginal discharge • Bleeding between periods • Pain during sex • Heavy bleeding during periods Infection that occurs in the throat, eye, or anus also might have symptoms in these parts of the body.
Hepatitis B	Some women have no symptoms. Women with symptoms may have: • Low-grade fever • Headache and muscle aches • Tiredness • Loss of appetite • Upset stomach or vomiting • Diarrhea • Dark-colored urine and pale bowel movements • Stomach pain Skin and whites of eyes turning yellow
HIV/AIDS	Some women may have no symptoms for 10 years or more. About half of people with HIV get flu-like symptoms about 3 to 6 weeks after becoming infected. Symptoms people can have for months or even years before the onset of AIDS include: • Fevers and night sweats

	• Feeling very tired • Quick weight loss • Headache • Enlarged lymph nodes • Diarrhea, vomiting, and upset stomach • Mouth, genital, or anal sores • Dry cough • Rash or flaky skin • Short-term memory loss Women also might have these signs of HIV: • Vaginal yeast infections and other vaginal infections, including STIs • Pelvic inflammatory disease (PID) that does not get better with treatment • Menstrual cycle changes
Human papillomavirus (HPV)	Some women have no symptoms. Women with symptoms may have: • Visible warts in the genital area, including the thighs. Warts can be raised or flat, alone or in groups, small or large, and sometimes they are cauliflower-shaped. • Growths on the cervix and vagina that are often invisible.
Pubic lice (sometimes called "crabs")	Symptoms include: • Itching in the genital area • Finding lice or lice eggs
Syphilis	Syphilis progresses in stages. Symptoms of the primary stage are: • A single, painless sore appearing 10 to 90 days after infection. It can appear in the genital area, mouth, or other parts of the body. The sore goes away on its own.

	If the infection is not treated, it moves to the secondary stage. This stage starts 3 to 6 weeks after the sore appears. Symptoms of the secondary stage are: • Skin rash with rough, red or reddish-brown spots on the hands and feet that usually does not itch and clears on its own • Fever • Sore throat and swollen glands • Patchy hair loss • Headaches and muscle aches • Weight loss • Tiredness In the latent stage, symptoms go away, but can come back. Without treatment, the infection may or may not move to the late stage. In the late stage, symptoms are related to damage to internal organs, such as the brain, nerves, eyes, heart, blood vessels, liver, bones, and joints. Some people may die.
Trichomoniasis (sometimes called "trich")	Many women do not have symptoms. Symptoms usually appear 5 to 28 days after exposure and can include: • Yellow, green, or gray vaginal discharge (often foamy) with a strong odor • Discomfort during sex and when urinating • Itching or discomfort in the genital area • Lower abdominal pain (rarely)

Testing for STIs

There is no one test for all STIs. Ask your doctor about getting tested for STIs. She or he can tell you what test(s) you might need and how it is done. Testing for STIs is also called STI screening. Testing (or screening) for STIs can involve:

- Pelvic and physical exam — Your doctor can look for signs of infection, such as warts, rashes, discharge.
- Blood sample
- Urine sample
- Fluid or tissue sample — A swab is used to collect a sample that can be looked at under a microscope or sent to a lab for testing.

Treatment of STIs

The treatment depends on the type of STI. For some STIs, treatment may involve taking medicine or getting a shot. For other STIs that can't be cured, like herpes, treatment can help to relieve the symptoms.

Prevention and control of STI

You can lower your risk of getting an STI with the following steps. The steps work best when used together. No single strategy can protect you from every single type of STI.

- Don't have sex: The surest way to keep from getting any STI is to practice abstinence. This means not having vaginal, oral, or anal sex. Keep in mind that some STIs, like genital herpes, can be spread without having intercourse.
- Be faithful: Having a sexual relationship with one partner who has been tested for STIs and is not infected is another way to lower your risk of getting infected. Be faithful to each other. This means you only have sex with each other and no one else.
- Use condoms correctly every time you have sex: Use condoms for all types of sexual contact, even if intercourse does not take place. Use condoms from the very start to the very end of each sex act, and with every sex partner. A male latex condom offers the best protection.
- Know that some methods of birth control, like birth control pills, shots, implants, or diaphragms, will not protect you from STIs. If you use one of these methods, be sure to also use a condom correctly every time you have sex.
- Talk with your sex partner(s) about STIs and using condoms before having sex: It's up to you to set the ground rules and to make sure you are protected.
- Talk frankly with your doctor and your sex partner(s) about any STIs you or your partner has or has had. Talk about symptoms, such as sores or discharge. Try not to be embarrassed. Your doctor is there to help you with any and all health problems. Also, being open with your doctor and partner will help you protect your health and the health of others.

- Have a yearly pelvic exam. Ask your doctor if you should be tested for STIs and how often you should be retested. Testing for many STIs is simple and often can be done during your checkup. The sooner an STI is found, the easier it is to treat.
- Avoid using drugs or drinking too much alcohol. These activities may lead to risky sexual behavior, such as not wearing a condom.

HIV and AIDS

The Human Immunodeficiency Virus (HIV) is a retrovirus that infects cells of the immune system, destroying or impairing their function. In other words, HIV is a virus that weakens the body's immune system, which is the body's defense system. As the infection progresses, the immune system becomes weaker, and the person becomes more susceptible to infections.

The most advanced stage of HIV infection is acquired immunodeficiency syndrome (AIDS). It can take 10–15 years for an HIV-infected person to develop AIDS; however, antiretroviral drugs can slow down the process even further.

HIV is transmitted through unprotected sexual intercourse (anal or vaginal), transfusion of contaminated blood, sharing of contaminated needles, and between a mother and her infant during pregnancy, childbirth and breastfeeding.

Modes of HIV Transmissions

HIV is spread through some of the body's fluids. HIV is in:
• Blood
• Semen
• Vaginal fluids
• Breast milk
• Some body fluids that may be handled by health care workers (fluids surrounding the brain and spinal cord, bone joints, and around an unborn baby)

HIV may be passed from one person to another by:

1. More common

- Having sex (vaginal, anal, or oral) with a person who has HIV
- Sharing needles with someone who has HIV, such as when using drugs
- Pregnancy, labour, birth, or breastfeeding if a mother has HIV

2. Less common

- Blood transfusion from an HIV positive blood donor, which is very unlikely today because blood banks test donated blood for HIV

- Eating food that has been pre-chewed by an HIV-infected person. The blood in a caregiver's mouth can mix with food while chewing. This is rare and has only been noted among infants whose HIV positive caregiver gave them pre-chewed food.
- Using a dirty tattooing needle (if it was used before on someone with HIV). Make sure the needle is new.
- Sharing a toothbrush or razor with someone who has HIV

HIV is not spread through:

• Kissing (there is a small chance of getting HIV from open-mouthed or "French" kissing except there's contact with blood)
• Touching, hugging, or handshakes
• Sharing food or drinks
• Sharing food utensils, towels and bedding, telephones, or toilet seats
• Donating blood
• Working with or being around someone with HIV
• Biting insects, such as mosquitoes
• Swimming pools or drinking fountains
• Playing sports

The Science behind HIV

HIV attacks and destroys the immune system's infection-fighting cells, called CD4 cells. They also are called CD4 positive T cells. HIV gets into these cells, makes copies of itself, and kills the healthy cells. As a person loses CD4 cells, the immune system weakens, making it harder for the body to fight infections and cancer. There are many different strains (types) of HIV. Most people have the HIV-1 strain. But, a person can be infected with more than one strain at a time.

HIV turns to AIDS when the immune system gets very weak. One way to know if a person has AIDS is if her CD4 cell count (the number of CD4 cells in a sample of blood) is very low (less than 200). Another way is if she has certain infections or cancers. Moving from HIV to AIDS is different for everyone. Some people live for 10 years or more with HIV without developing AIDS. Others get AIDS faster.

Signs and Symptoms of HIV/AIDS

Many people have no symptoms when they first get HIV. Some have no symptoms for years. It varies from person to person. But some people get a flu-like illness within a month or two after first getting HIV. It's important to remember that HIV is active inside your body, even when you don't have symptoms. As HIV spreads in your body, you'll start to feel sick. For many people, the first symptom they notice is large lymph nodes (swollen glands) that last for more than three months. Symptoms of HIV include:

• Being very tired (fatigue)
• Quick weight loss
• Fevers and night sweats
• Headache
• Diarrhea, vomiting, and nausea
• Mouth, genital, or anal sores
• Dry cough
• Rash or flaky skin
• Short-term memory loss

Test for HIV

You cannot rely on symptoms to know whether you have HIV. If you have symptoms, they may be caused by something else. And many people infected with HIV have no symptoms for many years. The only way to know whether you have HIV is to get a test.

Prevention of Transmission of HIV

HIV prevention refers to practices done to prevent the spread of HIV/AIDS. HIV prevention practices may be done by individuals to protect their own health and the health of those in their community, or may be instituted by governments or other organizations as public health policies.

Anybody can get HIV, but you can take steps to protect yourself from HIV infection.

• **Don't have sex:** Abstinence (not having sex of any kind) is the surest way to avoid HIV infection through sexual contact.
• **If you must have sex, get tested and know your partner's HIV status:** Talk to your partner about HIV testing and get tested before you have sex.
• **Be faithful to your partner:** If you and your partner are both HIV negative and have sex only with each other, you are not at risk of HIV infection through sexual contact.
• **Use condoms:** Use a condom every time you have vaginal, anal, or oral sex.
• **Limit your number of sexual partners:** If you have more than one sexual partner, get tested for HIV regularly. Get tested and treated for sexually transmitted infections (STIs), and insist that your partners do, too. Having an STI can increase your risk of becoming infected with HIV.
• **Don't inject drugs:** But if you do, use only clean needles and equipment and don't share your equipment with others.

Some HIV medicines used to prevent HIV infection

In some situations HIV medicines are used to reduce the risk of HIV infection

Pre-exposure prophylaxis (PrEP) – PrEP is an HIV prevention method that involves taking an HIV medicine every day. PrEP is intended for people who don't have HIV but who are at high risk of sexually transmitted HIV infection. PrEP should always be combined with other prevention methods, including condom use.

Post-exposure prophylaxis (PEP) – PEP involves taking HIV medicines as soon as possible after exposure to HIV to reduce the risk of HIV infection. For example, a health care worker exposed to HIV in the workplace may require PEP.

Prevention of mother-to-child transmission of HIV – HIV-infected women take HIV medicines during pregnancy and childbirth to reduce the risk of mother-to-child transmission of HIV. To further reduce the risk, their newborn babies also receive HIV medicine for six weeks after birth. In the United States, women with HIV are counseled not to breastfeed their babies to prevent mother-to-child transmission of HIV in breast milk.

Management of HIV (Use of Anti-Retro Viral Drugs)

Once HIV infection is diagnosed, a person has a life-long condition which will go through several stages and has many consequences. The disease needs to be managed by people with HIV themselves as well as their healthcare providers.

An overview of the needs of a person with HIV infection (not necessarily in order of priority) is as follows:

1. Education / information – learning how to best take care of yourself, staying informed about new treatments or approaches
2. Maintaining general health – self care, nutrition
3. Financial planning – medical aid, future provision for self and dependents
4. Monitoring HIV disease – regular medical check-ups, monitoring tests
5. Preventing opportunistic disease – avoiding exposure, alertness to early signs of disease, prophylactic medication
6. Psychological health – informing others, dealing with stigma, spiritual support, managing anxiety and depression
7. Sexual and reproductive – safer sex for partners and self, whether to have a baby, avoiding infection of the baby
8. Antiretroviral treatment: Standard antiretroviral therapy (ART) consists of the combination of at least three antiretroviral (ARV) drugs to maximally suppress the HIV virus and stop the progression of HIV disease. Huge reductions have been seen in rates of death and suffering when use is made of a potent ARV regimen, particularly in early stages of the disease.
9. Terminal care – care and treatment during the final stages of the disease.

Agencies/Organisation for HIV/AIDS Control

The non-governmental organisations listed below help in the control of HIV/AIDS around the world.

1. IAS (International AIDS Society)

2. UNAIDS (Joint United Nations Programme on HIV/AIDS)

3. WHO (World Health Organization)

Others include:

4. National Agency for the Control of AIDS (NACA)
5. Society for Family Health (SFH)

Myths about HIV/AIDS

1. I can get HIV by being around people who are HIV-positive: The evidence shows that HIV is not spread through touch, tears, sweat, or saliva.

You cannot catch HIV by:

- Breathing the same air as someone who is HIV-positive
- Touching a toilet seat or doorknob handle after an HIV-positive person
- Drinking from a water fountain
- Hugging, kissing, or shaking hands with someone who is HIV-positive
- Sharing eating utensils with an HIV-positive person
- Using exercise equipment at a gym

2. I don't need to worry about becoming HIV positive, new drugs will keep me well: Yes, antiretroviral drugs are improving and extending the lives of many people who are HIV-positive. However, many of these drugs have serious side effects. None yet provides a cure. Also, drug-resistant strains of HIV make treatment an increasing challenge.

3. I can get HIV from mosquitoes: Because HIV is spread through blood, people have worried that biting or bloodsucking insects might spread HIV. Several studies, however, show no evidence to support this even in areas with lots of mosquitoes and cases of HIV. When insects bite, they do not inject the blood of the person or animal they have last bitten. Also, HIV lives for only a short time inside an insect.

4. I'm HIV-positive, my life is over: In the early years of the disease epidemic, the death rate from AIDS was extremely high. But today, antiretroviral drugs allow HIV-positive people — and even those with AIDS — to live much longer, normal, and productive lives.

5. I'm straight and don't use HIV drugs, I won't become HIV-positive: Most men do become HIV-positive through sexual contact with other men or through injection drug use. However, about 16% of men and 78% of women become HIV-positive through heterosexual contact.

6. If I'm receiving treatment, I can't spread the HIV virus: When HIV treatments work well, they can reduce the amount of virus in your blood to a level so low that it doesn't show up in blood tests. Research shows, however, that the virus is still "hiding" in other areas of the body. It is still essential to practice safe sex so you won't make someone else become HIV-positive.

ASSESSMENT.

1. What is a Sexually Transmitted Infection?
2. List the examples of STI you know.
3. What are the major sources of STI?
4. What are the signs and symptoms of STI?

Week 5

Topic: Towards Better Health

Introduction

Pathogenic or harmful micro-organisms have the ability to wipe out the whole of humanity directly or indirectly. They therefore must be controlled through some measures in order to stay healthy.

Control of Harmful Micro-Organisms

1. The use of drugs like antibodies performs key role in checking the spread of microorganisms
2. Dehydration tends to inactivate the micro-organisms since most of them require water for metabolism
3. The use of high salinity or salt especially in preservation of food
4. Application of high temperature destroys pathogens. This is used in sterilization of materials e.g. in hospitals
5. Antiseptic application involves the use of low concentration of chemicals like phenol (carbonic acid). They prevent or inhibit the growth of micro-organisms. At times they kill them
6. Disinfectants are high concentration of phenol (carbolic acid). They kill micro-organisms outright.
7. The use of low temperature (freezing) also kills or inactivates some micro-organisms
8. The use of irradiation controls the growth of micro-organisms
9. Immunization: Vaccination or inoculation of anti-disease sera protects the individual from contacting the disease. This is because antibodies or anti-toxins are produced by the body

VECTORS

A vector is an organism that does not cause disease itself but which spreads infection by conveying pathogens from one host to another.

Species of mosquito, for example, serve as vectors for the deadly disease Malaria.

Note:

- A pathogen is a micro-organism that has the potential to cause disease.
- An infection is the invasion and multiplication of pathogenic microbes in an individual or population.
- Disease is when the infection causes damage to the individual's vital functions or systems.

Common Vectors and Diseases They Transmit

Vector	Organisms responsible	Disease
Female anopheles mosquito	Plasmodium parasites	Malaria
Housefly	Vibro cholerae	Cholera
Tsetse fly (Glossina spp)	Trypanosome spp	Sleeping sickness (Trypanosomiasis)
Aedes mosquitoes	Virus (arbovirus)	Yellow fever
Black fly (Simulium damnosum)	Round worm (Onchocera)	River blindness (Onchocerciasis)
Water snail	Flatworm (Schistosoma)	Bilharziasis or Schistosomiasis

WAYS OF CONTROLLING VECTORS

Housefly

1. Adults are killed using insecticides
2. Preventing breeding grounds
3. Covering our foods from flies

4. The surrounding pit-toilet must be covered and kept clean
5. Continuous spraying of insecticides even after the initial spray
6. The general environment must be kept clean

Mosquitoes

1. Breeding grounds must be destroyed
2. Surrounding bushes must be cut
3. Physical destruction of mosquitoes with brooms
4. Chemical destruction using insecticides e.g. dieldrin
5. Spraying of oil on water to frustrate their ability to breed due to lack of oxygen
6. Destroying or burying empty cans and bottles
7. The use of insect repellant on the body
8. The use of biological controls such as introducing tadpoles, bacilli bacteria, which are known to feed on the larvae
9. Making provision for nets in our doors and windows

Blackflies

1. The vectors are very difficult to fight. The only way possible is the destruction of the breeding sites
2. Other methods include the use of drugs such as suramin and diethyl carbamazine (with serious side effects)

Water snails

1. The use of molluscicides affects breeding of infective larvae
2. Good hygiene and sanitation in order to maintain clean environment
3. Outright treatment of infected people to stop the spread
4. Disrupting the food chain by killing some water weeds eaten by snails

Maintenance of Good Health

Introduction

For a person to remain healthy, he must maintain cleanliness around his environment. He must eat good food, drink clean and pure water, wear clean clothes and keep his environment tidy. This method will help a lot in preventing disease outbreak. However, keeping the environment clean is not the sole responsibility of single individuals. It involves the combined effort of the household, communities, nations and the world as a whole.

Ways of Maintaining Good health in a Community

Effective public health administration in a community can be achieved through the following ways:

Refuse disposal: Refuse are solid waste materials discharged through human activities from homes and industries into the environment. Reckless refuse dump around dwelling places creates bad odour, provides breeding grounds for insects and rodents that spread diseases

Refuse disposal can be done through the following ways:

1. Provision of dust bins in strategic locations
2. Burning refuse in incinerators
3. Dumping them in isolated areas far from human habitation
4. Burying refuse in a sanitary landfill

Sewage disposal: Sewage are waste water materials discharged from laundries, kitchens, toilets, bathrooms, e.g. urines and faeces

Sewage disposal can be done through:

1. The use of pit toilets where faeces and urine are passed into deep pits
2. The use of septic tanks where water is used to flush faeces and urine into a big tank dug in the ground
3. Community treatment process where sewage from various homes are collected and treated before being discharged into oceans or rivers

Protection of Water: In view of numerous diseases which man can contact because of drinking unclean water, water should be protected through the following ways:

1. Addition of alum to water
2. Boiling of water before drinking it
3. Filteration of water on cooling
4. Addition of chlorine to kill microscopic germs

5. Storage of water in clean containers

Note: All these should be done before water is passed through pipes into houses and other places where it is required.

Protection of food: It is true that diseases can be contracted through food. Therefore, both raw and cooked food should be properly protected. The following methods of food protection are recommended:

1. Keep food in refrigerators or deep freezers
2. Boil or cook raw food properly before eating
3. There should be inspection of food meant for public consumption
4. Washing of hands before and after eating of food
5. Food can also be preserved through canning
6. Keep the environment where the food is prepared clean
7. Avoid exposure of food to flies and other micro-organisms

Control of diseases: Individuals can control diseases by living in clean environment. Therefore, they can prevent diseases through the following ways:

1. Daily sweeping of the surroundings
2. Eating of good food and balanced diet
3. Taking of bath regularly
4. Wearing of clean and neat dresses
5. Living in well-ventilated houses
6. Cleaning of latrines and urinals with disinfectants regularly
7. Cleaning of teeth regularly with toothbrush and paste
8. Doing EXERCISES regularly
9. Treatment of any injury immediately or reporting same to the nearest hospital for treatment
10. Taking children through the various immunisations as prescribed by doctors
11. Taking no drugs except those prescribed by doctors

HEALTH ORGANIZATIONS

Health organizations are corporate (local and international) bodies concerned with the maintenance of good health of the people. International health organizations include:

- World Health Organisation (WHO)
- United Nations Children's Education Fund (UNICEF)
- International Red Cross Society

The major local health organisation in Nigeria is the Nigerian Medical Association (NMA)

Roles of Health Organizations

World Health Organization (WHO)

This is a specialised division of the United Nation Organisation (UNO) established in 1948 with headquarters in Geneva, Switzerland. Its major aim is to improve the health of the people in all the countries of the world.

The main functions of the organisation are:

1. It promotes measures for the control of the world's major diseases through vaccination programmes and use of antibiotics
2. It co-ordinates research programmes in all fields of health and makes the results known to all member-nations
3. It provides advice and help on health matters to member-nations on request, e.g. provision of medical experts, setting up health centres, etc.
4. It publishes medical journals
5. It helps to set up international quarantine regulations
6. It helps to provide drugs and vaccines in case of emergency
7. It provides warning signals in the event of an outbreak of epidemic diseases
8. It assists national health organisations in the control of diseases and vectors of diseases
9. It helps in maternal and child health care
10. It helps to set and recommend safe standard for drugs

United Nations Children's Education Fund (UNICEF)

The UNICEF, another special agency of the United Nations Organisation was set up to improve the health and welfare of the children all over the world. Specific functions of UNICEF are:

1. To provide for the emergency needs of children in devastated areas
2. To improve the nutrition of under-nourished children
3. To feed destitute children
4. To supply vaccines or equipment to prevent or control diseases that specifically affect children such as whooping cough, diphtheria, poliomyelitis and tuberculosis
5. To provide children's clothings and other needs
6. To assist in the improvement of the mothers and their children by providing training programmes and necessary equipment, e.g. provision of Oral Rehydration Therapy (ORT) to control diarrhoea in children

International Red Cross Society

The international Red Cross Society plays important roles in two major ways:

In time of war

1. They take proper care of the injured
2. They provided emergency and to those in distress
3. They are involved in the negotiation of the exchange of prisoners of wars between countries
4. They provide transport for the evacuation of refugees
5. They also provide welfare for the prisoners of war

In time of peace

1. They provide the general first-aid to patient
2. They assist in preventing accidents
3. They assist in the training of nursing aides
4. Red cross society maintains maternal and child welfare clinics
5. They provide help to victims of natural disasters such as earthquakes, floods, fire, etc.

Nigerian Medical Association (NMA)

The Nigerian Medical Association (NMA) is a national body concerned with the maintenance of good health within Nigeria. The main functions of NMA include:

1. Advising the government on how to improve the health status of the people
2. Alerting the nation where there is an outbreak of a disease
3. Carrying out research into ways of preventing and controlling diseases
4. Monitoring the recruitment of well trained doctors in hospitals
5. Assisting in the training of medical and paramedical staff needed in health care delivery.

Test Questions

1. A _____ is an organism that does not cause disease itself but which spreads infection by conveying pathogens from one host to another.
   a) Pathogen
   b) Vector
   c) Parasite
   d) Predator

2. Diseases can be controlled in the following ways except
   a) By treating injuries late
   b) By cleaning latrines and urinals with disinfectants
   c) By wearing of clean and neat dresses
   d) By living in well-ventilated houses

3. Female anopheles is to Malaria: Tsetse fly is to ____
   a) Sleeping sickness
   b) Night Blindness
   c) Cholera
   d) River Blindness

4. _____ is a way of maintaining good health
   a) Littering the street with dirts
   b) Improper sewage disposal
   c) Protection of food
   d) Pollution of water

5. Vibro cholerae is responsible for one of the following diseases
   a) Typhoid
   b) Malaria
   c) Bilharzia
   d) Cholera

6. _____ is the process whereby a person is made immune or resistant to an infectious disease, typically by the administration of a vaccine.
   a) Innoculation
   b) Immunization
   c) Protection
   d) Vaccinate

7. _____ is not a way of cleaning or purifiying water
   a) Filteration of water
   b) Addition of Chlorine
   c) Addition of Acid
   d) Addition of Alum

8. List 4 ways with which food can be protected.

Answers

1. B
2. A
3. A
4. C
5. D
6. B
7. C
8. Keep food in refrigerators or deep freezers
   Boil or cook raw food properly before eating
   There should be inspection of food meant for public consumption
   Washing of hands before and after eating of food

Week: 6

Topic: Population Studies

Introduction

Population is defined as the total number of organisms of the same species living together in a given area at a particular time. In an ecosystem, the community is made up of many populations of different species.

In population studies of a habitat, the following are usually studied:

- **Types of organisms**: This involves the listing of the various types of populations that are found in the particular habitat. It helps to determine the relationships that exist between the various organisms (plants and animals) in a habitat.
- **Dominance**: Dominance refers to those species that exert a greater influence or a major controlling effect on the other members of the community. The relative importance of a species in the community is expressed by dominance.

Dominance could be expressed in terms of:

o Their number

o Occupation of largest portion of space

o Possession of the highest biomass and

o The largest contribution to the energy flow in the habit. For a species to be dominant in a habitat, it should possess some of these attributes over other species.

Population Characteristics

These characteristics include:

- **Population size**: This refers to the total number of the species of the same kind in a given area or habitat. A large population stands a better chance of surviving dangerous and unfavourable conditions such as fire, diseases etc while a small population can easily be wiped out.
- **Population density**: Population density is defined as the number of individual organisms per unit area or volume of the habitat.

Mathematically, Population density = total population or population size / Area of habitat

Population density can be used to estimate the total number of individuals of a population or population size. Mathematically, population size = population density x area of habitat.

- **Population frequency**: This refers to the number of times an organism occurs within a given area a habitat.
- **Percentage cover**: This refers to the area or space covered or occupied by a given species in its habitat and it is expressed in percentage.
- **Population growth rate**: This refers to the net result of the influence of natality (birth rate) and mortality (death rate) of organisms in a giver habitat.

Factors Affecting Population

Factors which may affect the population of organisms in a given habitat include:

1. **Natality (birth rate)**: This refers to the rate of given birth to new organisms. This generally (be it plants or animals) leads to increase in population.
2. **Mortality (death rate)**: This refers to the rates at which organisms die in a habitat. Mortality generally leads to a decrease in population.
3. **Immigration (dispersal)**: This is the movement of organisms from different habitats into a new habitat. This tends to increase the population of this new area.
4. **Emigration**: This is the movement of organisms out of a habitat due to either scarcity of food or unfavourable conditions or for breeding purposes. This, however, reduces the population of a habitat.
5. **Availability of food**: The availability of food in a given habitat tends to increase the population of that habitat through rapid rate of reproduction and other organisms coming into feed.
6. **Seasonal Climatic Changes:** Unfavourable climatic changes may result in the decrease of population since most organisms may die or migrate out of the habitat while the reverse is the case when the conditions are favourable.
7. **Breeding periods:** Most organisms move out of a habitat during the breeding period or season, thereby reducing the population decreases during the breeding season in fish, toad, termite etc.
8. **Natural Disasters:** Natural disasters like fire, drought, floods, earthquakes etc may lead to a decrease in population as many organisms may die or move out of that habitat to a new area.

Method of Population Study

1. Population Studies by Sampling Method

Population studies can easily be carried out in a habitat especially in terrestrial habitat by sampling method, making use of an instrument called the quadrat. A quadrat is made of a square or rectangular wire, plastic, wooden or metal frame with predetermined area. For example, the area of a quadrat may be $1.5m^2$.

How to Conduct Population Studies

The population size or total population and population density of a particular species in a terrestrial habitat can be estimated by the following procedure:

1. Choose and locate the sample plot
2. Then identify the species in the plot
3. Measure the area with a measuring tape to know the area of the habitat
4. Throw or toss the quadrat randomly at intervals for up to 10 or above times
5. After each throw or toss, the number of species within the area of quadrat is recorded
6. The density of species is calculated by dividing the average number of times the species occurs within the quadrat by the area of the quadrat.

The calculation can be worked out this way:

Frequency of species = X

Number of toss = Y/10

Average number of species per quadrat = X = Z

Example: Estimate the population density and population size of specific grasses using the quadrat.

Solution:

Total area of habitat = $1.5m^2$

Frequency of the organisms (grasses), that is, the total number of times an organisms occurs in all the quadrats thrown in the habitat. Assume 400 times.

Number of tosses = 50

Average number of organisms per quadrat tossed = 400/50 = 8

Area of quadrat = $1.6m^2$

Density of organisms = 8 / 1.6 = 5 grasses per m^2

Population size = Density x Area of habitat = $5/m^2 \times 16m^2 = 80$

The population size of grasses in the habitat = 80 grass plants.

Estimation of Population using the transect Method: The tape should stretch with marking at intervals. The plants within the various intervals are recorded. This procedure is repeated a number of times until an accurate estimate of the number and types of plants in the habitat are obtained.

Capture mark recapture method

Censuring wild animal population is fraught with many difficulties of sampling errors and statistical bias. Occasionally, direct counts are possible, as in aerial birds or sea bird colonies, but for most animals this is impossible and various kinds of sampling methods must be employed. Most animals are not readily visible because of their behavior and habitat, or because they exist in such abundance or scarcity that they cannot be readily counted. It therefore becomes necessary to estimate numbers through programmes of capture-mark recapture.

The ratio of marked to unmarked animals in subsequent trapping runs provides a population estimate known as the Lincoln index. This is mathematically expresses as follows:

$P / M_1 = T_2 / M_2$

Where:

P = Unknown population

M_1 = Total number of individuals marked in the first capture period

T_2 = Total number of individuals captured in the second period

M_2 = Total number of those in the second capture period, which were previously marked.

However, the validity of this method involves the assumption that the:

1. Marked animals mix randomly in the population
2. Probability of recapture is the same as for each individual

iii. The system must be a closed one, i.e., there is no immigration or emigration, death or birth of the animal under investigation between the periods of sampling.

Ecological Factors

Ecological factors are those factors in the environment which can influence living organisms or cause changes in any habitat, be it aquatic or terrestrial habitat.

Ecological factors are grouped into two categories Biotic and Abiotic factors.

Biotic Factors

The biotic factors are made up of the effects of other plants and animals on a given organisms.

Examples of biotic factor are:

1. Competitions:Competition involves the interactions among two organisms of the same species or different species in which one neither outgrows the other nor survives while the other cannot grow nor survive.
2. Parasitism: This is a close association between two organisms in which one called the parasite lives in or on, and feeds at the expense of the other organisms called the host. The parasitic benefits from the association while the host usually suffers harm or even die.
3. Commensalism: Commensalism neither is an association between two organisms living together in which only one (the commensal) benefitted nor is harmed.
4. Predation: Predation is a type of association between two organisms in which the predator kills the other called the prey and feeds directly on it.
5. Pathogens: These are micro-organisms which can cause diseases in plants and animals leading to their reduction through death.
6. Mortality: Mortality is the death rate of organisms (plants or animals) in an environment. Mortality generally reduces the population of organisms in any habitat.
7. Migration: This is the movement of organisms either into a new habitat (immigration) or out of a habitat (emigration). These movements usually have effects on the other organisms inhibiting that habitat.
8. Dispersal: Dispersal is the spreading of new individuals from their parents to new habitat so as to start a new life in the new environment. Such spreading habits may affect the lives of other organisms in the new area.
9. Natality: This is the rate of giving birth to new offspring. Natality is generally known to increase the population of the habitat which will subsequently lead to certain problems among the organisms in that habitat
10. Food: Availability of food in a habitat generally leads to increase in population while lack of food leads to starvation and dearth
11. Diseases: Diseases are known to reduce the population of organisms (both plants and animals) in any habitat.
12. Pest: Pests are also known to affect the performance of plants in terms of yield and growth, in severe cases, the plants may even die.

Abiotic Factors

The abiotic factors comprise the following;

1. Climatic factors: These are temperature, rainfall, wind, pressure, sunlight or sunshine, humidity etc.
2. Chemical factors: These are made up of oxygen carbon dioxide, mineral salts, water and nitrogen.
3. Edaphic factors: These consist of soil, its water, chemical and physical composition, its pH, its nutrient, profile, structure and texture
4. Topographic factors: These are caused as a result of the shape of the earth's surface, e/g. effects of rivers, hills, mountains and valleys.

Ecological Factors common to all Habitat.

Factors affecting or common to all habitats (both aquatic and terrestrial habitats) include:

- Temperature
- Rainfall
- Light
- Wind
- Pressure
- Hydrogen ion concentration (pH).

Of these factors, temperature and rainfall determine the major biomes of the world.

Temperature

1. Temperature determines the vegetation of an area
2. It is necessary for the germination of seeds
3. It affects the distribution of plants and animals
4. It regulates the activities of majority of the living things.
5. High temperature affects evapo-transpiration and reduces the performance of animals.
6. It affects the wilting of field crops, ripening and maturity of crops.
7. It leads to loss of soil nutrients through volatilization
8. Unfavourable temperature may result in seed dormancy.

Rainfall

1. Rainfall determines seasons in some places e.g. Nigeria where we have rainy and dry seasons.
2. It determines the type of vegetation in an area.
3. It determines the distribution of plant and animal
4. Rainfall provides a dwelling place or habitat for some organisms, e.g. fish, crab, shrimps, sea weeds.etc.
5. Rainfall is necessary for seed germination
6. It helps to dissolve nutrient in the soil thereby making them available to plants
7. It is the main source of water in rivers, ponds, lakes, oceans etc.
8. Plants use water for photosynthesis.

Wind

1. Wind determines seasons in Nigeria, for instance, the South-West wind is responsible for rainy season while the North-East wind brings harmmatan or dry season.
2. It helps in the distribution of rainfall
3. It can aid the spread of diseases
4. It aids the pollination of flowers
5. It also aids the disposal of seeds and fruit
6. High velocity wind may cause wind erosion
7. Wind is responsible for water currents and waves.

Light

1. Sunlight is necessary for photosynthesis to take place in green plant.
2. It affects evapo-transpiration.
3. It affects the productivity of crops due to length of day, i.e., photosynthesis
4. Light affects flowering and fruiting in plant
5. Light is the ultimate source of energy for all organisms.

6. It affects the activities of animals, e.g. some animals are active during the day while others are active at night.

Pressure

1. Atmospheric pressure decreases as one goes up from the sea level
2. In aquatic environment, pressure increases as one move down the water.
3. Plants and animals have special adaptations of a particular level of pressure to enable them survive.
4. Too high or too low pressure will affect the lives and activities of plants and animals
5. Pressure is responsible for the movement of winds.

Hydrogen Ion Concentration (pH)

1. pH values range from 1 to 14, with pH 1 being very acidic, pH 7 neutral and pH 14 very alkaline.
2. Living organisms are highly sensitive to pH changes.
3. Too high or two low pH will affect the lives and activities of plants and animals
4. Plants and animals are adapted to special pH values. E.g. pH of fresh water is low while marine pH is high.
5. Most plants thrive well in neutral or slightly alkaline soil while acidic soils support little vegetation.

Ecological Factors Common to Aquatic Habitats

Factors affecting or common to aquatic habitats are:

- Temperature
- Rainfall
- Wind
- Light
- Pressure
- Hydrogen ion concentration (pH)

These factors have been explained above. Other factors not explained are:

- **Salinity:** Salinity is defined as the degree of saltiness or concentration of salt solution in water. Salinity is low in fresh water, high in sea water and moderate in brackish water. Aquatic organisms need to maintain the osmotic balance between their body fluids and their aquatic surroundings to survive. For example, organisms living in fresh water will require some adaptive features to enable them get rid of excess water that enters their bodies while those in sea water equally have adaptations to enable them cope with excess water in their bodies.

- **Turbidity/Transparency:** Turbidity is caused as a result of suspended materials in water. Clear water has low turbidity is also influenced by season. It is higher during the rainy season than in dry season. Turbidity reduces light penetration into the water, resulting in the inability of aquatic green plants to carry out photosynthesis, and it causes pollution.

- **Dissolved Gases:** Dissolved gases in this case refer to oxygen and carbon dioxide. The oxygen concentration of water decreases with depth. Oxygen is required by most aquatic organisms for respiration. It is also required for the decaying of organic substance. Carbon dioxide is required as raw materials for photosynthesis.

- **Density:** Density of water varies with the types of aquatic habitats. While the density of pure fresh water is 1.00, that of sea water is 1.028 at atmospheric pressure and $0^{O}C$. Organisms like fish, have streamlined bodies which enable them to move easily through water while other organisms which float on the water surface are sensitive to changes is density.

- **Current:** Water currents increase aeration and the turbidity of the water. It also affects the distribution of aquatic organisms. The type of organisms found in an aquatic habitat is affected by the speed of water current. For example, animals living in fast moving waters usually have structures for attaching themselves to rock surfaces so that they cannot be swept away.

- **Total movement and waves:** Tidal movements and waves affect the organisms in certain level of the water attach themselves to substances or may even live in burrows. Some may possess hard body cover to prevent evaporation of water from their bodies. In the open sea, wave cause the aeration of the surface waters, enabling aquatic organisms to have sufficient supply of dissolved gases for their respiration.

Ecological factors common to terrestrial habitats

Factors affecting terrestrial habitats are:

- Temperature
- Rainfall
- Wind

- Light
- Pressure
- Hydrogen ion concentration pH

These factors have been discussed under factors common to all habitats. Other factors not discussed are:

- **Relative humidity:** Relative humidity is the amount of water vapour in the air. It results in the formation of rain. Relative humidity affects the performance of plants and animals, and also determines their distribution. Low humidity causes aridity or dryness of a place. It also wheat is grown in northern Nigeria during harmattan.
- **Edaphic or soil factors:** These include:

1. **Soil type:** The type of soil determines the fertility of the soil. It also determines the type of vegetation found in an area. Soil types determine the type of crops to be grown. They equally determine the porosity and water retaining capacity, e.g. while sandy soil is porous and cannot retain water; clay soil is not porous and can retain water.
2. **Soil texture:** Soil texture refers to the degree of coarseness or fineness of soil particles. It determines the type of soil in an area, the level of soil fertility and the type of crops to be grown. Soil texture affects the level of leaching and erosion.
3. **Soil structure:** Soil structure refers to the arrangement of the various soil particles in the soil. It determines the fertility of the soil, and its water retaining capacity. It also affects the level of soil organisms as well as the level of soil aeration and percolation.
4. **Moisture content:** Moisture content is the amount of water available in the soil. It affects the type of vegetation of an area, the distribution of plants and animals. It also determines the fertility of the soils as well as the growth of plants in the habitat.

Topographic factors or land surface: Topographic factors or land surfaces include:

1. **Elevation:** Elevation refers to the height of the land above the sea level. Elevation affects the growth of plants and the level of erosion in an area. It also determines the distribution of plants and animals.
2. **Type of drainage:** Drainage is the removal of excess water from the soil. It affects the availability of water in the soil and determines the growth of plants in the area. Excessive drainage leads to soil erosion and poor growth of plants.
3. **Degree of Exposure:** The degree of exposure of the land is affected by rainfall and vegetation cover. Low degree of exposures ensures the availability of nutrients to

plants and the distribution of plants and animals. It also has effects on erosion and evaporation.

Measurement of Ecological Factors

Ecological factors that require measurement are: rainfall, temperature, wind, relative humidity, pressure, light, pH, turbidity, depth of water, slop etc. These ecological factors and the instruments used in measuring them are outlined below:

Instrument Functions/uses

1. Rain gauge – Measuring the amount of rainfall
2. Minimum and maximum mercury on glass thermometer – Measurement the lowest and highest temperature of the day
3. Anemometer – Measuring the speed of wind
4. Wind vane—Indicate the direction of wind
5. Hygrometer – Measures relative humidity
6. Barometer – Measures pressure
7. Photometer or light meter – Measures light intensity on land
8. Hydrophotometer – Measures light intensity in water
9. Colorimeter or pH indicator – Measures acidity or alkalinity of soil or solution.

Test Questions

1. _____ is defined as the total number of organisms of the same species living together in a given area at a particular time.
   a) Crowding
   b) Overpopulation
   c) Population
   d) Survival
2. ____ is used to measure acidity or alkalinity of soil or solution.
   a) Colorimeter
   b) Hydrometer

c) pH vane
d) Wind vane

3. _____ is caused as a result of suspended materials in water
   a) Turgidity
   b) Turbidity
   c) Salinity
   d) Moving waters

4. _____ is defined as the degree of saltiness or concentration of salt solution in water
   a) Salinity
   b) Salt Level
   c) Turbulence
   d) Turbidity

5. _____ refers to the total number of the species of the same kind in a given area or habitat
   a) Population density
   b) Population characteristics
   c) Population
   d) Population size

6. One of this is not an ecological factor affecting terrestial habitats.
   a) Temperature
   b) Rainfall
   c) Wind
   d) Porosity

7. Sunlight is not necessary for photosynthesis to take place in green plant. True or False

8. _____ is used to measure pressure
   a) Barometer
   b) Colorimeter
   c) Wind vane
   d) Speedometer

9. _____ refers to the number of times an organism occurs within a given area a habitat
   a) Population density
   b) Population size
   c) Population frequency
   d) Population Growth

10. _____is the movement of organisms either into a new habitat or out of a habitat.
    a) Immigration
    b) Migration

c) Emgration
d) Movement

Answers

1. C
2. A
3. B
4. A
5. D
6. D
7. False
8. A
9. C
10. D

Week 7

Topic: Functioning Ecosystem

Introduction

An ecosystem is a basic functioning unit in nature. It is made up of living organisms (plants and animals) and their non-living environment. The biotic or living components such as the producers and consumers interact in their environment resulting in the ecosystem being a functional unit.

Autotrophs, Heterotrophs and Decomposers

Autotrophs

Autotroph is an organism that serves as a primary producer in a food chain. Autotrophs obtain energy and nutrients by harnessing sunlight through photosynthesis (photoautotrophs) or, more rarely, obtain chemical energy through oxidation (chemoautotrophs) to make organic substances from inorganic ones. Autotrophs do not consume other organisms; they are, however, consumed by heterotrophs.

Energy Production

Autotrophs produce their own energy by one of the following two methods:

- Photosynthesis – Photoautotrophs use energy from sun to convert water from the soil and carbon dioxide from the air into glucose. Glucose provides energy to plants and is used to make cellulose which is used to build cell walls. E.g. Plants, algae, phytoplankton and some bacteria. Carnivorous plants like pitcher plant use photosynthesis for energy production but depend on other organisms for other nutrients like nitrogen, potassium and phosphorous. Hence, these plants are basically autotrophs.
- Chemosynthesis – Chemoautotrophs use energy from chemical reactions to make food. The chemical reactions are usually between hydrogen sulfide/methane with oxygen. Carbon dioxide is the main source of carbon for Chemoautotrophs. E.g. Bacteria found inside active volcano.

Heterotrophs

Heterotrophs are organisms that survive by feeding on organic matter produced by or available in other organisms. It is an organism that consumes other organisms in a food chain, hence, they are called consumers. In contrast to autotrophs, heterotrophs are unable

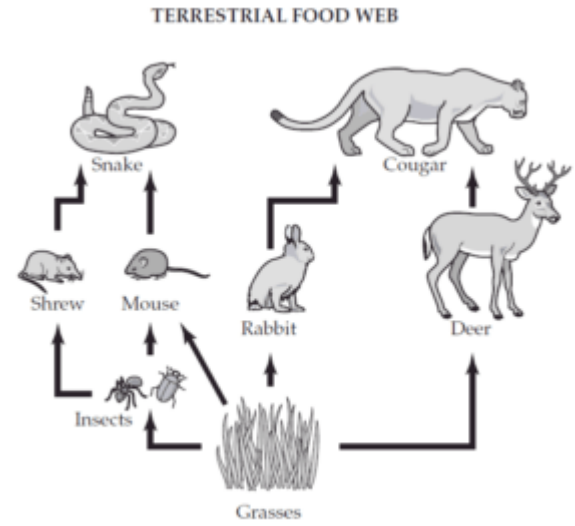
to produce organic substances from inorganic ones. They must rely on an organic source of carbon that has originated as part of another living organism. Heterotrophs depend either directly or indirectly on autotrophs for nutrients and food energy.

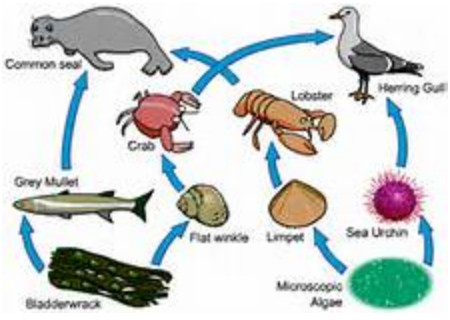
Decomposers

Decomposers are organisms that feed on dead organisms and other decaying organic materials. Fungi and bacteria are decomposers in energy transformation in an ecosystem. They are responsible for breaking down the complex organic compounds into simple nutrients. There are different types of decomposer organisms, which are responsible for returning simpler nutrients to the soil to be used by plants — and so the energy transformation cycle continues.

Food Chain and Food Web

Every organism needs to obtain energy in order to live. For example, plants get energy from the sun, some animals eat plants, and some animals eat other animals.





food web (in an aquatic habitat)

Food Chain

A food chain is the sequence of who eats whom in a biological community (an ecosystem) to obtain nutrition. In other words, food chain is defined as a feeding relationship involving the transfer of energy through food from producers to consumers. A food chain starts with the primary energy source, usually the sun. The next link in the chain is an organism that makes its own food from the primary energy source — an example is photosynthetic plants that make their own food from sunlight (using a process called photosynthesis) and chemosynthetic bacteria that make their food energy from chemicals in hydrothermal vents. These are called autotrophs or primary producers.

Some eat the autotrophs; these organisms are called herbivores or primary consumers — an example is a grasshopper that eats grass.

The next link in the chain is animals that eat herbivores – these are called secondary consumers — an example is a rat that eat grasshopper.

The next link in the chain is animals that eat the secondary consumers – these are called tertiary consumers – an example is a snake the eat rat

In turn, these animals are eaten by larger predators — an example is an owl that eats snakes.

The tertiary consumers are eaten by quaternary consumers — an example is a hawk that eats owls. Each food chain ends with a top predator and animal with no natural enemies (like an alligator, hawk, or polar bear).

The arrows in a food chain show the flow of energy, from the sun or hydrothermal vent to a top predator. As the energy flows from organism to organism, energy is lost at each step.

Trophic Levels

The trophic level of an organism is the position it holds in a food chain.

Primary producers (organisms that make their own food from sunlight and/or chemical energy from deep sea vents) are the base of every food chain – these organisms are called autotrophs.

Primary consumers are animals that eat primary producers; they are also called herbivores (plant-eaters).

Secondary consumers eat primary consumers. They are carnivores (meat-eaters) and omnivores (animals that eat both animals and plants).

Tertiary consumers eat secondary consumers.

Quaternary consumers eat tertiary consumers.

Food chains “end” with top predators, animals that have little or no natural enemies.

When any organism dies, it is eventually eaten by detrivores (like vultures, worms and crabs) and broken down by decomposers (mostly bacteria and fungi), and the exchange of energy continues.

Some organisms' position in the food chain can vary as their diet differs. For example, when a bear eats berries, the bear is functioning as a primary consumer. When a bear eats a plant-eating rodent, the bear is functioning as a secondary consumer. When the bear eats salmon, the bear is functioning as a tertiary consumer (this is because salmon is a secondary consumer, since salmon eat herring that eat zooplankton that eat phytoplankton, that make their own energy from sunlight).

A network of many food chains is called a food web. Food web is defined as a complex feeding relationship among organisms in the same environment with two or more inter-related food chains.

Numbers of Organisms:

In any food web, energy is lost each time one organism eats another. Because of this, there have to be many more plants than there are plant-eaters. There are more autotrophs than heterotrophs, and more plant-eaters than meat-eaters. Although there is intense competition between animals, there is also interdependence. When one species goes extinct, it can affect an entire chain of other species and have unpredictable consequences.

Equilibrium

As the number of carnivores in a community increases; they eat more and more of the herbivores, decreasing the herbivore population. It then becomes harder and harder for the carnivores to find herbivores to eat, and the population of carnivores decreases. In this way, the carnivores and herbivores stay in a relatively stable equilibrium, each limiting the other's population. A similar equilibrium exists between plants and plant-eaters.

The number of organisms in a food chain can be represented graphically in a pyramid. Each bar represents the number of individuals at each trophic level (feeding level) in the food chain.

In this example a large number of caterpillars living in a single oak tree provide food for several blue tits, which in turn are consumed by a sparrowhawk.

The pyramid of numbers usually shows that the number of organisms at each trophic level gets smaller towards the top. This particular case is an exception – one tree provides food for many caterpillars.

Pyramid of Biomass

A pyramid of biomass is a more accurate indication of how much energy is passed on at each trophic level.

Biomass is the mass of living material in each organism multiplied by the total number of organisms in that trophic level. This makes it easier to compare the food value of a small number of large organisms with a large number of small organisms. Pyramids of biomass usually are a true pyramid shape.

The biomass in each trophic level is always less than the trophic level below. This is because biomass is a measure of the amount of food available. When animals eat, only a small proportion of their food is converted into new tissue, which is the food for the next trophic level. Most of the biomass that animals eat is either not digested, or used to provide the energy needed for staying alive.

Processes of Ecosystems

The diagram with the plants, zebra, lion, and so forth illustrates the two main ideas about how ecosystems function: ecosystems have energy flows and ecosystems cycle materials. These two processes are linked, but they are not quite the same.

Energy Flows and Material Cycles

Energy enters the biological system as light energy, or photons, is transformed into chemical energy in organic molecules by cellular processes including photosynthesis and respiration, and ultimately is converted to heat energy. This energy is dissipated, meaning it is lost to the system as heat; once it is lost it cannot be recycled. Without the continued input of solar energy, biological systems would quickly shut down. Thus the earth is an open system with respect to energy.

Elements such as carbon, nitrogen, or phosphorus enter living organisms in a variety of ways. Plants obtain elements from the surrounding atmosphere, water, or soils. Animals may also obtain elements directly from the physical environment, but usually they obtain these mainly as a consequence of consuming other organisms. These materials are transformed biochemically within the bodies of organisms, but sooner or later, due to excretion or decomposition, they are returned to an inorganic state. Often bacteria complete this process, through the process called decomposition or mineralization.

During decomposition these materials are not destroyed or lost, so the earth is a closed system with respect to elements. The elements are cycled endlessly between their biotic and abiotic states within ecosystems.

ASSESSMENT.

1. Define the term “Ecosystem”.
2. Explain the following terms; Autotrophs, Heterotrophs and Decomposers.
3. What is a “Food chain”?

4. Draw an illustration of a food chain.

Week 8

Topic: Energy Transformation In Nature

Introduction

The transformations of energy in an ecosystem begin first with the input of energy from the sun. Energy from the sun is captured by the process of photosynthesis. Carbon dioxide is combined with hydrogen (derived from the splitting of water molecules) to produce carbohydrates (CHO). Energy is stored in the high energy bonds of adenosine triphosphate, or ATP.

Energy Loss in the Ecosystem

The solar radiation is used by plants during photosynthesis. Some are lost to the earth's surface while some are stored in plants' parts stems, leaves, etc. and are not used up.

LAWS OF THERMODYNAMICS

First Law of Thermodynamics

The law states that energy can neither be lost nor created especially as it is converted from one form to another.

Second Law of Thermodynamics

The law states that no energy transformation is 100% efficient, since some are lost in form of heat.

Decomposition in Nature

Decomposers are organisms, mainly bacteria and saprophytes responsible for the breaking down of dead organic materials which could be of plants or animals origin. These decomposers are grouped into two classes:

1. Micro-decomposers: These are small or microscopic organisms that can cause decay, e.g. certain bacteria and fungi.
2. Macro-decomposers: These are bigger organisms that can cause decay of dead organic materials, e.g. earthworms, termites, snails, mushroom, toad stools, etc.

Process of Decomposition

The decomposers secrete enzymes onto their food source such as decaying plant. These enzymes break down complex organic compounds (food) like carbohydrates and proteins into simple soluble inorganic compounds.

Roles of Decomposers in Ecosystem

1. Decomposers play major roles in the ecosystem in the following ways:
2. They enrich the soil with nutrients required for plant growth
3. They contribute to environmental pollution
4. Decomposition is useful in the making of cheese and yogurt
5. They also prevent an unsightly accumulation of remains and wastes of living organisms on earth surface.

Test Questions

1. What law of thermodynamics is this? “The law states that no energy transformation is 100% efficient, since some are lost in form of heat.”
   a) First Law
   b) Second Law
   c) Third Law
2. There are two types of decomposers namely _____
3. Energy from the sun is captured by the process of _____
4. Energy is stored in the high energy bonds of _____
5. _____ are organisms, mainly bacteria and saprophytes responsible for the breaking down of dead organic materials which could be of plants or animals origin.

Answers

1. B
2. Micro and Macro decomposers
3. Photosynthesis
4. ATP or Adenosine Triphosphate
5. Decomposers