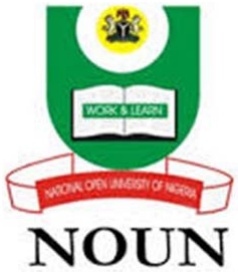

NATIONAL OPEN UNIVERSITY OF NIGERIA

SCHOOL OF EDUCATION

COURSE CODE: SED 221

COURSE TITLE: BIOLOGY FOR INTEGRATED SCIENCE II

BIOLOGY FOR INTEGRATED SCIENCE II

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COURSE UNITS – TWO

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(WRITTEN 2015)

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MODULE 1: PLANT STRUCTURE AND FUNCTION

UNIT 2: PLANT BODY: EXTERNAL FEATURES

CONTENTS

1.0 Introduction
2.0 Objectives
3.0 Main Contents
    3.1 Life Cycles in Flowering Plants
    3.2 Typical Body Plan in Angiosperm
    3.3 Three Plant Tissue Systems
4.0 Conclusion
5.0 Summary
6.0 Tutor-Marked Assignment
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1.0 Introduction

In the last unit, an attempt was made to introduce the concept of classification of living organisms to you. You learned the criteria of classifying organisms and the use of binomial nomenclature deviced by Linnaues to name them. The focus of this unit, is to study the external features of a typical plant as well to outline the three plant tissue systems.

2.0 Objectives

After studying this unit, you should be able to:

- explain the 3 life cycles in plants
- describe the external features of a typical plant
- name the three plant tissue systems

3.0 Main Contents

3.1 Life cycles of Angiosperms
3.2 Typical External Features of Angiosperm
3.3 Plant Tissue Systems

3.1 Life Cycles of Angiosperms

In unit 1, you have learned that there are over 300,000 known species of plants. Out of this number, about 260,000 are well-known species of seed-bearing vascular plants such as gymnosperms (pine trees) and angiosperms, flower-producing plants such as roses, corn, cactuses and elms (Starr 2000).

Flowering plant life cycles extend from germination to seed formation, then death. Three types of cycles are known, viz:

1. Annuals – These are plants that have one growing season. They produce seeds and complete the life cycle within a single growing season. They are generally non-woody or herbaceous in nature e.g. maize, guinea corn, wheat, groundnuts, marigolds and alfalfa.

2. Biennials live for two growing seasons – The first year constitutes the vegetable stage, during which the store of food material is built up. Seeds are produced in the second year. Examples are carrot, cabbage and cocoyam.

3. Perennials are plants that live or grow for three or more years. They continue vegetative growth and seed formation year after year (Starr, 2000).

Self-Assessment Exercise I

1. What is the approximate number of the angiosperm species?
2. Discuss the 3 lifecycles of angiosperms

3.2 Typical Body Plan of Angiosperm

Generally, flowering plants have a body plan that consists of shoots and roots. The shoots bear stems, leaves, flowers and other structures. The roots are specialized structures that typically penetrate the soil and spread downward, and outward through it. A root system anchors the plant to the soil and absorbs water and dissolve minerals. A typical body plan of angiosperm is shown in Figure 1.

Principal Parts of a Vascular Plant

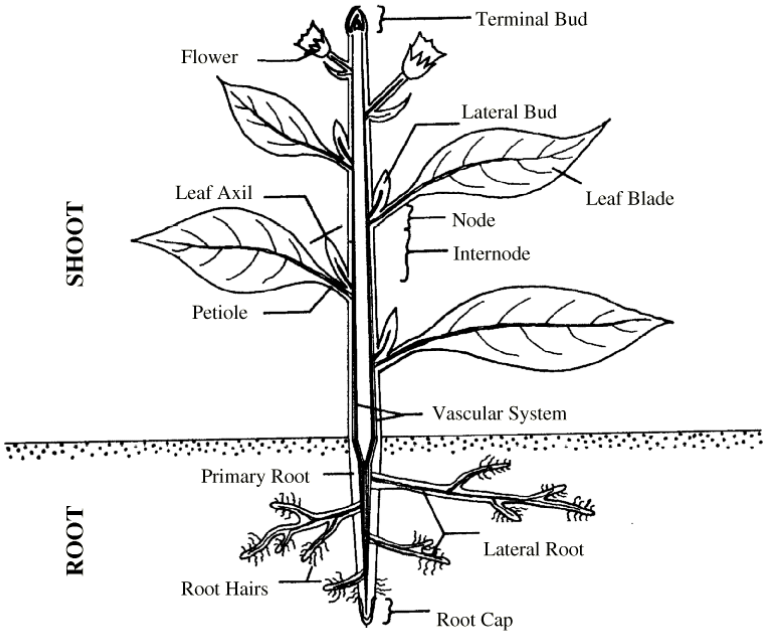


Figure 1: Body plan of a typical angiosperm

Self-Assessment Exercise 2

1. Describe the components of a typical plant
2. Draw and label the external features of a plait

3.3 Plant Tissue Systems

Generally, a flowering plant consists of stems, branches, leaves and roots. Each of these components has three major tissue systems outlined below:

i. The ground tissue system – this is very extensive and makes up the bulk of the plant body.
ii. The vascular tissue system – has two kinds of tissues that distribute water and solutes through the plant body.
iii. The dermal tissue system, covers and protects the plant surfaces

The 3 tissue systems explained above are illustrated further in Figure 2, below

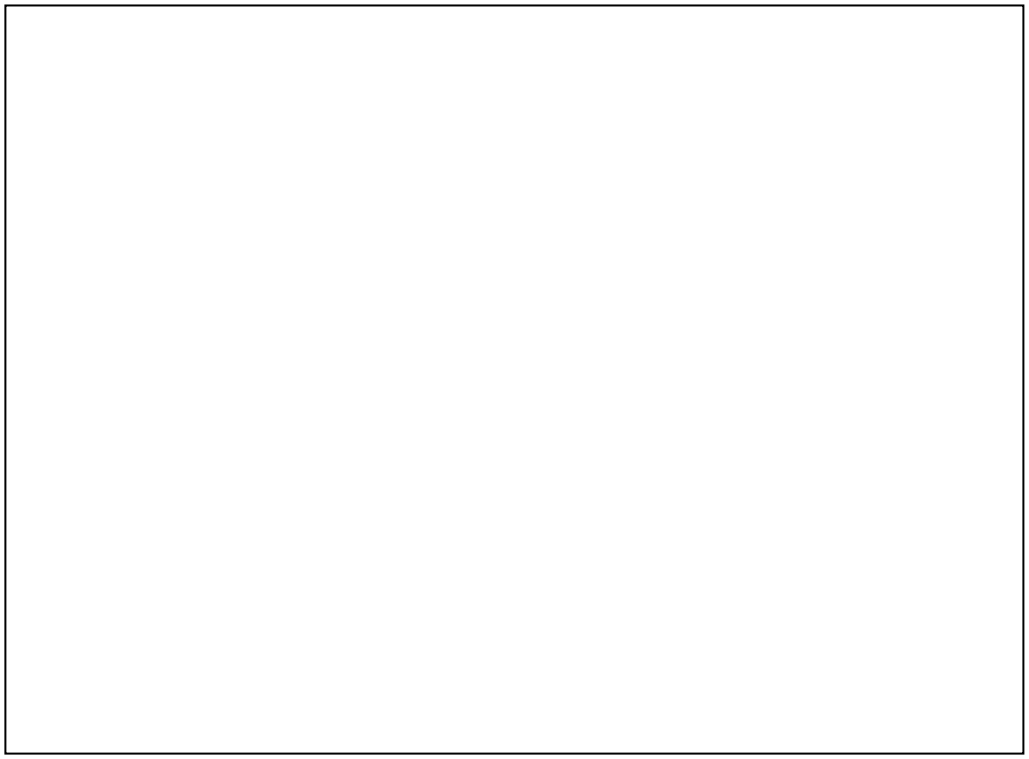


Figure 2: Plant Tissue System

Self-Assessment Exercise 3
Name the 3 tissue systems in flowering plants

4.0 Conclusion

Angiosperm plants have more than 260,000 known species. They dominate the plant kingdom. They have 3 life cycles of (i) annuals (ii) biennial and (iii) perennials. Three types of tissues are found, namely (i) ground tissue system (ii) vascular tissue system and (iii) dermal tissue system

5.0 Summary

Plant body plan consists of shoots and roots. The shoots appear above the soil while the roots are under the soil. The 3 types of tissue systems in flowering plants have these functions:

i. The ground tissue system makes up bulk of the plant and is supportive in function.

ii. The vascular tissue system conducts water, dissolved minerals and organic substances
iii. The dermal tissue covers and protects the surfaces of both the root and the shoot systems

6.0 Tutor-Marked Assignment

1. Name the 3 life cycles in angiosperms
2. Describe the 3 types of tissue systems in angiosperms

7.0 References/Further Readings

Ambuno, S., Egunyomi A, Osallwe V.C. (2008). *Comprehensive Certificate Biology for Senior Sec. Schools* University Press Plc Ibadan.

Starr, C. (2000) *Biology, Concepts and applications* Brooks/Cole United Kingdom.

MODULE 1: PLANT STRUCTURE AND FUNCTION

UNIT 3: PLANT MERISTEMS AT A GLANCE

CONTENTS

1.0 Introduction
2.0 Objectives
3.0 Main Contents
    3.1 Meristems Defined
    3.2 Types and Functions of Meristems
4.0 Conclusion
5.0 Summary
6.0 Tutor-Marked Assignment
7.0 References/Further Readings

1.0 Introduction

In unit 2, you learned the life cycles in flowering plants as well as the tissue systems. In this unit, you will learn about meristems, unique regions in plants where tissues originate. Shoot apical, root apical and lateral meristems will be discussed in the unit.

2.0 Objectives

After learning the contents of this unit, you should be able to:

- define what meristems are
- discuss apical and lateral meristems
- name the tissues that originate from the meristems

3.0 Main Points

1.1 Defining meristems
1.2 Types of meristems
3.3 Tissues arising from the meristems

3.1 Defining Meristems

Meristem is a layer of actively diving cells, non-vacuolated cells found in regions of growth in plant, e.g. between eylern ad phloem. Meristems are the only areas of cell dullsion in plants, the principal meristems being situated at the tips of stems and roots commonly known as apical meristems.

Self-Assessment Exercise 1

1. Explain in your own words the concept of "meristerm"
2. What are the functions of Meristerms?

3.2 Types of Meristem

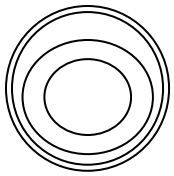
There are basically three types of meristem that include the following:

1. Shoot apical Meristem:
   This is found at the dome-shaped bud. The cells actively divide through mitosis and mass of new cells in formed. At first, these cells are small with thin walls but they soon enlarge with thick walls of cellose. During this meristem activity, the mass of new cells that have been formed loose their ability to divide as they are moved further and further away from the meristems (Ambuno *et al*. 2008).

2. Root apical meristem
   The meristem of the root is protected by a hood-shaped root cap made of parenchyma cells. The outer layers of the cap are rubbed off by contact with the soil particles as the root pushes its way into the soil. As the cell are warn away, new cells are added on the inside by the activity of the meristem called calyptrogens (Ambuno *et al*. 2008).

3. Lateral Meristems
   Also during the growing season, the older stems and roots of many plants thicken. The increase in girth starts with lateral meristem each a cylindrical array of cells that forms inside stems and roots. One lateral meristem the vascular cambium, produces secondary vascular tissues (Starr, 2000).

The 3 meristems outlined above or illustrated in Figure 1



Self-Assessment Exercise 2

1. List the 3 meristems found in flowering plants
2. Describe fully the root apical and the lateral meristems

3.3 Tissues arising from the meristems

The lengthening of every shoot and root originates at apical meristem located in their dome-shaped tip. The cells that emerge at the initial stage become the primary meristems known as protoderm, ground meristem and procambium. These are immature forms of the primary tissues, epidermis, ground tissue and vascular tissue respectively.

Self-Assessment Exercise 3

Name the tissues that arise from the meristems

4.0 Conclusion

Meristems are localized regions from a plant whose cells are actively dividing to produce mass of cells which after sometime differentiate, elongate and form different tissues in the plant. Plants grow at 3 places, viz, at the shoot apical meristem, at the root apical meristem and at the lateral meristem which lead to the growth and development of the vascular bandle.

5.0 Summary

In this unit, you have learned the meaning of meristem, that is is a region of active cell division at 3 localized regions in a plant. The shoot apical meristem, the root apical meristem and the lateral meristem represent the growth regions of the plant. The plant is growing continuously growing in these regions throughout its life span.

6.0 Tutor-Marked Assignment

1. What is a meristem?
2. Mention the 3 meristems found in a plant

7.0 References/Further Readings

MODULE 1: PLANT STRUCTURE AND FUNCTION

UNIT 4: PLANT TISSUES

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    3.1 Simple Tissues
    3.2 Complex Tissues
    3.3 Dicot Tissues
    3.4 Monocot Tissues
4.0 Conclusion
5.0 Summary
6.0 Tutor-Marked Assignment
7.0 References/Further Readings

1.0 Introduction

Tissue is a mass of similar cells specialized for a particular function example connective tissue, nervous tissue. In this unit, you will learn structure and function of various types of plant tissues. The unit explains simple tissues such as parenchyma, collendyma, and complex tissues such as xylem and phloem tissues. The unit also discusses monocot and dicot tissues.

2.0 Objectives

After studying this unit, you should be able to:

- define simple tissues
- explain what complex tissues are
- describe dicot tissues
- discuss monot tissues

3.0 Main Points

3.1 Simple Tissues

Tissues refer to groups of cells that are similar in form and function. When tissues are made up of only one types of cells, they are called simple tissues such as parenchyma, collenchymas and schlerenchyma. Tissues that are made up of different types of cells are called complex tissues. thus, xylem and phloem tissues are complex tissue.

a. Parenchyma cells are simple tissues characterized by
   i. thin wall
   ii. capable of cell division
   iii. photosynthetic and
   iv. ability to store food

b. Collenchyma cells are elongated with thick walls and adapted for the support of young growing stems and organs.

c. Sclerenchyma cells contain thick secondary wall often containing lignin a hard substances. See diagrams of the 3 types of simple tissues.

Self-Assessment Exercise 1

1. Define simple tissues
2. List features of parenchyma cells

3.2 Complex Tissues

These are tissues made up from different types of cells. Two vascular tissues, xylem and phloem are typical examples of complex tissues. Xylem conducts water and dissolved minerals. It also helps in supporting the plant. The cells of xylem are deat at maturity and are called vessel members and tracheids. The cell walls in xylem tissue form water-conducting pipelines and strenthem plant parts (Starr, 2000). See diagrm of xylem tissues.

Phloem conducts sugars and other solutes. Its main conducting cells, called sieve-tube members are alive at maturity. (see diagram illustrating phloem tissues).

Dermal tissues are also complex in nature. All surfaces of primary plant parts are covered and protected by a dermal tissue system called epidermis.

Dicots and monocots are the two classes of flowering plants. Most trees and shrubs other than conifers, such as maples, elms, roses, cacti, peas, beans, lettuces, cotton and carrots are dicots, palm trees, lillies, orchids, bamboos, wheat corn, sugarcane and pineapples are familia monocots.

Self-Assessment Exercise 2

1. Explain in your own word the meaning of complex tissues
2. Describe the features of xylem tissues

4.0 Conclusion

Tissues can be simple or complex. The latter is made up of different cells while the former is made up of same types of cells. Parenchyma tissue is a simple tissue while xylem and phloem are complex tissues.

5.0 Summary

Tissues are mass of cells that are structurally and functionally similar. Tissues can be simple or complex. Parenchyma, schlenchyma and collenchymas cells are simple tissues, while phloem and xylem tissues are complex. Dicots and monocots have the same tissues but different features. Most of the plant body consists of parenchyma, collenchymas and sderenchyma. Each of these simple tissues is composed of only one type of cell.

Xylem and phloem are vascular tissues monocots and dicots consists of the same tissues, but each has some of the tissues organized in distinctive ways.

6.0 Teacher-marked Assignment

1. Describe the features of Xylem tissues
2. Explain the nature of parenchyma cells

7.0 References/Further Readings

Ambuno, S., Egunyomi A., Osakwe V.C. (2008) *Comprehensive Certificate Biology for Senior Sec. Schools*

Starr, C. (2000) Biology: Concepts and Applications. Brooks/Cole United Kingdom.

MODULE 2: ENVIRONMENTAL BIOLOGY

UNIT 1: POPULATION ECOLOGY

CONTENTS

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    3.1 Population Defined
    3.2 Factors Affecting Population Growth
    3.3 Population Studies
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5.0 Summary
6.0 Tutor-Marked Assignment
7.0 References/Further Readings

1.0 Introduction

This unit focuses on ecology, environmental Biology that deals with the systematic study of how organisms interact with one another and with their physical and chemical environment. Ecological interactions start within and between populations and they extend on through communities, ecosystem and the biosphere. In this unit, emphasis is on population ecology, its characteristics, density, birth and death rates, and immigration.

2.0 Objectives

After studying this unit, you should be able to:

- define the concept population
- enumerate factors that affect population growth
- carry out basic population studies

3.0 CONTENT/MAIN POINTS

3.1 Population Defined

Hantmann and Pigford (1984) define population as "the total number of animals or plants in a given region. The term is often restricted to the number of a given species". Thus, population is a collection of organisms of the same species living in a particular area or space. To illustrate this further, the total number of tilapia fish in a fond; total number of mango trees in an orchad and the number of grasshopper in a given area all represent the populations of the organisms mentioned. A population may show a pattern of logistic growth and may be influenced by birth rate, death rate and availability of resources.

Self-Assessment Exercise 1

1. Explain the concept "Population"
2. How does birth rate and death rate affect population?

3.2 Factors Affecting Population

Population of a given areas may be affected by several factors. One factor is "carrying capacity" which refers to the maximum number of individuals that can be sustained indefinitely by the resources of a given environment. The number may rise or fall with changes in resources availability (Starr, 2000). Population is similarly affected by birth rate, death rate, immigration, emigration and disease/calamity, wars, famine, and natural disasters.

Self-Assessment Exercise 2

List any 5 factors that affect population of a given area

3.3 Population Studies

From time to time, biologists wish to know the population of a given species per unit area. This can be established by conducting population studies. In conducting such studies, population density can be determined by using quadrat sampling techniques. In this technique, a quadrate with grids is thrown. At every throw, the number of each species within the quadrat is noted. The average number of occurrences of each species in a quadrate (frequency) is recorded. To calculate the density of a species, the frequency is divided by the area of the quadrate. In this way the population density of the species can be determined.

Self-Assessment Exercise 3

Explain how you can use a quadrate to determine the population of grasshopper in a given habitat.

3.4 Techniques of Studying Populations

Several methods or techniques are used to estimate populations of organisms in a given area. Ambuno *et al* (2008) suggest the use of :

i. quadrate sampling
ii. transect sampling and
iii. marking-recapture sampling

i. Quadrat Sampling

A quadrate is a rectangular or square-shaped wooden or metal frame. It is thrown randomly within the study area. At each landing of a throw, the are covered by the quadrate is observed, noting the species and number. By throwing the quadrate several times, the average number of occurrences of a species is known.

ii. Transect-Sampling

In this technique, a rope or tape marked at regular intervals is stretched across the study plot. Plants occurring at the marked intervals are recorded. If this is done several times in different places, the types of plants and their numbers can be estimated.

iii. Marking-recapture Sampling

This technique is used to estimate population sizes of animals such as fish, insects, birds and reptiles. Many animals of a particular species are caught, marked individually and the number recorded as A. These animals are then released back into the population, giving them some time to mix with other members of the population.

The animals are captured again and their numbers (marked and unmarked) recorded as B. Out of these, the numbers of marked animals from the previous catch is recorded as C. The population size is then estimated by using the formular:

$$\text{Population} = \frac{A \times B}{C}$$

(Ambuno *et al.* 2008)

Self-Assessment Exercise 4

1. Name 3 techniques of determining population of organisms
2. Explain the meaning of population density

4.0 Conclusion

Ecology is the systematic study of organisms with reference to their environment. Population ecology studies population of organisms in the environment.

5.0 Summary

Population refers to a collection or a group of organisms of the same species which occupies a particular space. Population of a given organisms is not always constant. It changes from time to time due to factors such as birth rate, death rate, calamity, immigration, emigration and availability of resources in the environment. Several methods or techniques are used to estimate population of organisms. Quadrate sampling, transect-sampling and marking recapture sampling are often used to estimate populations of organisms.

6.0 Tutor-Marked Assignment

2. Define the concept population
3. List 5 factors that affect population
4. Discuss methods of estimating population of organisms

7.0 References/Further Readings

Hartmann-P., and Pigford J.N. (1984) *Dictionary of Science* Edward Arnold London.

Ambuno, S, Egunyomi E and Osakwe, V. C. (2008) Comprehensive Certificate Biology for Senior Sec. Schools. UP PLC, Ibadan.

Starr, C. (2000) Biology: Concepts and Applications. Brooks, Cole U. K.

MODULE 2: PLANT STRUCTURE AND FUNCTION

UNIT 5: PLANT GROWTH AND DEVELOPMENT

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    3.2 Criteria used to Classify Organisms
    3.3 Major Groupings of the Plant Kingdom
    3.4 General and Species of same Plants
4.0 Conclusion
5.0 Summary
6.0 Tutor – Marked Assignment
7.0 References/Further Readings

1.0 Introduction

In unit 4, you have learned about plant tissue, simple and complex, in this units you will learn the process of growth and development in plants. specifically the unit discusses growth and its mechanism of cell division, cell differentiation and development and also gives an overview of factors that affect growth.

2.0 Objectives

After studying this unit, you should be able to:

- Explain the process of growth
- Given an overview of growth mechanism
- Discuss mitosis and meiosis
- Outline factors attesting growth

3.0 Main Points

3.1 Growth Defined
3.2 Mitosis the mechanism of Growth
3.3 Differentiation and Development
3.4 Factors Affection Growth.

3.1 Growth Defined

Growth is one of the seven life processes common to all living things. It is an irreversible or permanent increase in size of an organisms due to formation of new cytoplasmic materials in other words, growth is increase in cellular mass of an organism which is characterized either by an increase in the size of an individual cell or by the division of a cell into two daughter cells. Growth in plants takes place in localized points called meristems, which you have studied in unit 3.

Self – assessment Exercise 1

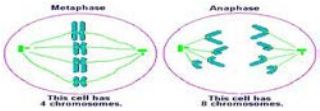
1. Explain in your own words the concept of growth.
2. Name the growth regions in plants

3.2 Mitosis – the mechanism of Growth

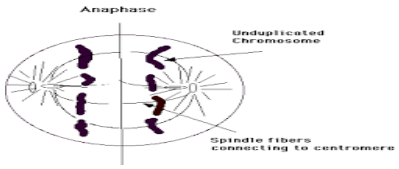
Mitosis is a type of cell division taking place during an organisms normal growth, in which the chromosome numbers is not reduce and which results in the equal division of the nucleus. Mitosis is a continuous process and follows a sequence of phases, namely: prophase, metaphase anaphase and telophase, see fig. 1

Prophase

Metaphase



Anaphase



Telophase

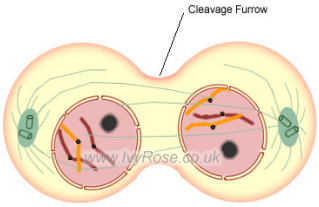


Fig. 1 Mitosis

Self – assessment Exercise 2

1. Explain the process of mitosis
2. Draw and label the stages of mitosis

3.3 Differentiation and Development

At the cellular level, the most significant growth process is increase in cell number by mitosis as explained above. At the molecular level, molecular growth is needed and this involves the process of growth and differentiation. The latter refers to the acquisition of specific structural and functional properties by different cell such that the cells become specialized in different ways to carry out activities expected of it.

At meristems, new cells are produced. As new cells move further away from the meristems, they loose the ability to divide and become differentiated from one another this phenomenon is called differentiation. At maturity, when differentiation is completed, some cells continue to live for the development of the organism.

Self – assessment exercise 3

1. What is differentiation of cells?
2. Explain what happens at the meristem

3.4 Factor Affection Growth

Several factors are known to affect the process of growth in organisms. In plants some of the factors are external while others are within the plant itself. The external factors include (i) availability of nutrients, (ii) temperature (iii) Sunlight (iv) and PH concentration. Those factor that are internal to the plant indole acetic acid (IAA), gibberline and kinins.

Self – assessment Exercise

1. Name the internal factors affecting growth in plants.
2. Describe the functions of IAA and gibberlins in plants

4.0 Conclusion

Plant growth at cellular level takes place through mitosis – a process that lead to increase in cell numbers. At the molecular level, differentiation of newly produced cells at the meristerns lead to cells elongating and assuming specialized functions for development.

5.0 Summary

Growth is an irreversible increase in mass due to increase in protoplasm. If is one of the seven life processes common to all living things. In plants growth take place in some localize regions called meristems. There meristem i.e shoot apical, root apical and lateral meristems are actively producing new cells via mitosis. These cells, elongate, differentiate and assume specialized functions for the growth and development of the plant. Several factors are known to affect growth in plants. Such factors are availability of nutrients, intensity of sunlight, PH medium and temperature. Other factors centure on hormonal influence on the growth pattern of the plant. Such hormones as IAA, gibberins, auxins and kinis have one kind of effect or another, i.egiantism or dwarfism.

6.0 Tutor – Marked Assignment

1. Explain the process of growth
2. Describe the process of mitosis in plants
3. Name 3 factors that affect growth in plants.

7.0 References/Further Readings

Embuno, S.; Egunyomi A, Osakwe, V.C (2000) comprehensive certificate Biology for senior Secondary school Up Plc, Ibadan

Starr,C (2000) Biology, Concepts and Applications. Brooks/Cole UK.

MODULE 2: PLANT STRUCTURE AND FUNCTION

UNIT 2: PLANT CLASSIFICATION

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    3.2 Criteria used to Classify Organisms
    3.3 Major Groupings of the Plant Kingdom
    3.4 General and Species of same Plants
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7.0 References/Further Readings

1.0 Introduction

The living world consists of numerous types of plant and animals that vary in form, appearance and origin. It is estimated that there are over a million different kinds of animals and over three hundred thousand different kinds of plant (Ambuno et al 2009). Hence the need to sort them out into groups. This is the focus of this unit.

In this unit, you will learn the meaning and rationale for classification, and the criteria used to classify the plants, and major groupings of the plant kingdom

2.0 Objectives

After studying this unit you should be able to:

- Explain the meaning of Classification
- Justify the need to classify organisms
- List criteria used to classify plants
- Mention general and species of some plants

3.0 Main Contents

3.1 Classification

Meaning and Rationale living things are very numerous and are found on land, in sea and in the air. For easy reference, it is obvious that plants and animals have to be sorted out according to their similarlies. The grouping of organisms on the bases of their common features is called classification. The science of classification is known as taxonomy, which deals with identification and naming of organisms.

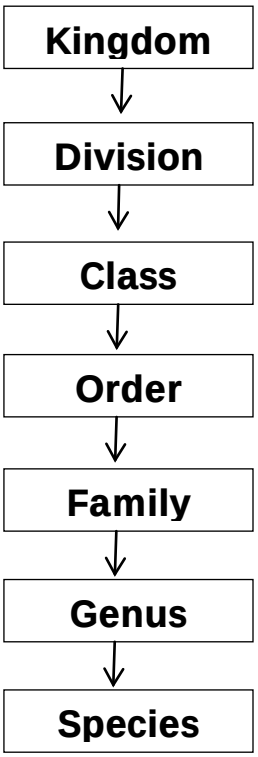
Self p Assessment Exercise 1

Explain the meaning of "Classification why is it important to classify organisms"

3.2 Criteria used to classify and name organisms many criteria are used in classifying organisms:

i. External features
ii. Internal feature
iii. Evolutionary records
iv. Evidences from physiology
v. Evidences from embryology
vi. Evidences from anatomy

Placing organisms into groups is called systematies it is one thing to sort out organisms into appropriate grouping. It is quite another thing to name the organismsscientification. Binomial system of nomenclature is used to name an organisms the system was deviced by a Swedish naturalist called Linnaeus. In this system each organisms is given two names, generic and specific names, example Zea mays for maize and mangeferaindica for mango. According Linnaeus, the classification is done in herarchy outlined thus:



Self – Assessment Exercise 2

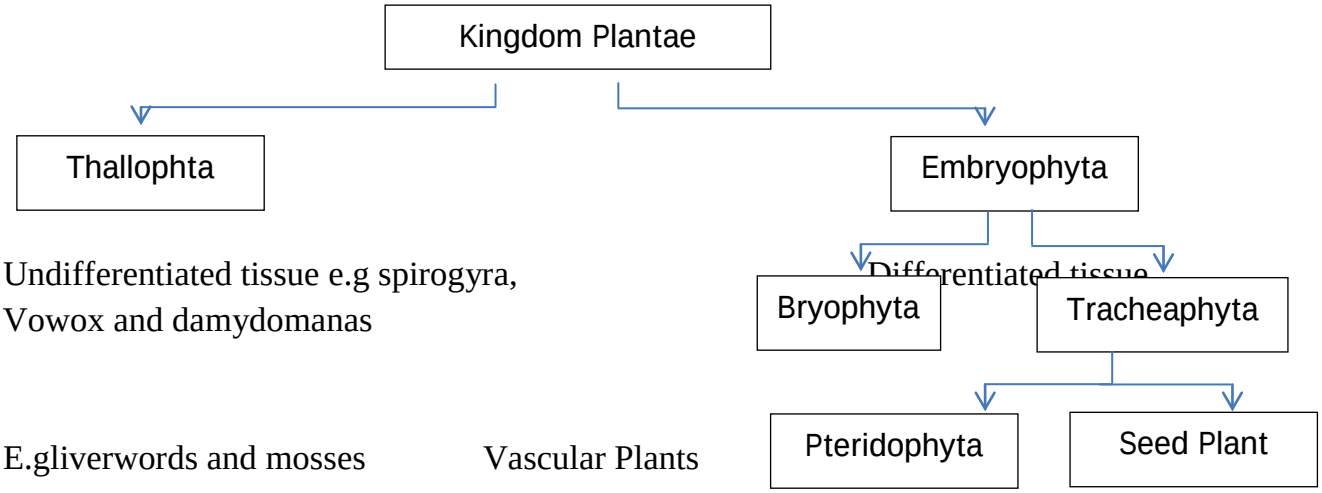
List any 5 criteria that are used in classing an organisms.

3.3 Major Grouping of the Plant Kingdom.

Kingdom plantae consists of two major Divisions of the green plants, namely (i) the Thallophyta and (ii) the Embryophyta. Ambuno et al (2008) outlines the differences between the two as follows:

Thallophyta	**Embryophyta**
1. Primitive from evolutionary trend	More advance
2. Undifferentiated tissue called thullus.	Tissue differentiated into simple roots, sterns, leaves
3. Unicellur reproductive structure	Reproductive structure are multicellur
4. Zygotes do not develop into embuno within the female reproductive organs where they are.	Embryo starts development within the female reproductive organs hence the name embrophyta

Members of the plant kingdom are further illustrated in figure 1



Self – assessment 3

Describe briefly the features of the biyophytes

4.0 Conclusion

Plants are very many and vary. There are 300,000 different types of plants to study them effectively and for easy reference, plants are classified using many criteria. Sorted plants are then named using binomial normenclat using generic and specific names.

5.0 Summary

The scientific way of classifying living organisms is known as taxonomy. Several criteria such as internal features, external structures, physiological and anatomical as well as evolutionary trends are used to classify living things. A Swedish naturalist, Linnauesdeviced a way of naming organisms where an organisms is given two names, generic and specific, using this system, maize is known as Zea mays, mango is called mangiferaindica.

The kingdom plnatae consists of Thallophyta and embryophyta. The former consists of undifferentiated tissue called “thullus” e.g spirogyra and volvox. The former contents the more advanced plants with which we are more formuliar.

6.0 Tutor – marked Assignment

Explain the concept “taxonomy” Discuss the classification of plants.

7.0 References/Further Readings

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MODULE 2: ENVIRONMENTAL BIOLOGY

UNIT 2: ENERGY FLOW IN AN ECOSYSTEM

Contents

1.0 Introduction
2.0 Objectives
3.0 Main Contents
    3.1 Ecosystem Defined
    3.2 Components of an Ecosystem
    3.3 Energy Flow in an Ecosystem
    3.4 Trophic Levels
4.0 Conclusion
5.0 Summary
6.0 Tutor – Marked Assignment
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1.0 Introduction

In unit, you have learned the concept of population, factors affecting it and techniques of population study. This unit focuses on energy flow in an ecosystem. An ecosystem is a community of organisms consisting of producers, with one another and with the environment. You will learn in the unit, components of the ecosystem and the role they play and the flow of energy from the primary source to every individual in the ecosystem

2.0 Objectives

After studying this unit, you should be able to:

- Define the concept “ecosystem”
- Outline components of the ecosystem
- Describe the energy flow in an ecosystem
- Discuss trophic levels in an ecosystem

3.0 Main Points

3.1 Ecosystem Defined

An ecosystem is an association of organisms and their physical environment, interconnected by an ongoing flow of energy and a cycling of materials through it (Starr, 2000). Every ecosystem is an open system, in that it has inputs and outputs of both energy and nutrients. Whether an ecosystem is a pond, a sea shove, a savannah grassland or an Antarticecosystem, the participants or components remain predominantly similar in set-up and functions

Self-assessment Exercise I
Define ecosystem in your own words

3.2 Components of an Ecosystem

An ecosystem consists of producers, consumers decomposers and detritivones and the energy flow and a cycling of materials. The producers are the automophes, the green plants that manufacture food through the process of photosynthesis. These organisms capture energy from the sum and eventually fix it into compounds that they produce and ultimately get to the ecosystem.

The consumers are the heterotrophes, the animals that consume the food synthesized by the green plants, consumers may be primary, secondary or tertiary, according to the level or position in the food chain. The decomposers are members of the ecosystem that decompose compounds and release the material into cycles.

Self-assessment Exercise 2

1. Name the components of an ecosystem
2. Explain the role of autotrophes.

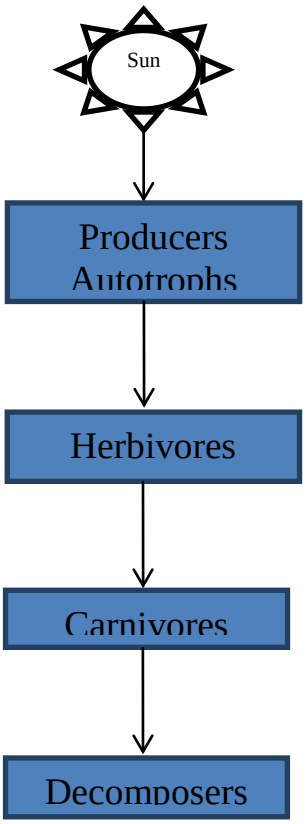
3.3 Energy flow in an Ecosystem

In any ecosystem, energy flows in only one direction. Most commonly, energy flow begins when photosynthetic autotrophes harness sunlight energy and convent it to forms that they and other organisms of the ecosystem can use. Autotrophs are primary producer organisms for the ecosystem. (Starr, 2000).

Energy-rich organic compounds that the primary producerssysnthesise become incorporated in their body tissues. They are stone forms of energy, and they serve as the fouldation for the ecosystems food webs. Such webs consist of a number of interconnected food chains.

3.4 Major Pathways of Energy Flow

Plants fix only a small point of the energy from the sun. they stone half of that in new tissues but lose the rest as metabolic heat. Other organisms tap into energy stored in plant tissues, remains or wastes and they too loose heat. All of these heat losses represent a one – way flow of energy out of the ecosystem. See figure I, for illustration.



Self – Assessment Exercise 3

1. What is the ultimate source of energy in an ecosystem
2. Discuss the flow of energy in a freshwater ecosystem

3.4 Trophic Level

All organisms in an ecosystem can be classified in a accordance to their functional roles in an order of feeding relationship, called trophic levels "who eats whom" see figure 2 for illustration.

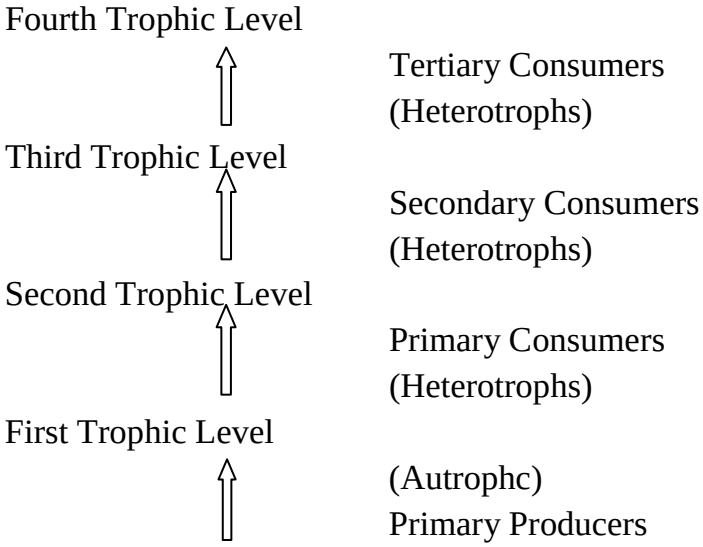


Figure I Trophic level in an Ecosystem

Self – assessment Exercise 4

1. Explain the meaning of trophic level
2. Draw a simple food chain in a savannah ecosystem

4.0 Conclusion

An ecosystem consists of producers, consumers, decomposers and detritivones and the physical environment, connected by a one – way energy flow and a cycling of material. A food webs is a network of crossing, interlinked food chains involving primary producers, consumers and decomposers.

5.0 Summary

An ecosystem is an arry of producers, consumers, detrilivones and decomposer and their environment. It is an open system, with inputs and outputs of energy and nutrients. There is a one-way flow of energy into and out from an ecosystem and a cycling of material among its organisms. Ecosystem are generally in stable and

balanced conditions. Disturbance of one aspect of an ecosystem often has unexpected effects on other, seemingly unrelated parts. Besides, human activities are also disrupting the natural cycles of material and are thereby endangering ecosystems

6.0 Tutor – marked Assignment

1. Define the term ecosystem
2. Explain what energy flow is
3. List the components of an ecosystem

7.0 Reference/Further Readings

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UNIT 3: BIOGEOCHEMICAL CYCLES

CONTENTS

1.0 Introduction
2.0 Objectives
3.0 Main Content
    3.1 Biogeochemical Cycles
    3.2 The Cycling Elements in Biogeochemical Cycles
4.0 Conclusion
5.0 Summary
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7.0 References/Further Readings

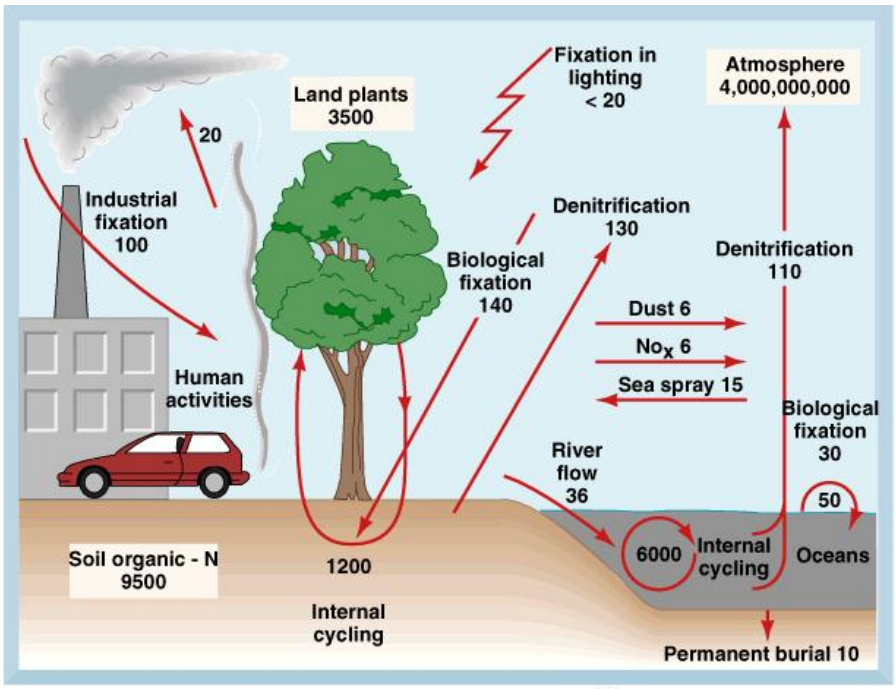
1.0 Introduction

All matter cycles which is neither created nor destroyed. The earth is essentially a closed system in respect to matter which amounts to the cycling of all matters.

The cycling in the biogeochemical cycles can be viewed in general and by matter which are in form of elements like carbon, nitrogen, oxygen, phosphorus or molecules (water). And the earth system can be subdivided into:

- Atmosphere
- Hydrosphere
- Lithosphere and
- biosphere

The movement of matter between these parts of the earth system is what is referred to as biogeochemical cycles. These cycles are part of the larger cycles that describe the functioning of the whole earth. These cycles are those in which human interact.



The global nitrogen cycle. Pools (□)and annual (→) flux in $10^{12}gN_2$. Note that the industrial fixation of nitrogen is nearly equal to the global biological fixation. (*SOURCE:* Data from Söderlund, and T. Rosswall, 1982 , O. Hutzinger (ed.), *The Handbook of Environmental Chemistry,* Vol 1, Pt. B., Springer-Verlag New York, Inc., New York).

Generalized biogeochemical cycle

2.0 Objectives

This unit examines the biogeochemical cycles and by the end of it you are expected to be able to:

1. define the biogeochemical cycles
2. explain each one of the different cycles
3. determine the effects of human activities to these cycles
4. draw the cycles of matter in the biogeochemical cycle
5. relate these cycles to what you can see happening around you.

3.0 Main Content

3.1 Biogeochemical Cycles

In the earth system, the geological cycle includes:

- tectonic cycle
- rock cycle
- hydrologic cycle

- biogeochemical cycles

But for this unit, the focus shall be on the hydrologic cycle and the bio-geochemical cycles which are those in which the humans interact the most. We shall look at each of these in details.

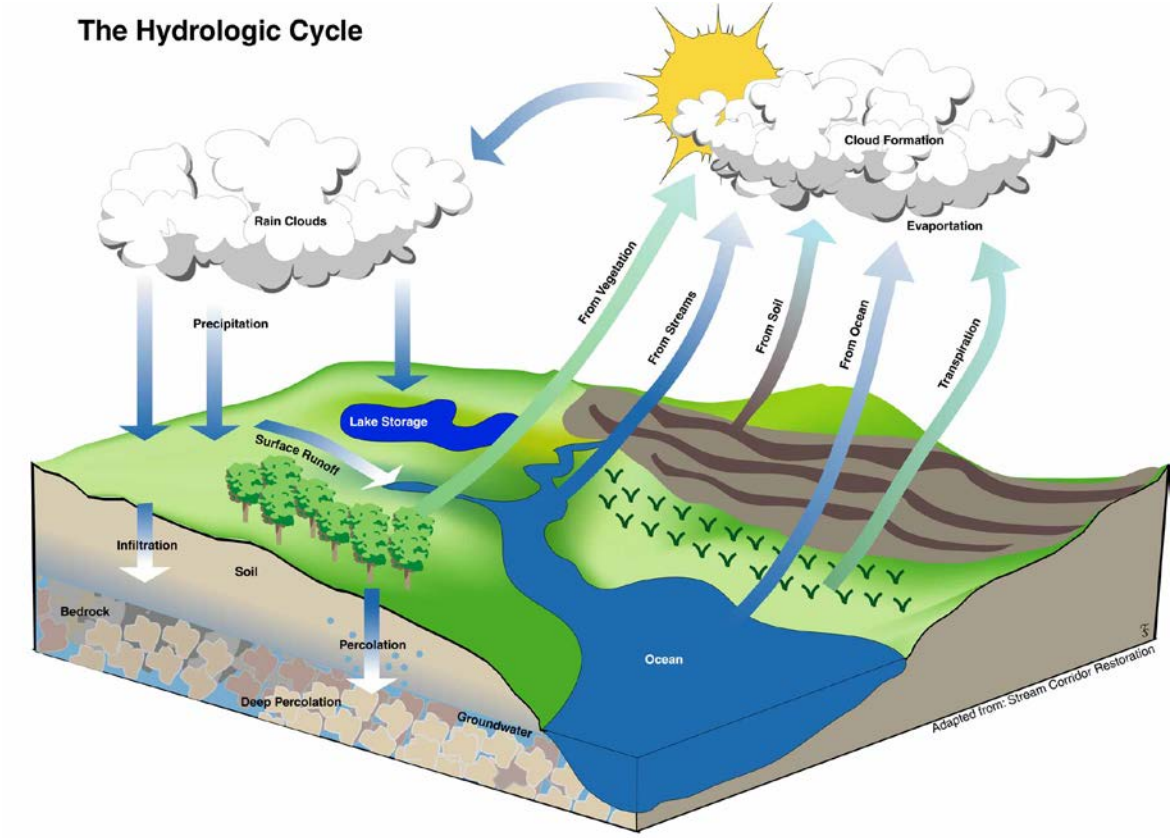


Fig. 2: Hydrologic Cycle (Water Cycle) Showing the Transfer of Water from Ocean to the Atmosphere and back to the Ocean again.

Water cycle is a continuous circulation between the atmosphere and the earth's surface. The energy required for driving this cycle is directly or indirectly from the sun. the earth's water is constantly being recycled so that the total amount remain constant. However, the distribution of water across the globe changes over time from place to place. Ninety-eight percent of the water is in the oceans, rivers, lakes, streams, and rivers that make up about two-third of the earth's surface. Most of the remaining water is in living organisms, glaciers, polar ice, water vapour and in the soil.

When rainwater falls on the land, solar heat evaporates some back to the atmosphere. The water left is drunk by animals absorbed by plants while runoffs

drain into the seas, lakes and some sink through the soil to accumulate as ground water. This penetrates the land until it reaches an area of saturation known as the "water table". Water in the water table may emerge from beneath the surface in the form of "springs" and artesian wells.

Water evaporates from the bodies of water and is transpired by plants which make up more than 98% of the earth's "biomas". Water also evaporates from the surfaces of animals and damp areas of the earth as the sun shines on them. The water vapour rises into the atmosphere, condenses andfalls back to earth in form of rain, snow, and hail in a constant cycle. The endless cycling of water on earth as rain, back to the atmosphere through evaporation, then back again to earth as rain, maintains the various aquatic environments and water supplies needed for life on land. This continuous cycling is referred to as "water cycle" (Fig 2 and 3).

The water cycle has been disrupted by humans in many ways beyond "aquifer depletion".

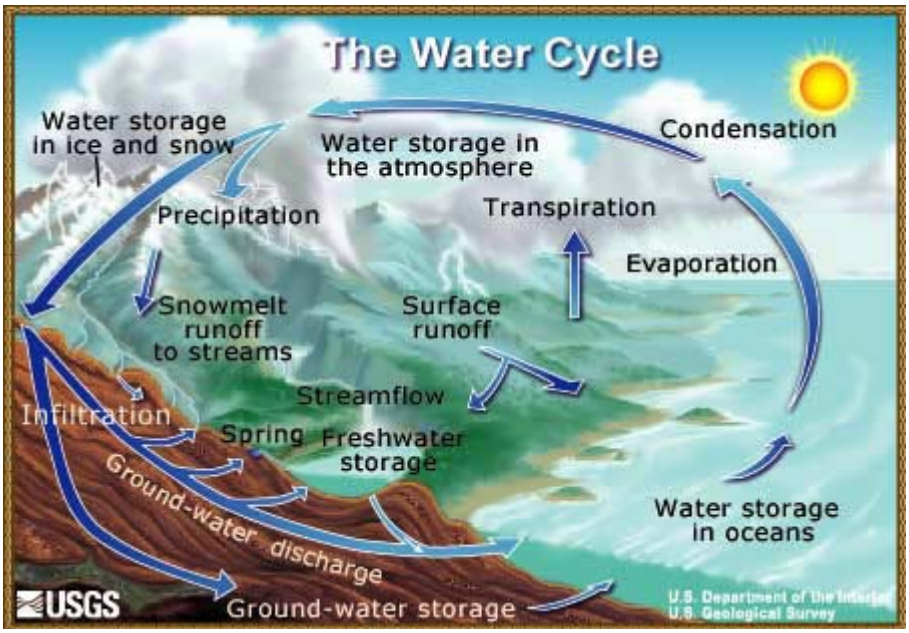


Fig 3: Water Cycle

The creation of reservoirs, large-scale irrigation projects, and even the use of air conditioning have created a major redistribution of fresh water. High global temperatures are increasing evaporation and transpiration rates leading to many parts of the globe becoming more arid.

The water cycle carries many chemical nutrients through the ecosystem. It is therefore, an important factor in modifying environmental temperatures.

3.2 The Cycling Element in Biogeochemical Cycles

The Carbon Cycle

The carbon cycle can be defined as the process by which the circulation of carbon found in the organic molecules of living things and this is derived either from carbon dioxide in the air or the bicarbonate ions dissolved in water. In the process of "feeding" (acquiring the energy living thing need to maintain themselves and grow, respire), bacteria process. Carbon (and nitrogen) in such a way that allows these elements to be recycled (Fig. 4).

Bacteria feed on organic matter (carbohydrate) thereby using up the energy and releasing carbon dioxide.

Other sources of carbon are the sedimentary limestone ($CaCO_3$) deposit, dead remains of organisms as a gas in the atmosphere constituting 0.03% of the air and in fossil fuels such as coal and natural gas.

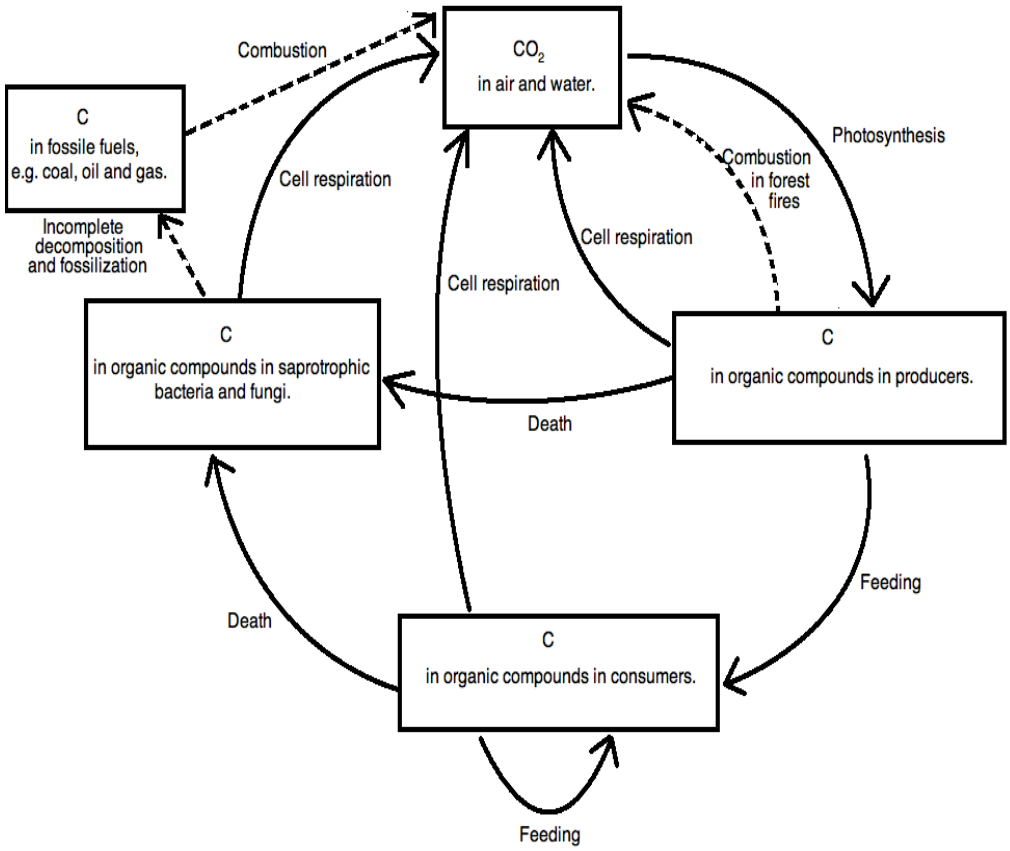


Fig. 4: Carbon Cycle

By means of photosynthesis green plants (primary producers) extract carbon from the atmosphere incorporating it into sugars and other complex organic molecules to produce plant tissues.

The plants are in turn eaten up by animals (primary consumers) which digest the plant and absorb the plant materials, converting it into compounds which make up the tissues of the animals. By this process the carbon atoms in the plants are now passed into the food chain by the animals. The animals release these into the environment via faeces and urine.

During respiration, animals and other organisms in order to obtain energy release carbon dioxide and water into the atmosphere as wastes. While at death, these organisms decompose to be broken down by decomposers into complex carbon compounds which are broken down to form free carbon dioxide which returns to the atmosphere (Fig. 4)

These activities that is; photosynthesis, respiration and decay are very vital processes in the lives of organisms, ensuring that carbon in the form of carbondioxide is recycled.

Carbon dioxide plays a very important role in regulating the temperature of the earth's surface.

The heat radiated from the earth's surface get absorbed by carbon dioxide and it is radiated back to the earth's surfacing thereby warming the earth. This process is what is referred to as "green house effect".

Oxygen Cycle

The oxygen cycle is the biogeochemical cycle that describes the movement of oxygen within its three main reservoirs; the "atmosphere" (air), the total content of biological matter within the "biosphere" (sum total of the ecosystem) and the "lithosphere" (earth's crust). The major or main driving factor of oxygen cycle is photosynthesis which is responsible for life on earth.

The largest of earth's reservoirs of oxygen is found within the silicate and oxide minerals of the curst and mantle forming about 99.5%. only a very small portion has been released as free oxygen to the biosphere (0.01%) and atmosphere is photosynthesis which produces sugars and free oxygen from carbon dioxide and water.

$6CO_2 + 6H_2O \xrightarrow{Sun\,(energy)} C_6H_{12}O_6 + 6O_2$

The photosynthesizing organisms are the plants on land and the "phytoplankton" of the oceans.

Tiny marine "cyanobacterum prochlorococcus" discovered in 1986 also account for half of the photosynthesis of the open ocean.

Another source of atmospheric free oxygen comes from "photolysis" which is the breaking down of atmospheric water and nitrous oxide by high energy "ultraviolet" radiation into component atoms. The free H and N atoms escape into space leaving O_2 in the atmosphere:

$2H_2O + energy \rightarrow 4H + O_2$

$2N_2O + energy \rightarrow 4H + O_2$

Free oxygen get lost from the atmosphere by respiration and decay when animal life and bacteria depend upon and release carbon dioxide back into the atmosphere.

The lithosphere (earths crust) also take up free oxygen by chemical weathering and surface reactions. Example of surface weathering chemistry is the formation of iron oxide (rust)

$4FeO + O_2 \rightarrow 2Fe_2O_3$

Oxygen can cycle between the biosphere and the lithosphere. Marine organisms in the biosphere produce "calcium carbonate" shell material ($CaCO_3$) that is very rich in oxygen. After death, the shells are deposited on shallow sea floor and when buried over time they create the "limestone" sedimentary rock of the lithosphere.

Oxygen Cycle Reservoirs & Flux

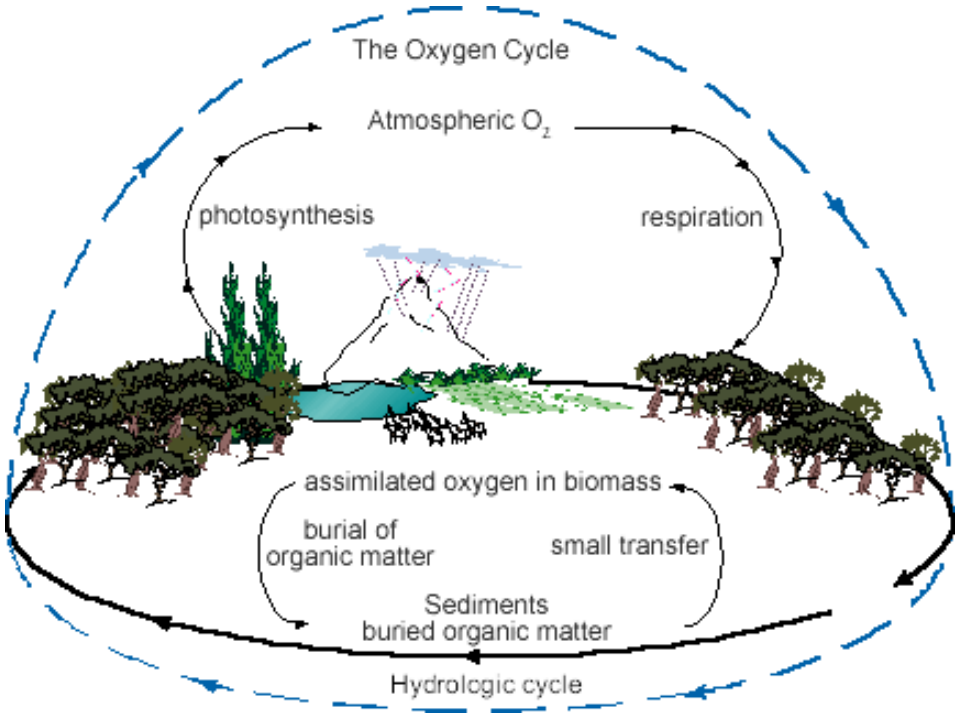


Fig. 5: Oxygen Cycle

The effects of human activities on oxygen and carbon dioxide levels in the atmosphere can be summarized in Table 1.

Table 1: Effects of Human Activities on Oxygen and Carbon Cycle

Human Activities	Oxygen Cycle	Carbon Cycle
1. Deforestation (results in less photosynthesic organisms)	More oxygen is removed from the atmosphere	Less oxygen is released into the atmosphere
2. Increased combustion of fuel	Less carbon dioxide is removed from the atmosphere	More carbon dioxide is released into the atmosphere
Overall effects	Oxygen level in the atmosphere decreases	Carbon dioxide level in the atmosphere increases

Nitrogen Cycle

Nitrogen in the atmosphere makes up 78% of its constituents and only about 18% are found in form of protein in the living cells. There are about 69,000 metric tons of nitrogen in the air over each hectare of land but the total amount of nitrogen in the soil do not exceed 3.9 metric tons per hectare.

The discrepancy results from the nitrogen in the atmosphere being "inert" which means it cannot combine chemically with other molecules readily. This makes it unavailable to plants and animals for their use in building proteins and other substances containing nitrogen. The plants obtain most of their nitrogen needs from the soil in form of inorganic compounds and ions from animals wastes through their roots. Animals through their digestive processes, bacteria and fungi breakdown the more complex molecules of dead plants and animals tissues to simpler ones. Nitrogen from the air is also fixed by been converted to nitrogenous compounds by various "nitrogen-fixing bacteria". Some of these organisms gain access to various species particularly legumes such as peas, ground nuts, beans, clover, alfalfa, etc. whose hair roots have nodules where colonies of these bacteria stay. While other bacteria are free living in the soil (Fig. 5).

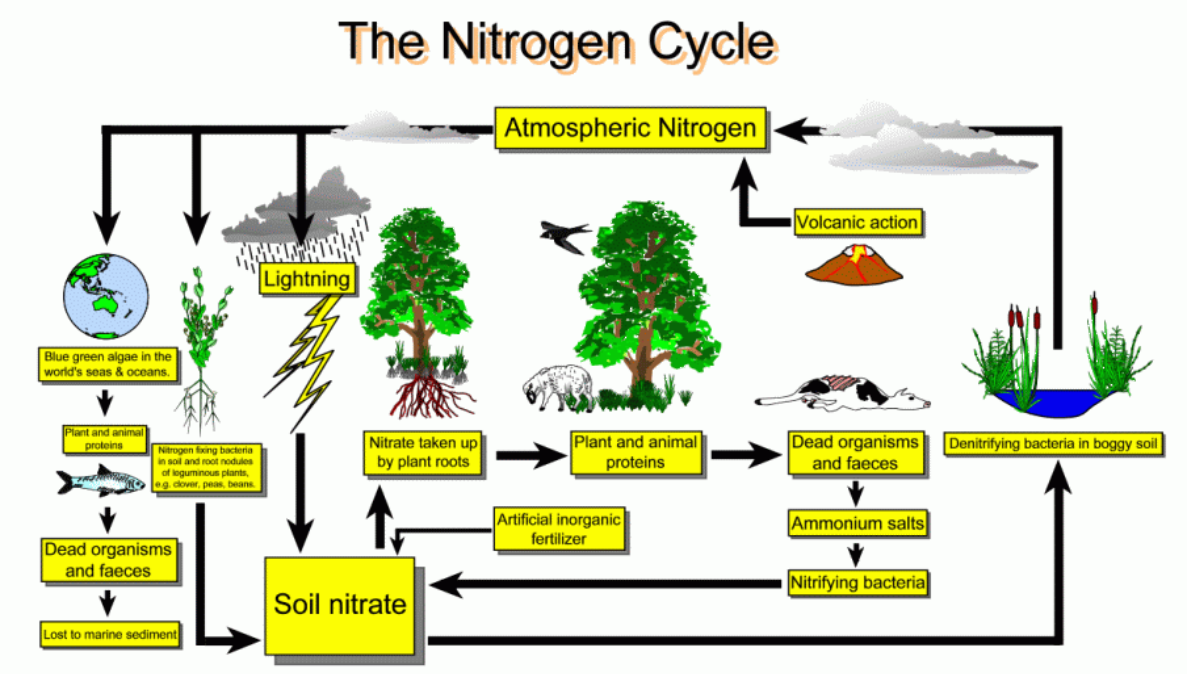


Fig 5: Nitrogen Cycle

In Fig 5, you can see that there is a constant flow of nitrogen from dead plants and animal tissues into the soil and back to plants. Decay bacteria and fungi breakdown great quantity of dead leaves and other tissues. With all these activities, the amount of nitrogen in the soil is still inadequate. That is why the addition of artificial fertilizer is very necessary in order to increase soil nitrogen content.

Nitrogen is constantly been lostthrough leaching as water carries away the topsoil during erosion. Also through the harvesting of crops, some nitrogen content is lost and this can be reduced if vegetable and animal wastes are recycled and returned to the soil.

Burning of grasses cause lost of nitrogen in the soil. The application of inorganic fertilizer usually looses the nitrogen through water leaching because nitrates remain in the water which are lost to the plants. The inorganic fertilizer is produced by fossil fuel. Much of the nitrogen from this fertilizer is lost by leaching because nitrates remain in the water and do not become attached to soil particles.

Precipitation returns a little nitrogen to the soil from the atmosphere, where it has accumulated as a result of the action of light on industrial pollutants, fixation by flashes of lighting and diffusion of ammonia released through decay. The activities of nitrogen-fixing bacteria and volcanoes also contributes to the natural way of replenishing the nitrogen.

The nitrogen cycle therefore is vulnerable to human disruption because most of it depends on the activities of microorganisms that are very sensitive to changes in pH and pollution.

Phosphorus Cycle

Phosphorus is an essential nutrient for plant and animals in the forms of ions (PO_4^{3-} and HPO_4^{2}). It is an important component of the DNA molecules, and that of stored energy (ATP and ADP) and that of fats of cell membranes. It is part of the building block of part of human and animal body such as bone and the teeth.

Phosphorus is also found on earth water, soil and sediments. Unlike others, phosphorus cannot be found in the atmosphere as gas. Usually, phosphorus is liquid at normal temperatures and pressures. So it's cycle is only within the water, soil and the sediments, though, it can be bound in the atmosphere as "dust" particles.

Its cycles is the slowest on land and in sediments, to living organisms and much slowly back into water, soil and sediments.

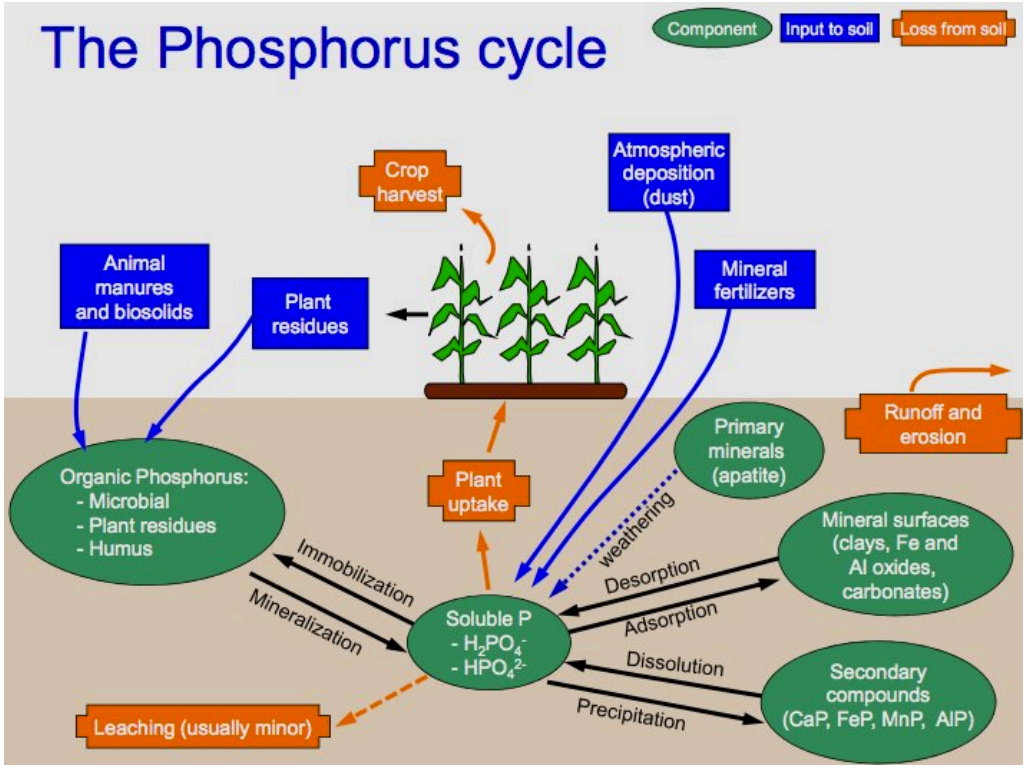


Fig. 6: Phosphorus Cycle

Phosphorus cycle is the biogeochemical cycle that describes the movement of "phosphorus" through the lithosphere, hydrosphere and biosphere.

4.0 Conclusion

In the biogeochemical cycles, there are elements and molecules that are continuously been recycled in order to maintain the balance in nature. Some of these were discussed in this unit. It was discovered in the unit that several activities of human are responsible to the depletion of some and increasing of others. These reduction or excess, are responsible for the changes occurring on the earth's surface such include the depletion of the ozone layer which now allows harmful ultraviolet radiations to penetrate to the earth's surface and the low yields in both the land and seas.

5.0 Summary

In the unit, you learnt about water on hydrological cycle, carbon cycle, nitrogen, oxygen and phosphorus cycles. You discovered that nature has a way of running

the cycles balanced and at equilibrium there by maintaining constant level of each elements. But human activities have ways of interrupting the cycles.

6.0 Tutor-Marked Assignment

1. Explain what you understand by biogeochemical cycles
2. Describe the contribution of microbial organisms in the fixing of nitrogen in the soil.

7.0 References/Further Readings

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UNIT 4: DIFFERENT HABITATS

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3.0 Main Content
    3.1 Different Habitats
    3.2 Factors influencing the habitat
    3.3 Terrestrial habitats
    3.4 Aquatic habitat
4.0 Conclusion
5.0 Summary
6.0 Tutor- Marked Assignment
7.0 References/Further reading

1.0 Introduction

In the biosphere, there are various types of habitat which refers to where living organisms live. There are two broad divisions which are;

1. Aquatic habitat, which refers to those living organisms, found in water and in environs. These can be subdivided into:
    - Marine habitat
    - Estuarine habitat
    - Fresh water

While the (2) is terrestrial habitat which consist of

- Marsh habitats
- Forests habitat
- Grass habitat
- Arid lands and
- Sahara desert

2.0 Objectives

By the end this unit, you would have learnt about the various types of habitat in the biosphere, you will be able to:

1. Identify the major habitat and division within them.
2. Mention factors influencing environment and habitat
3. Describe the various type of habitat

3.0 Main Content

3.1 Different Habitats

As have been described at the introduction that the biosphere consists of two major habitats, which are:

Aquatic, terrestrial, and each can be sub divided into

1. Aquatic- marine, estuarine (brackish water), and fresh water.
2. Terrestrial- marshes, forest grass lands an arid.

A habitat is defined as a particular area of an environment where plant, animals and other microorganism live. Any habitat may have a very large number of different plants and animals species living in it with their peculiarities. The plants and animals in a particular habitat is "population". Plants and animals of a particular habitat make up a "community". A community consists of population of various species, living together and is dependant to each other.

3.2 Factors Influencing the Habitats

These number of factors affecting the habitats can be group into two which "abiotic" (Physical factors) and biotic factors.

3.2.1 Abiotic factors

These are factors which are physical such as temperature, rainfall, light intensity, humidity, oxygen concentration, wind direction, velocity, salinity, topography, pH, carbon dioxide concentration, amount of pollutants in the environment. All these affect the distribution of plants and animals in the habitat. Temperature, rainfall and light intensity are part of climatic population of that habitat.

3.2.2 Biotic factors

The abiotic factors learnt about are the physical aspects of the environment operating within the habitat. In every habitat, the plants and the animals are dependant on one another and on the other living components with the habitats. All these living forms constitute the biotic factors.

Biotic factor can be classified into three heading, which are:

1. Effects of other animal's e.g. grazers, browsers, parasites pests, pollinating insects etc.
2. Effects of other plants(shading, climbing, parasites) etc
3. Effects of man e.g. agriculture, grazing, forestry, savanna-burning urbanization etc.

Table 2: Factors Influencing Distribution of Population in the Habitat

Abiotic Factors		Biotic Factors		Combined Factors	
Factor	Main Examples	Factor	Main Example	Factors	Main Examples
Light	Quality Quantity Duration	Competition Predation Mutualism Human activity		Soil type	Texture Organic content, soil air, soil water
Heat	temperature Extreme Seasonality		Pesticides, fire, domestication of animals and plants	Fire	
Water	salinity rain Nutrients rain Snow dew Humidity Water currents Pressure		Land use change eg in agriculture and dam construction		
Atmosphere	gasious content eg carbon dioxide, oxygen, air pressure, weather system.		Deforestation pollution eg linked use of fossil fuel.		
Topography	altitude Aspect Gradient		Contaminated land		

3.3 Aquatic Habitats

You will learn about the different aquatic habitats: which are;

Marina Habitat

A marine habitat is made up of the shore and the open sea. Due to the width and great depth of the sea it accommodates more living things than the land and fresh water combined together.

Some of the characteristics of the sea includes; Continuous circulation of water and strong trade winds which in turn set up definite currents. The moon and sun produce the waves and tides by their pulls. The sea also has salty water of o concentration of 3.5% salt. The organisms have an internal salt constant similar to the seawater which makes them "isotonic" with the sea water so that they have no problem of "osmo-regulatory".

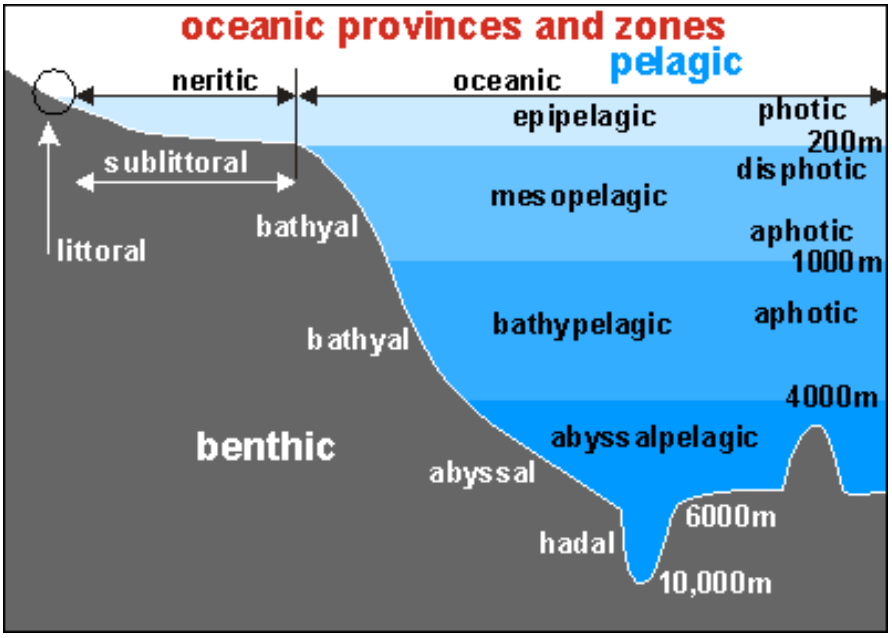

Fig 8: Marine Habitats Zones

Moving from the coast towards the sea, there are three noticeable marine habitats zones which are; "Intertidal, neritic, or littoral" and "oceanic zones"

a. Intertidal Zone

This includes the shoreline between the high and low tides which makes it exposed to water and air constantly. It is very rich in organic matter and dissolved oxygen. Since the water in this area is in constant motion, the living organisms are limited to only borrowing worms, gastropod, clams on sandy shores and attached organisms like algae (green & red) oysters and barnacles on the rocky shores.

b. **Neritic (Littoral) Zone:**

The zone extends from the shoreline to the edge of the continental shelf were the depth of water is about 200 meters. Because of the depth of water there is no longer much waves and tides so that the water is no longer been stirred up by them.

It is a very rich zone with free floating algae and bottom anchored algae which are primary producers for plant eating animals.

In this zone, the organisms vary from location to location as the neritic zone experience more variations in temperature, water turbulence, salinity and lighting than other zones. It is the region of commercial fish harvest such as sardine, cod mackerel, herring, salmon etc. this high productivity in the neritic (littoral) zone could be attributed to its richness in nutrients, and a large part of it is in the photic (lighted) part of the ocean.

c. Ocean (Aphotic) Zone

This is the deep water that spreads beyond the edge of the continental shelf. This zone is very unproductive due to lack or insufficient photosynthetic materials. Though, there is enough light at the water surface, nutrients are insufficient and water oxygen is very low. It is also cold and dark in the zone.

The living organism present in this zone are mainly minute floating plants and animals called “plankton”. These are usually unicellular algae, protozoans, small crustaceans and larvae of invertebrates.

Phytoplanktons are the primary producers in the open ocean where they are eaten up by herbivorous zooplankton. These are in turn consumed by carnivorous zooplankton which are fed upon by small fishes e.g. mackerel and are also eaten by larger fishes like tuna while the shark feeds on the tuna.

Estuarine Habitat (Brackish Water)

This habitat is unique in that it is created by the mixing of fresh and salt water brought about by tidal actions. The estuarine or brackish waters in characterized by spring currents and salinity which changes during the day month and year.

The characteristics of this zone include; frequent changes in temperature, salinity and concentrations of suspended sediment. Estuarine are shallow and light usually

penetrate to the bottom. Phytoplankton sea and marsh grasses and detritus feeders are very common. Animals include; shrimps, crabs and snails which are eaten by higher trophic members such as fishes and birds.

In Nigeria, the Niger Delta area is an estuarine habitat
In the mangrove estuarines or swamps, in the tropical coastal regions, there are the "red mangrove trees e.g. Rhyzopora", white mangrove e.g. "Avicenna", "Pandanus" and "Raphia" palms used for cane furniture are found

Fresh Water Habitats

Fresh water habitat has low salinity and the ocean tides and waves are absent here. The low salt concentration in this habitat varies in flowing water. Fresh water organisms are usually affected by the following abiotic factors:

1. Light intensity at different depths of water
2. Temperature
3. Transparency or turbidity of water
4. Velocity of the water
5. Nature of the current in the water
6. Chemical conditions e.g. salinity
7. Oxygen and carbon dioxide
8. Hydrogen ion concentration (pH) of water
9. Surface area, depth and nature of the bed of the water body.

There are various types of fresh water habitats which an be seen in two ways either the body of water has the current moving in once direction or not. The freshwater having a unidirectional current is called "Loti" and these include streams, rivers and springs. While the second type of freshwater bodies lacking any unidirectional current are therefore, stagnant or stationary are called "Lentic" and they include:

Lakes and Ponds: Lakes are made up of three zones which are "Littoral" zone, limnetic zone and profundal zone.

Littoral zone refers to the shallow water region in which sunlight penetrates to the bottom. The limnetic zone is the open water zone extending to the depth of

effective sunlight penetration while profundal zone is the bottom and deep water area beyond the depth of effective sunlight penetration.

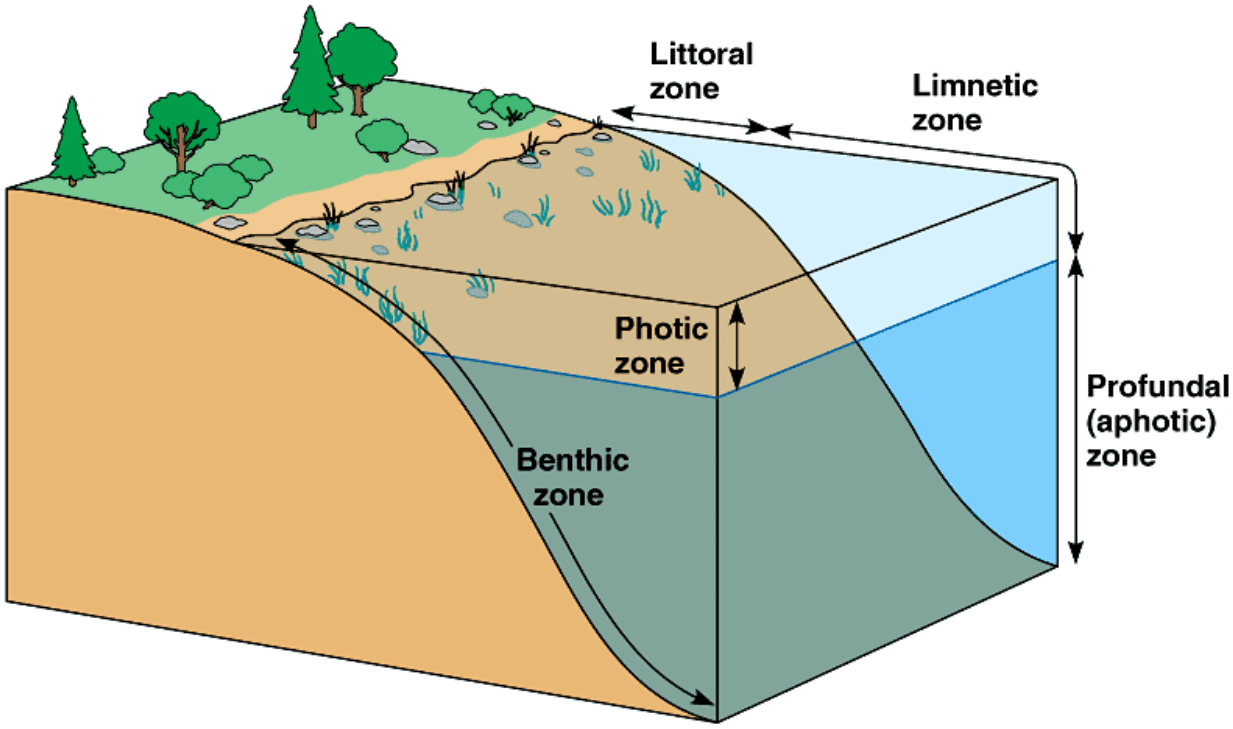

Fig. 9: Major Zones of a Lake

Rivers

In the river, the current whether fast or sluggish determines the kind of organisms that will be found there. Rivers with sluggish current, the organisms found in it will be similar to those in a lake. Rivers with fast current contain organisms with adaptive features to cope with fast running water will be found. Such include main producers of algae which attach firmly to the substratum, some diatoms, aquatic mosses and the animal population are: water sponges, snails, flatworm with sticky under surface insect larvae, and fish with flat streamline bodies which allow them move in an around rocks and stones.

Some of these adaptive features of fresh water organisms are:

1. Amphibians and crustaceans adapt to life in ponds which are usually dry for most of the year during which period, they remain dormant
2. Organism attach themselves to rock or stone in swift water
3. The presence of air spaces in plants like waterly and water hyacinth which makes them buoyant in water.

4. Absence of cuticle on the epidermis of surface layers of submerged freshwater plants.
5. Many aquatic animals (fishes) have gills which they use in breathing in dissolved oxygen in water.
6. Reproduction in some of the organisms involves the formation of cyst which ensures survival when the water dries.

3.3 Terrestrial Habitats

Like the aquatic habitat, terrestrial are subdivided but according to the types of vegetation the have which in turn depends on the amount of rainfall ad temperature. Low rainfall and cold temperature will give rise to dry land and poor vegetation. But when the annual rainfall is high and the temperature range is high, it will produce luxuriant forests.

Marsh Habitat: Is the ecosystem that connects both the aquatic and the terrestrial. It is an habitat transformed from aquatic to terrestrial. It is a low and met land habitat and usually dominated by grasses and sedges.

Characteristics of a marsh:

1. it holds a large volume of water thereby helping to regulate the influence the inflow of the stream over it.
2. It is soft, wet and water-logged with pools of water
3. Relative humidity quite high
4. It is highly productive due to nutrients and organic matter remains which had accumulate in it
5. It is always flooded with shrubs and grasses which grow extensively.
6. Low population of fish but it supports wide variety of animals and water birds.

There a two types of marshes which include;

i. Freshwater marsh – which is characterized with algae, water lettuce, lemma, salvina, sword grass and water avum. Toads and fishes are also present.
ii. Salt water marsh – this has algae, grasses and sedges. The animals include; clams, hermit crabs, worms, oyster, barnacles and mud skipper.

Forest Habitat

The forest is a type of vegetation consisting mainly of woody (trees), shrubs, climbers with few or no grasses.

Tropical forest is a habitat with less fluctuation in its climate. The climate sort of remain constant. The rainfall is evenly distributed through the year with the temperature remaining constant. The soil is rich in organic matter. Though acidic due to leaching.

The habitat is ideal for plant growth because;

a. The ground is well drained
b. Rainfalls most of the year
c. There is abundant sunshine
d. The trees therefore, grow very big up to 60m and some have to be supported by buttress roots. Some examples of trees found here are "Termialis superb" (afora), "Triplochiton scelroxylon" (obeche", "milicia excels" (iroko), "Khaya ivorensis" (mahogany), and "Mitragyna sp" (abura), all these are timber trees of high economy importance.

The forest floor is covered with moist decaying plant materials like leaves, fallen branches, fruits, etc. decomposers like fungi and bacteria as well as mosses liverworts and lichen are very common.

The animals in the forest;

The distribution of animals in the forest is greatly affected by the stratification of the forest which are into three distinct layers, the upper, middle and lower strata. The upper stratum are made up of the scattered trees of 40-50 metres in height with very wide spreading crowns. The birds are found in every stratum which are mainly hornbills, barbers, turaces and starlings. The middle stratum consisting mainly of shrubs and extending from lower part of the upper layer consists of mixed groups that are always in search of food which include bulbuls, drongos, warblers, flycatchers, and other insectivorous birds, while the animals include monkey rodents, snakes and insects.

Among these animals there are "ground dwellers" which animals found among leaf-litter and soil as decomposers and detritus feeders. Thos that live in the soil include termites, earthworms, crickets, snakes and the pouched rats. Living in the leaf litter are invertebrates such as ants, millipedes, centripedes, spiders, snails.

Also above the litters are soldier ants, toads, lizards, snakes and few birds like guinea fowl.

Larger animals found here are mainly mammals like pigs, bushbucks, deer, antelopes and porcupines are found on the ground feeding on falling leaves and fruits.

Aboreal dwellers are also found in the forest. These are animals that live or visit trees often. Common arboreal invertebrates like grasshoppers, butterflies and spiders and vertebrates such as chameleons, lizards, snakes, flying-squirrels, bats and the leaf eating read colobus monkeys.

Grassland Habitat

In the tropics, the savanna is grassland and it has the following characteristics:

1. It's vegetation is mostly dominated by tall grasses which are burnt annually.
2. Scattered all over are herbs and trees which are not as tall as those in the forest and they are mostly legumes.
3. Trees and shrubs have thick carks and twisted trunks
4. Typically, the climate of the savanna is low in the amount of rainfall and intensity. Has a long dry season, high temperature and hot environment with high evaporation. There is scarcity of water in this habitat, so there is problem of water conservation, which is greater than that of the forest and marsh.
5. Savanna soils are shallow and are often leached. The soil lack important nutrient like phosphorus and potassium, so the soils have low fertility.

There are different types of Grassland habitats which are;

1. Guinea savanna located mostly in West Africa
2. Sudan and Sahel which is borders of the Sahara desert.

Plant distribution in the grass and habitat, the trees commonly found are in the guinea savanna which include; "Danella oliveri" "Parkia biglogosa", the Shea butter tree "Adansoma digitata" (baoba) while the grasses include "Andropo gan", Cymbopogon" and "Hypovarrhenia".

The common animal species includes giraffe, elephants, and antelopes, which are browsers but the grazers are also found in large population which include zebra, wilder beast , gazelle, warthog. Carnivorous mammals are large animals like lions, leopards, foxes and lynxes, others are hyenas, jackal which are scavengers that feed on carcasses left behind by other animals, invertebrates found in savanna include grasshoppers, termites, flies and other insects. Many termites , flies and other insects. Many termites hills abound.

Arid Land Habitats

The arid lands are the driest habitats where water is not available to living organisms because of the relatively very low availability of rainfall. Examples of arid lands are; tropical deserts, the warm temperate deserts and the arctic tundra.

a. **Tropical Deserts:** These are characterized by very hot-days and very cold nights. Rainfall is very rare and unpredictable. The wind that blows across the desert is very hot and carries loads of sand particles thereby eluding the land.
b. **Warm Temperate Deserts:** In this habitat, scanty rain falls every year during summer. In winter, the temperature go down below freezing point.
c. **Arctic Tundra:** In this habitat, the subsoil is usually frozen leaving few centimeters of the topsoil. The melted water from the topsoil is too little to wet the soil, so it makes it muddy and water logged. During winter, the temperature can be 15^0c which makes lakes, rivers, and soil moisture to be frozen. Plants commonly found in this habitat include; the annual and succulent plants which resist the drought by storing water e.g. “Euphorbia” and “Cacti” while the animal community have adapted way of conserving water and adapting to high temperature. These are rodents e.g. rats, snakes, lizards and birds like ostrich and the falcon. Common invertebrates include beetles, scorpion and spiders.

4.0 Conclusion

In this unit, you studied in detail about the various habitats of the world. The re were two major types which are aquatic and terrestrial habitats. Each is sub-divided into subzones, the aquatic habitats are zoned into; 1) Marine 2) Estuarine (brackish) and 3) freshwater while the terrestrial habitats are divided into 1) Marsh

2) Tropical forest and 3) Grassland and Arid (desert) habitats. Each of these subdivisions are further subdivided.

5.0 Summary

Under aquatic habitats, you learnt that;

1. The marine habitat consisted of the open sea and the shoreline. It supports producers, consumers and decomposers
2. Estuarine (brackish) habitat is subjected to daily tidal fluctuations, it supports mangrove forest, bacteria and great decaying organic matter.
3. Freshwater habitats (lakes and rivers) has lower salinity and there is no waves and tides. It has producers which are phytoplankton and hydrophytes and the consumers are zooplankton, protozoa, insects, toad, fish and birds

While the terrestrial habitats consist of;

1. Marsh which are wet lands formed around lakes or ponds. They are highly productive due to their richness in nutrients.
2. Tropical forests are stratified and are dominantly tall tree plants that form canopies. The animals are arboreal and ground dwellers.
3. Grassland are characterized by grasses. There are three types which are savanna, guinea, sudan and sahel and
4. Arid (desert) habitat, these have very scanty rain with high temperature in the day and very low temperature in the night. Deserts plant and animals show adaptation for conserving water and withstanding extreme temperatures. It has very low productivity. You also learnt about the factors influencing the habitats.

6.0 Tutor-Marked Assignment

1. What is a marine habitat?
2. List three aquatic habitats
3. Describe the structure and components of an arid habitat

7.0 References/Further Readings

Anibuno, S., Egunyomi, A., & Osakwe, V.C. (2006). Comprehensive Certificate Biology for Senior Secondary Schools. Ibadan: University Press Plc.

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UNIT 5: INTERACTIONS BETWEEN ORGANISMS

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1.0 Introduction
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1.0 Introduction

In this unit you will learn about the various interactions that exist between organisms in the environment. The various associations that enable organisms to live successfully. These interactions or associations can be viewed under the following; predator-prey or symbiotic relationships. The symbiotic relationship can be broken to mutualism, commensalism and parasitism. All these are in terms of feeding.

2.0 Objectives

In this unit, you are expected to be able to;

1. Explain the different types of interactions between organisms in the environment.
2. Identify the interaction or association between organisms in the environment
3. State the benefits or importance of such association
4. List examples of both plants and animals that exhibit the different associations.

3.0 Main Content

3.1 Types of Interactions (Associations) between Organisms

In nature, every organism has a predator that uses its for food. There are two major types of association which are predator-prey relationship and symbiosis relationships which can be viewed under mutualism, commensalism and parasitism.

1. **Predator-Prey Association:** The predator in this association feeds on the prey thereby reducing the population of the preys. The size of the predator population is determined by the number of the prey available. If the predator population is more than the prey, the prey will become extinct. But this does not happen in the natural exosystems. The predator and prey do not live in close proximity, but the predator must search for the prey. It is a relationship where an animal captures and eat other animals (prey). Examples snake and rat, bat and rat, frog and insects, etc.

2. **Symbiosis:** In this association, there is closeness between organisms which are of two different species. The association may be temporary or permanent.

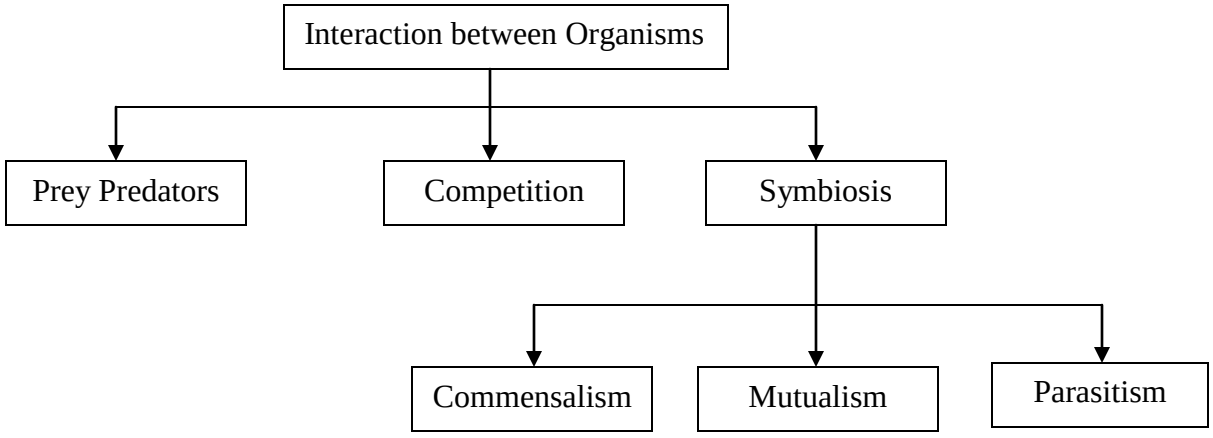

Fig. 10: Interactions between organisms

There are three categories that can be used to describe the different types of symbiotic relationships based on the degree of benefits or harm to each of the two. Species. These are “mutualism” where both species benefit from one another. “Commensalism” in which one benefits but the other is unaffected by the associations and the third is “parasitism” where one species benefit and the other suffered or is harmed. There is also “Competition” which may be among the same species and the stronger takes the prey when they compete for a prey.

3.2 Interactions between Organisms

In plants the three categories of symbiotic associations exist and you will learn about them.

a. **Mutualism**

Mutualism is an interaction that benefits both organisms. Where the association is very close, one of the organism cannot survive without the other, which means one of the organisms lives with the other.

Examples of mutualism are;

i. Lichen consists of fungi and algae living together. The algae which is the producer of food obtains shelter from the fungi.

ii. Leguminous plants roots provide shelter and food for bacteria which are nitrogen-fixing bacteria which change nitrogen to nitrates which is needed by the plants. They live in the nodules on the roots.

Fig. 12: Nodules of a leguminous plant

iii. Intestine of herbivores and bacteria, some bacteria live in the rumen and reticulum of herbivores like sheep and goat where they break down complex carbohydrates. The microorganisms digest the cellulose eaten by the animal which they cannot digest but the bacteria secret an enzyme called cellulase which breaks cellulose down to an absorbable compound for the animal while in return the bacteria get nutrient shelter and protection.

iv. Egret birds and cattle; while egret birds are often perching on cattle's back, removing the blood sucking ticks from the skin. The cattle are saved from the blood-sucking ticks while the egret birds feed on the ticks.

b. **Commensalism**

In this association, the commensal derives some benefits while the host neither gain nor loose anything. Examples;

i. The shark and the remora fish. The shark receives nothing from the association while the remora fish gets free transport by being carried around by the shark and feeds on food scraps from the shark.
ii. The mussels and Barnacles; The mussels which is the host is not affected but the Barnacles get shelter on the shell
iii. Hermit crab and hydra: The hydra is found on the shells occupied by hermit crabs. The hydra feeds on the food particles obtained from the crab.
iv. Small epiphytes (fern) and orchid on large trees: check out on most large trees in the tropical forests have one epiphytes. They use the host plant only as bases of attachment only do not take nutrient from the trees so the trees are not harmed

c. **Parasitism**

This association involves two organisms, one the host the other the parasite-living and deriving benefits from the host, while the host suffers from the relationship. Various examples exist in plants and animals. Examples;

i. Tapeworm and human: The parasite lives in the human intestine where it obtains food and shelter whereas the human loses weight and becomes weak clue to lack of enough nutrient which had been taken by the worm.
ii. A tree and the wood fungus: The wood fungus lives on the bark of the tree where it obtains food and shelter. But the tree is weakened and may die due to lack of nutrient which the fungus had taken.
iii. Rafflesia and tree: The rafflesia obtains food and shelter from the tree because it lacks chlorophyll to produce its own food and the tree, the host is weaken and may die.

In animals, the parasites may be within or without the animals. The without are called "ectoparasites" while the within are "endoparasites".

Examples of ectoparasites in animals they have hooks, claws or suckers for attachment to the furs or skin of the animals e.g. ticks, louse (lice) have claws for firm attachment to the host's skin.

Endoparatistes are highly adapted to the life instide the host body. They are found among the digested food insid the stomach, intestine etc. they live inside the alimentary canal and therefore, do not need digestive system of their own. Examples are tapeworm, round worm, hookworms etc.

4.0 Conclusion

The interactions between organisms were discussed which were under predator-prey association and symbiotic relationship was subdivided into three major grops depending on the type of association and these were into mutualism where two different species benefit from the association; commensalism where one benefits but the other do not suffer an lost nor gain from the association and the third one is parasitism where one benefits but the other usually the host donor and could be harm to the point of death.

5.0 Summary

You learnt that there are two major interactions in nature between organisms. These usually involve two unrelated species. In predator-prey relationship, one eats up the other (prey) and in the symbolic association, there are various degree harm done to the host or benefits for both while in mutualism nor suffer for the relationship.

6.0 Tutor-Marked Assignment

1a. Identify the different types of interaction between organisms in nature

1b. List some examples

7.0 References/Further Readings

Anibuno, S., Egunyomi, A., & Osakwe, V.C. (2006). Comprehensive Certificate Biology for Senior Secondary Schools. Ibadan: University Press Plc.

Taylor, D.J; Green, N.P.O. & Stout, G.W. (2008). Biological Science. 3rd Edition. Cambridge Low Price Edition.

MODULE 3: ENVIRONMENTAL MANAGEMENT

UNIT 1: Pollution

UNIT 2: Sanitation and Sewage Treatment

UNIT 3: Soil and Components

UNIT 4: Effects of Human Activities on Environment

UNIT 5: Conservation and Methods of Conserving Natural Resources.

UNIT 1: POLLUTION

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2.0 Objectives
3.0 Main Content
    3.1 Types of Pollution
    3.2 Effects of Pollution
4.0 Conclusion
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1.0 Introduction

Pollution can be defined as the release into the environment of substances in such quantities that they can cause harm to people and other organisms in the environment. Pollution of any type can affect all aspects of the environment and could easily be transferred between components of life support system.

2.0 Objectives

By the end of this unit, you should be able to:

1. identify the different types of pollution
2. explain the effects of pollution on the environment both biotic and abiotic components
3. mention the causative agents of pollution

3.0 Main Content

3.1 Types of Pollution and Pollutants

Pollution is the discharging of unwanted substances or energy into the environment mainly through human activities which became harmful to the health and wellbeing of man and other living organisms at certain level. These substances are called “pollutants”.

Pollutants are sometimes not waste nor harmful until they accumulate to a certain extent that now makes it harmful. Some examples are pesticides, detergents, sewage, plastic, glass, metal scraps, et. Pollutants are grouped into two groups which are “biodegradable” that is those that can be broken down by bacterial activities making them harmless substances. They remain as long as they are in the environment. Examples of biodegradable pollutants include; pesticides, sewage, herbicides etc and examples of non-degradable pollutants are plastic, glass, metal scraps, etc.

Self-Assessment Exercise

Move out of your house to the outside and add more lists to the non-degradable pollutants you can find.

Pollutants can be dispersed in the air, water, land and soil. We shall look at each of them individually:

a. **Air Pollution**

Until very recently, air pollution had been considered as a local problem common in urban industrial centres. But it is now apparent that pollutants can be transported from long distance in the air, causing adverse effects in other environment than the source of emission. The main causes of air pollution include;

i. The substances produced when burning fossil fuels like natural gas, coal and oil.
ii. Chlorofluorocarbons (CFCs)
iii. Noise produced from industrial machines, vehicles and aircrafts, etc.
iv. Radiations,
v. Dust.

With gases occurring naturally in the atmosphere pollution in the air will affect their quantity and quality such as depletion of Ozone (O_3). In some locations,

ozone increases with increasing air pollutant on the ground. This raised level of ozone will cause damage to crop and its association with hydrocarbons and nitrite (NO_2) pollutants, there will be smog which causes health hazard to human.

b. **Water Pollution**

The pollution of streams, rivers and lake is the greatest. The main cause of water pollution is the constant dumping of wastes into bodies of water. Another source is the drainage into water bodies of pollutants in the air, vegetation, soil, etc. via rain.

Some of the pollutants of water are refuse, and sewage agricultural wastes, crude refined oil and industrial wastes.

- **Refuse and Sewage:** These are lots of household waste (refuse) and sewages mostly human faeces is dumped directly into rivers. In well planned urban cities, sewage from various points (homes, offices and schools) are passed through underground to rivers and seas. The sewage and refuse are bio-degradable because they are organic materials. Therefore, bacteria and fungi (decomposers) breathe using oxygen, thereby reducing the amount of oxygen in the water. This leads to very low oxygen in the river which results in death of many organisms in the aquatic habitat.

- **Agricultural Waste:** Pesticides and herbicides used to control pests and weeds but they also kill other plants and insects which are not targeted. Leftover of these are then washed into rivers, streams and sea. While some remain in the ground and worked their ways into the food-chain and became cumulated in the plants' and animals' bodies. An example is DDT.

- **Oil Pollution:** This has posed more threat to water surface than any other globally. Causes of oil spillage include oil well blow out, raptures or leakage of oil storage tanks and pipeline and careless discharges of waste oil products from refineries into the environments. Because most oil spill is insoluble and lighter than water, it floats on the surface of water bodies.

- **Industrial Wastes:** Water polluted by chemical wastes which are the major pollutants from factories, mining and smelting works, refineries etc. The pollutants include organic solvents, dyes, oils, heavy metals like mercury

and lead, acids and alkali. There are laws to protect this from happening but most industries do not obey the law. So the wastes are discharged directly into the water bodies causing harm to aquatic habitat. Most industrial wastes are non-biodegradable, hence they remain in the water causing extensive damage to the living things.

- **Thermal Pollution:** Power plant industries for generating electricity, steel plants, paper mills, and sewage treatment plants produce large quantities of heat which need cooling of the engines or machineries with water. Such water is drawn from nearby river or stream and returned back as hot or warm water into the river. Most cold-blooded organisms in the river eventually die due to inability for them to have adequate oxygen supply from the warm or hot water.

c. **Soil Pollution**

Soil is very important for the proper functioning of the terrestrial ecosystem because it contains the major water and nutrients for plants. Many decomposers also live in the soil.

Most soil pollution is caused by the excessive use of pestidcides. Heavily sprayed field accumulated pesticides in the soil which affects the soil dwellers mainly the decomposers. Death of invertebrates after productivities because of poor recycling of nutrients.

Fertilizers though, help provide ready nutrients of plants, they affect the soil structure and become harmful after usage for a long period.

For example surfur dioxide in the air when released form surfuric acid in the presence of water. Rainfall (water) containing surfuric acid (acid rain) causes the rapid leaching of calcium ions into streams and lakes thereby causing the soil to loss its fertility.

3.2 Effects of Pollution

There are several effects of pollution on the biogeochemical balance of the biosphere while some habitats had been denatured. Here you will learn the different pollution and their effects.

1. Air Pollution: This can be caused by bush burning during clearing in preparation for new Planting season

   Effects

   a. It destroys the organic matter constituent of the soil
   b. It reduces the living organisms in the soil
   c. It releases smog into the atmosphere thereby affecting the cycles of nature.
   d. It causes the oxidation of nitrogen and sulphur into their gaseous form
   e. Reduces the water content of the soil making the soil non-productive

2. Water Pollution: This involves the releases of pollutants like pesticides, fertilizer, sewage etc into the water bodies

   Effects

   a. It reduces the quality of the water
   b. It releases chemicals into the water which causes death to the water living organisms.
   c. It clouds the surface of the water which causing, little or no photosynthesis for the green plants.

3. Deforestation: This occurs when the forest trees are cut down either for usage by human to build great cities or to make timber etc.

   Effects

   a. Many animals, birds and rodents are driven away from that habitat
   b. Exposure of the soil to erosion leading no low or no productivity
   c. Change from habitat dense forest teaming with life to desert with nothing
   d. Increases the temperature leading to global warming because of exposure to sunlight and ultraviolet radiation.
   e. Leads to extinction of animal, bird and plant species.

You can read more about the effects of pollution on the habitat, biosphere and on the globe on your own.

4.0 Conclusion

You have learnt about the different types of pollution that exists and the causative agents called pollutants. The pollutants had also been grouped into either to be biodegradable or non-biodegradable. The pollutions that occur in the ecosystems rob the ecosystem from functioning naturally by interfering in the constituents of the soil, air and the biosphere.

5.0 Summary

In the unit, you learnt about the three major pollutions which are air, water and soil pollutions. In each there are various sources of pollutants which are caused by the activities of human. The economic importance of these cannot be over emphasized.

6.0 Tutor-Marked Assignment

1. Explain “acid rain” and its effect on the soil
2. identify some industrial wastes dump into rivers and sea

7.0 References/Further Readings

Anibuno, S., Egunyomi, A., & Osakwe, V.C. (2006). Comprehensive Certificate Biology for Senior Secondary Schools. Ibadan: University Press Plc.

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UNIT 2: SANITATION AND SEWAGE TREATMENT

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1.0 Introduction

Waste water is any water that has been polluted or adversely affected in quality by liquid wastes discharged by domestic residents, commercial properties, industry, and or agricultural wastes.

Sewage on the other hand as discussed in the previous unit, is the part of wastewater contaminated with faeces or urine of human. These human wastes cumulate from domestic, municipal or industrial liquid waste products disposed. Via pipe or sewer system in to the rivers. Sanitation is the hygienic means of preventing human contact from the hazards of waste. In order to promote health.

2.0 Objectives

By the end of this unit, you should be able to:

1. Define waste water, sanitation and sewage
2. identify the sources of sewage
3. understand the relationship between waste water, sewage and sanitation.

3.0 Main Content

3.1 Sewage and Sanitation

Untreated sewage contain;

- Water
- Nutrients (nitrogen and phosphorus)
- Solids (including organic matter)

- Pathogen (bacteria, viruses, protozoa)
- Helminthes (intestinal worms and worm-like parasites)
- Oils and greases
- Runoff from the sheets, parking lots and roofs
- Heavy metals (mercury, calcium, lead, chromium, copper)
- Many toxic chemicals (PcBs, dioxins, furans, pesticides, phenols and chlorinated organics).

All the above and more are contained in sewage including plastics, toilet papers, etc. these waste when not properly attended to will cause health hazards to human and other living organisms in the ecosystem. That is why "sanitation" is very necessary. Hygienic means of prevention can be by using septic tanks sewage system.

Joint Monitoring Program's for water and sanitation of WHO and UNICEF defines improved sanitation as "connection to a public sewer, or to a septic system, pour flush latrine, simple pit latrine ventilated improved pit latrine while the "not improved sanitation" is public or shared latrine, open pit latrine and bucket latrines,

Effects on Human Health

i. Sewage released into the rivers and seas can cause threat to both human and the environment.
ii. It contaminates the coastal marine environments by causing infectious diseases linked to bathing and swimming in marine waters and also to the consumption of sea food.
iii. Human exposure to toxins associated with algae blooms also impose great risks.
iv. Most health ailments are caused by pathogens which can be spread from coast to coast. These illnesses include, typhoid, diarrhea, cholera, dysentery, hepatitis A, etc.
v. Sea organism are infected with bacteria and virus which can survive several months especially shellfish and fish which may habour such pathogen for a year or more.

Effects on the Environment

Nutrients are very essential chemical elements that organisms need to survive and reproduce. Macronutrients needed in large quantities include carbon, hydrogen, potassium, sulphur, magnesium and calcium while the micro nutrients require in lesser quantity are iron, zinc copper, when these nutrients are in excess, through fertilizers, from agricultural means, or by burning of fossil fuels, nitrogen oxides are released in excess.

The presence of all these decreases the oxygen in the marine. Increase in nutrients may lead to "eutrophication" which is excessive growth of marine plant life and decay. Algae experience a population increase (algae bloom) which limit sunlight available and cause lack of oxygen in water. When the level of oxygen decline, marine animals, coral reefs, sea grass beds and other vital habitats suffer and die.

Some "algal blooms" are toxic and can harm and even kill whales, dolphins and other marine mammals.

Pollution by sewage has been found to cause in the Caribbean region:

i. Fish mortality
ii. Eutrophication
iii. Threats to corals, swamp ecosystems and sea grass beds
iv. Biological diversity loss.
v. Red tides which have killed marine organisms
vi. Threats to human health due to elevated numbers of pathogenic microorganisms (virus, bacteria) and toxins created by algal bloom
vii. Threat to tourism

3.2 Sewage Treatment

Sewage treatment is the process of removing contaminants from wastewater including house hold sewage and run-off (effluents). This includes physical, chemical, and biological processes to remove physical chemical and biological contaminants.

Sewage treatment aims at producing an environmentally safe fluid waste stream (treated effluents) and a solid waste (heated sludge) suitable for disposed or reuse as farm fertilizer.

There are various ways for treating sewage. It can be where the sewage is created..

i. Sewage treated close to where created at a place called “decentralized system or” on site system in “septic tanks”, biofilters” or aerobic treatment systems.
ii. It can be collected and transported by a network of pipes and pumps stations to a municipal treatment plant called “centralized system”.

Sewage do not only include those generated in the residential, institutions, industrial and other establishment as earlier discussed. But may include storm water run-off. The sewage systems capable of handling storm water are known as “combined sewer system”. This requires much larger treatment facilities as rain water travels over roofs and the ground it picks up various contaminants which include soil particles, and other sediments, heavy metal, organic compounds, animal waste, oil and grease.

All sewage collections and treatment are subject to local, state, and federal government regulations. Sewage treatment process involves three stages called primary, secondary and tertiary treatment.

Primary Sewage Treatment

This involves the storing of sewage water in a large tank or basin for a period, in order to allow the settlement of heavy metals, solids to the bottom, while lighter solids like toilet papers, leaves, etc float on top. The floating and the settled materials can then be removed leaving only liquid and dissolved materials.

Secondary Sewage Treatment

At this stage, the dissolved and suspended biological matters are removed. It require a separation process in order to remove the micro organisms.

Tertiary Sewage Treatment

At this stage, the treated water is disinfected chemically or physically prior to discharge into a stream, river, etc or being used for irrigation groundwater, etc.

4.0 Conclusion

You learnt about wastewater, sewage and sanitation. The interrelationship between the three was extensively discussed. The sources of sewage and their importance were learnt and the various processes required to sanitize water wastes before they can be thrown back into the system again.

5.0 Summary

In the unit, you learnt about the meaning of water wastes, sewage and sanitation. That sewage is cumulating of domestic, industrial and municipality wastes which are pumped into water cycle that need to be sanitized before going back into the cycle. You also learnt the three stages of sewage treatments in order to make wastewater pure again for usage.

6.0 Tutor-Marked Assignment

1. Pay a visit to the water works in your locality or water treatment (sewage treatment plant) and write a comprehensive report.

7.0 References/Further Readings

Khopka, S.M. (2004). *Environmental Pollution Monitoring and Control*. New Delhi: New Age International.

EPA Washington DC (2004). Primer for Municipal Waste Water Treatment System. Document No EPA 832 – R 04-001

Kartal, B., Kuenen, G.J. & Vanloosdredt, M.C.M. (2010). Sewage Treatment with Anammox. *Science*, 328:702-3

UNIT 3: EFFECTS OF HUMAN ON THE ENVIRONMENT

CONTENTS

1.0 Introduction
2.0 Objectives
3.0 Main Content
    3.1 Effects of Human Activities on the Environment
4.0 Conclusion
5.0 Summary
6.0 Tutor- Marked Assignment
7.0 References/Further reading

1.0 Introduction

In the biosphere, the most active of all the organisms is man. And man's activities is in every area of the environment. Man as part of the ecosystem, must ensure the preservation and stability of the environment. He also require a life of comfort therefore, man engages in several activities to bring about this, which involves alteration of several manipulations of the environment to suit his purpose and luxury. Such activities have great impacts on the natural equilibrium of the biogeochemicals of the biosphere. These activities include; decrease in water quality, increased pollution and greenhouse gas emissions, depletion of natural resources and contribution to global climate change. Some of these are the direct results of human activities. Where as others are secondary effects that are part of a series of actions and reactions. Each of these will be briefly examined.

2.0 Objectives

In the unit, you will learn about the various activities of human on the environment. You should then be able to:

1. Identify the various activities
2. Explain the kind of activity that affect the natural balance of the environment
3. Mention some of these activities and what they cause in the environment

3.0 Main Content

3.1 Effects of Human Activities on the Environment

Here we shall study the different activities of human on the biosphere which include;

1. Pollution

As you have seen earlier, pollution refers to the release into the environment of substances or energy in such quantities and for such a period that they cause harm to human or other organisms in the environment. Pollution can affect every aspect, human-made and natural, abiotic and biotic and can be easily transferred.

- **Air Pollution:** Pollutants entering the atmosphere produce their effects in one or two ways. They may;
  a. Enter the tissues of plants and animals directly either through the stomatal pores or lungs.
  b. First be deposited in the soil or in water, then absorbed by plant in solution and pass to animal via food web.

For (a) the main pollutants in the category are produced as a result of industrial processes, domestic fires and internal combustion engines. Pollutants produced include: soot, tarry residues, ash, sulphur dioxide, carbon monoxide etc.

All these pollutants produce harmful effects

Table 3: Effects of Air Pollutants in the Atmosphere

Pollutants	Effects	
	Plants	Animals
Soot	- Clog pores of leaves - High concentration reduces light penetration to the ground which leads to reduction in photosynthesis	Clog spores on the skin
Sulphur dioxide		- Soil organisms dies because of increase in soil acidity - Human aggravated with a range of respiratory diseases e.g. bronchitis - Carry cancer-producing substances
Heavily polluted air		
Carbon dioxide	Produce greenhouse effect leading to increase in temperature because of increase in heat penetration. This could result in decrease in amount of water locked up in the polar region leading to increase in sea water level.	

b. Pollutants in this group are mainly radioactive materials from nuclear processes including nuclear weapon testing. Chemical pesticides especially those sprayed from aircrafts with radioactive materials, airborne materials are dispersed wider and rapidly and radio-active materials penetrate with ease in the food web causing great havoc to both animals and plants. A radioactive isotope like “strontium 90 is biologically indistinguishable from calcium which has slow rate of decay can pose as danger to health for years. It causes damage to blood forming tissue and can be easily absorbed by grasses taken by cattle

and can enter human through cow milk. Pesticides when sprayed through aerial, can behave like radio-active materials. There are all sorts of side-effects which may take long time to manifest. Pesticides became inserted into food web and may result in sudden death of birds or unexplainable drop in soil fertility, due to imbalance in the soil microbes.

A long term consequence of the application of pesticides against insect pests is that, it may not eliminate the insect but eliminate the predator in the habitat due to large concentration of the chemical in the good chain.

2. **Water Pollution**

Water pollution can affect human because of his need for fresh water. The most effects on inland waters are those due to outflow of factory and industrial waste, human sewage and the runoff of nitrates from over-fertilized land

Factory Wastes

a. Oil forming a thing widely dispersed film on the water surface, thereby reducing the uptake of oxygen by the water.
b. Detergents. Reduces the oxygen capacity of freshwater.
c. Suspended particles; these clog the water and contaminates freshwater cloudy. So that light cannot penetrate.
d. Poisonous chemicals such as sulphides and sulphites which are reducing substances thereby lowing the oxygen concentration in the water.

3. **Wild Life and Deforestation**

The effects of man's activities on wild life are due to variety ofcauses which are numerous. Man hunt most animals, birds, reptiles and mammals for games and food or they cut down the trees for making timbers for building the industries. Most lands are cleared and turned to urban cities thereby sending the animals, birds, reptiles and mammals pacing.

These actions led to the extinction of a very large number of species and due to the deforestation, desert encroachment occurs.

4. **Soil Pollution**

The following are some practices that has affected the quality of the soil which are;

a. Bush burning: this involves the setting on fire bush to clear out the vegetation, this
    i. Destroys the organic matter content of the soil
    ii. It reduces the population of soil living organisms
    iii. It oxidates nitrogen and sulphur into their gaseous forms.
    iv. It exposes the soil to erosion and leaching
    v. It increases the pH of the soil
    vi. The smoke leads to environmental pollution
    vii. It destroys the soil structure and reduces the soil water content.
b. Land clearing: clean clearing of vegetation for building or farming causes;
    i. Results in the disturbance or removal of the top soil
    ii. Exposes the soil to direct sunlight hence, increasing the rate of evaporation.
    iii. It increases the temperature of the soil leading to the death of microorganisms living there.
c. Fertilizer application; fertilizer application involves the introduction of certain chemicals or substances to the soil in order to improve its fertility. Excess and long duration causes;
    i. Leads to soil acidity
    ii. Reduces the activities of soil organisms
    iii. Hinders the growth of crops.

Natural Resources

Man search for economy empowerment had led him to go deeper into the earth surface to search for the black gold (oil), minerals such as gold, copper, etc. and other minerals. Problems associated with these include;

i. Soil erosions are found where excavations had taken place in search of minerals.
ii. Population pressure where minerals or resources are located. There is always drift from rural to industrial locations
iii. Increase in land, water and air pollution due to wastes from such refineries, factories and industries.
iv. Roads, railway and aircrafts increase to transport from points of production to urban and internationally thereby causing destruction of various habitats.

v. Drifting from farming to white collar jobs leading to the urban will increase greatly.
vi. Construction of dams and bridges.

4.0 Conclusion

Many activities of human have created many changes in the ecosystems of the earth that some habitats had been completely wiped out. E.g. deforested areas, some had been changed from a tropical forest to a city with sky scrapers. Others had been excavated in search for the black gold that the once upon a time forest is covered with oil spillage "good for nothing" land where all the plants and animals have all died. Some biogeochemical cycles had been tempered with causing 'greenhouse effect' or depletion of one layer e.g. the "ozone layer" leading to "global warming" causing the polar regions to begin to melt while the ocean and sea overflow causing tsunamis, etc to occur. Due to deforestation, desert encroachment is all over the place, the qualities of water and air are no more conducive for living organisms. The effects are just too numerous.

5.0 Summary

In the unit, you learnt about various activities of human that have greatly affected the balance in the atmosphere, hydrosphere and even in the earth's crust. Most of these effects are irreversible especially in the exploration of human into the deep crust of the earth in the search for natural oil and gas, and mineral resources.

6.0 Tutor-Marked Assignment

1. What effects do deforestation have on the biosphere?

7.0 References/Further Readings

Iwena, O.A. (2012). *Essential Agricultural Science for Senior Secondary Schools*, 16th Edition. Lagos: Tonad Publishers Ltd.

Taylor, D.J., Green, N.P.O., & Stout, G.W. (1998). Biological Science, 3rd Edition. Cambridge: Cambridge Low Price Editions.

UNIT 4: BASIC SOIL COMPONENTS

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1.0 Introduction
2.0 Objectives
3.0 Main Content
    3.1 Basic Soil Components
4.0 Conclusion
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6.0 Tutor- Marked Assignment
7.0 References/Further reading

1.0 Introduction

Soil can be defined as a porous medium consisting of five basic components which are minerals, water, gases, organic matter and microorganisms. Soil can be said to be a dynamic natural body consisting of properties derived from climate and biotic effects. Soil is as a result of weathering of the topography, action on parent rock materials over time.

These five basic components of the soil when present in the proper amount forms the backbone of all terrestrial plant ecosystem.

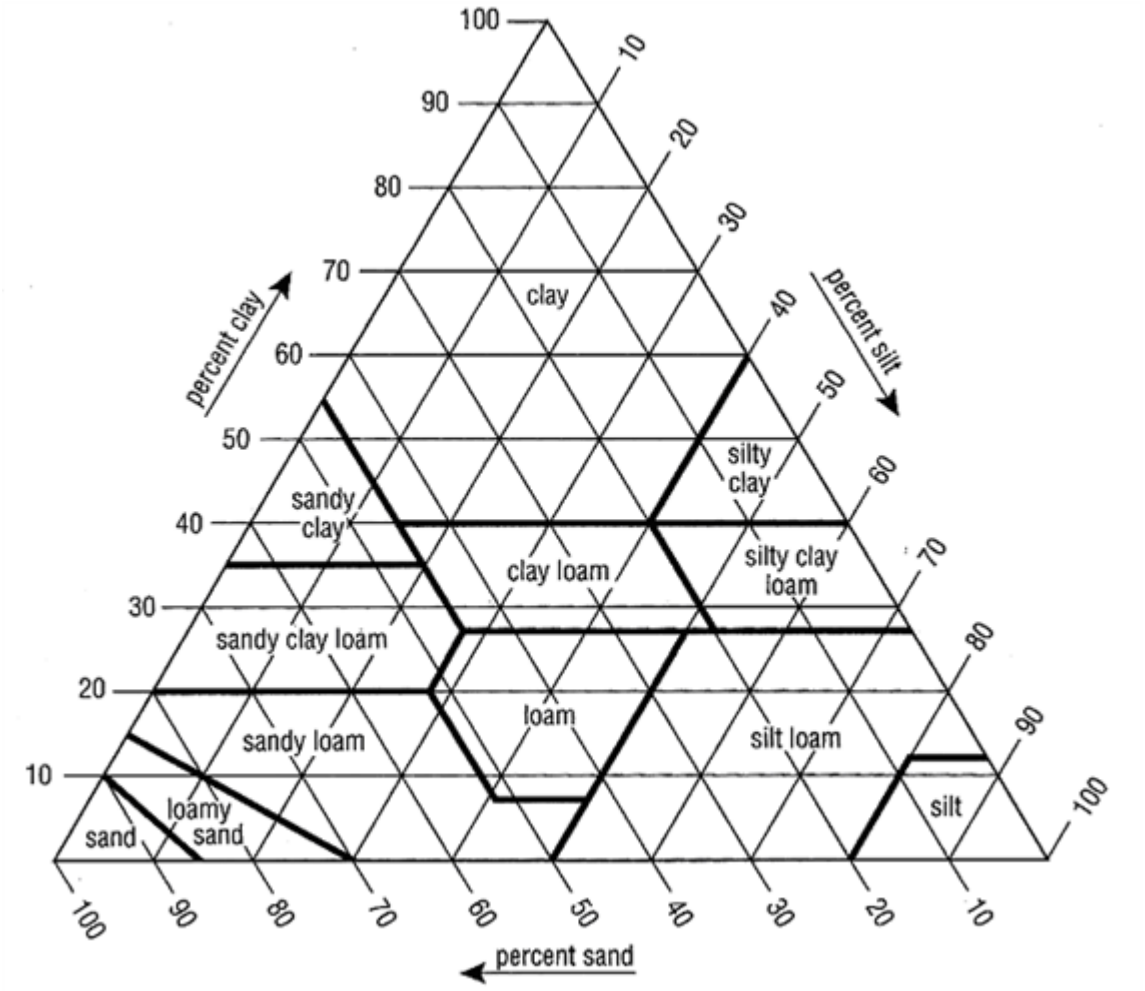

Fig. 22: Soil (Soil as Matrix of Minerals)

2.0 Objectives

By the end of this unit, you are expected to:

1. Explain the various basic soil components
2. Describe the importance of each component to plant growth
3. Identify the uses of soil components

3.0 Main Content

3.1 Basic Soil Components

Soil is made up of a matrix of minerals, organic matter, air and water. Each component has its own importance for the support of plant growth, microbial community and the chemical decomposition .

Soil is the weathered top layer of the earth's crust on which plants grow and derive their nutrients. It is made up of;

a. Mineral – Inorganic matter which are; sand silt and clay
b. Organic matter such as humus
c. Air
d. Water and
e. Living organisms such as earthworm, bacteria and fungi.

These components work together and are connected to determine the soil properties which include;

- Soil moisture
- Soil nutrients
- Soil acidity (pH value)
- Soil temperature
- Soil texture and
- Soil structure

a. **Mineral**

The largest components of soil is the mineral portion which is responsible for about 45-49% of its volume. Soil minerals are derived from two major mineral types;

i. Primary minerals such as those present in sand and silt which are materials similar to the parent material from which they come from which can be "round" or irregular in shape.
ii. Secondary Minerals – These result from the weathering of primary materials which releases important ions and forms more stable mineral forms such as "silicate clay". Clay has large surface area and helps in the water-holding capacity of the soil. Also, the negative and neutral charges around soil minerals determines the soil's ability to retain important nutrient e.g. cations, contributing to a soil's cation exchange capacity.

The "texture" of a soil is determined by the percentage of sand, silt and clay found in the soil.

- If sand particles are dominant in a soil, it is classified as "sandy soil". Sandy soil is porous and deficient in nutrients

- When clay particles are dominant, the soil is said to be “clayey soil”. Such soil will be difficult to till but very good for moulding.
- Soil with a fair proportion of sand, silt and clay is classified as “loamy soil” and is very fertile.

b. **Organic Matter**

Organic matter is another component of the soil and it forms about 1-5%. Organic matter is derived from dead plants and animals thus has a high capacity to hold or provide the essential elements and water to plant growth. Soils with high organic matter are termed productive. The percentage of decomposed organic matter in or on soil is often used as an indicator of a productive and fertile soil. Prolonged decomposition of organic materials can lead to making them unavailable to plant creating what is known as “recalcitrant carbon stores” in the soil.

c. **Air**

Gases or air is another basic component of soil and its occupies the same space as water. It constitutes about 2%-50% of the soil volume. Oxygen is essentiall for root and microbe respiration which help to support plant growth.

Carbon dioxide and nitrogen very important for underground plant functions e.g. nitrogen fixing bacteria. When there is water-logging, gas-exchange by the roots are prevented leading to plant death.

d. **Water**

This occupies between 2-50% of the soil volume. Water is very important or the transportation of nutrients to growing points in plants and soil organisms. It is also needed to facilitated both biological and chemical decomposition.

The capacity of soil to hold water depends largely on the soil texture. The more small particles in soils, the more water the soil can retain. Clay soils have the greatest water-holding capacity while sand has the least.

The amount of organic matter in the soil influences the water-holding capacity of the soil because organic matter has high affinity for water.

e. **Living Organism (Microorganisms)**

These are the microorganisms which are found in the soil in very high numbers but constitute less than 1% of the soil volume. The largest of these organisms are the earthworms, nematodes and bacteria, achnomycetes, algae and fungi. These are the primary decomposes who consume the organic matter, water and air to recycle raw organic matter into humus which is rich in readily available plant nutrients.

Other microorganisms present in the soil are specialized ones, such as nitrogen-fixing bacteria having symbiotically with plants and are major source of nitrogen and are therefore very essential for soil development. Mycorrhizae are fungal complexes that form mutualistic relationship with plant roots.

Without microorganisms in the soil, the soil would have been of little value in supporting plant growth.

4.0 Conclusion

The basic soil component you have discovered are essentially five and they include minerals, organic matter, air, water and microorganisms. Each of these have their roles in determining the fertility or productivity of the soil.

5.0 Summary

In the unit, you learnt that the mineral component of the soil could be three depending on the particle size and the parent material from which the soil weathered. The three types are sand, silt and clay. The proportion of these three determines the texture of the soil and the richness of the soil. You also discovered that water holding capacity is highest with clay and lowest with sandy soil.

Soil rich in organic matter and living organisms are said to be fertile and productive while soil with little or no microorganisms is dead soil.

6.0 Tutor-Marked Assignment

1. Discuss the five basic soil components
2. Enumerate two importance of each

7.0 References/Further Readings

Iwena, O.A. (2012). *Essential Agricultural Science for Senior Secondary Schools*, 16th Edition. Lagos: Tonad Publishers Ltd.

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UNIT 5: CONSERVATION METHODS OF NATURAL RESOURCES IN THE ENVIRONMENT

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1.0 Introduction
2.0 Objectives
3.0 Main Content
  3.1 Conservation Methods of Natural Resources in the environment
  3.2 Reasons for Conservation
4.0 Conclusion
5.0 Summary
6.0 Tutor- Marked Assignment
7.0 References/Further reading

1.0 Introduction

In earlier units of this module, you have learnt how human activities had affected natural habitats and the earth's surface greatly. Here you will learn about conservation methods that can help redeem some of the looses or how to bring about their recovery.

2.0 Objectives

By the end of this unit, you should be able to:

1. Understand the conservation
2. Explain different ways in conserving the natural resources
3. State reasons for conservation

3.0 Main Content

3.1 Conservation Methods of Natural Resources in the Environment

Conservation is the maintenance of the biosphere meaning taking actions to avoid species decline or extinction or permanent detrimental change to the environment. Or environmental conservation can be seen as the totality of various efforts made to protect the environment from damage or the prevention of further damage.

Due to population pressure and the impacts of technology and industrial developments, the natural environment is been degraded partially or sometimes permanently.

Successful conservation is not a matter of science but that which requires public and governmental supports. For this reason, conservationists often stress the utilitarian benefits of successful conservation.

Methods of Conservation

i. Voluntary environmental approach
ii. Ecosystems approach
iii. International environmental agreements
iv. National Government approach

Each of these methods will be considered

i. **Voluntary Environmental Approach**

Many organisms and companies on their own take cautious actions to save the environment. This occurs most in developing countries because they appreciate environmental conservation better. This they do in the ways they handle water disposal and emit gases.

Other voluntary advocacy groups exist who fight for the environment. When some developmental projects are embarked upon, such groups could stage a protest and or go to court when they perceive that such project will be harmful to the environment.

ii. **Ecosystem Approach**

This involves stakeholders coming together to evaluate the environmental impact of projects to be undertaken. These stakeholders may include relevant government departments as well as representatives of industries and that of the immediate community which the project is sited. By this, various aspects of the environment of that projects are often taken care of in the planning and implementation.

iii. **International Environmental Agreements**

To save and conserve the world's environment, the international community often comes up with some agreement which are signed by multiple government. Example of such agreement regarding the amount of

carbon emission a country is allowed to emit into the world's atmosphere. The agreements are usually for the concerns of impact such elements have an animal, ocean, rivers and air pollution. Most of these international agreements have legal binding documents that have legal implications when they are not followed. In other times, the agreements serve as "Code of Conduct" for members.

iv. **National Government Approach**

Every nation of the world can legislate agreements regarding the environment of their country. And effective legislations are enforced which makes this more effective than international community. An example is legislation regarding "tree felling in forest reserve areas and game poaching (killing of animals) in Game Reserves.

3.2 Reasons for Conservation of the Environment

The following reasons and more can be advanced for environment conservation. Some of these include that environmental conservation will;

1. Help to keep the environment safe and health
2. Helps control erosion, pollution and restore the land topography
3. Prevents some plants and animal species from going into extinction that is completely disappearing from the biosphere
4. Enables man to have full enjoyment of the environment as nature has provided without contaminations
5. Helps to maintain the natural beauty of the environment
6. Helps control global warming, greenhouse effect, depletion of the ozone layer and other climate change.

4.0 Conclusion

Environmental conservation is needed for things to be restored as nature had it before human activities tampered with nature. Most justifications for nature conservation, centre on human benefits that will accrue from maintaining a full range of biodiversity and the avoidance of environmental degradation.

These are as aesthetic that is beauty of nature, free and healthy environment and less or eradication of erosion and pollution all over the globe.

5.0 Summary

You have learnt the definition and meaning of conservation. The various methods employed to achieve this laudable work and benefits of conservation.

6.0 Tutor-Marked Assignment

1. Discuss the different methods of environmental conservation and give examples of each method

7.0 References/Further Readings

Taylor, D.J., Green, N.P.O., & Stout, G.W. (1998). Biological Science, 3rd Edition. Cambridge: Cambridge Low Price Editions.

Emielu, S.A. (2014). Senior Secondary Geography. New Syllabus Edition. Nigeria: Geographical Bureau, Ilorin.

ANSWERS TO TUTOR-MARKED ASSIGNMENTS

Module 2- Unit 4

1. A marine habitat is made up of the shore and the open sea and it has great depth and wide area

2. Four aquatic habitats are; marine, estuarine, freshwaters

3. Arid habitat are the deserts habitats where water is not available, very low rainfall, and they are characterized by very hot day and very cold night.

Unit 5

1a. The difficult types of interactions between organisms are; predator-prey, and symbiosis (mutualism, commensalism and parasitism)

b. List examples; (1) Tapeworm and human (P), (2) shark and remora fish (M); (3) Trees and epiphytes (C)

Module 3 – Unit 1

1. "Acid-rain" refers to the rain water that combines with surfuric aid in the air which falls on the soil causing much leaching of calcium thereby rendering the soil infertile
2. Industrial wastes dump into rivers and seas include; solvents, dyes, oils, heavy metals like mercury, etc.

Unit 2

Personal repot on sewage treatment plant in the students' locality

Unit 3

Effects of deforestation on the biosphere

i. Destruction of some habitats
ii. Reduces the number of species in a particular habitat and ecosystem
iii. Cause the extinction of some plants and animal species
iv. Leads to desert encroachment
v. Cause damage to soil fertility of the area.

Unit 4

1. Discussing the five basic soil components
   - Mineral
   - Water
   - Air
   - Organic matter
   - Microorganisms
2. Mineral – (i) determines texture of the soil
   (ii) determine the water holding capacity
   Water - determines the availability of nutrient
   - Determines the richness of the soil with dissolved matter.
   Air - same as matter
   Organic matter – determine the fertility of the soil
   - responsible for quality of the soil
   Microorganisms – help in decomposing organic matter to make it available to the plants' root
   - provide humus and help in the recycling of raw organic materials

Unit 5

1. The four different methods of environmental conservation are:
   i. Voluntary Environmental Approach
   ii. Ecosystems Approach
   iii. International Environmental Agreement
   iv. National Government Approach

One example each

1. Development of a project can be challenged by a voluntary group
2. Care is taken in planning and implementation of industry where representatives of the government community and that of the industry must agree
3. Code of conduct document must be duly considered before any member country emit certain gases into the environment
4. No felling or game poaching in forest and Game Reserves