NATIONAL OPEN UNIVERSITY OF NIGERIA

SCHOOL OF EDUCATION

COURSE CODE: SED 121

COURSE TITLE: GENERAL BIOLOGY FOR INTEGRATED SCIENCE

COURSE GUIDE

SED 121
GENERAL BIOLOGY FOR INTEGRATED SCIENCE

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Module 5 General Principles of Genetics, Ecology, Taxonomy and Organic Evolution…….

MODULE 1 LIVING AND NON-LIVING THINGS

Introduction

In this module, you will be exposed to what living and non-living things are. The characteristics of living things will also be explained and the major classification of living things will be discussed. The module will also discuss the differences and major divisions of plants and animals. Module one is thus divided into four (4) units as follows:

Unit 1 Living and Non-Living Things and Characteristics of living things.
Unit 2 Classification of Living Things
Unit 3 Differences between Plants and Animals
Unit 4 Major Divisions for Plants and Animals

UNIT 1 LIVING AND NON-LIVING THINGS AND CHARACTERISTICS OF LIVING THINGS

CONTENTS

1.0 INTRODUCTION

In this unit, you will be introduced to the meaning of living and non-living things. Characteristics of living things will also be discussed fully.

2.0 OBJECTIVES

At the study of this unit, you should be able to:

- Explain the meaning of living and non-living things
- State clearly the characteristics of living things

3.0 MAIN CONTENT

3.1 Living and Non-Living Things

One important activity of scientists is classifying things. They have various ways of doing this. One of the ways is to divide things into two groups, i.e. those that are living and those that are non-living. This may not be as easy as it may appear.

SELF-ASSESSMENT EXERCISE

Here is a list of items in the environment that we are familiar with: cow, mat, birds, salt, banana, stone, lizard, snake, football, grass. In the form of a table sort the items out into living and non-living.

Ensure that you put the items into the right group.
Which group did you put the cow? And which group did you put the football.

To make the classification of these objects easier, as science students we can look at those things that are the same about all living objects. These things are called characteristics.

3.2 Characteristics of Living Things

How do you decide if something is living or not? It is obvious that living things are different from things that have never lived. The first thing is to observe certain things that you know living things do.

- Look at a group of different types of animals.
- Write down all the things you observe about them, that tells you they are living.
- What things do they do that something like a stone that has never lived cannot do?
- Your list of those things living things do may be like the one below:
    - Take in air and use some in breathing
    - Take in food from their surrounding
    - Get rid of waste products
    - Grow bigger
    - React to what goes on in their environment
    - Produce young ones.

If you have plants in your group of objects, it may not be easy to decide that the plant is living.

This is because many things the plant does to stay alive are not easy to see.

Most plants have parts which are green. The green colour is produced by a chemical called chlorophyll in the leaves. Chlorophyll helps the plant to make use of energy from the sun to produce food, which is used up by the plant for growth and also stored as food for other animals.

SELF-ASSESSMENT EXERCISE

1) Put two seeds of maize in a small container with good soil.
2) Water daily and observe what happens to the seed each day.
3) Each day make a drawing of your observations of the maize seeds.
4) On the seventh day make a drawing of the seedling.
5) What are your observations and conclusion about the seed plant.
6) List the characteristics of living thing that you observed in the seed plant within the seven days.

4.0 CONCLUSION

This unit exposed you to what living and non-living things are with examples. It also discussed the characteristics of living things i.e. those things living things can do which non-living things cannot carry out.

5.0 SUMMARY

In this unit, you learnt that scientists have various ways of grouping objects into living and non-living things. You have also learnt that living things differ from non-living things, because living things can move on their own, grow, respond to stimulus, reproduce themselves, feed etc. these are together described as the characteristics of living things.

6.0 TUTOR-MARKED ASSIGNMENT

i. Explain why you say a group of organisms are living.
ii. Make a list to show the major characteristics of living things

7.0 REFERENCES/FURTHER READING

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UNIT 2 CLASSIFICATION OF LIVING THINGS

CONTENTS

1.0 INTRODUCTION

In this unit, you will be introduced to the major classification of living things into two; the plants and the animals. Major features of each of these will also be discussed.

2.0 OBJECTIVES

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

- classify living things into two, the plants and the animals
- state clearly the major features of plant
- state clearly the major features of animals

3.0 MAIN CONTENT

3.1 Classification into Plant and Animals

In unit one, you learnt that living things have certain characteristics they all can show. You also learnt that both plants and animals are called living things because they both can exhibit these characteristics, although some of these characteristics are not easily seen in the plant.

The most widely used classification adapted from Linnaeus was based on only two kingdoms, that is the plant and animal. This popular classification worked with familiar organisms like grass, baobab, orange as plants and dog, goat, sheep, man as animals. There are however some organisms like bacteria, viruses, sponges that cannot fit easily into either of the two kingdoms, therefore there is the need for another kingdom for these groups. This new group thus looked at the cellular structure of the organisms to place these groups. The more modern classification therefore recognizes five kingdoms namely Plantae, Animalia, Monera,

Fungi and Protoctista. Monera e.g. bacteria, fungi e.g. yeast, mushroom and Protoctista e.g. amoeba, euglena

3.2 Major Features of Plants and Animals

a. **Plants:** All living things called plants are green in colour they are non-motile and are multicellular. They are also autotrophic organisms because of the presence of chlorophyll. Examples includes spirogyra, fern and maize (Zea mays).

b. **Animals:** These groups of organisms are eucaryotes whose cells have no cell wall or chloroplasts as such they cannot produce their own food. They are mostly heterotrophic in their feeding habit. They range from cellular to multicellular. Most animals are motile, i.e. can move on their own from one place to the other. Examples include; hydra, tapeworm earthworm, cockroach, got, cows, etc.

SELF-ASSESSMENT EXERCISE

I a. Collect sample of water from a stagnant water body. Use a hand lens or microscope to identify as many organisms as possible in the water.

b. Make drawings of each of the organisms stating the name of each organism Also, state with reasons whether the organism is a plant or an animal.

ii. Walk round a school compound or a farm yard environment. Identify the various types of plants and animals you can see. Group them into their class stating reasons.

4.0 CONCLUSION

Living things are classified into two major groups i.e. plants and animals, base on the feature they have in common. However there are some organisms that do not fall into these two categories.

5.0 SUMMARY

- Living things are classified mainly into two, plants and animals based on certain criteria.
- Other examples that do not fit into the two criteria are further classified as either Monera, Fungi or Protoctista.

6.0 TUTOR-MARKED ASSIGNMENT

State the features of organism that are classified as Monera, Fungi and Protoctista. For each, give examples of the organisms found in the group.

7.0 REFERENCES/FURTHER READING

Taylor, D.J; Green, N.P.O & Stout, G.W. (1997). *Biological Science*. 3rd Edition. New York: Cambridge University Press.

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UNIT 3 DIFFERENCES BETWEEN PLANTS AND ANIMALS

CONTENTS

1.0 INTRODUCTION

In this unit you will learn about the major differences between plants and animals even though they are both living things.

2.0 OBJECTIVES

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

- State the differences between plants and animals based on the characteristics of living things.

3.0 MAIN CONTENT

3.1 Differences between Plant and Animals

From the exercises you had on grouping living things into living and non-living things, you must have had some difficulties grouping plants into living things. However the explanation on the characteristics of plants should convince you that plants are living. Since they grow, feed, reproduce, etc. there are however differences between plants and animals even though they are all living.

SELF-ASSESSMENT EXERCISE

1) Make a collection of different types of plants from your environment (how many different types can you get? 15 or 20?).
2) Write down a list in your workbook of ways you can tell that it is a plant.
3) Make a list of the differences you can observe between these plants and animals.

After you have recorded your observations, do they look like what you have in the table of differences between plants and animals below?

Table of Differences between Plants and Animals

	Characteristics	Plants	Animals
1	Feeding	These mostly manufacture their food, i.e. autotrophic. Using water, mineral salts absorbed from soil and carbon dioxide from the atmosphere with chlorophyll in the leaves	Animals do not have chlorophyll, hence cannot manufacture food, rather, they depend on plants for their food. They are said to be heterotrophic
2	Movement	Generally, plants are static and fixed to a position. Movement is only restricted to growth and stimuli	Animals can move from place to place in search of food, shelter and water.
3	Respiration	The whole body surface of plants are involved in gaseous exchange i.e. through stomata and lenticels in higher plants	Most animals have special organs for exchange of gases between the body and the environment. E.g use of gills by aquatic animals, trachea by insects and lungs by terrestrial animals.
4	Growth	In plants growth is apical i.e. tip of root or stem.	In animal, growth occur in all parts of the body. Usually, growth stops in animals when they reach adult stage.
5	Response to stimulus	In plants response is slow. Organ of sense is absent or not well developed.	In animals response is almost immediately. Animals also have well developed organs of sense.
6	Reproduction	Methods vary, and are both sexual or	Also well developed sexual organs that

		asexual	could be used sexually or asexually.
7	Excretion	Plant excrete waste to the environment in various forms CO_2 from respiration and O_2 from photosynthesis	Animals have well developed organs of excretion and excrete urine, carbon dioxide, etc. through the skin, kidney, nose as the case may be.

4.0 CONCLUSION

Although plants and animals are all living things and they both exhibit the characteristics of living things that have been discussed, their mode of carrying out these characteristics differ from one to the other.

5.0 SUMMARY

You have learnt the differences between plants and animals in the manner in which they carry out the characteristics of living things that are identified in unit 1.

6.0 TUTOR-MARKED ASSIGNMENT

i. State the differences between fungi and monera
ii. State three plant-like and two animal-like characteristics of Euglena.

7.0 REFERENCES/FURTHER READING

Taylor, D.J; Green, N.P.O & Stout, G.W. (1997). *Biological Science*. 3rd Edition. New York: Cambridge University Press.

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UNIT 4 MAJOR DIVISIONS FOR PLANTS AND ANIMAL KINGDOM

CONTENTS

1.0 INTRODUCTION

This unit will expose you to the different groupings of plants and animals based on certain features they have in common.

2.0 OBJECTIVES

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

- group plants into their different classes based on features they have in common.
- state examples of plants in each of the classes.
- group animals into their different classes
- state examples of animals in each of the classes.

3.0 MAIN CONTENT

3.1 Divisions of Plants Kingdom

We already know that living things vary from one another and they are divided into plant and animals kingdoms. There are over a million different kinds of animals and over three hundred thousand kinds of plants. Both plants and animals are classified into groups according to features they have in common and names are assigned to each group. The science of classification is referred to as taxonomy. Taxonomy is the method of classification that deals with identification and placing of organisms into groups on the bases of their similarities and differences.

All green plants belong to the kingdom Plantae. These plants are non-motile, multicellular and autotrophic. The plantae can be divided into two major groups, the thalophyta and embryophyta.

a. **Thallophytes:** They are red, green, and brown algae they have chlorophyll although other pigments are present in the brown and red algae. Examples of green algae are; chlamydomonas, spirogyra and volvox, (they are found in fresh water sea and moist places on land).
b. **Embryophytes:** These are divided into Bryophyta and Tracheophyta

i. **Bryophytes:** They are small green plants found in moist places, i.e. wet rocks, forest floor, swamps etc. examples are liverworts, Hornworts and mosses.

ii. **Tracheophytes:** There are also called vascular plants. This is because they have vascular tissues for conducing water and food. Examples of tracheophytes are;

- Pteridophytes e.g. fern
- Gymnosperms (have naked seeds) e.g. conifer
- Angiosperms flowering plants. They have seeds inside a fruit, they are the largest group in the plant kingdom. They are further grouped into dicotyledons (beans) and monocotyledons (maize)

3.2 Classification of Animals

Like the plants, the animals are also classified into groups according to the feature they have in common. All animals belong to the kingdom Animalia, they are multicellular eukaryotes whose cells do not have cell wall or chloroplasts. They are divided into two major groups; invertebrate (animals with no backbone) and vertebrata (animals with backbones). Further classification uses body design, body cavity and body symmetry.

a. **Invertebrates**

These do not have backbones and they are further subdivided base on the feature stated above. They include:

i. Porifera (sponges) (multicellular aquatic animals)
ii. Coelenterate also aquatic e.g. sea anemone, jelly fish, hydra, etc
iii. Platyhelminthes also called flatworms e.g. tapeworms and the flukes
iv. Nematodes (roundworms) examples include ascaris, guinea worm
v. Mollusca soft segmented bodied animals e.g. snail
vi. Annelid body is metamerically segmented example earthworm

vii. Arthropoda: A very large group of animals and are bilaterally symmetrical and paired jointed appendages. The classes includes:
   a. Crustacean e.g. crab, shrimp, prawn
   b. Insect e.g. housefly, grasshopper, cockroach, mosquito, etc.
   c. Arachinida e.g. spider
   d. Chilopoda e.g. centipede
   e. Diplopoda e.g. millipede

viii. Echinodermata e.g. starfih

b. Vertebrates

These are animals with well developed head and brain also a backbone known as vertebral column. They also possess internal skeleton of bone. They are further divided into subgroups:

i. Pisces e.g. fishes
ii. Amphibian e.g. toad and frog
iii. Reptilian (reptiles) e.g. lizard, snake, crocodiles, chameleon, etc
iv. Aves (birds) e.g. fowl, turkey, doves, etc
v. Mammalian e.g. man

SELF-ASSESSMENT EXERCISE

1) Make a collection of different types of plants, try and classify each into the class it belongs stating reasons for your classification based on their features.
2) Make a collection of different types of animals too. Pictures of those you cannot easily obtain are also adequate. Classify each of the animals stating reasons based on their features too.

4.0 CONCLUSION

This unit exposed you to the two major classifications of living things into plants and animals. The criteria for classification, is also explained and examples of plants and animals stated in each of the various groupings.

5.0 SUMMARY

In this unit you have learnt that plants and animals are classified into various groups based on certain criteria. The plants are classified into two major groups, the thallophytes and the embryophytes. The animals are divided into vertebrates and invertebrates. The different groupings

for each of the plants and animals were further done stating examples for each.

6.0 TUTOR-MARKED ASSIGNMENT

i. State three similarities and three differences between bryophytes and pteridophytes.

ii. In a tabular form, state the differences between monocotyledonous and dicotyledonous plants.

iii. a. State five general characteristics of vertebrates and invertebrates.

b. List the classes of vertebrates and state five characteristics of any of the classes stating example.

7.0 REFERENCES/FURTHER READING

Taylor, D.J; Green, N.P.O & Stout, G.W. (1997). *Biological Science*. 3rd Edition. New York: Cambridge University Press.

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MODULE 2 GENERAL MORPHOLOGY OF SOME EXAMPLES OF MAJOR DIVISIONS OF PLANT KINGDOM

Introduction

In this module you will be exposed to examples of some major divisions of the plant kingdom. The general morphology i.e. physical characteristics of specific examples of these plants will be discussed. In specific terms, this module will discuss the structure, nutrition, reproduction and life cycles of fern plant, an example of the group pteridophytes. Also the structure and life cycles of bean (a dicotyledonous plant) and maize a monocotyledonous plant will be explained. Module Two is thus divided into three units as follows:

Unit 1 General Morphology and Life Cycle of Fern (Pteridophyte)
Unit 2 General Morphology and Life Cycle of Beans (a Dicotyledon)
Unit 3 General Morphology and Life Cycle of Zea mays (A Monocot)

UNIT 1 GENERAL MORPHOLOGY AND LIFE CYCLE OF FERN PLANT (PTERIDOPHYTE)

CONTENTS

1.0 INTRODUCTION

This unit will expose you to the physical structure of fern plants which is an example of a member of the group pteridophyta. The unit will discuss its life cycle, method of reproduction and nutrition.

2.0 OBJECTIVES

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

- describe the structure, and reproduction in the fern plants
- draw and describe the life cycle of the fern plants, which is an example of a pteridophyte

3.0 MAIN CONTENT

3.1 Morphology of the Fern Plant

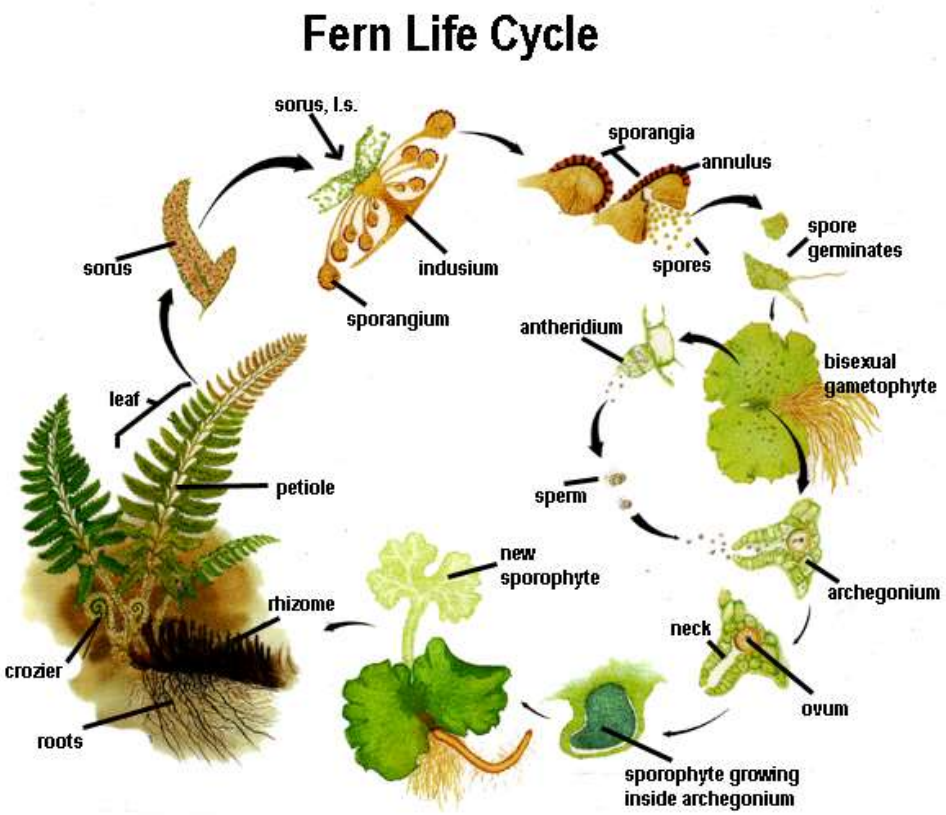
Fern plant belongs to the division of plants referred to as pteridophytes. These plants possess true roots, stems and leaves like flowering plants. They however, produce spores instead of seeds. The leaves are called fronds and they have good conducting vessels in their roots, the stem (rhizome) and the fronds. They are shade-loving plants found in damp places.

Fern Plant

Nutrition: They have green fronds which can provide food by photosynthesis.
Reproduction: This occurs by production of spores. This is a dominant stage in the life cycle of the plant. The second stage is the gametophytes

stage where eggs and sperms are produced. This stage of reproduction occurs in moist places, as moisture is needed for the sperm to swim to the egg for fertilization.

3.2 Life Cycle of Fern Plant



Two distinct generations are seen in the life cycle of the fern plant, namely, the sporophyte generation and the gametophyte generation. When the plant is matured, the leaves houses small dots called sori (singular sorus) appearing on the lower side of the leave. These produce spores, which are released and eventually carried by wind to a new location. When the spores fall on a moist surface, it begins to grow new plant. The second stage is gametophyte where eggs and sperms are produced. These fertilize each other and the new young one is produced.

4.0 CONCLUSION

Fern plant, a representative of the group of plants called pteridophyte is a common plant found in moist environment. The life cycle, include the sporophyte generation and the gametophyte generation, the two occur in the life cycle of the plant.

5.0 SUMMARY

In this unit you have learnt:

- the structure of the fern plant
- where they are commonly found
- their feeding process
- their reproduction system as well as the life cycle of the plant

6.0 TUTOR-MARKED ASSIGNMENT

COLLECT SOME SPECIMEN OF THE FERN PLANT, OBSERVE ITS LEAVES (fronds) carefully, draw showing the sori on the under surface of the plant. With the aid of the hand lens observe carefully the shape and nature of the fronds, draw and label carefully. Ensure that the parts are fully labeled.

7.0 REFERENCES/FURTHER READING

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UNIT 2 GENERAL MORPHOLOGY AND LIFE CYCLE OF BEANS (A DICOTYLEDONOUS) PLANT

CONTENTS

1.0 INTRODUCTION

This unit will expose you to the physical structure of a dicotyledonous plant (beans). This is a plant in the group referred to as the angiosperm. The life cycle of the plant and method of reproduction will be discussed.

2.0 OBJECTIVES

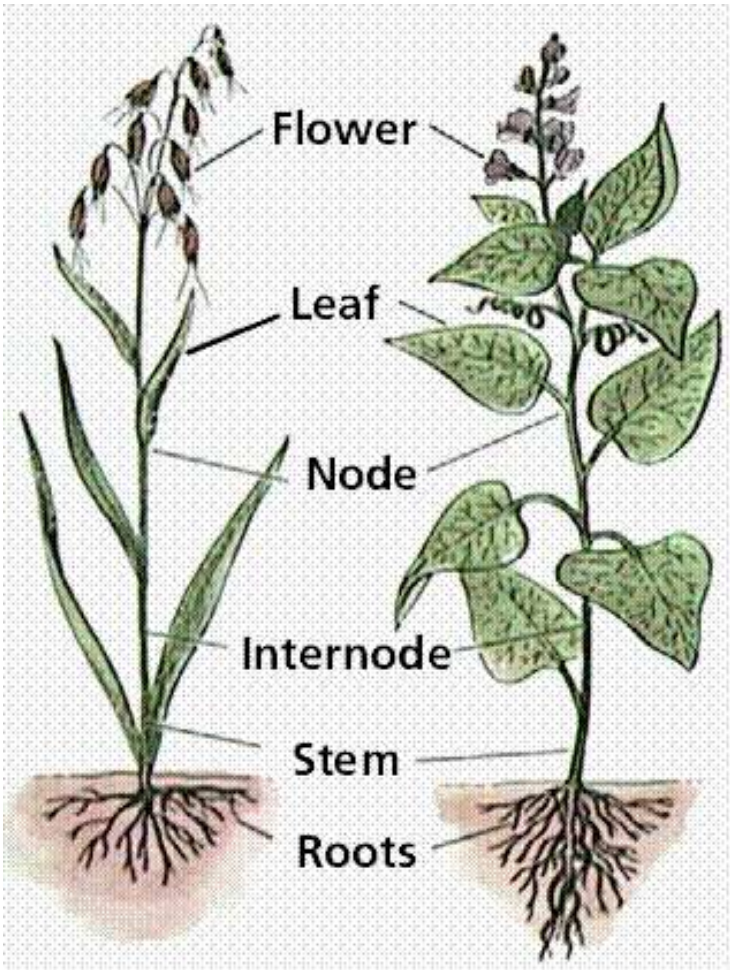
At the end of this unit, you should be able to:

- describe the structure of the beans plant
- describe the life cycle of the plant
- explain the nutritional and reproduction types of the plant

3.0 MAIN CONTENT

3.1 Morphology of Beans – A Dicot Plant

The beans plant belongs to the group of plant referred to as angiosperm. This plant is further classified as a dicotyledonous plant and a typical example of a flowering plant. They are found growing everywhere especially in the savanna regions. It is a plant very rich in protein.

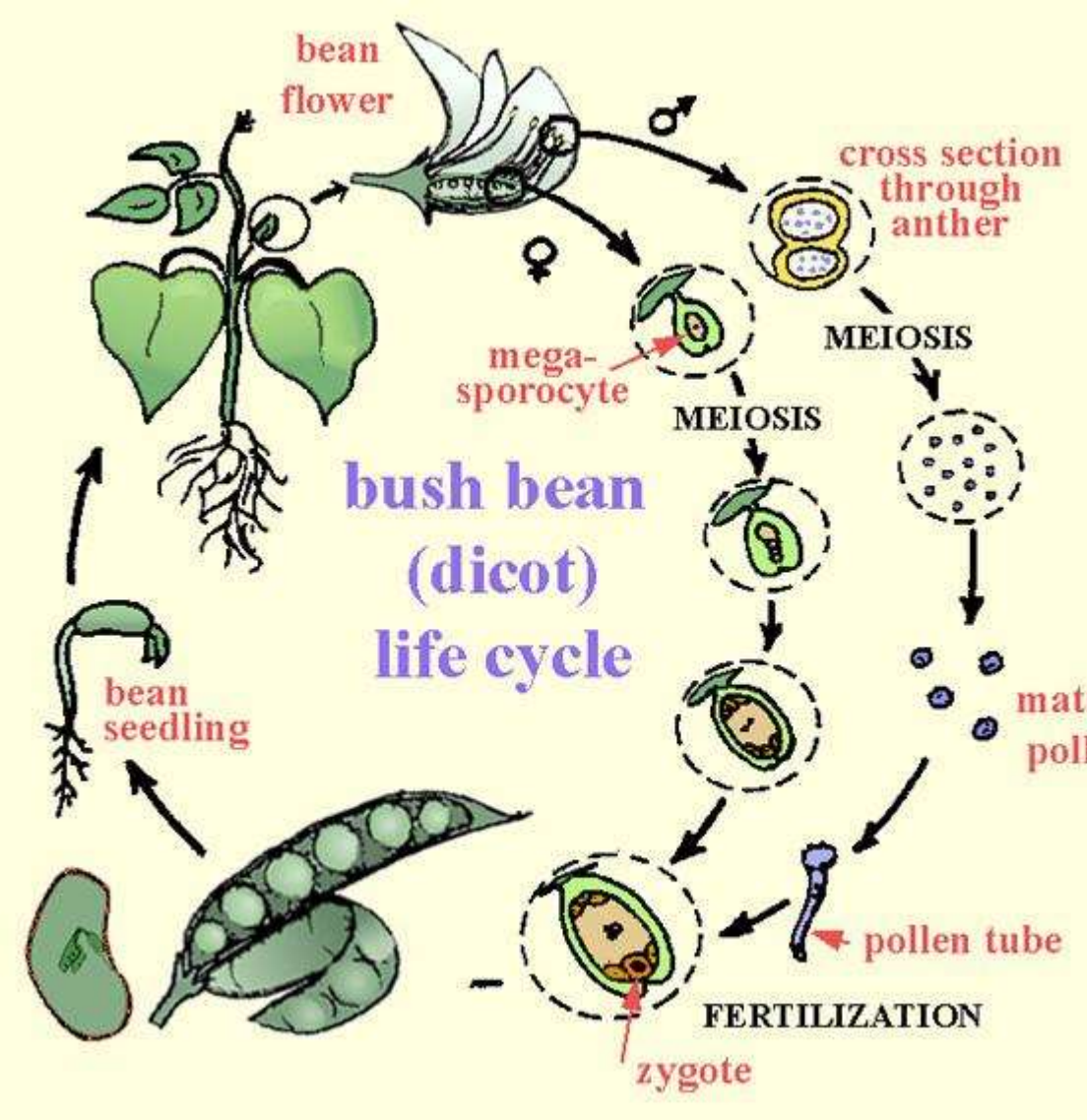


Bean Plant External Feature

Nutrition: The plant produces its own food by the process of photosynthesis.
Reproduction: This is sexual in nature. The male and female gametes are produced on the flower. The process of pollination and fertilization leads to formation of the zygote ie the embryo. The embryo eventually forms the seed, them the fruit.

3.2 Life Cycle of Bean

The matured bean plant carries the flower where the sex cells i.e. pollen grain and ovary are seated.



SELF-ASSESSMENT EXERCISE

Take some bean seeds:

1) Put them in a pot with wet soil
2) Leave the seeds in the wet pot of soil to germinate and grow
3) Observe the seed as it passes through the stages of germination for five days
4) Continue to wet the pot daily for the next one more week
5) Draw the seedling as it grows after the first week
6) Describe the plant base on the features you can see, that clearly make it a dicot plant.

4.0 CONCLUSION

The bean plant, a representative of the group of plants called angiosperms, is a typical example of a dicotyledonous plant (2 seed

leaves). The plant reproduces sexually, resulting in the production of seeds and fruits.

5.0 SUMMARY

In this unit you have learnt that:

- beans seed is a typical example of an angiosperm
- it is a dicot plant and reproduces sexually, resulting to the production of seeds
- beans is a plant very rich in protein

6.0 TUTOR-MARKED ASSIGNMENT

i. State clearly the features of the plant that are classified as angiosperms
ii. Why is the bean plant regarded as a dicotyledonous plant?
iii. Reproduction system in beans is described as sexual, describe what this means.

7.0 REFERENCES/FURTHER READING

Taylor, D.J; Green, N.P.O & Stout, G.W. (1997). *Biological Science*. 3rd Edition. New York: Cambridge University Press.

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UNIT 3 GENERAL MORPHOLOGY AND LIFE CYCLE OF ZEA MAYS (MAIZE)

CONTENTS

1.0 INTRODUCTION

In this unit you will learn the structure of the maize plant, a typical example of a monocotyledonous (one seed leaves) plant in the class angiosperm. The life cycle of the plant as well as the mode of reproduction will also be discussed.

2.0 OBJECTIVES

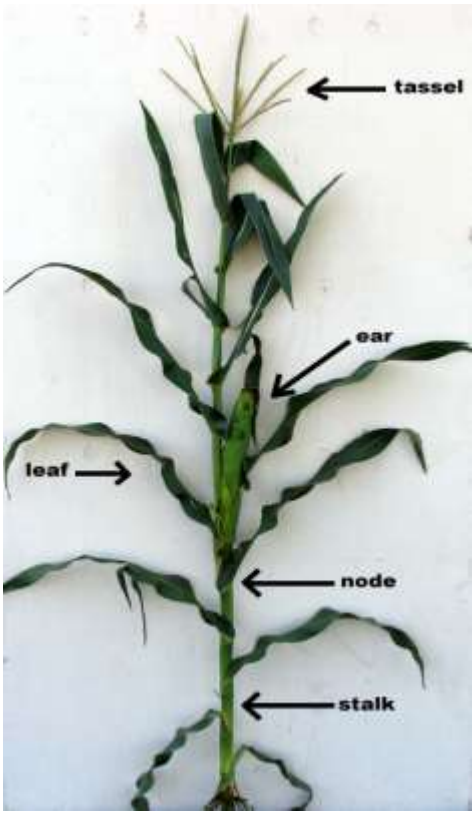
At the end of this unit, you should be able to:

- describe the physical structure of the maize plant
- describe the life cycle of the plant
- discuss the mode of the nutrition in the plant

3.0 MAIN CONTENT

3.1 Morphology of the Maize Plant (Monocot)

The maize plant belongs to the group of plants referred to as angiosperms. The plant is further classified as a monocotyledon. It is a typical example of a flowering plant. They have stems, roots and leaves which are green and used for photosynthesis. Maize plant is very rich in the class of food called carbohydrates.

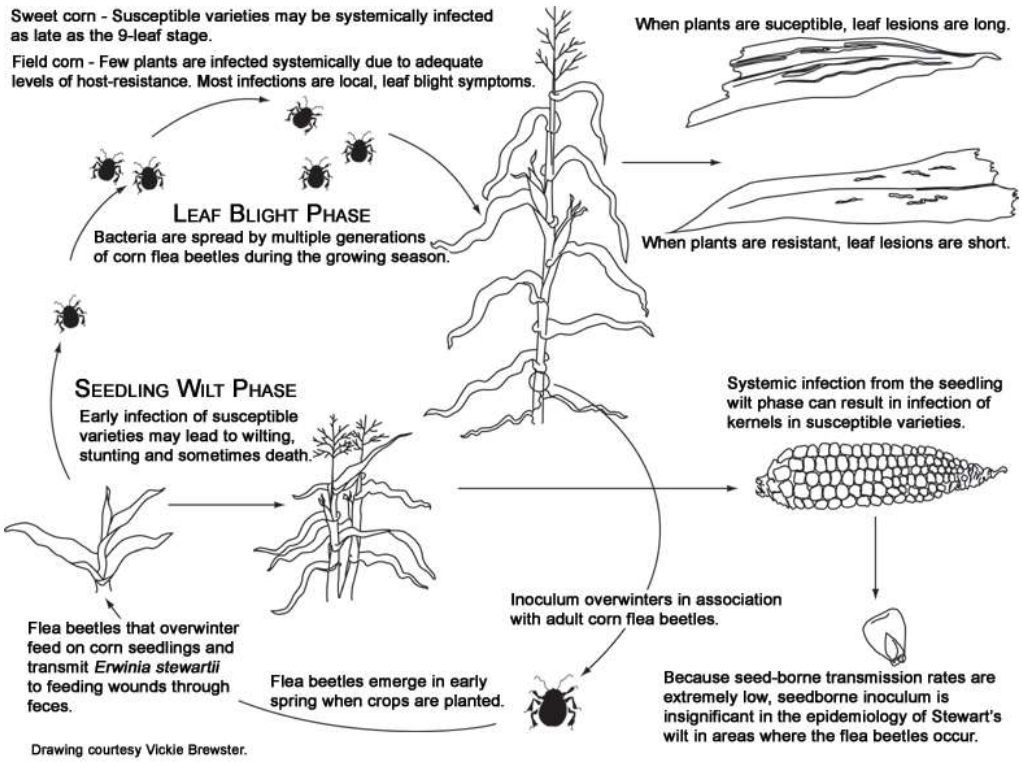


External Features of Maize Plant

Nutrition: The plant is a typical green plant that produces its food by photosynthesis.
Reproduction: As a flowing plant, the reproduction system is sexual in nature. The flowers produce pollen grains (male gamete) and the ovule (female gamete) pollination leads to the fertilization which results in the production of the seeds.

3.2 Life Cycle of the Maize Plant

When the plant is fully mature flowers are produced. The flower carries the male and the female organ necessary for pollination and germination to occur.



Life Cycle of Maize

SELF-ASSESSMENT EXERCISE

1) like you did for the growing of the potted plant for the beans, carry out the same process and produced a potted plant for the maize.
2) Draw the feature of the maize plant
3) List out the feature of the maize plant and write down the differences between the maize plant and the beans.
4) What are the features that make the maize a monocot plant?

4.0 CONCLUSION

The maize plant, a representative of the group of plants called Angiosperm is a typical example of a monocot plant. The plant produces sexually resulting in the production of seeds and fruits.

5.0 SUMMARY

In this unit you have learnt that:

- Maize is a typical example of an angiosperm
- It is a monocot plant that reproduces sexually
- Maize is a plant very rich in carbohydrate.

6.0 TUTOR-MARKED ASSIGNMENT

i. State clearly five differences between monocot and dicot plants
ii. List the features of maize that makes it a monocotyledonous plant

7.0 REFERENCES/FURTHER READING

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MODULE 3 STRUCTURE CHARACTERISTICS AND LIFE CYCLES OF SOME MEMBERS OF VARIOUS ANIMAL PHYLA

Unit 1 Structure, Characteristics and Life Cycle of Examples of Invertebrates
Unit 2 Structure, Characteristics and Life Cycle of Examples of Vertebrates

UNIT 1 STRUCTURE, CHARACTERISTICS AND LIFE CYCLE OF EXAMPLES OF INVERTEBRATES

CONTENTS

1.0 INTRODUCTION

In this unit, you will learn about some members of the phylum invertebrate. The external structure, characteristics and life cycle of Ascaris and cockroach as examples of invertebrate are highlighted.

2.0 OBJECTIVES

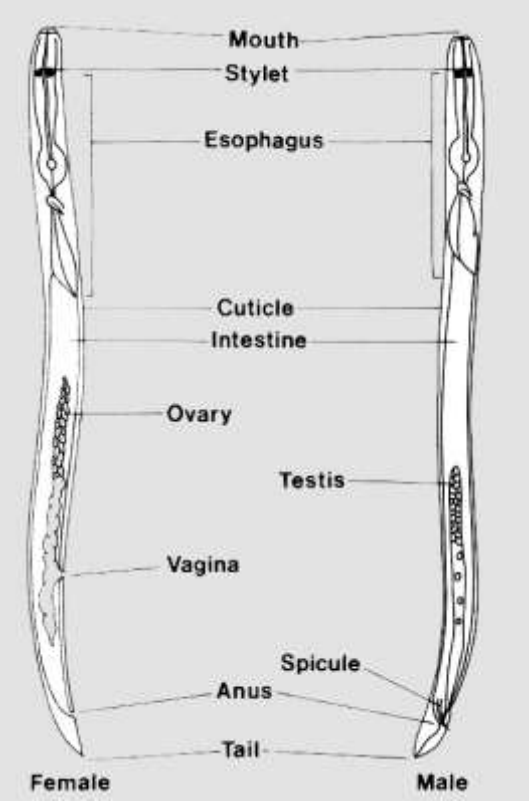
At the end of this unit, you should be able to:

- list the characteristics of invertebrates
- state examples of organisms referred to as invertebrates
- describe Ascaris as an example of an invertebrate

3.0 MAIN CONTENT

3.1 Structure, Characteristics and Life Cycle of Ascaris Lumbricoides

Ascaris is an example of invertebrate (animals without backbone) and in the class Nematoda. It is a common round worm found in the intestine of human being. It lives freely in the lumen feeding on the content of the digestive tract. The sexes are separate the female is larger (about 30cm in length) and has a straight tail, while the male is smaller (about 20cm in length) with the tail curved ventrally. The worm is whitish or pinkish in colour when fresh. The surface of the body is smooth and shiny covered with cuticle. The cuticle protects against mechanical and chemical injury, it also allows for movement in several directions as well as acting as an exoskeleton. The worm causes ascariasis disease.

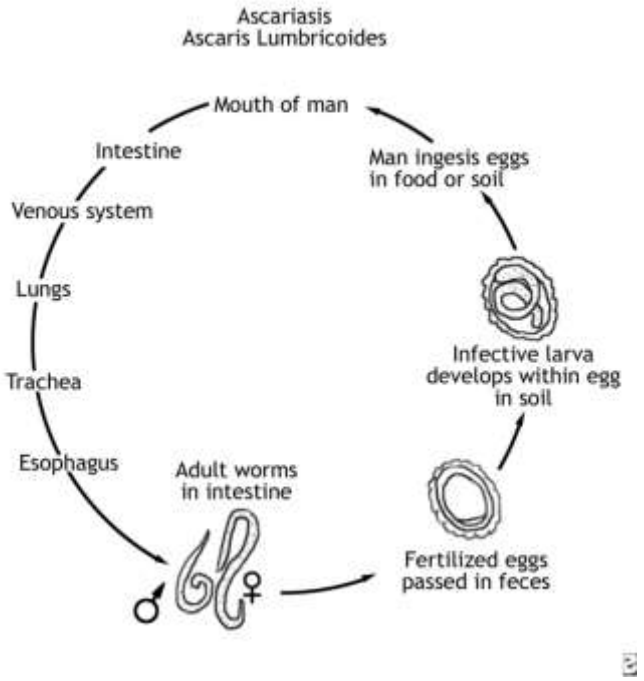


External feature of Ascaris

Life Cycle

- Ascaris adult worm inhabits the small intestine where when fully grown they are passed out in the stool.
- Where both male and female worm infects the human, fertile eggs are produced in thousands.
- Infection by male only do not produce eggs
- Ova are passed out in the faeces

- Embryo develops into infective second stage larvae in the environment
- When this is ingested by human, the ova hatches in the small intestine releasing larvae which then penetrates the intestinal wall migrating through the lymphatic system to the heart and lungs (a times to the kidney or brain).
- The larvae usually reach the lungs in four days after ingestion of the egg.
- In the lungs the larva mature over a period of ten days then moves through the bronchi back to the intestine.
- In the intestine they mature to adult worms
- Mature adult then begins to produce ova (eggs) which are then excreted, completing the cycle.
- The worm is mostly found in the small intestine, and a times any location from the oesophagus to the rectum.

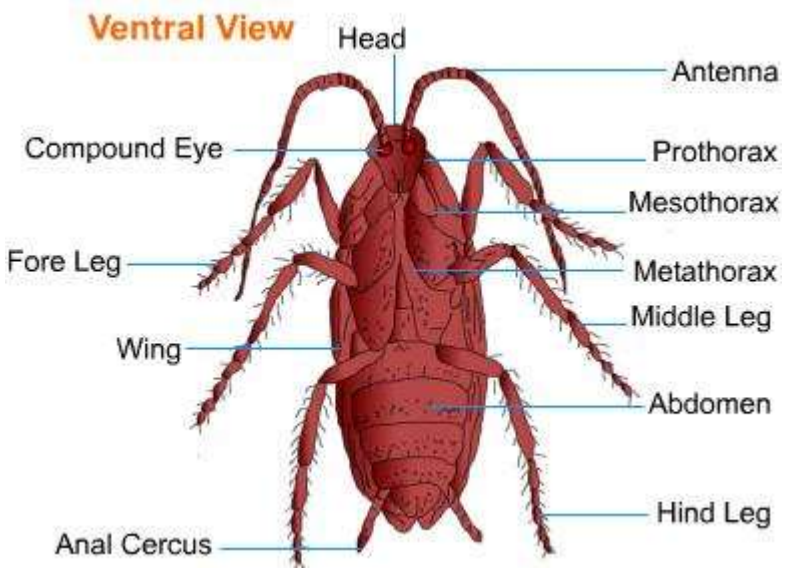


Lifecycle of Ascaris

3.2 Structure, Characteristics and Life Cycle of Cockroach (Blatta periplaneta)

Cockroach is an example of invertebrate animal in the phylum Arthropoda, class insecta. It is a well known pest. They are found in homes living in cracks and crevices. Both sexes of the periplanata species have wings and can weakly fly. The insect has a body divided into head, thorax, and abdomen with the thorax bearing three pairs of walking legs. Spiracles (breathing tubes) are clearly seen along the sides

of the abdomen and two on the thorax. Cockroaches are scavengers feeding on a variety of organic matter e.g. food, wood, paper, etc.



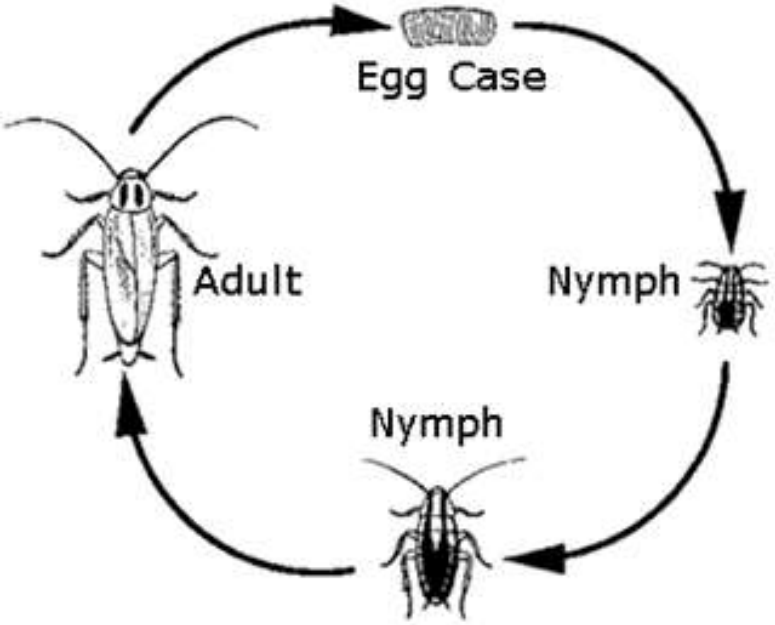
External Features of Cockroach

Life Cycle of Cockroach

Adult female cockroach produces eggs which are enclosed in resilient egg case called *oothecae*.

- The eggs hatch producing the young nymph that look like the adult but do not have wings. The length of time it takes the egg to hatch from the oothecae depends on the specie of cockroach as well as the environmental conditions.
- The nymphs undergo a series of moulting before fully becoming mature adults.
- The nymph develops into the adult cockroach with a change in colour from pale to dark brown.
- Adult cockroach has an average life span of about a year

The type of life cycle of cockroach is described as incomplete and at normal room temperature complete development takes sixty days. Cockroach transports pathogenic organisms and are known to cause intestinal diseases.



Life cycle of cockroach

SELF-ASSESSMENT EXERCISE

1) 1a. Make a large labeled drawing of Ascaris
2) observe the mouth part and the tail region, state whether it is a male or female specie
3) What differences and similarities can you observe between Ascaris and hookworm.
4) Make a large drawing of cockroach and label the parts fully.

4.0 CONCLUSION

Classifying organisms helps to put them in the group they belong, depending on characteristics these organisms share in common. Two examples of invertebrates was discussed. You will notice that they are both invertebrates i.e. animals without backbone, however, other characteristics further helped to place them in different classes.

5.0 SUMMARY

In this unit you have learnt:

- The structure, characteristics and the life cycle of Ascaris
- Ascaris is a round worm that can infest the human being through eating infected food especially fruits and vegetables
- Ascaris causes the disease ascariasis
- The structure of cockroach and its life cycles, also an invertebrate
- Cockroach are found living in cracks and crevices in homes

- That cockroaches transport pathogens that can cause intestinal diseases.

6.0 TUTOR-MARKED ASSIGNMENT

i. a. Describe the lifecycle of Ascaris
   b. State reasons why Ascaris is classified as an organism in the class Nematoda
ii. a. Describe the life cycle of the cockroach
   b. Explain what is meant by "incomplete" as it relates to the life cycle of the cockroach.

6.0 REFERENCES/FURTHER READINGS

Marshal, a.J. & Williams, W.D. Textbook of Zoology Vol. 1. Invertebrates New Edition. ELBS and Macmillan

Grove, A.J. and Newell, G.E. New Edition Animal Biology. London: University Tutorial Press Ltd.

UNIT 2 STRUCTURE, CHARACTERISTICS AND LIFE CYCLE OF EXAMPLES OF VERTEBRATES

CONTENTS

1.0 INTRODUCTION

This unit discusses some examples of organisms in the group referred to as vertebrates (animals with backbone). You will learn about specific examples like the fish and lizard. Their structure, characteristics and life cycle will be highlighted.

2.0 OBJECTIVES

At the end of the unit, you should be able to:

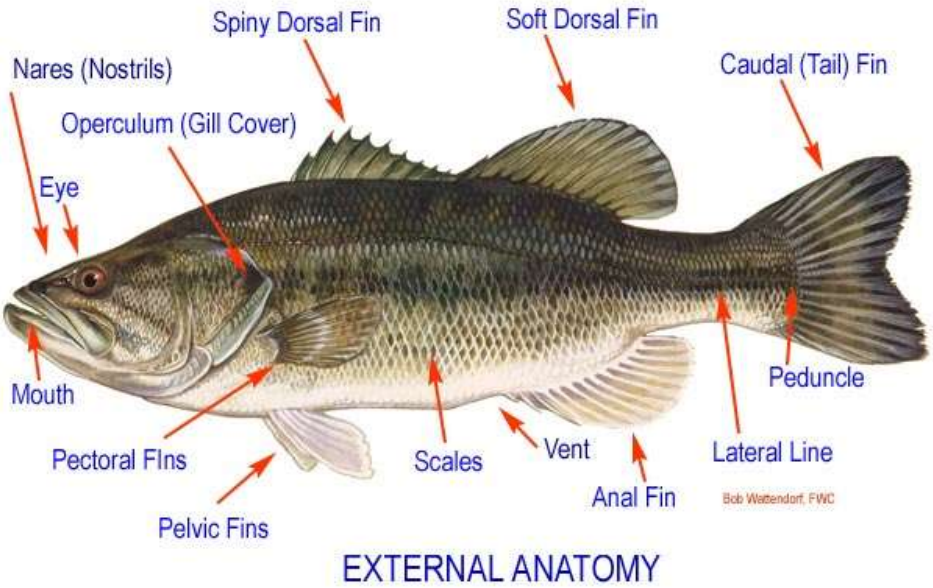
- state why fish and lizard are grouped together as vertebrates
- describe the characteristics and life cycles of fish and lizard.
- explain the economic values of both fish and lizard.

3.0 MAIN CONTENT

3.1 Structure, Characteristics and Life Cycle of Fish - Tilapia

Fish is an example of a vertebrate and belongs to the class Pieces. It is a bony animal with gills for breathing. The organism has outer covering of overlapping scales. Their life is aquatic. The body is divided into three, the head, trunk and tail, the body is streamlined, tempering at both ends. The entire body is covered by scales and the organisms used the fins for movement. The colour of Tilapia is bright and may change with environmental conditions. In most fishes, the darker pigments are in the dorsal part of the body given the fish a darker dorsal part, that blends

with the bottom of the water. Gills are used for respiration and covered by the operculum. Two of the fins are paired, and used as limbs for movement, i.e. pelvic and pectoral finds. These fins also aid in steering and maintaining balance when the fish is resting. Caudal fin, found at the tail end aids in propelling the fish. The dorsal fins, which is situated in the middle line of the trunk is used to keep the fish upright while swimming. Fish is a good source of protein.

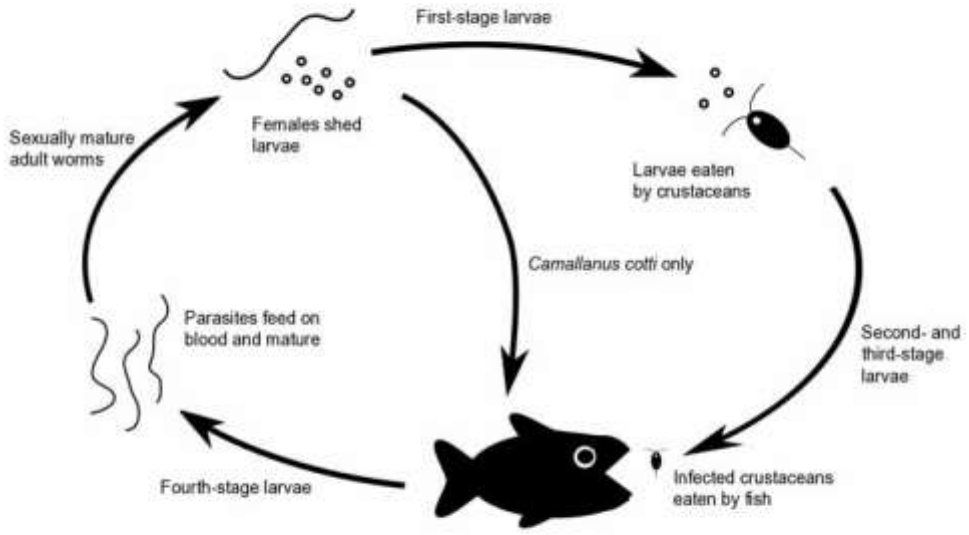


External features of tilapia fish

Life Cycle

Male and female are separate, reproduction is sexual. The matured female produces eggs from the single ovary. As the eggs grow the ovary enlarges and may even bulge the sides of the fish. In the matured male, sperms are developed in the paired testes. The female lays her eggs in spawns in shallow, slow-moving part of the water, the matured male then swims over them discharging the sperm over the eggs. The fertilization thus is external. Development of the eggs begins and takes two to six weeks depending on the temperature of the environment.

The life cycle is thus simple, and can be represented thus:



Life Cycle of Tilapia Fish

3.2 Structure, Characteristics and Life Cycle of Lizard – Agama agama

Like the fish the lizard too is an example of vertebrates and belongs to the class referred to as the Reptiles. Other examples of animals in this class include the snake, crocodiles etc. these animals unlike the fish are completely adapted to life on dry land. The skin is dry, and bears horny epidermal scales. They breathe through lungs, no external ear. A head and distinct neck region is present. The trunk ends with a long tail. The male Agama lizard is larger in size with purple to orange bright colour. The female is smaller and not brightly coloured.

The lizard feeds mostly on small insects. The lizard crawls when moving using their four limbs they also burrow through soil especially during reproduction. In most cases sexual reproduction occurs

(External Features of the Lizard Agama agama)

Life Cycle of Lizard

Male and female are separate reproduction is sexual, however, development of the egg occur outside the body of the female i.e. in the environment. Matured eggs produced by female and matured sperm produced by the male come together. Fertilization occurs internally i.e.in the body of the female resulting in the production of the fertilized egg. These eggs are laid in the soil by the female. After some time, they

hatch into the young ones that look exactly like the adult. The life cycle can be represented thus;

Adult → Egg → Young → Adult

SELF-ASSESSMENT EXERCISE

1) Get a specimen of a fish and that of a lizard. Make external drawing of each and label fully.
2) What are the features you can observe in the two organisms that make them to belong to the same group called vertebrates.
3) Any differences between these and the invertebrates? List the differences

4.0 CONCLUSION

Fish and Agama lizard are described as animals. These two are grouped together as vertebrates. This is because of the feature they have in common. The structure, characteristics and lifecycles of each were described.

5.0 SUMMARY

In this unit you have learnt:

- The external features, characteristics and life cycles of fish and Agama lizard.
- These two are example of vertebrates (animals with backbone).
- Fish reproduces sexually and fertilization is external.
- Lizard reproduces sexually and fertilization is internal, however, development of the embryo is outside the body of the female.
- Fish lives completely in water and breathe using gills.
- Lizard leaves, completely on dry land and breathes using lungs.

6.0 TUTOR-MARKED ASSIGNMENT

i. a. Describe the general characteristics of vertebrates
   b. why is the fish referred to as an example of a vertebrate. List five reasons.
ii. Both fish and lizard are examples of vertebrates, what are the uses of each to human being?

7.0 REFERENCES/FURTHER READING

Grove, A.J. and Newell, G.E. New Edition Animal Biology. London: University Tutorial Press Ltd.

Moon, T.J; Otto, J.H. & Towle, A. Modern Biology. Holt, Rinehart and Winston Inc. New Edition.

MODULE 4 FUNCTIONING OF THE LIVING SYSTEM

Introduction

The living organism is a complex dynamic system created by nature. For it to function effectively certain components are needed. These components include the structural elements in the living system e.g. tissues, organs and the system. For example, cardiovascular, nervous, musculoskeletal, digestive secretion, endocrine systems etc. These systems work together with one another for the proper functioning of the entire living system. This module will expose you to the various systems, how they function to ensure a proper functioning of the living organisms. The unit will thus expose you to how each of the systems for nutrition, respiration, excretion, body fluid circulation, nervous and chemical co-ordination function in the living system. Examples are discussed among plants and animals. The module is thus divided into two units as follows:

UNIT 1 Nutrition, Respiration, Excretion and Growth among Plants and Animals
UNIT 2 Body Fluid Circulation, Nervous and Chemical Coordination.

UNIT 1 NUTRITION, RESPIRATION, EXCRETION AND GROWTH AMONG PLANTS AND ANIMALS

CONTENTS

1.0 INTRODUCTION

The characteristics of living things examined in module one include nutrition, respiration, excretion, growth etc. this unit will further explain

the systems that aid in carrying out these activities, stating examples in plants and animals.

2.0 OBJECTIVES

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

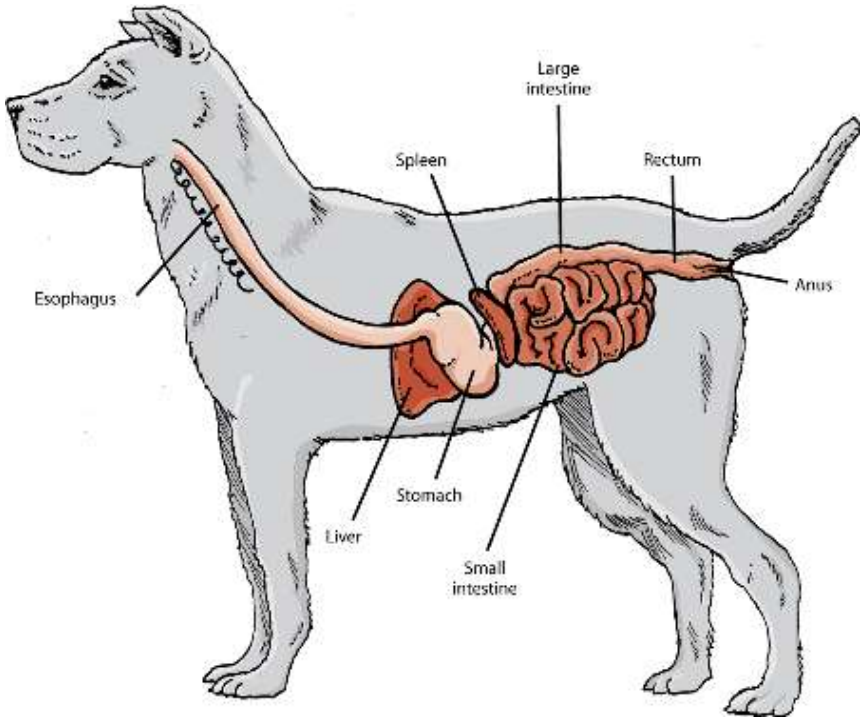
- explain how the systems function to carryout nutrition and respiration in plants and animals
- explain how the systems function to carry out excretion and growth in plants and animals

3.0 MAIN CONTENT

3.1 Nutrition System

Methods of feeding differ among living things. The type of feeding habit determines the manner of feeding, for examples the structure of the mouth part of an animal correlates closely with what is eaten and method of eating. Animals that are fluid feeders suck or mop up liquids like nectar, plant sap, blood or fruit juice. Examples of such animal is the butterfly, they make use of straw-like proboscis to mop up their meal. The feeding system in such animal is thus simple. Higher animal like dog is carnivorous i.e. feeding on flesh. The dog has mouth part that suits such feeding. There is the presence of teeth of various type i.e. front teeth biting and cutting and broad flat molar for chewing. These help break the food into pieces and aid digestion. The digesting system is more complex in man, the organs work together hand-in-hand to aid digestion and absorption of the food.

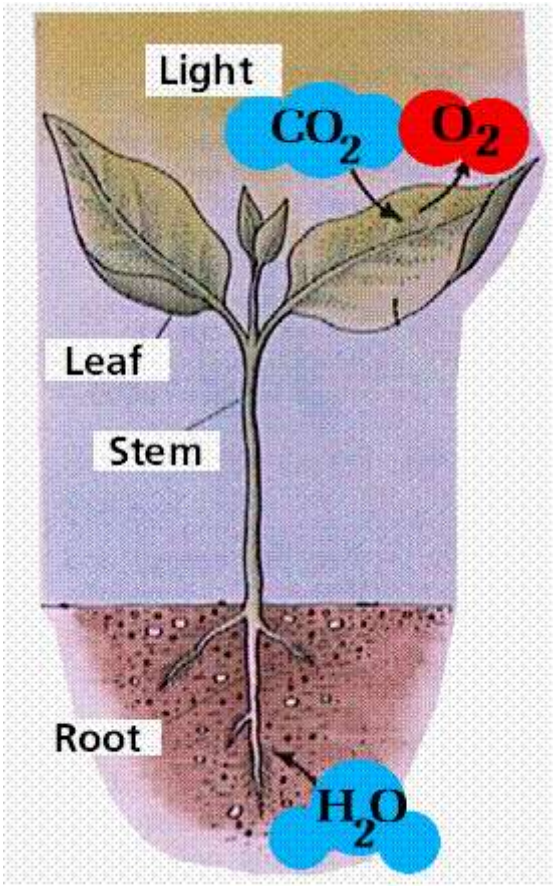
Mosquito Feeding



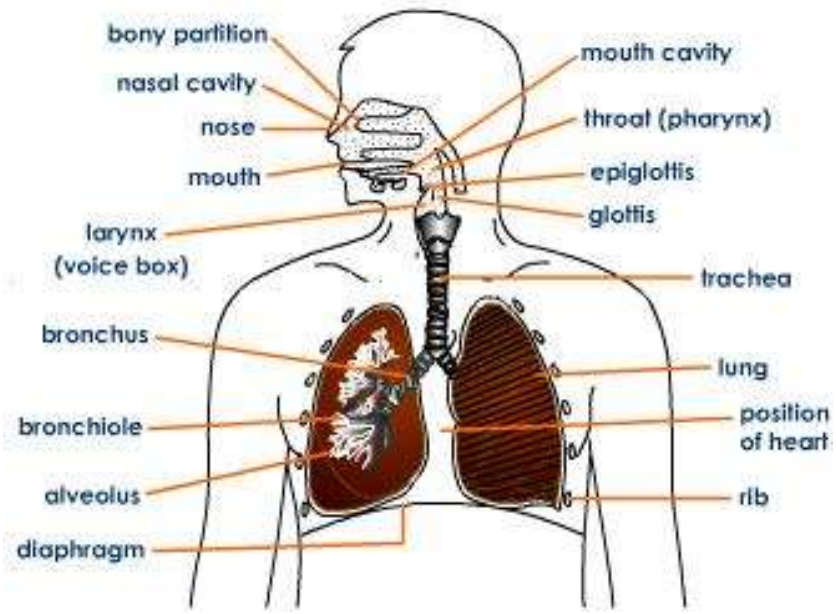
Digestive System of Dog

3.2 Respiration System

This involves the process of absorption of gases in and out of the body of the living organisms as well as the use of these gases to release energy for the organism to live. In lower organism, gaseous exchange take place through the body surface example unicellular organisms. However, higher animals have the breathing system, which along with others form the respiratory system. In plants the stomata, guard cells, allow gases pass in and out of the plant. In the tissue of the plant, the gases (CO_2 and others) in the presence of the green pigment (chlorophyll), water and sunlight energy forms food. The food formed, part is stored and part used by the plant itself for internal respiration, which thus gives the energy required to the plant. In animals (especially) higher animal, the gas required (oxygen) is taken into the body through the breathing system (nose, lungs). In the cell of the body oxygen is used to breakdown the digested food to release energy for the body to use. The respiratory system thus differ from organism to organisms, the processes are however the same.



Respiratory System of Plant

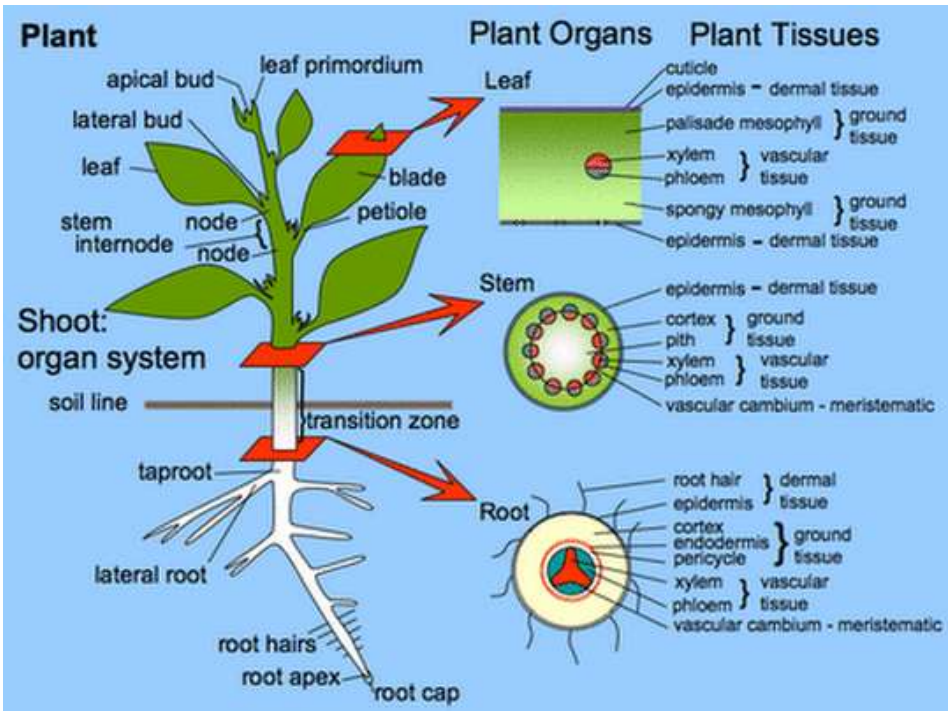


Respiratory system of Man)

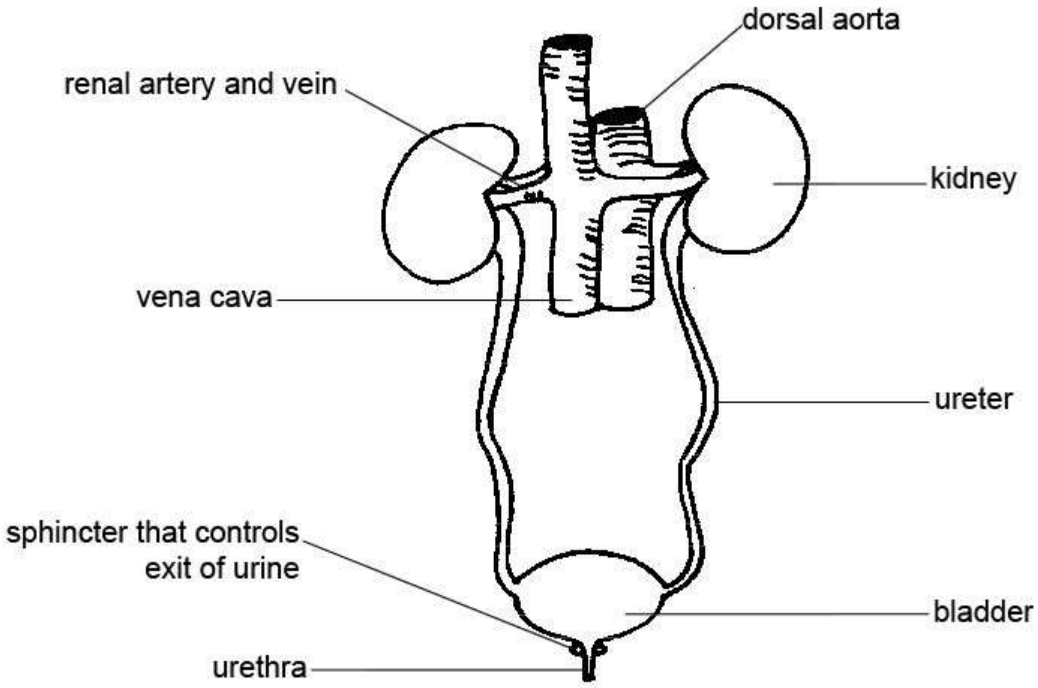
3.3 Excretory System

The activities that take place in the system of living organism leads to production of waste materials, these waste materials are in different

forms, they are removed from the living system in order to keep the systems working well. Where the wastes are not removed they could damage the organs of the body. The process of removal is called excretion and the organs working together to remove the wastes are the excretory systems. Excretory waste materials are mostly in form of gases in both plants and animals, example include carbon dioxide (CO_2) (waste from respiration). In plants, oxygen is the waste produced from photosynthesis and CO_2 from respiration these are removed through the stomata. In animals, waste materials like urine, which is removed through the kidney and sweat which is removed through the skin. The excretory systems in higher animals therefore include such organs as kidney, ureter, urethra, and the bladder. These work hand-in-hand to remove urine, while the lungs carry out the process of removing the gaseous CO_2.



Excretory System of Plant



Excretory System of Animal

3.4 Growth System

Every living thing whether plant or animal carry out the process of growth. Growth is the irreversible increase in the size of living things. Living things do not just get bigger in size when they grow they also develop e.g. some cells in animals developed into bones, others into muscles, and some others into skin and so on. This shows that living things grow as well as develop e.g. plants develop roots, leaves and flowers.

SELF-ASSESSMENT EXERCISE

1) Put some maize seeds in a pot with soil.
2) Water daily until the maize seeds germinates
3) From the point of germination, record the size of plant, the size of the leaves daily for ten days
4) Draw a graph to show how the plant grew daily (plot height of plant on vertical axis against the time (days of readings) on the horizontal axis
5) What can you find out from your graph about the way your plant grew
6) Is the growth by the same amount each day?
7) What part of the plant, seem to be growing most?

4.0 CONCLUSION

The process of nutrition, respiration, excretion and growth take place in living things. In the body of thee living things, specialized organs work together to carry out each of the processes. The specialized organs each form the system e.g. digestive system, respiratory system, excretory system etc. Each of the systems functions in conjunction with one another to make the entire organisms.

5.0 SUMMARY

In this unit, you learnt that;

- nutrition (feeding)is carried out by all living things and the method differ from one organisms to the other.
- The nature of feeding goes with the type of digestion system of the organisms.
- Respiration occur in both plants and animals using the respiratory system. Type of respiratory system differ between plants and animals, plants uses the stomatal opening while higher animals make use of the lungs.
- Excretion also uses excretory system, stomata in plants, body surface in lower animals and the kidney and skin in higher animals.
- Growth occurs in living things and it is an irreversible increase in size of the organism.

6.0 TUTOR-MARKED ASSIGNMENT

i. a. Describe the process of respiration in lower classes of organism like amoeba and spirogyra

   b. Describe the respiratory system and how respiration occurs in the human being. State two differences, and two similarities between respiration in lower animals like amoeba and human being.

ii. a. Describe the process of photosynthesis in plant

   b. state the different ways food produced during photosynthesis are used by plants.

7.0 REFERENCES/FURTHER READING

Grove, A.J. and Newell, G.E. New Edition Animal Biology. London: University Tutorial Press Ltd.

Moon, T.J; Otto, J.H. & Towle, A. Modern Biology. Holt, Rinehart and Winston Inc. New Edition.

UNIT 2 BODY FLUID CIRCULATION, NERVOUS AND CHEMICAL COORDINATION

CONTENTS

1.0 INTRODUCTION

To convey food digested and other materials in the body from point of production to point of use, a means of transportation is necessary. The body fluid i.e. blood is used for this purpose. Messages are also conveyed from one part of the organisms through the nerves. This unit will expose you to these different means of transportation among plants and animals.

2.0 OBJECTIVES

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

- describe how body fluid transport materials from one part of the body of the organisms to the other, stating examples of such materials transported.
- explain what is meant by nervous coordination among higher organisms and the organs responsible for that.
- describe how chemical coordination occur in living organisms.

3.0 MAIN CONTENT

3.1 Body Fluid Circulation

In higher animals, the body fluid carrying nutritive fluid, waste material and water is the blood. The body does the conveyance in a movement or flow referred to as the circulation. The body fluid (blood) is made up of cells scattered in a non-living substance which makes up the fluid portion called the plasma. An average human being has about 12 pints of blood making about 9% of the body weight. Digested food, in the form

of glucose, fatty acids, glycerin and amino acid are transported. These are carried (transported) to the liver and other parts of the body. Along with this the body fluid also transports nitrogenous wastes, urea etc from the body where they are produced to the organs of excretion. The solid components of the body fluid contain red blood cells which convey oxygen to all body tissues to be used for respiration. Other cells include white blood cells and platelets. In plants, transportation of water from the roots and food produced in leaves to regions of storage and usage is done by the process of translocation, and simple diffusion. The vascular tissues carryout the transportation of the water and the food. Xylem tissue conducts water from root to leaves. Root pressure, capillarity and transpiration pool helps in the transportation of water in the xylem vessels. Phloem vessels conduct food from leaves to all parts of the plant.

3.2 Nervous and Chemical Coordination

The nervous system is responsible for nervous coordination in living organisms. The nervous system functions as the control center for body activities. This involves impulses (messages) being carried along nerves. The system is a two way communicating system. Impulses are sent from the body tissues and organs to nerve centers ie the Central Nervous System (CNS) and from this center to the tissues and organs. The brain and spinal cord makes up the central nervous system and they communicate with all parts of the body through the nerve cells. The different parts of the brain coordinate different activities of the organism e.g. certain region of the cerebrum controls muscles of the legs, trunk, arms, shoulder, neck, face, tongue, etc.

The chemical coordinating system is also known as the endocrine system, this system brings about coordination in living organisms. Chemical substances called hormones are produced by endocrine glands. The hormones are chemical substances produced and sent to various organs of the body where they bring about changes in the organisms. These chemical substances are released directly into the body fluid, the fluid then carry them to where they bring about changes. For example the adrenal hormone produced around the kidney but bring about changes in the blood i.e. raising blood glucose level and regulation of some elements in the blood.

4.0 CONCLUSION

This unit discussed the blood as the body fluid that transports digested food and other materials to different tissues of the body where such are required. Water and other materials are also transported from the point they are produced to where they are excreted. Nervous and chemical

coordination was also described. Examples are shown among plants and animals.

5.0 SUMMARY

In this unit, you learnt that;

- the blood is the fluid that transport materials in the body of living organisms especially among higher animals
- materials transported by body fluid in higher animals include carbon dioxide, water, digested food, urine, etc.
- the central nervous system transmit nervous impulse to different parts of the body through nerve cells.
- Chemical coordination is controlled by hormones.

6.0 TUTOR-MARKED ASSIGNMENT

i. a. Describe how water is transported in plants.
   b. Compare water transportation in plants and higher animal. State two similarities and two differences between transportation in plants and animals.

ii. a. The central nervous system transmits messages in higher animals. Describe the nature of transmission of messages in plants.
   b. what are the differences between nervous system and the endocrine system?

7.0 REFERENCES/FURTHER READING

Grove, A.J. and Newell, G.E. New Edition Animal Biology. London: University Tutorial Press Ltd.

Moon, T.J; Otto, J.H. & Towle, A. Modern Biology. Holt, Rinehart and Winston Inc. New Edition.

MODULE 5 GENERAL PRINCIPLES OF GENETICS, ECOLOGY, TAXONOMY AND ORGANIC EVOLUTION

UNIT 1 GENERAL PRINCIPLES OF GENETICS

CONTENTS

1.0 INTRODUCTION

Living things, whether plant or animal have varieties. Within same group of organisms, characteristic life and physical features may differ. These differences are due to variations. The branch of biology that deals with the study of variation of inherited characteristics is called genetics.

This unit will expose you to the concept of genetics, the basis for variation and the application of the use of variation in heredity.

2.0 OBJECTIVES

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

- Explain the meaning of genetics
- State the basis for variation among organisms
- State examples of the application of the principles of heredity

3.0 MAIN CONTENT

3.1 Concept of Genetics

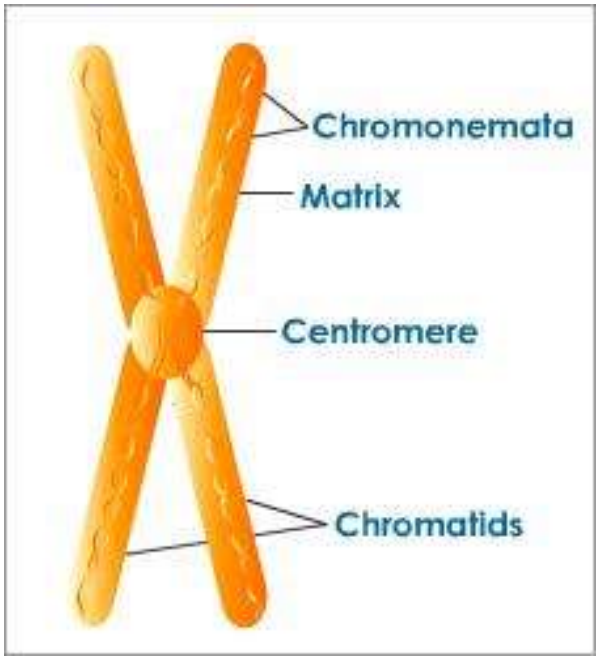
Genetics is a branch of biology that deals with the study of variations in organisms and the inheritance of the varied characteristics. Another definition sees genetics as the study of heredity i.e. how biological characteristics are passed on from one generation to another (from parent to offspring).

Although living things arise from their parent, variations are observed in the offspring e.g. variation like height, skin colour, size, hair colour, etc. these variations are due to some inborn characteristics that are hereditary. Characters are carried by genes and genes are located on chromosomes. The gene that carry the characters are thus transferred from parent to offspring.

3.2 Basis of Heredity

Gregor Mendel is a great scientist that worked on genetics, he stated that chromosome are responsible for transmission of characters and that they are carried in gametes and zygotes. Subsequent scientists proposed that chromosomes are the carriers of gene and studies eventually established that Mendel's factors are located on chromosomes. These chromosomes are seen as thread-like structures in the nucleus of all eukaryotic cells. A stained chromosome can be seen in the nucleus of a cell when viewed at high magnification using a light microscope. The structure of each as seen during cell division is in a duplicated form connected by a centromere. Each member of the pair is called a chromatid, it is thread-like in appearance.

Chemical analysis of chromosome shows that they are composed of proteins combined with nucleic acid and are of two kinds of deoxyribonucleic acid (DNA) and Ribonucleic Acid (RNA). The DNA is the primary material that makes up the gene. Differences in heredity among organisms are thus due to differences in their protein constituents. DNA has the ability to duplicate itself during cell formation, thus carrying the characters which are then transmitted to the offspring.



Structure of the Chromosome

3.3 Application of Principles of Heredity

Principles of heredity i.e. transmission of hereditary materials from parent to offspring is used in agriculture and medicine.

In agriculture, it involves the selection of certain traits or characters that are favoured and is therefore passed on unchanged to the offspring (asexual). Another method is through sexual means i.e. involved cross-breeding with the aim of producing bigger and healthier individuals, e.g. in animals and plants.

In medicine, it is used for counseling parents on risk of disease to themselves or the offspring e.g. sickle cell anaemia, sex determination, blood group etc.

4.0 CONCLUSION

In this unit, you have learnt that genetics is a branch of biology that deals with the study of variations in organisms and how it occurs. The chromosome has also been described as carrying genes and are the hereditary materials which have the capacity to vary in the organism.

5.0 SUMMARY

In this unit, you learnt that;

- Genetics is the branch of biology that deals with transmission and variation of inherited characters.
- The characters are carried by genes which are located on the chromosome
- Chromosomes are seen in the nucleus of cells in thread-like form.
- Chromosomes are capable of replicating themselves, thus transmitted through sex cells
- The principles of heredity are used in agriculture to improve quality of plants and animals
- The principle of heredity is used in medicine to improve quality of offspring as well as counsel parents.

6.0 TUTOR-MARKED ASSIGNMENT

i a. State Mendel's first law
b. Describe the experiment Mendel carried out on cross-breeding of pea plant.
c. State the final conclusions arrived at in Mendel's experiment on cross-breeding of pea plants

ii. a. What are chromosomes?
b. How many chromosomes does a human being have in each body cell?
c. How many of these does the young human being inherit from the parents?

7.0 REFERENCES/FURTHER READINGS

Grove, A.J. and Newell, G.E. New Edition Animal Biology. London: University Tutorial Press Ltd.

Moon, T.J; Otto, J.H. & Towle, A. Modern Biology. Holt, Rinehart and Winston Inc. New Edition.

UNIT 2 GENERAL PRINCIPLES OF ECOLOGY

CONTENTS

1.0 INTRODUCTION

Living organisms are found living in an environment, the subject that teaches relationship between plants, animals and their environment is called ecology. In this unit, you will be exposed to the meaning of ecology and the various types of environment (ecosystem) where plants and animals are found living together.

2.0 OBJECTIVES

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

- explain the meaning of ecology
- describe the different components of an environment (ecosystem)
- list and describe different types of ecosystems and organisms found there
- explain how energy flows in an ecosystem

3.0 MAIN CONTENT

3.1 Concept of Ecology

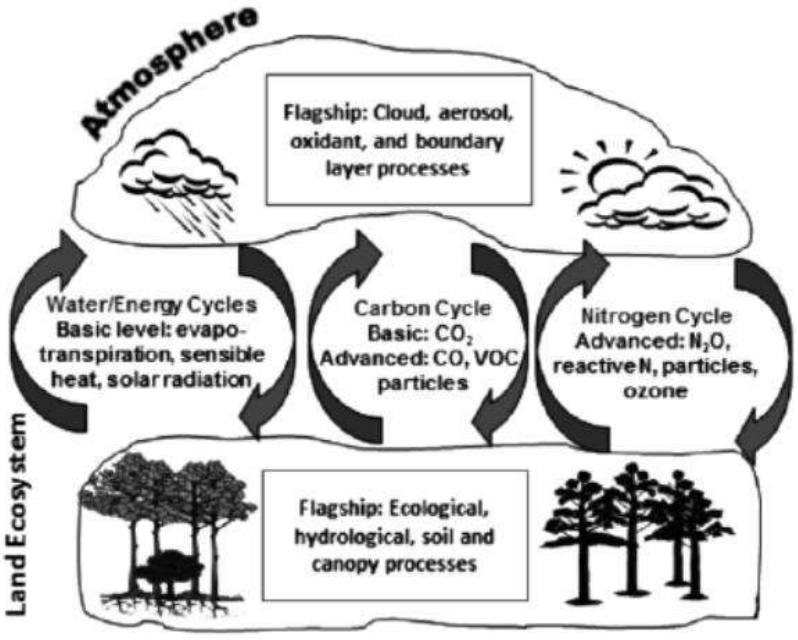
Ecology is a branch of biology that deals with the study of the relationship of living organisms with each other and their non-living or physical surroundings. From this definition it is clear that the surrounding in which an organism is found is very important in describing the ecology of it. The study of ecology has been found to give scientific foundations for the understanding of agriculture, forestry and fisheries. It also aids in predicting, preventing and remedying pollution. The study of ecology also helps in understanding the likely

consequences of massive environmental interventions in construction of dams, or diversion of rivers. Also helps provide the rationale for biological conservation.

In studying ecology, animals and plants of the environment constitutes the living part and described as the biotic component while the non-living part (containing matter and energy) are referred to as the abiotic component of the system called the ecosystem. The different types of ecosystems, together forms the biosphere. The biosphere therefore includes all the living things and the physical environment where they interact.

3.2 Types of Ecosystem

There are two major types of ecosystem they are terrestrial and aquatic ecosystem. Terrestrial ecosystem is the land environment, and comprises of different types i.e. forest, savanna, desert etc. while aquatic could be fresh water type, salt water or brackish water types of ecosystem. These are the environment where organisms; plants or animals are living.

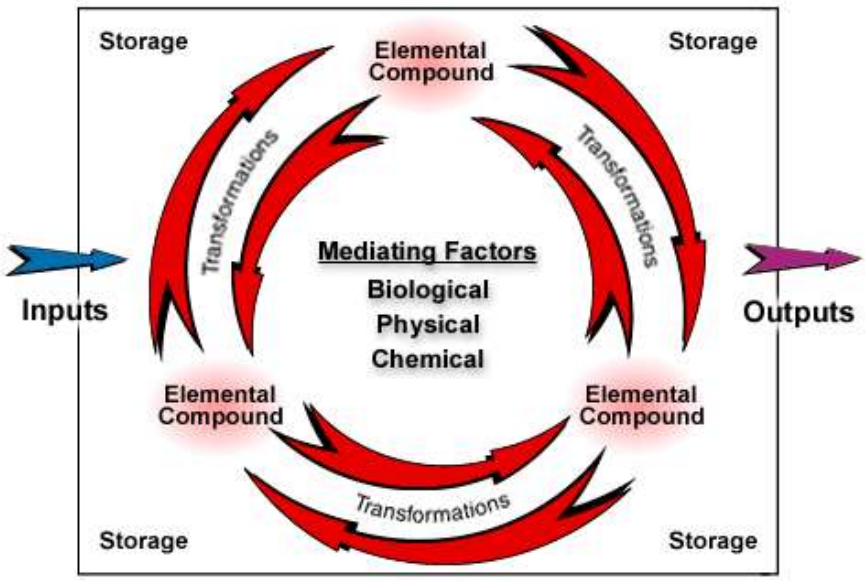


Land Ecosystem

Picture of Water Ecosystem

3.2.1 Energy Flow in Ecosystem

The major reason for the study of the ecosystem is in the understanding of the connection between the different organisms and their physical environment. The energy flow and the biochemical cycling are the important functional links between the different ecosystem components. Sources of energy of an ecosystem include (i) the sun (ii) food. The sun is the major source of energy that the producers use for production of food through the process of photosynthesis. The food eaten by the consumers provides energy. These energies flow between the organism themselves and between them and the environment (food chain and food web). The energy flow in an ecosystem can thus be shown diagrammatically as:



Biogeochemical Cycling

The activities in the entire system is continuous and ensures continuity of the biotic components.

4.0 CONCLUSION

In this unit you have learnt what ecology is, the study of organisms (plants and animals) and their relationship with their environment. The environment seen as the ecosystem is either aquatic or terrestrial and the major function of the ecosystem described under energy flow in the system. The sun is described as the major source of energy that plants used to produce food. The different types of food are also sources of energy in the ecosystem.

5.0 SUMMARY

In this unit, you learnt that;

- Ecology is the study of relationship between living and non-living things of an environment.
- Major component of the ecosystem are plants, animals and the physical environment.
- Different types of ecosystem are aquatic and terrestrial, with examples of organisms found in them.
- Energy flow in ecosystem and major source being the sun, food also is another source of energy relating the organisms to one another in one way or the other.

6.0 TUTOR-MARKED ASSIGNMENT

i a. Identify a terrestrial ecosystem

b. List and describe the different types of plants and animals that can be seen in such an ecosystem.

d. Describe the feeding relationship between two major plants and two major animals in the environment

7.0 REFERENCES/FURTHER READING

Ambuno, S; Egunyomi, A & Osake, V.C. (2008). Comprehensive Certificate Biology for Senior Secondary Schools, New Edition. Ibadan: University Press Plc.

Taylor, D.J; Green, N.P.O & Stout, G.W. (1997). *Biological Science*. 3rd Edition. New York: Cambridge University Press.

UNIT 3 GENERAL PRINCIPLES OF TAXONOMY

CONTENTS

1.0 INTRODUCTION

For the purpose of study and identification, organisms are grouped based on similarities and differences in their features. The grouping carried out using taxonomic features. The more recent uses the natural relationships between organisms. Both the internal and external features are used to group organisms into their different kingdom, phyla etc in the case of animal and kingdom, division etc in the case of plants.

2.0 OBJECTIVES

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

- Describe taxonomical method of classifying organisms
- Explain the bases of the classification methods
- Explain the present day features used for classification
- Classify examples of plants and animals

3.0 MAIN CONTENT

3.1 Concept of Taxonomy

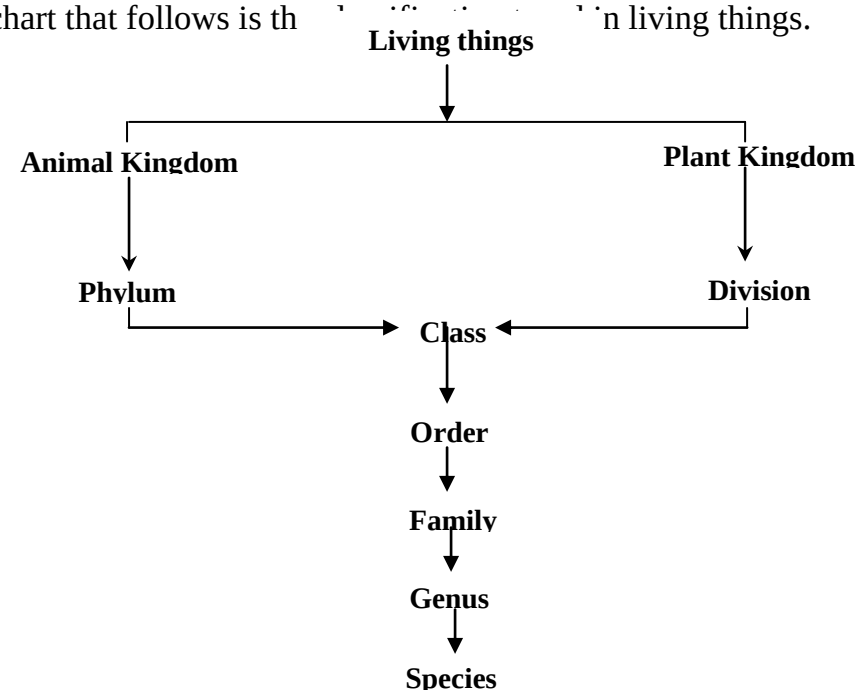
Taxonomy is the classifying of living organisms based on resemblances and differences in their forms and shapes. Taxonomy has two branches, namely, naming of the organism also called nomenclature and the placing of the organisms in groups called systematic, the grouping is done on the basis of their similarities and differences. Nomenclature on the other hand is based on the binomial system, where each organisms has two Latin names; a generic name beginning with capital letter and

specific name beginning with lower case letter e.g. the human being is a *Homo sapiens*, genus Homos and specie sapiens. Italics are used to indicate Latin names or underline as such Homo sapiens. The groupings of organisms go beyond the genus and species. The largest grouping is the kingdom, phylum follows and others include class, order, family, genius and species

3.2 The Basis for Natural Classification

Two types of classification are found among living things, they are natural and artificial. Artificial is based on one or a few easily observed characteristics usually designed only for practical purpose with emphasis on simplicity and convenience. However the natural classification uses natural relationships between organisms, looks at more evidences including internal and external features. In addition, similarities of embryo, morphology, anatomy, physiology, biochemistry, cell structure and behavior are all relevant. Most classifications today is based on evolutionary (phylogenetic) relationships i.e. natural. Other classification methods uses phenetic ie observable characteristics.

The chart that follows is th[illegible]n living things.



3.2.1 Example of Classification of Named Plant and Animal

i. Animal
African Elephant (*Loxodonta Africana)*
Kingdom - Animalia
Phylum - Chordate
Sub phylum - Vertebrata

Class	-	Mammalian
Order	-	Proboseidea
Family	-	Elephantidae
Genus	-	Loxodonta
Species	-	Africana

ii. Plant

Maize (*Zea mays*)

Phylum	-	Plantae
Division	-	Tracheophyta
Class	-	Angiospermae
Sub class	-	Monocotyledonae
Order	-	Graminacea
Family	-	Zea
Species	-	mays

SELF-ASSESSMENT EXERCISE

- Pick one example each of a lower and higher plant and animal
- Carry out the taxonomic classification as it was done for the two organisms in 3.2.1

4.0 CONCLUSION

Taxonomic classification of living things was carried out by scientists, using resemblances and differences in the forms and shapes of the organisms. Two branches of taxonomy are nomenclature and sytematics, while nomenclature uses binomial system systematics uses differences and similarities of their features.

5.0 SUMMARY

In this unit, you learnt that;

- Taxonomy is the classification of living organisms based on resemblances and differences in their shape and forms
- Taxonomy has two branches i.e naming of the organism – nomenclature and systematics – grouping on the basis of similarities and differences
- Organisms are grouped into kingdom, phylum, class, order, family, genus and species in the case of animals, while in the case of plants the phylum is called division.
- Natural classification styles uses, physiological and physical features i.e. internal and external features of organisms.

6.0 TUTOR-MARKED ASSIGNMENT

i. a. Describe the bases upon which living organisms are grouped.

b. With specific examples of plants and animals and using the taxonomic system of grouping, classify two named plants and two named animals.

7.0 REFERENCES/FURTHER READING

Ambuno, S; Egunyomi, A & Osake, V.C. (2008). Comprehensive Certificate Biology for Senior Secondary Schools, New Edition. Ibadan: University Press Plc.

Taylor, D.J; Green, N.P.O & Stout, G.W. (1997). *Biological Science*. 3rd Edition. New York: Cambridge University Press.

UNIT 4 GENERAL PRINCIPLES OF ORGANIC EVOLUTION

CONTENTS

1.0 INTRODUCTION

Living things each originated from somewhere i.e. they each have a beginning. The study of evolution explains origin of organisms and possible variations among them. In this unit you will learn what evolution is, and the different theories scientists have postulated to explain the origin of life i.e. where and how life began. Variations among living things are also discussed.

2.0 OBJECTIVES

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

- Explain what organic evolution is
- Discuss at least three theories describing how life originated
- Describe the bases for variation among organisms
- State examples of variations among organisms

3.0 MAIN CONTENT

3.1 Concept of Evolution

Evolution is a branch of biology that deals with the study of how change had occurred in organisms over a period of time. It is described as a postulate that states that all present representatives of plants and animals have themselves arisen from pre-existing forms of its own kind, by a gradual process of change over a period of time. The theory is one of the powerful ideas in biology that explains how living things evolved from

simple chemical substances. The theory also explains origin of life, the diversity and variations among living things.

3.2 Theories of the Origin of Life

Several theories have been postulated to explain the origin of life on earth and even the origin of the earth itself. These theories are diverse and uncertain. The following are the major theories that try to explain the origin of life on earth.

- Theory of special creation – i.e. life created by a supernatural being at a particular time in life. The theory has support from most of the major religions of the world. The belief is that a supernatural being i.e. God created everything in certain number of days, others have their explanation.

- The theory of spontaneous generation – this explains that life arose from non-living matter through a process of spontaneous generation i.e. that particles of matter contained 'active principle' which produced living organisms when conditions were favourable. With spread in religion this theory lost popularity.

- The theory of steady state – this theory believed and laid its explanations on the fact that life has no origin. The theory explains that the earth and life have always existed, they never originated from anywhere, the theory does not accept the use of fossils as evidence for evolution and that life existed sometimes in the past.

- The theory of Cosmozoan – this theory believes that life came to this earth from somewhere else i.e. life must have arisen once or several times in various parts of the universe.

- The theory of biochemical evolutions. They believed that life arose according to chemical and physical laws. Substances went through chemical reactions to form existing structures and this type of sequence of events would have produced primitive self-replicating heterotrophic organisms

3.3 Variations in Organisms

Living organisms show variations between and among them. These variations which could be similar or different could be in terms of the heights, colour, size, weight, finger prints etc. These differences and similarities are due to;

i. Inheritance – i.e. genetically inherited characteristics i.e. occur in reproduction
ii. The environment – i.e. the influence of environment, these could be acquired characters due to situations in the environment, ie. good feeding, e.g plants grown in an area with good nutrient will grow better than one in area with poor nutrient.

Variations in organisms could also be;
i. Morphological i.e. its physical features e.g. size, height, skin, hair, finger etc.
ii. Physiological i.e. this deals with the functions and the activities of the organism e.g. behavior i.e. aggressive or not aggressive and blood groups e.g blood groups.

Evolution helps to group and explain these variations among organism of the world.

4.0 CONCLUSION

In this unit you have learnt that evolution is an area of study in biology that explains the origin of life on earth. The unit also explained the theories speculated to explain the origin of life on earth. Variation and the types of variations among organisms were also highlighted.

5.0 SUMMARY

In this unit, you learnt that;
- Evolution is the study of how life originated on earth
- Theories speculated ranged from theories of special creation to spontaneous generation
- Variations occur in organisms and the study of evolution has been very useful in explaining the types and bases for such variations.

6.0 TUTOR-MARKED ASSIGNMENT

i. Describe fully with examples two of the theories explaining the origin of life.
ii a. What is variation?
b. Explain two major types of variations among organisms of the world stating examples
c. Describe two uses of variation in human beings in today's life.

7.0 REFERENCES/FURTHER READING

Ambuno, S; Egunyomi, A & Osake, V.C. (2008). Comprehensive Certificate Biology for Senior Secondary Schools, New Edition. Ibadan: University Press Plc.

Taylor, D.J; Green, N.P.O & Stout, G.W. (1997). *Biological Science*. 3rd Edition. New York: Cambridge University Press.