**COURSE GUIDE**

# SED 121
# GENERAL BIOLOGY FOR INTEGRATED SCIENCE


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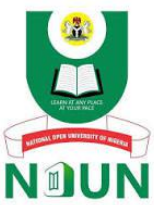



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**MAIN COURSE**

**CONTENTS**

# MODULE 1 LIVING AND NON-LIVING THINGS



## UNIT1 LIVING AND NON-LIVING THINGS AND CHARACTERISTICS OF LIVING THINGS

**Unit Structure**



## 1.1 Introduction

The world of living and non-living things can be very interesting. Looking around our environment we can see varieties of things that have life (Living things ) and others that do not have life (Non-living things)
It is easy to differentiate between living organisms and the non –living things based on certain characteristics. In this unit we want to look at living things and non –living things with examples in each case as well as the characteristics that distinguish them.

## 1.2 Learning Outcomes

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

- Explain the meaning of living and non-living things in your own words
- Identify five living and non- living things in your environment
- State five characteristics that distinguish living and non-living things in your environment.

## 1.3 Living and Non – Living Things

### 1.3.1 Meaning of Living Things

These are things in our environment that have life. They are either plants or animals that are able to carry out the characteristics / features of living things.

All living things breathe, eat grow, move, reproduce and have senses. These are collectively referred to as characteristics or features of living things . Organisms in our environment that are capable of carrying out these activities are referred to as living things. Plants and animals fall into the category of living things because they have life and are capable of carrying out these activities of life.

**Self- Assessment Exercise1**

| |
|---|
| In your own words explain the meaning of living things |

### 1.3.2 Meaning of Non-Living Things

These are things in our environment that do not have life. Non- living things abound in our environment right from our rooms to the entire environment where we live.. They are things that cannot exhibit the characteristics or features of living things. They are inanimate bodies or objects in environment that are lifeless and cannot move, grow, reproduce, etc. Non living things can be natural or man made

**Self- Assessment Exercise 2**

| |
|---|
| In your own words explain the meaning of non- living things |

### 1.3.3 Examples of Living and Non-Living Things

There are several examples of living and non –living things in our environment. Common examples of living things include cow, goat, human beings, birds, lizards, snakes bacteria, insects, mosses, mango tree, grass etc.

Examples of non-living things in our environment include stone, salt, soil, table, chair, bed, book, rock, pencil, etc.

**Self- Assessment Exercise 3**

| |
|---|
| Give five examples of living and Non –living things in your environment |

## 1.3.4 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 do not have life. 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 no life cannot do?

  Your list of those things living things do may be like the one below:

- Can move (Movement)
- Take in air and use some in breathing (Respiration)
- All living things must die after sometime (Death)

Take in food from their surrounding (Nutrition)
React to what goes on in their environment (Irritability)
Living things grow bigger (Growth)
Get rid of waste products (Excretion)

- Produce young ones. (Reproduction)
  This can be summarized using the acronym MR. D. NIGER
- If you have plants in your group of objects, it may not be easy to decide that plants are living things.

This is because many things the plants do to stay alive are not easy to see and the ways they carry out some of the activities are different from the ways animals carry out these activities. For example plants cannot move their whole body from one place to another like animals but part of plants body like the shoots move to the direction of sun, roots move towards water.

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 plants for growth and also stored as food for other animals.

**Self- Assessment Exercise 4**

| |
|---|
| Itemize some characteristics of living things |

## 1.4 Summary

In this unit, you learnt that scientists have various ways of grouping objects into living and non-living things. While living things are organisms that have life, non- living things do not have life. Common examples of living things in our environment include cow goat, human beings, lizards, grass, mango tree, etc while examples of non-living things include stone, salt, soil, glass table, chair etc. You have also learnt that living things differ from non-living things, because living things can move on their own, respire, die, feed, respond to stimulus, grow, excrete waste products and reproduce themselves. These are together described as the characteristics of living things.

## 1.4 References/Further Reading/Web Resources

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

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## 1.6 Possible Answers to Self- Assessment Exercises

**SAE 1**
Living things are organisms that have life and are able to exhibit the characteristics of living things.

**SAE 2**
Non- living things are things that do not have life and cannot carry out the characteristics of living things.

**SAE 3**
Common examples of living things include man, cow grass, mango tree, lizard, snake, etc While examples of non-living things include soil, salt ,table, chair, glass etc

**SAE 4**
The characteristics of living things include Movement, Respiration, Death, Nutrition, Irritability, Growth, Excretion and Reproduction

# UNIT 2 CLASSIFICATION OF LIVING THINGS

**Unit Structure**



## 2.1 Introduction

Scientists have a way of classifying living things for ease of studying them. In this unit, you will be introduced to the major classification of living things into two groups; plants and the animals. Major features of each of these groups will also be discussed.

## 2.2 Learning Outcomes

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

- Classify living things in your environment into two groups; plants and animals
- State four major features of plants in your environment
- State four major features of animals in your environment

## 2.3 Classification of Living Things

### 2.3.1 Classification into Plants 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 plants.
Classification of living things is the sorting or grouping or arranging of living things (in group) according to their common or similar characteristics, features or qualities shared ( Michael, 2020)

The most widely used classification is as introduced by Carolus Linnaeus (1707-1778) and was based on natural relationship and structural similarities between living organisms (Ega, Olusi, Amuta,

Usman, Adejoh, 2008). The classification is based on only two kingdoms, that is the plant and animal. This popular classification work with familiar organisms like:grass, baobab, orange, etc. as plants and dog, goat, sheep, man, etc. as animals. There are, however, some organisms like bacteria, viruses, sponges, etc. that cannot fit easily into either of the two kingdoms, therefore there is the need for another kingdom for these groups. This new group looks at the cellular structure of the organisms to classify them. The more modern classification therefore recognizes five kingdoms namely: Plantae, Animalia ,Monera, Fungi and Protoctista. Monera eg bacteria, Fungi eg yeast, mushroom,etc and Protoctista eg amoeba, euglena, etc

**Self-Assessment Exercise 1**

State the five kingdoms recognized by the modern classification system giving an example in each case.

## 2.3.2 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 which helps them to manufacture food through the process of photosynthesis Examples include 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 depend on plants and animals for food. 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, goat, cows, etc.

**Self-Assessment Exercises 2**

State five features of plants in your environment
State five features of animals in your environment.

## 2.4 Summary

Living things are classified mainly into two groups, plants and animals based on certain criteria
Plants are multicellular and green because of the presence of chlorophyll which helps them to manufacture their food.(Autotrophs)

Animals have no chlorophyll and cannot manufacture food but depend on plants and animals for food (Heterotrophs).
Other examples that do not fit into the two criteria are further classified as either Monera, Fungi or Protoctista.

## 2.5 References/Further Reading/Web Resources

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

Dutta, A.T.C. (2009). *Botany for degree students*. 6th Edition. New Delhi. Oxford University Press.

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## 2.6 Possible Answers to Self- Assessment Exercises

**SAE 1**

1. The five kingdoms recognized by the modern classification system and their examples are as follows:

a. Plantae e.g Mango tree
b. Animalia e.g Cow
c. Monera e.g Bacteria
d. Fungi e.g Mushroom
e. Protoctista e.g Amoeba

**SAE 2**

Three features of plants are :

1. Non- motile
ii. They are multicellular
iii. They are autotrophic because they can produce food with the help of chlorophyll

Three features of animals are:

i. They have no chloroplasts and cannot produce food
ii. Most animals are motile
iii. They are heterotrophic in their feeding habit i.e they cannot manufacture their own food so they depend on plants and animals for their food.

# UNIT 3 DIFFERENCES BETWEEN PLANTS AND ANIMALS

**Unit Structure**



## 3.1 Introduction

Living things are broadly categorized into plants and animals. This is because plants and animals have life and can carry out the characteristics of living things. However, the ways plants carry out these activities are slightly different from the ways animals carry out these activities of life and that is part of the reasons why people find it difficult to classify plants as living things. In this unit you will learn about the major differences between plants and animals based on the characteristics of living things despite the fact that they are both living things.

## 3.2 Learning Outcomes

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

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

## 3.3 Differences Between Plants and Animals

Plants and animals are living things. However, it is sometimes difficult grouping plants into living things. However the explanation on the characteristics of plants should convince you that plants are living things too since they grow, feed, reproduce, etc. There are however differences between plants and animals even though they are all living things. Table 1 shows the differences between plants and animals. You can pick a plant and animal in your environment and observe the differences between them as state in Table 1.

**Table 1: 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 Leave | Animals do not have chlorophyll, hence Cannot Manufacture food, rather, they depend on plants and animals 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 movements 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 | Plants 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. |

**Self –Assessment Exercise 1**

State five differences between plants and animals in your environment based on the characteristics of living things.

## 3.4 Summary

Plants can manufacture their own food through the process of photosynthesis while animals cannot manufacture food but depend on plants and animals for their food.
While plants cannot move their body from one place to another like animals they carry out growth movements.
Plants respond slowly to stimuli while animals respond rapidly to stimuli.
Animals have specialized organs for respiration like lungs and gills while the whole body surfaces of plants are involved in gaseous exchange.
Growth in plants occurs on the tips of the stem and the roots while in animals growth occurs in all parts of the body.

## 3.5 References/Further Reading/Web Resources

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

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## 1.6 Possible Answers to Self-Assessment Exercises 1

The differences between plants and animals based on the characteristics of living things are as follows:

1. Feeding – Plants are autotrophic feeders (i.e they are able to manufacture their own food while animals are heterotrophic feeders (ie they depend on plants and animals for their food since they cannot manufacture their own food.
2. Movement – While animals are able to move their whole bodies from one place to another, plants only show growth movements with parts of their bodies moving towards sunlight or water
3. While animals have specialized organs for respiration like lungs and gills, the whole body surface of plants are involved in gaseous exchange
4. Growth in plants occurs on the tips of the stem and the roots while in animals growth occurs in all parts of the body.
5. In plants response to stimuli is slow while it is rapid in animals.

# UNIT 4 MAJOR DIVISIONS OF PLANTS AND ANIMAL KINGDOM

**Unit Structure**



## 4.1 Introduction

There are varieties of plants and animals all over the world and scientists have tried to classify them in a way that they will be easy to study. This unit will expose you to the different groupings of plants and animals based on certain features they have in common.

## 4.2 Learning Outcomes

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

- Group plants into their different classes based on features they have in common.
- State two examples of plants in each of the classes.
- Group animals in your environment into their different classes
- State two examples of animals in each of the classes.

## 4.3 Divisions of Plant 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 the 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. It is a branch of biology that classifies all living things. It is the practice of identifying them into categories and naming them. (Michael,2020).

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

i. Pteridophytes e.g. fern
ii. Gymnosperms (have naked seeds) e.g. conifer
iii. 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)

**Self-Assessment Exercise 1**

| |
|---|
| Give the different classes of plants with one example in each case |

## 4.4 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 are animals without backbones and they are further subdivided based on the features stated below. They include:

i. Porifera (Sponges) (Multicellular aquatic animals): e.g. Sponges
ii. Coelenterate also aquatic e.g. Sea Anemone, Jelly Fish, Hydra,
iii. Platyhelminthes also called flatworms e.g. Tapeworms and the Flukes
iv. Nematodes (Roundworms): Examples include Ascaris, Guinea Worm
v. Mollusca: They are soft segmented bodied animals e.g. Snail
vi. Annelid: The body is metamerically segmented example earthworm
vii. Arthropoda: A very large group of animals and are bilaterally symmetrical and paired jointed appendages. The classes include:

a. Crustacean e.g. crab, shrimp, prawn, lobsters, etc
b. Insect e.g. housefly, grasshopper, cockroach, mosquito, etc.
c. Arachnida e.g. spider, scorpion, mites, ticks,etc
d. Chilopoda e.g. centipede
e. Diplopoda e.g. millipede
viii. Echinodermata e.g. starfish, sea urchins, sea cucumbers and bristle star.

**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 from
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 2**

| |
|---|
| 2.Group animals into their different classes stating two examples in each case. |

## 4.5 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.

## 4.6 References/Further Reading/Web Resources

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

Dutta, A.T.C. (2009). *Botany for Degree Students*. 6th Edition. New Delhi. Oxford University Press.

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Michael, M.C.(2020).Essential biology for senior secondary schools. Ogun: Tonad publishers.

## 1.7 Possible Answers to Self Assessment Exercises Within the Content

**SAE 1**

**1.** The different classes of plants and the examples are as follows:

a **Thallophytes:** They are red, green, and brown algae. Examples include; chlamydomonas, spirogyra etc.

**b** **Embryophytes:** These are divided into Bryophyta and Tracheophyta

**I.** **Bryophytes:** They are small green plants found in moist places e.g wet rocks, forest floor, swamps etc. Examples are liverworts, mosses.

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

i. Pteridophytes e.g. fern
ii. Gymnosperms e.g. conifer
iii. Angiosperms : They are further grouped into dicotyledons (Beans) and monocotyledons (Maize)

**SAE 2**

2. Animals can be grouped into the following classes :

a. **Invertebrates :** They are animals without backbones and they are further subdivided as follows :

i. Porifera : e.g. Sponges
ii. Coelenterate e.g. Hydra,
iii. Platyhelminthes also called flatworms e.g. Tapeworm
iv. Nematodes (Roundworms): e.g Guinea Worm
v. Mollusca: They are soft segmented bodied animals e.g. Snail
vi. Annelid: The body is metamerically segmented e.g earthworm
vii. Arthropoda: A very large group of animals and are bilaterally symmetrical and have paired jointed appendages. The classes include:

a. Crustacean e.g. crab
b. Insect e.g. housefly
c. Arachnida e.g. spider
d. Chilopoda e.g. centipede
e. Diplopoda e.g. millipede
f. Echinodermata e.g. starfish

## b. Vertebrates

These are animals with 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 from
iii. Reptilian (Reptiles) e.g. lizard, snake, crocodiles, chameleon, etc
iv. Aves (Birds) e.g. fowl, turkey, doves, etc
v. Mammalian e.g. man

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

Unit 1 General Morphology and Life Cycle of Fern Plant (Pteridophyte)
Unit 2 General Morphology and Life Cycle of Beans (A Dicotyledonous) Plant
Unit 3 General Morphology and Life Cycle of Zea Mays (Maize)

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

**Unit Structure**



## 1.1 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.

## 1.2 Learning Outcomes

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

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

## 1.3 General Morphology and life Cycle of Fern Plants (Pteridophytes)

### 1.3.1 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 produce food by photosynthesis.

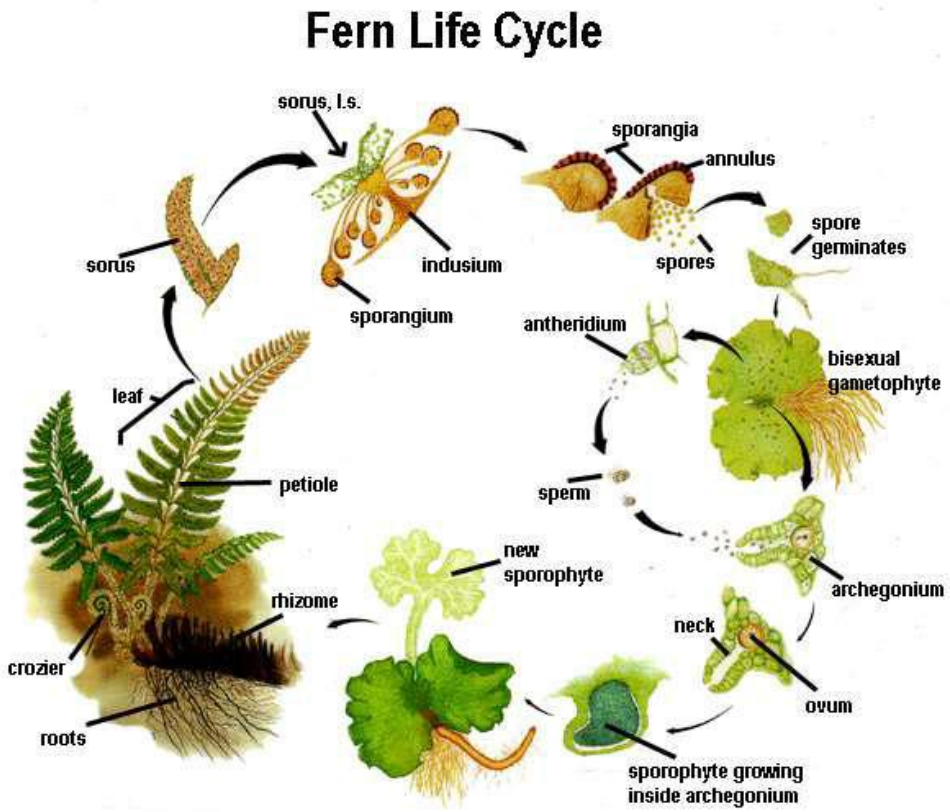
**Reproduction**: This occurs by production of spores. This is a dominant stage in the life cycle of the plant. The second stage is the gametophytes stage where eggs and sperms are produced. This stage of reproduction

occurs in moist places, as moisture is needed for the sperms to swim to the eggs for fertilization.

**Self-Assessment Exercises 1**

| | |
|---|---|
| 1. | Describe the structure of a Fern plant |
| 2. | Describe reproduction in Fern plants |

## 1.3.2 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 leaves. 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 into new plants. The second stage is gametophyte where eggs and sperms are produced. These fertilize each other and the new young one is produced.

**Self Assessment Exercises 2**

| |
|---|
| Describe the life cycle of the Fern Plant |

## 1.4 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

## 1.5 References/Further Reading/Web Resources

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

Dutta, A.T.C. (2009). *Botany for Degree Students*. 6th Edition. New Delhi. Oxford University Press.

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

## 1.6 Possible Answers to Self Assessment Exercises within the Content

**SAE 1**

1. Structure of the Fern plants: They 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.
2. Reproduction in Fern Plants 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 sperms to swim to the eggs for fertilization.

**SAE 2**

Life Cycle of fern plant: There are two distinct generations in the life cycle of the fern plant, namely, the sporophyte generation and the gametophyte generation. The leaves of the mature Fern plant houses small dots called sori (singular sorus) appearing on the lower side of the leaves. 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 into new plants. The second stage is gametophyte where eggs and sperms are produced. These fertilize each other and the new young one is produced.

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

**Unit Structure**



## 2.1 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.

## 2.2 Learning Outcomes

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

- Describe the structure of the beans plant
- Describe the life cycle of the beans plant
- Discuss nutrition and reproduction in Beans plant

## 2.3 General Morphology and Life Cycle of Beans plant

### 2.3.1 Morphology of Beans – A Dicot plant

The beans plant belong to the group of plants 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 plant very rich in protein.

**Bean Plant External Feature**

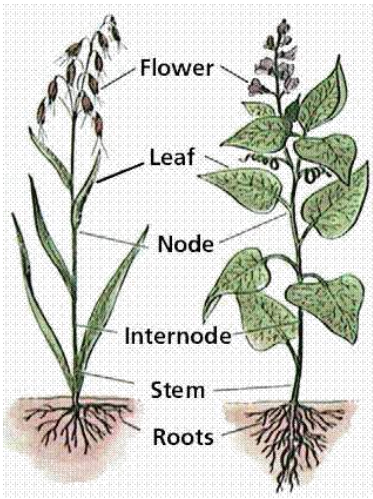
**Nutrition**: The plant produces its own food through the process of photosynthesis.

**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, then the ovary forms the fruit.

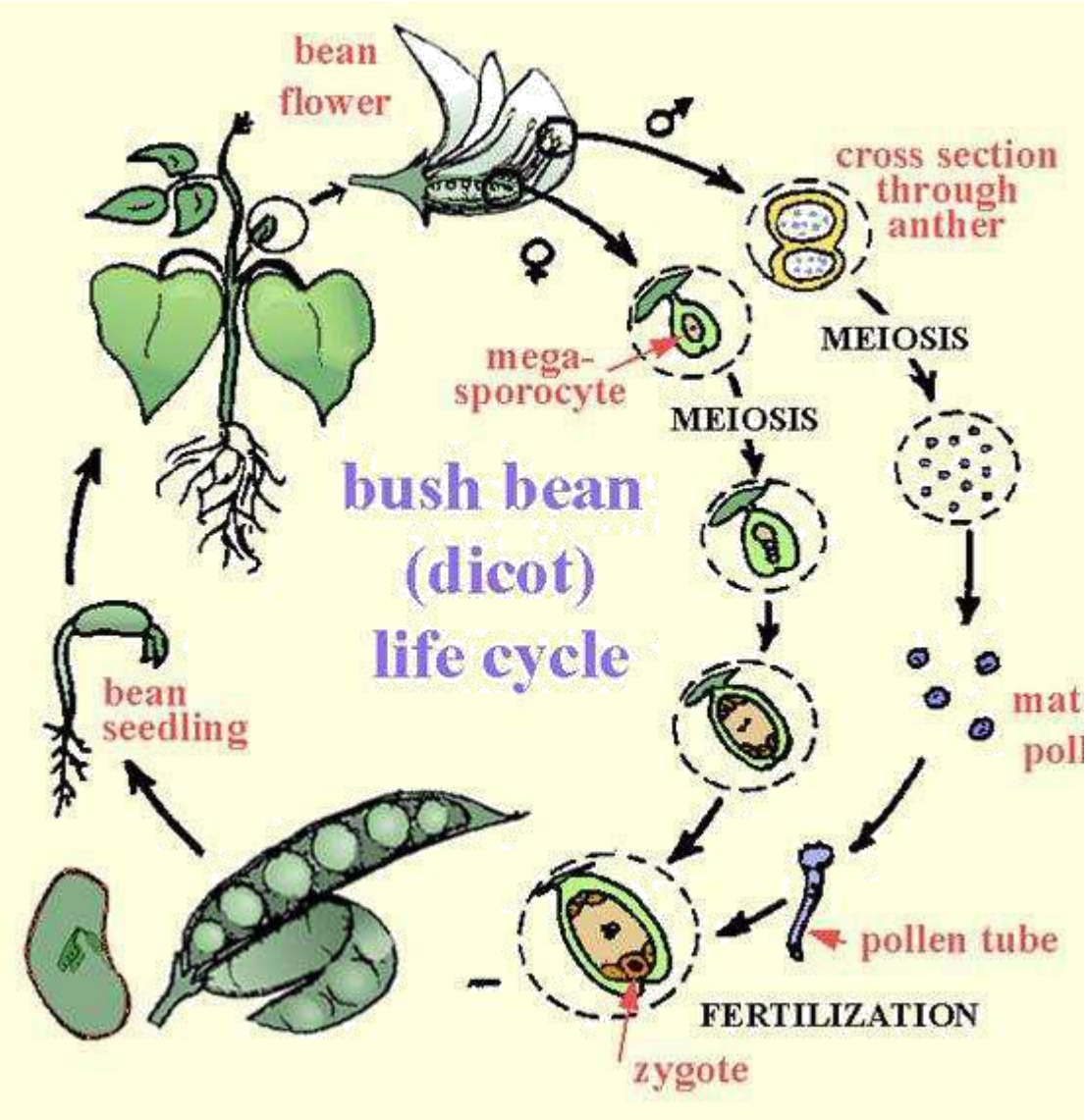
**Self-Assessment Exercises 1**

1. Describe the structure of a bean plant
2. Discuss nutrition and reproduction in bean plant



### 2.3.2 Life Cycle of Bean plant

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




## 2.4 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

## 2.5 References/Further Reading/Web Resources

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

Dutta, A.T.C. (2009). *Botany for Degree Students*. 6th Edition. New Delhi. Oxford University Press.

Freeman, S. (2008*). Biological Science*. 3rd Edition. Pearson Education Inc. Publishers.

Roberts, M.B.V. (2003). Biology - A functional Approach. 4th Edition.

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

## 2.6 Possible Answers to Self Assessment Exercises Within the Content

1. The bean plant belongs to the group of plants 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.

2. Nutrition in the bean plant is autotrophic. This is because the bean plant produces its own food through the process of photosynthesis

   Reproduction in bean plant 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, then the ovary forms the fruit.

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

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

**Unit Structure**



## 3.1 Introduction

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

## 3.2 Learning Outcomes

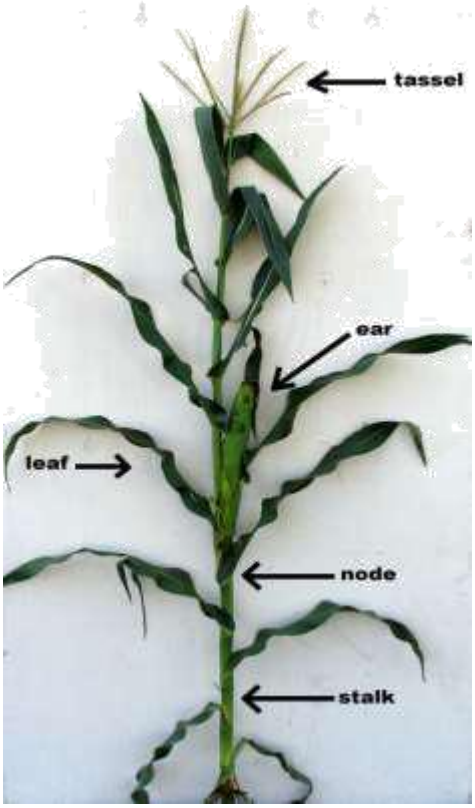
By the end of this unit, you should be able to:

- Describe the physical structure of the maize plant
- Describe the life cycle of the maize plant
- Discuss the mode of nutrition in the maize plant

## 3.3 General Morphology and Life Cycle of Zea Mays (maize)

### 3.3.1 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.

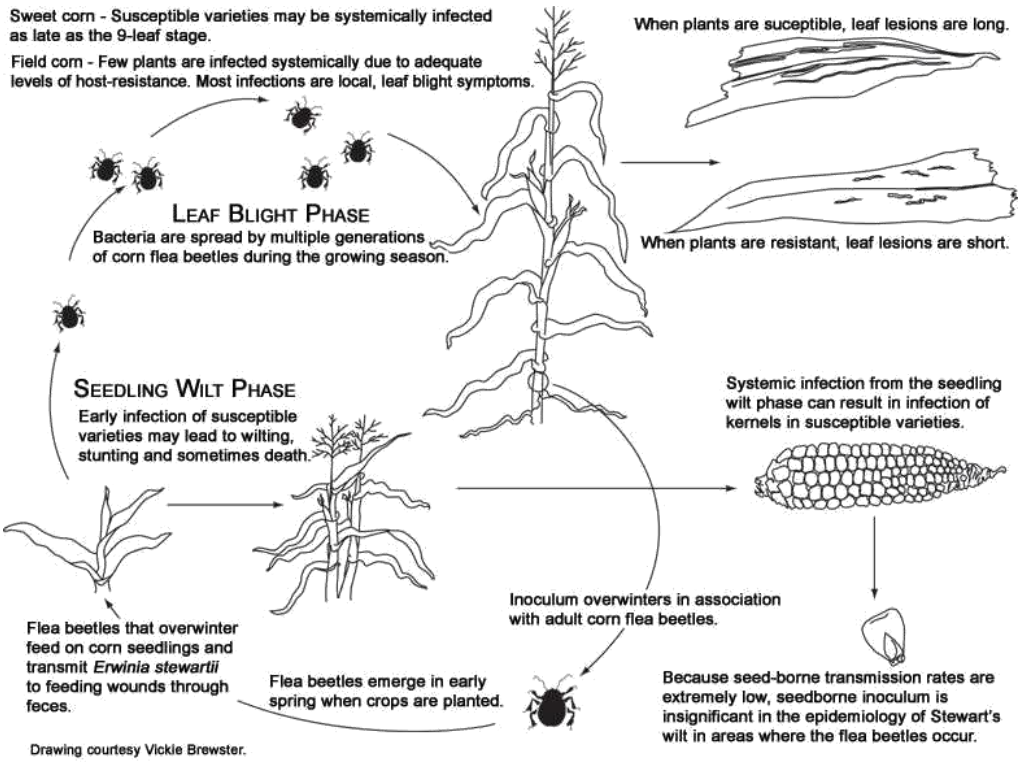
**Reproduction**: As a flowering plant, the mode of reproduction is sexual in nature. The flowers produce pollen grains (male gamete) and the ovule (female gamete) pollination leads to the fertilization which results in the production of the seeds.

**Self-Assessment Exercises 1**

1. Describe the physical structure of the maize plant
2. Discuss the mode of nutrition in the maize plant
3. Describe reproduction in maize plant

## 3.3.2 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 Exercises 2**

| |
|---|
| 4. Describe the life cycle of the maize plant |

## 3.4 Summary

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

## 3.5 References/Further Reading/Web Resources

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

Dutta, A.T.C. (2009). *Botany for Degree Students*. 6th Edition. New Delhi. Oxford University Press.

Freeman, S. (2008*). Biological Science*. 3rd Edition. Pearson Education Inc. Publishers.

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

## 3.6 Possible Answers to Self Assessment Exercises in the Content

**SAE 1**

1. The maize plant is an example of an angiosperms and 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.
2. Nutrition in the maize plant is autotrophic. Since the plant is a typical green plant, it produces its food by photosynthesis.
3. Reproduction in maize plant is sexual in nature. The flowers produce pollen grains (male gamete) and the ovule (female gamete) and pollination occurs leading to the fertilization which results in the production of the seeds.

**SAE 2**

The life cycle of the maize plant starts with the production of flowers when the plant is fully matured. The flower carries the male and the female organs necessary for pollination, fertilization and the subsequent production of the fruits and the seeds.

# 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

**Unit Structure**



### 1.1 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.

### 1.2 Learning Outcomes

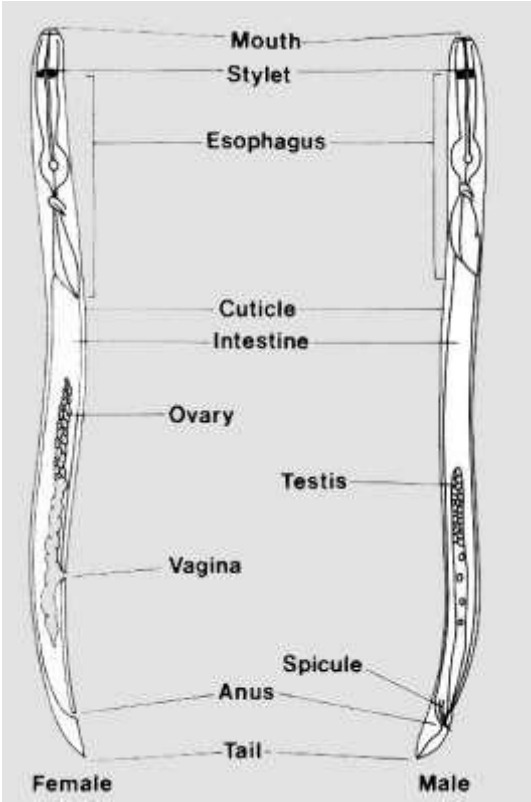
By the end of this unit, you should be able to:

- List the characteristics of invertebrates
- Describe the structure and life cycle of Ascaris- Nematode
- Describe the structure and life cycle of cockroach- Arthropoda

## 1.3 Structure, Characteristics and Life Cycle of Examples of Invertebrates

### 1.3.1 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 beings. 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.

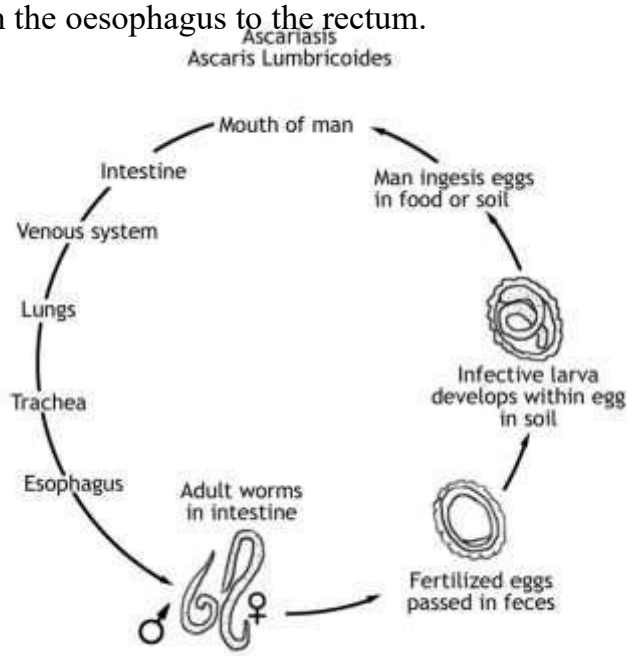



**External feature of Ascaris**

**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 infect 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 (at 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 at times any location from the oesophagus to the rectum.




**Life Cycle of Ascaris**

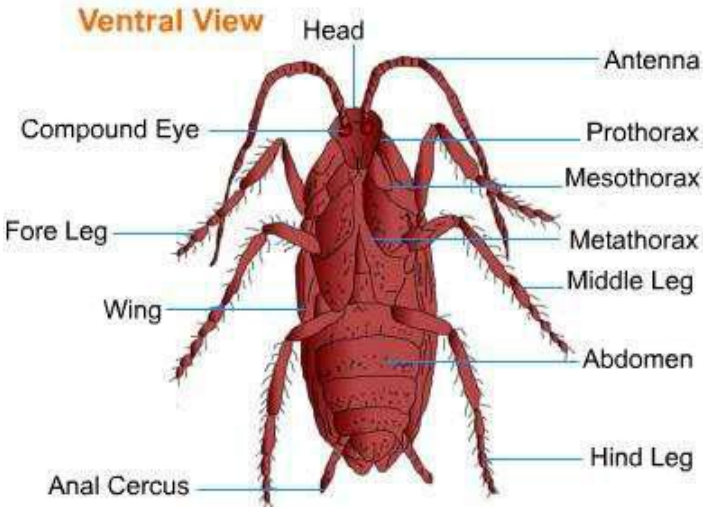
**Self-Assessment Exercises 1**

| | |
|---|---|
| 1. | List the characteristics of invertebrates ( Ascaris- Nematode) |
| **2.** | Describe the structure and life cycle of Ascaris- Nematode |

### 1.3.2 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*.

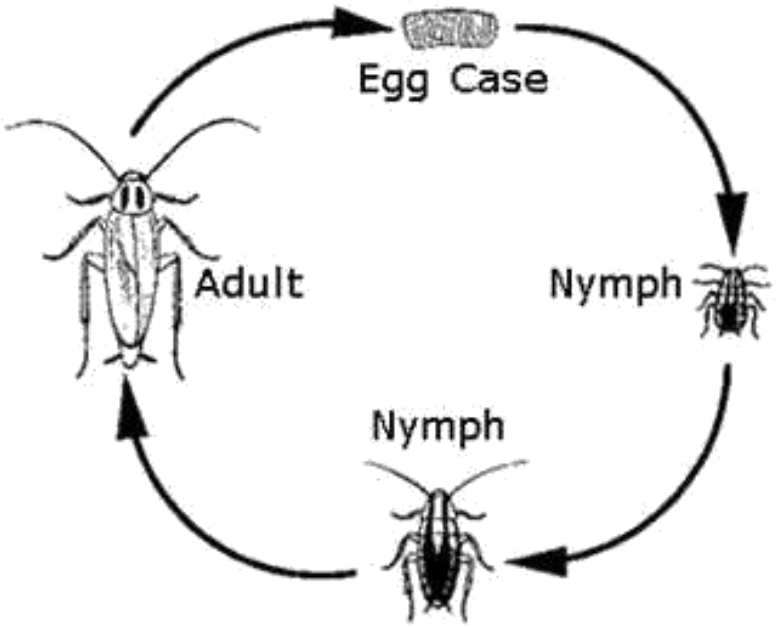
- The eggs hatch producing the young nymph that look like the adult but do not have wings. The length of time it takes the egg to hatch from the oothecae depends on the specie of cockroach as well as the environmental conditions.

- 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 2**

| |
|---|
| Describe the structure and life cycle of cockroach- Arthropoda |

## 1.4 Summary

In this unit you have learnt:

Ascaris is a round worm that can infest the human being through eating infected food especially fruits and vegetables
Fertile eggs produced by Ascaris that inhabit the small intestine develop infective second stage larvae.
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
Ascaris causes the disease ascariasis
Cockroaches are found living in cracks and crevices in homes

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

Cockroaches undergo incomplete metamorphosis from egg through nymph to adult cockroach
Cockroaches transport pathogens that can cause intestinal diseases.

## 1 .5 References/Further Reading/Web Resources

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.

## 1.6 Possible Answers to Self Assessment Exercises Within the Content

**SAE1**

1. The characteristics of invertebrates Ascaris include : They are animals without backbone and round worms found in the intestine of human beings. They live freely in the lumen feeding on the content of the digestive tract. The worm causes ascariasis disease.
2. The structure of Ascaris is described as follows: 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 life cycle of th ascaris is described as follows. The mature male and female ascaris worm inhabit the human small intestine and fertile eggs are produced in thousand. The eggs develop 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. 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 worm. Mature adult then begins to produce ova (eggs) which are then excreted, completing the cycle.

**SAE 2**

.Cockroach is an example of invertebrate animal in the phylum Arthropoda, class insect. They are found in homes living in cracks and crevices. 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

The life cycle of a cockroach is described as follows :

Adult female cockroach produces eggs which are enclosed in resilient egg case called *oothecae*.The eggs hatch producing the young nymph that looks like the adult but do not have wings. The nymphs undergo a series of moulting before fully becoming mature adults.

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

**Unit Structure**



## 2.1 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.

## 2.2 Learning Outcomes

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

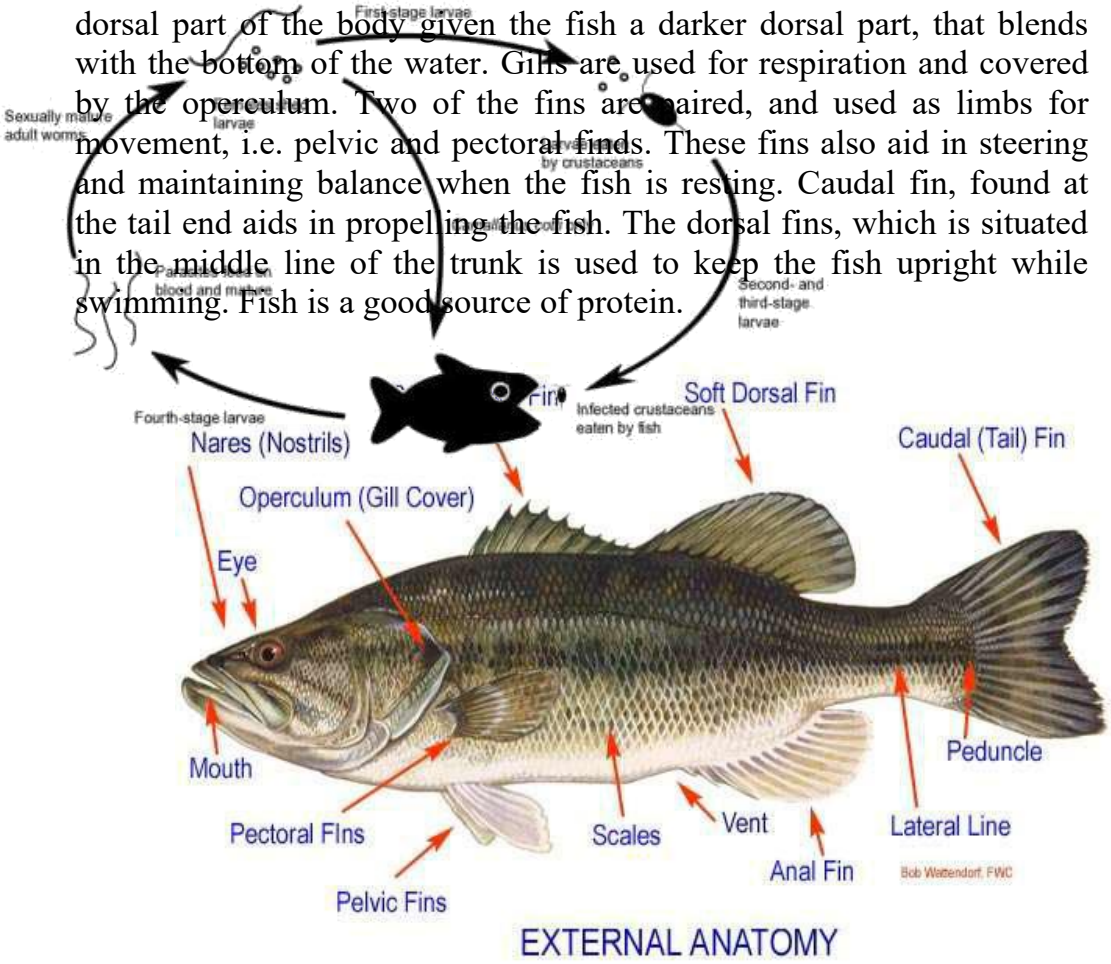
- Describe the characteristics and life cycle of fish
- Describe the characteristics and life cycle of Lizard

## 2.3 Structure, Characteristics and Life Cycle of Examples Vertebrates

### 2.3.1 Structure, Characteristics and Life Cycle of Fish - Tilapia

Fish is an example of a vertebrate and belongs to the class Pisces. 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 use 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**

**Self-Assessment Exercises 1**

| |
|---|
| Describe the characteristics and life cycle of fish |

## 2.3.2 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 eggs 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 2**

| Describe the characteristics and life cycle of Lizard |
|---|

## 2.4 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.

## 2.5 References/Further Reading/Web Resources

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.

## 2.6 Possible Answers to Self Assessment Exercises Within the Content

**SAE 1**

1. The characteristics of fish are as follows: 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 use the gills for respiration and covered by the operculum They have fins for movement.

   The life cycle of the fish is described as follows. :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.

**SAE 2**

The characteristics of lizard is as follows Like the fish the lizard too is an example of vertebrates and belongs to the class referred to as the Reptiles. 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.

Life cycle of lizard is described as follows: In most cases sexual reproduction occurs

Male and female are separate Reproduction is sexual, however, development of the eggs 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 mature lizard. hatch into the young ones that look exactly like the adult.

# MODULE 4 FUNCTIONING OF THE LIVING SYSTEM

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

**Unit Structure**



## 1.1 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.

## 1.2 Learning Outcomes

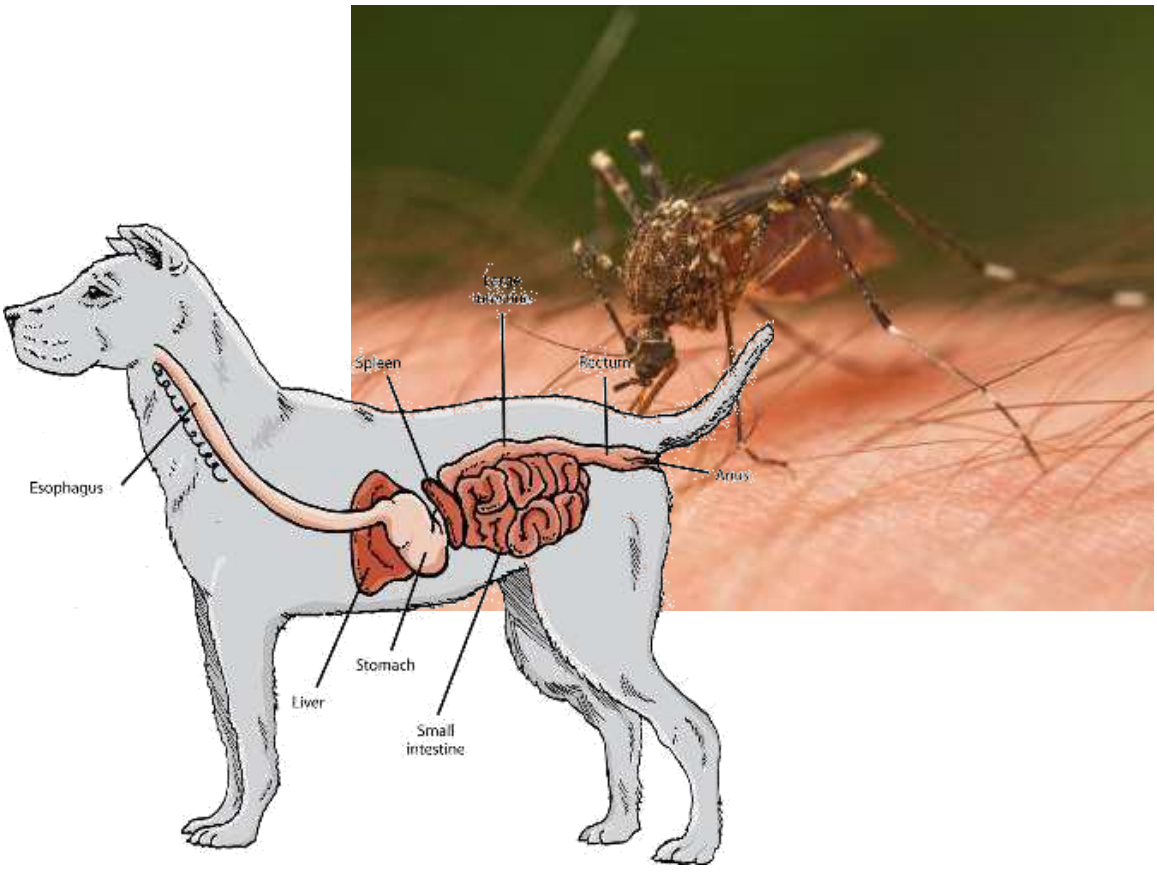
By the end of this unit, you should be able to:

- 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

## 1.3 Nutrition, Respiration, Excretion and Growth Among Plants and Animals

### 1.3.1 Nutrition System

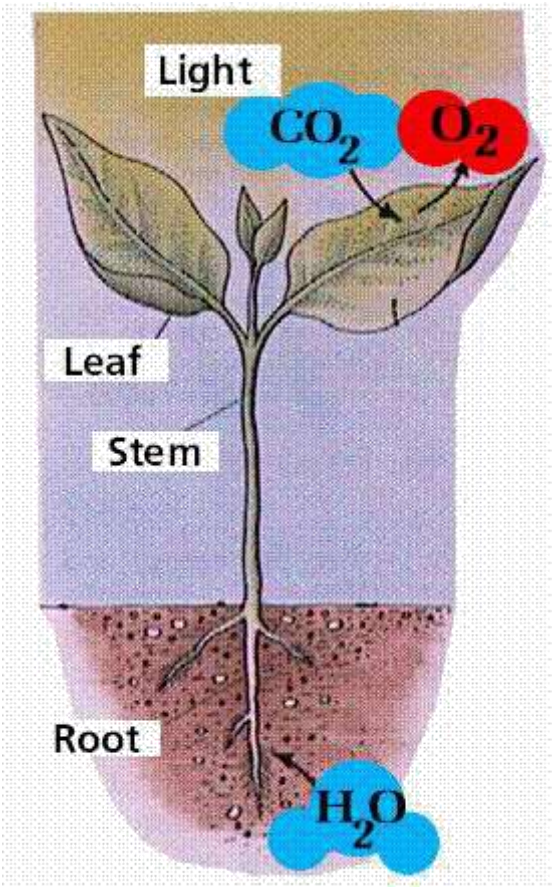
Methods of feeding differ among living things. The type of feeding habit determines the manner of feeding, for example the structure of the mouth part of an animal correlates closely with what is eaten and method of eating. Animals that are fluid feeders suck or mop up liquids like nectar, plant sap, 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 digestive system is more complex in man, the organs work together hand-in-hand to aid digestion and absorption of the food.



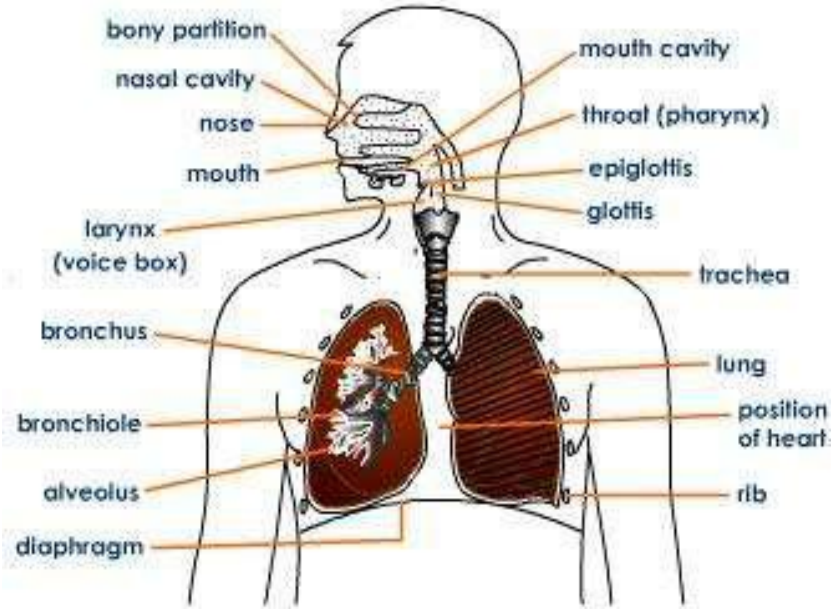

**Digestive System of Dog**

## 1.3.2 Respiratory 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 takes 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**

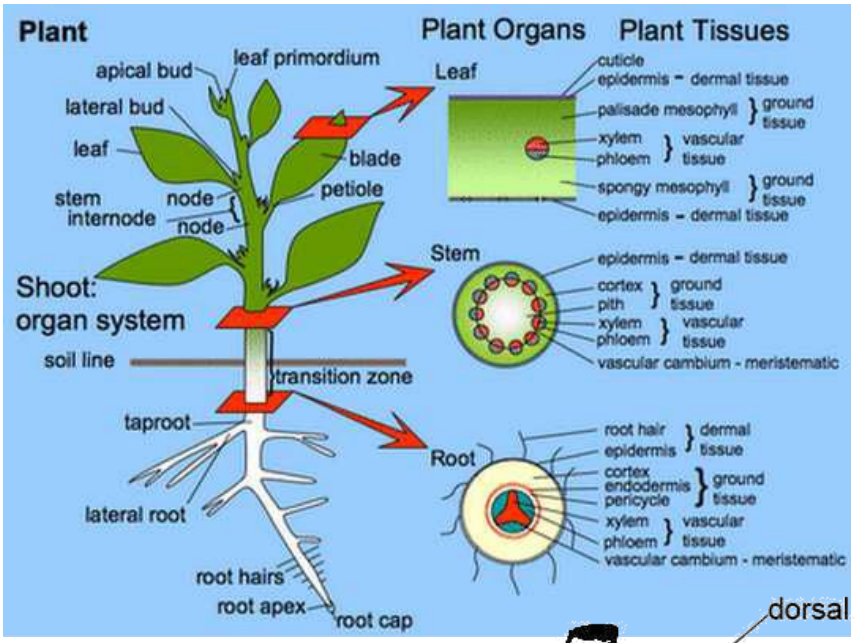
**Self-Assessment Exercise 1**

| |
|---|
| Explain how the systems function to carryout nutrition and respiration in plants and animals |

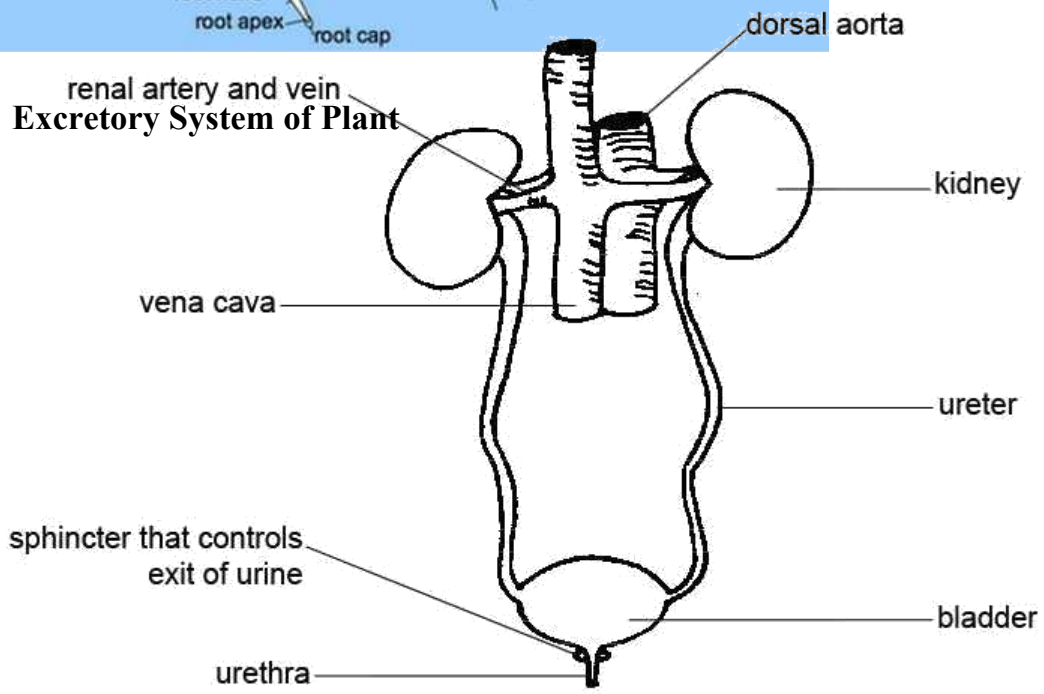
### 1.3.3 Excretory System

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**

### 1.3.4 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 develop 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 2**

| |
|---|
| Explain how the systems function to carry out excretion and growth in plants and animals |

## 1.4 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 digestive system of the organisms.

Respiration occurs 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 the size of the organism.

## 1.5 References/Further Reading/Web Resources

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.

## 1.6 Possible Answers to Self Assessment Exercises within the Content

**SAE 1**

In lower organism, gaseous exchange takes place through the body surface example unicellular organisms. Higher animals have the breathing system, which along with others form the respiratory system. 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.

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.

**SAE 2**

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 material like urine is removed through the kidney and sweat 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 $CO_2$.

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 develop 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.

# UNIT 2 BODY FLUID CIRCULATION, NERVOUS AND CHEMICAL COORDINATION

**Unit Structure**



## 2.1 Introduction

To convey digested food 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.

## 2.2 Learning Outcomes

By 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 occurs in living organisms.

## 1.3 Body Fluid Circulation, Nervous and Chemical Coordination

### 2.3.1 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, glycerol 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 carry out 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 plants.

**Self-Assessment Exercises 1**

Describe how body fluid transport materials from one part of the body of the organisms to the other, stating examples of such materials transported.

## 2.3.2 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 i.e. 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.

**Self -Assessment Exercises 2**

Explain what is meant by nervous coordination among higher organisms and the organs responsible for that.
Describe how chemical coordination occurs in living organisms.

## 2.4 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.

## 1.4 References/Further Reading/Web Resources

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.

## 2.6 Possible Answers to Self Assessment Exercises Within the Content

**SAE 1**

Digested food in the form of glucose, fatty acids, glycerol and amino acids are transported by the blood to the liver and other parts of the body and other nitrogenous wastes, urea from the body where they are produced to the organs of excretion. etc 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 carry out 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 plants.

**SAE 2**

The nervous system is responsible for nervous coordination in living organis. 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 i.e. 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 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.

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



## UNIT 1 GENERAL PRINCIPLES OF GENETICS

**Unit Structure**



## 1.1 Introduction

Living things, whether plants or animals 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.

## 1.2 Learning Outcomes

By 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

## 1.3 General Principles of Genetics, Ecology, Taxonomy and Organic Evolution

### 1.3.1 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 parents to offsprings).

Although living things arise from their parent, variations are observed in the offsprings 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 parents to offsprings.

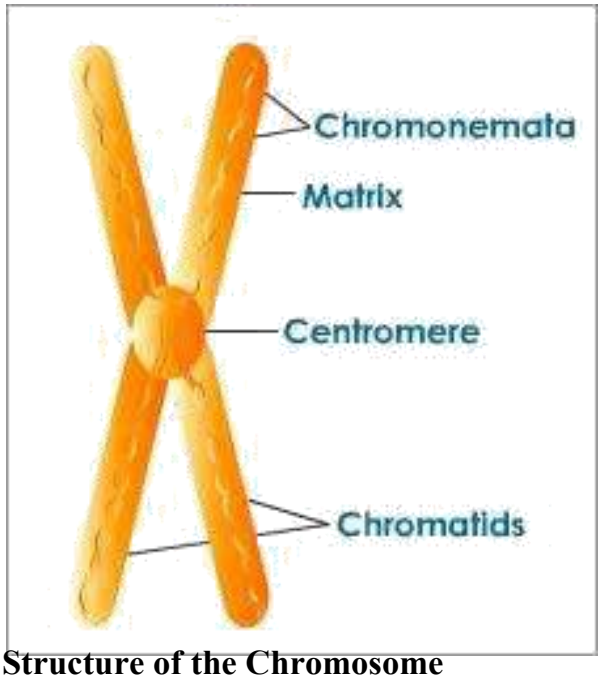
**Self-Assessment Exercise 1**

| |
|---|
| Explain the meaning of Genetics in your own words |

### 1.3.2 Basis of Heredity

Gregor Mendel is a great scientist that worked on genetics, he stated that chromosomes are responsible for transmission of characters and that they are carried in gametes and zygotes. Subsequently 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: 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 offsprings.




**Structure of the Chromosome**

**Self-Assessment Exercise 2**

State the basis for variation among organisms

## 1.3.3 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. which involves 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.

**Self-Assessment Exercise 3**

State examples of the application of the principles of heredity

## 1.4 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.

## 1.5 References/Further Reading/Web Resources

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.

## 1.6 Possible Answers to Self Assessment Exercises Within the Content

**SAE 1**

1. Genetics is a branch of biology that deals with the study of variations in organisms and the inheritance of the varied characteristics. It is the scientific study of heredity and variation.

**SAE 2**

2. Gregor Mendel is a great scientist that worked on genetics, he stated that chromosomes are responsible for transmission of characters and that they are carried in gametes and zygotes. Subsequently scientists proposed that chromosomes are the carriers of gene and studies eventually established that Mendel's factors are located on chromosomes. Chemical analysis of chromosome shows that they are composed of proteins combined with nucleic acid and are of two kinds: 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 offsprings.

**SAE 3**

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. which involves 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.

# UNIT 2 GENERAL PRINCIPLES OF ECOLOGY

**Unit Structure**



## 2.1 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.

## 2.2 Learning Outcomes

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

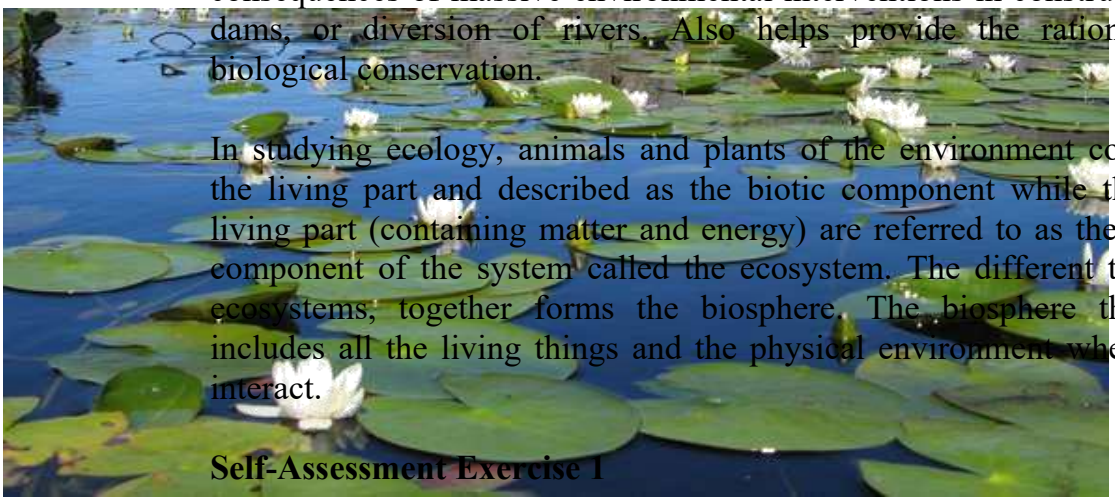
- Explain the meaning of ecology
- Describe the different components of an environment (ecosystem)
- List and describe different types of ecosystems and organisms found there
- Explain how energy flows in an ecosystem

## 2.3 General Principles of Ecology

### 2.3.1 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.



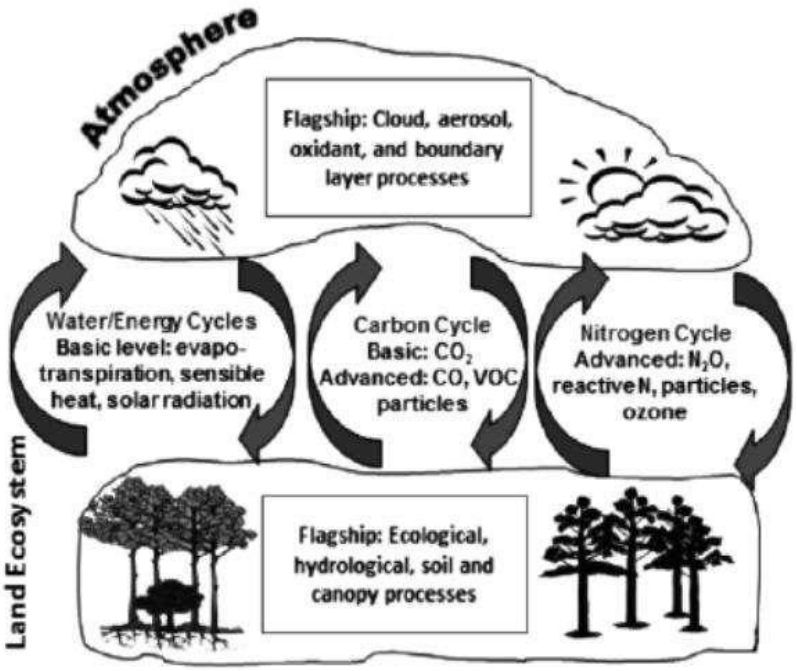
In studying ecology, animals and plants of the environment constitute the living part and described as the biotic component while the non-living part (containing matter and energy) are referred to as the abiotic component of the system called the ecosystem. The different types of ecosystems, together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

**Self-Assessment Exercise 1**

| |
|---|
| Explain the meaning of ecology |

## 2.3.2 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**

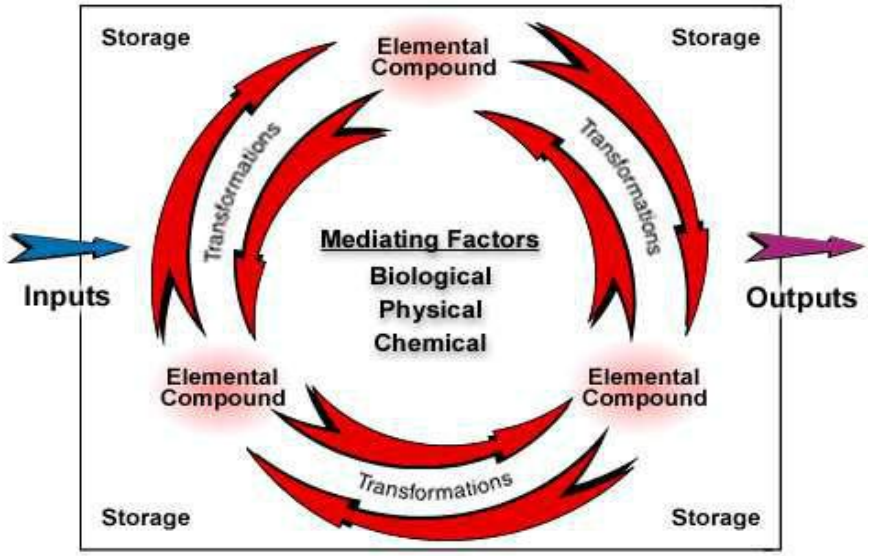
**Picture of Water Ecosystem**

**Self-Assessment Exercise 2**

| |
|---|
| Describe the different components of an environment (ecosystem) |

## 2.3.3 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.

**Self-Assessment Exercise 3**

1. List and describe different types of ecosystems and organisms found there
2. Explain how energy flows in an ecosystem

## 2.4 Summary

In this unit, you learnt that;

Ecology is the study of relationship between living and non-living things in 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.

## 2.5 References/Further Reading/Web Resources

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.

## 2.4 Possible Answers to Self Assessment Exercises Within the Content

**SAE 1**

**1.** 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.

**SAE 2**

**2.** Animals and plants of the environment constitute 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.

**SAE 3**

1. 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.

2. 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).

# UNIT 3 GENERAL PRINCIPLES OF TAXONOMY

**Unit Structure**



## 3.1 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 method 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.

## 3.2 Learning Outcomes

By 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

## 3.3 General Principles of Taxonomy

### 3.3.1 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.

**Self-Assessment Exercise 1**

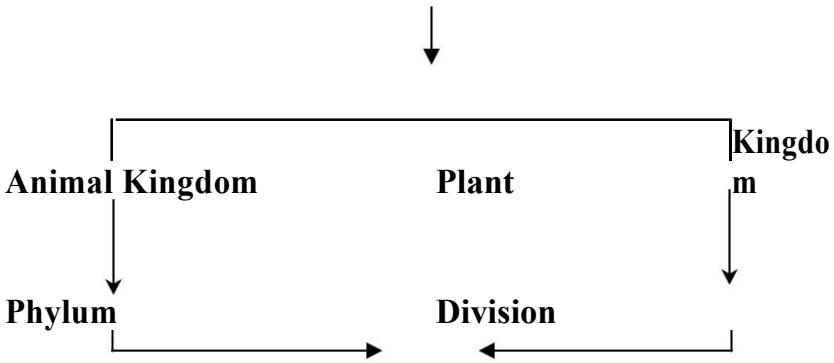
| Explain the term taxonomy |
|---|

## 3.3.2 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 the classification trend in living things.

**Living things**




**Class**

**Order**

**Family**

**Genus**

**Species**

**Self-Assessment Exercise 2**

| |
|---|
| Explain two types of classification used for living things, |

## 2.3.3 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 |

**Self-Assessment Exercise 3**

| |
|---|
| Give a Classification of African Elephant |

ii. Plant

Maize (*Zea mays*)

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

**Self-Assessment Exercise 4**

| |
|---|
| Give a Classification of maize |

## 3.4 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.

## 3.5 References/Further Reading/Web Resources

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.

## 3.6 Possible Answers to Self Assessment Exercises Within the Content

**SAE 1**

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.

**SAE 2**

Two types of classification are used for living things, they are natural and artificial. While artificial is based on one or a few easily observed characteristics usually designed only for practical purpose with emphasis on simplicity and convenience, natural classification on the other hand 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

Examples of classifications of animals and plants are

**SAE 3**

1. African Elephant (*Loxodonta Africana)*

| | | |
|---|---|---|
| Kingdom | - | Animalia |
| Phylum | - | Chordate |
| Sub phylum | - | Vertebrata |
| Class | - | Mammalian |
| Order | - | Proboseidea |
| Family | - | Elephantidae |
| Genus | - | Loxodonta |
| Species | - | Africana |

**SAE 4**

ii. Plant

Maize (*Zea mays*)

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

# UNIT 4 GENERAL PRINCIPLES OF ORGANIC EVOLUTION

**Unit Structure**



## 4.1 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.

## 4.2 Learning Outcomes

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

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

## 4.3 General Principles of Organic Evolution

### 4.3.1 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.

### 4.3.2 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 the spread of religion, this theory lost popularity.

The theory of steady state – this theory believes 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 believes 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

**Self-Assessment Exercises 1**

1. Explain organic evolution
2. Discuss at least three theories describing how life originated

### 4.3.3 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, i.e. 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.

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

**Self-Assessment Exercises 2**

| |
|---|
| Describe the bases for variation among organisms<br>State examples of variations among organisms |

## 4.4 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.

## 4.5 References/Further Reading/Web Resources

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.

## 2.6 Possible Answers to Self Assessment Exercises Within the Content

**SAE 1**

**1.** 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.

2. 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 the spread of religion, this theory lost popularity.

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.

**SAE 2**

1. Inheritance – i.e. genetically inherited characteristics i.e. occur in reproduction

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

2. Variations in organisms could also be;

i. Morphological i.e. its physical features e.g. size, height, skin, hair, finger etc.

iii. 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.