NATIONAL OPEN UNIVERSITY OF NIGERIA

SCHOOL OF SCIENCE AND TECHNOLOGY

COURSE CODE: BIO 102

COURSE TITLE: GENERAL BIOLOGY II

COURSE GUIDE

BIO 102
GENERAL BIOLOGY II

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Introduction

BIO 102: General Biology II is a one-semester, 2 credit- hour course in Biology. It is a 100 level, second semester undergraduate course offered to students admitted in the school of science and technology, school of education who are offering Biology or related programmes.

The course guide tells you briefly what the course is all about, what course materials you will be using and how you can work your way through these materials. It gives you some guidance on your Tutor-Marked Assignments.

There is/are Self-Assessment Exercise(s) within the body of a unit and/or at the end of each unit. The exercise(s) is/are an overview of the unit to help you assess yourself at the end of every unit.

What You will Learn from this Course

This course contains nineteen (19) units which cover a generalized survey of the plant and animal kingdom based mainly in the study or similarities and differences in the external features, ecological adaptation of plant and animal forms.

Plants and animals consist of different forms: from the simple forms to the complex forms. At the end of this course, you would have acquaint yourself of the different forms of the plant and animal kingdom, especially their external features and ecological adaptation.

Course Aims

The aim of this course is to provide a generalized survey of the plant and animal kingdom based mainly on the study, or similarities and differences in the external features, ecological adaptations of plants and animals forms.

Course Objectives

In addition to the aim of this course, the course sets an overall objective which must be achieved. In addition to the course objectives, each of the units has its own specific objectives. You are advised to read properly the specific objectives for each unit at the beginning of that unit. This will help you to ensure that you achieve the objectives. As you go through each unit, you should from time to time go back to these objectives to ascertain the level at which you have progressed.

By the time you have finished going through this course, you should be able to:

Know the similarities and differences in the different forms of plants and animals
Understand the different classifications of plants and animals
Describe plants and animals based on their external features
Recognize plants and animals based on their possession of specific adaptive features.

Working through this Course

In this course, you will be advised to devote your time in reading through the material. You would be required to do all that has been stipulated in the course: study the course units, read the recommended reference textbooks and do all the unit(s) self-assessment exercise(s) and at some points, you are required to submit your assignment (TMAs) for assessment purpose. You should therefore avail yourself of the opportunity of being present during the tutorial sessions so that you would be able to compare knowledge with your colleagues.

Course Materials

You are to be provided with the two major course materials. These are:

Course Guide
Study Units

The course comes with a list of recommended textbooks. These textbooks are supplement to the course materials so that you can avail

yourself of reading further. Therefore, it is advisable you acquire some of these textbooks and read them to broaden your scope of understanding.

Study Units

This course is divided into 4 modules with a total of nineteen units which are divided as follows:

Module 1

Unit 1 Living Organisms
Unit 2 Algae
Unit 3 Bryophytes
Unit 4 Pteridophytes
Unit 5 Seed Plants (Gymnosperms and Angiosperms)

Module 2

Unit 1 Animal Kingdom (Protozoa)
Unit 2 Phylum Porifera
Unit 3 Phylum Coelenterate
Unit 4 Phylum Platyhelminthes
Unit 5 Phylum Aschelminthes

Module 3

Unit 1 Phylum Annelida
Unit 2 Phylum Mollusca
Unit 3 Arthropods
Unit 4 Phylum Echinodermata

Module 4

Unit 1 Vertebrates/Vertebrata (Fishes)
Unit 2 Amphibia
Unit 3 Reptiles
Unit 4 Aves (Birds)
Unit 5 Mammalia

Textbooks and References

I shall like to recommend that you reference the underlisted textbooks as the course progresses:

Aina, J.O., Asun, P. and Ndu, F.O.C. (1999). *Senior Secondary School Biology I.*

Idodo-Umeh, G. (1999). *College Biology*. Benin City: Idodo-Umeh Publishers Ltd.

Sarojini, I.R. (1993). *Modern Biology for Senior Secondary School's.* Africana – Feb Publisher Ltd.

Vidyathi, R.D., Pandey, P.N. (1978). *Textbook of Zoology*. New Delhi: S. Chand and Company Ltd.

Assessment

There are two components of the assessment for this course:

The Self-Assessment Questions (SAQs) or Exercise
The Tutor-Marked Assignment (TMAs)
The End of Course Examination

Self Assessment Questions (SAQ)

The exercise within each unit is/are meant to probe your understanding of then concept in the unit. It is non-grading and as such does not add up top your grade in the course.

Tutor-Marked Assignment (TMA)

The TMA is the continuous assessment component of your course. It accounts for 30 percent of the total score you will obtain in this course.

Final Examination and Grading

The course is to be concluded by this examination. The final examination constitutes 70 percent of the whole course. You will be adequately informed of the time of the examination. The examination will consist of questions which reflect all the basic concepts you would have learnt through the duration of the course.

Summary

This intends for you to have an underlying knowledge of the similarities and differences in the external features, ecological adaptations of plants and animals. By the time you complete this course, you will be able to answer conveniently questions that border s on the:

external features of different plants and animal forms
general characteristics of plants and animals
general adaptive features of plants and animal forms

ecological adaptation of plants and animal forms
various classification of plants and animals

I wish you success in this course.

Best wishes.

MAIN COURSE

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MODULE 1

UNIT 1 LIVING ORGANISMS

CONTENTS

1.0 INTRODUCTION

The world of Living things is very vast in numbers, ancient in history, and complex in diversity. The Science of biology has many disciplines, all attempting to provide us a true picture of the nature of living things. A casual observation of living organisms around you anywhere will reveal a wide variety of plants and animals varying in sizes, shapes, colour, speed of locomotion, etc. Also, they exhibit some similarities of features or behaviours. Therefore in this unit, we shall be looking at the various methods of classification of living organisms, and the characteristics of each group by which it can be identified.

2.0 OBJECTIVES

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

list the different groups of living organisms
explain the different methods of classification
list the five–kingdom classification of organisms, its classifications and examples
maintain the major characteristics of the major groups of plants and animals.

3.0 MAIN CONTENT

3.1 Classifications of Living Organisms

More than 1.8 million kinds of living organisms have been examined and described. There are still many more to be discovered and described, therefore, we must have a meaningful way of classifying, identifying and naming them. Aristotle (384-322 BC) a Greek philosopher, was the first to make an attempt to classify living organisms. The present method of classifying and naming living organisms is based on the work of Linnaeus (1707-1778), a Swedish naturalist. The study of the general principle of classification is known as taxonomy or systematic.

Hierarchy of Living Organisms

Kingdom has the largest group of organisms. Each kingdom is split into smaller groups, and these groups into even smaller groups and so on. The arrangement of living organisms in this hierarchy from the highest to the lowest is as follows:

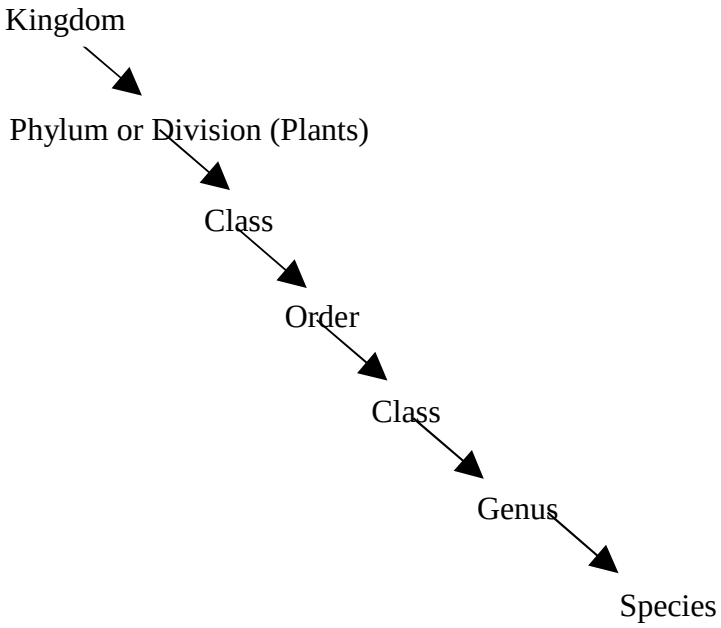


Fig 1.1

As we go down (fig 1.1) the variety of organisms decreases. *The kingdom* has the largest variety of organisms. They have certain important features in common but show many differences. The *species* is the smallest unit of Classification. They are identical in general appearance. They can mate with one another and produce fertile offspring. Organisms within a species are very closely related.

3.1.1 Binomial Nomenclature

This is the use of a standard system to name living organisms, though we are familiar with common names of living organisms such as Mango, Goat, Pawpaw, Lion etc. In Binomial Nomenclature, each kind of organisms is given two names: the first name is the genus to which the organism belongs and the second been the species to which it belongs. On the genius name begins with an initial capital letter, Hence the scientific name of Pawpaw is *Carica Papaya*, Lizard – *Agama agama*. The names are written in italics or underlined separately.

3.1.2 Kingdoms

All living organism were placed into two kingdoms by Linnaeus. The Kingdom was plants and animals. This is known as two – kingdom classification. In this classification, many one-celled organisms could not fit in properly; it failed to establish clear-cut distinction between plants and animals. It also could not indicate correct relations among organisms. So, in 1969, Whittaker proposed the five- kingdom classification (Table1.1) which is generally used at present. The classifications are:

Moneras
Protists
Fungi
Plantae and
Animalia

The Kingdom Monera contains the prokaryotes – Which are the very simple –celled organisms that has no true nuclei. The eukaryotes- which cells are highly organized with definite or true nuclei are classified into the four remaining kingdom: protist, fungi, plantae and animalia.

3.2 The Characteristics of the Five – Kingdom Organisms

Table1.1

Kingdom Monera (Prokaryotes)

Single- Celled organisms, motile or non-motile, microscopic Simple – Celled Structure with no definite nucleus. Examples includes Bacteria, Blue-green algae, actinomycetes

Kingdom Protista (Eukaryotes)

Single –Celled, motile or non-motile. Organisms are much larger than the monerans. Complex Cell Structure with a definite nucleus. Examples includes: Chlamydomonas, Amoeba

Kingdom Fungi (Eukaryotes)

Non-motile organisms usually of thread-like structure or hyphae. Plant- like but cannot carry out photosynthesis due to absence of chlorophyll, obtain food through surface from living or non living organism source by absorption, reproduction could be by asexual or sexual or sexual spores. Examples includes: moulds, Mushrooms, shine moulds, yeasts.

Kingdom Plantae

Many-celled, non-motile, contain Chlorophyll that enables them make their own food by Photosynthesis. Plants have indeterminate growth. Examples includes: Mosses, Ferns, Pines, Seed Plants (yam, bean, and plants).

3.3 Kingdom Plantae

Plants can readily be understood in the context of their autotrophic mode of nutrition. They simply transform light energy into chemical energy by anchoring firmly in one place with a maximum surface area to capture sunlight. Plants use the cheapest material around, water and carbohydrate to generate size. Because plants are immobile, they are extremely responsive to environmental cues and have their life cycle in perfect synchrony with the seasons.

Plants have a unique mode of development. This involves giving by meristems at their tips. They also have remarkable power of regeneration. Any single plant cell can regenerate an entire plant with its cell types. The cells have cellulose cell wall.

The plant kingdom is mainly classified into:

Algae
Bryophytes
Pteridophytes
Gymnosperms
Angiosperms
Thallophytes (Alga)

Algaes, also known as Thallophytes are the simple green plants. They are aquatic plants (lives in water) that are thread like or flat (thallus) bodies with no roots or stems. They inhabit damp places on the land surface. They exhibit a distinct alternation of generation. The sporophyte is always attached and dependant on the gametophyte.

Though bryophytes colonized terrestrial habitats but they are still dependant on water for completion of their life cycle. They produce motile gametes which require a thin film of water for their motility. Only in the presence of this film of water male gamete can reach non-motile female gamete to accomplish fertilization. Due to this reason, bryophytes are regarded as amphibians.

Algae exhibits biological diversity and have the ability to produce a wide variety of metabolic products, hence they are extensively exploital in biotechnology. Algae other usefulness includes: an important source of food for fresh water and marine organisms and also supplies oxygen to them.

Used as biofertilizer, for example nitrogen fixing algae which Farmers can grow in their fields are used to enrich soil
Controlling pollution in water bodies and also in purification of sewage.

3.4 Tracheophytes (Pteridophytes, Gymnosperm and Angiosperm)

The tracheophytes are known as vascular plants. This is because they have vessels or vascular tissues for conducting water and food. They are the largest group of plants which includes the seed plants (flowering plants) as well as some spore-bearing, non flowering plants like ferns.

3.5 Kingdom Animalia

All animals belong to this kingdom. They are multicellular, eukaryote heterotrophy (organism). They lack photosynthetic pigments and obtain nutrients by ingesting other organisms. Their Cells lack cell wall. Many of the members exhibit advanced tissue differentiation and complex organ systems and move about freely, they are characterized by quick response to stimuli, with specialized nervous tissue for coordination. Growth is determinate, mostly with definite size and shape.

Animals are Classified into Two Main Groups

i. Invertebrata (invertebrate): animals with no backbone
ii. Vertebrata (vertebrate) : animals with backbone

The division and subdivision of animals are based on several important features including body symmetry, body design and body lavity.

TABLE 1.2

Sub-Phylum Invertebrata

Phylum	Cellular Organization	Coelom	Body Symmetry	Distinguishing Feature	Examples
Porifera	No tissues	None	Asymmetrical	Aquatic adults Non-motile, Filter feeders, posses pores & Collar cells.	Sponges
Coelenterates	Tissues	None	Radical	Polyp & medusa forms, stinging cells on tentacles	Jelly fish, Hydra, corals
Platyhelminthes	Organs	None	Bilateral	Flat body with definite head and tail end	Flukes, Tape worm
Nematodes	Organs	Pseudo-Coelom	Bilateral	Cylindrical, unsegmental body	Ascaris, hookworm,
Annelids	Organs	Coelom	Bilateral	Cylindrical Segmented body	Earthworm, Leeches.
Molluscs	Organ	Coelom	Bilateral	Unsegmental	Snails,

	System			body muscular foot, mantle cavity, shell presenting most cases	Cysters, Clams.
Arthropods	Organ System	Coelom	Bilateral	Joint tail appendages, Chitinous exoskeleton, Specialized Segments and sensory system	Crustaceans Snails, insects, spiders.
				Spiny skeleton; System of water canals , tube feet	Star fish, Sea cucumber sea urchins

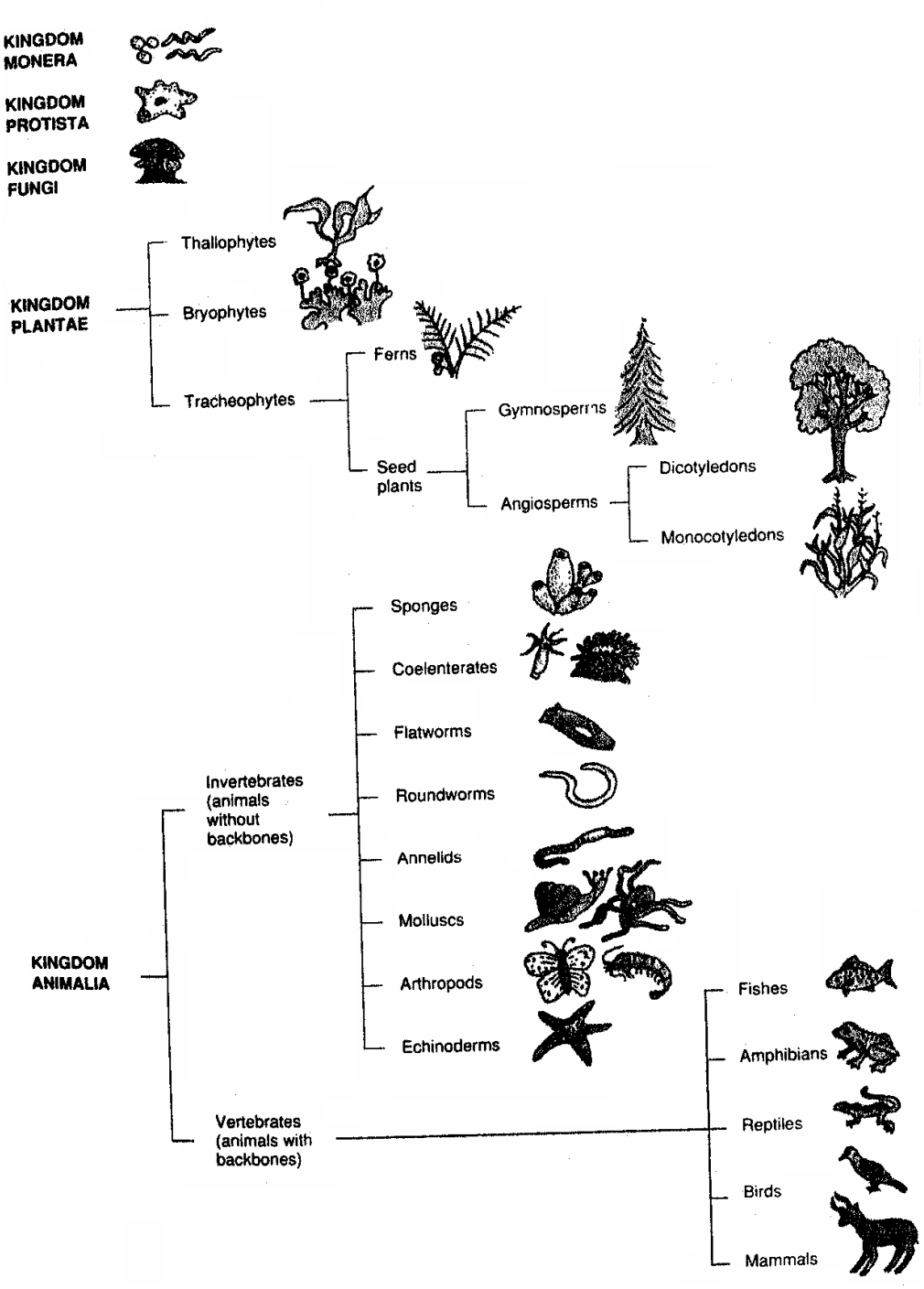
Table 1.3

Sub-Phylum Vertebrata

The General Characteristic factors of Vertebrates are shown below on Table

Pisces	Covered with scales and slimes	Modified into fins	Through gills	Bony fish, Cartilaginous fish
Amphibians	Soft and moist	Two fore legs and two hind legs,	Through gills in young, skin and lungs in adults through lungs	Frog, Toad
Reptiles	Covered with dry scales	Two fore legs and two hind legs with toes ending in claws		Lizard, Snakes, Alligators etc
Aves	Covered with feathers, scales on feet	Forelimbs modified into wings, hindlegs with toes ending in claws	Through lungs	Birds
Mammals	Covered with hair (fur)	Two forelegs and two hindlegs ending in claws	Through lungs	goat, Cow, Dog, Man

Classification of Living Organisms at a Glance



SELF ASSESSMENT EXERCISE

Classify the following kingdoms of organizations into prokaryotes and Eukaryotes

i Monera
ii Protista
iii. Fungi

iv. Plantae
v. Animalia

4.0 CONCLUSION

The vastness and the diverging of living organism is well appreciated in this study.

5.0 SUMMARY

In this Unit, you have learnt that;

i. There is a general principal of classification of living organisms which is known as Taxonomy, and also their hierarchical structure
ii. The Binomial nomenclature that identifies each type of organism is made up of its generic and specific names.
iii The Five-kingdom classification of living organism is generally in use now, and it has its limitation.
iv. Thallophytes, Bryophytes, Tracheophytes belong to the kingdom plantae.
vi. The Kingdom Animalia are grouped into Vertebrates and Invertebrates.
vii. Living Organisms have their Characteristic features which distinguish them from one another.

6.0 TUTOR-MARKED ASSIGNMENT

1. Differentiate between Bryophytes and Tracheophytes
2. Why are invertebrates grouped under the kingdom Animalia.

7.0 REFERENCES/FURTHER READINGS

Aina, J. O., Asun, P. and Ndu, F. O. C. (1999). *Senior Secondary School Biology I*.

Indira Ghandi National Open University (2002). *Plant Diversity – 1A: Diversity of Plants and Related Organisms*. Pgs. 15-20.

Idodo – Umeh, G. (1996). *College Biology*. Benin City: Idodo –Umeh Publishers Ltd.

Sarojini, T. R. (1993). *Modern Biology for Senior Secondary Schools*, Pgs. 9 – 40.

UNIT 2 ALGAE

CONTENTS

1.0 INTRODUCTION

We have learnt about the various groups and classification of the plant and animal kingdoms in the last unit.

In this unit we shall be looking at the first classification of the plant Kingdom, which is the Algae.

Algae show great diversity in size and structure. They are unicellular, Colonical, filamentous and thalloid in form. Some are microscopic, while others are very big in size. They do not form complex organs or tissues. The study of their ultra structure under electron microscope shows that blue-green algae have prokaryotic type of cell like that of bacteria while all other algae are eukaryotes.

2.0 OBJECTIVES

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

mention the characteristics of algae.
distinguish algae, morphologically
classify algae
show the external features of spirogyra
outline the various ecological habitat and adaptation of algae.

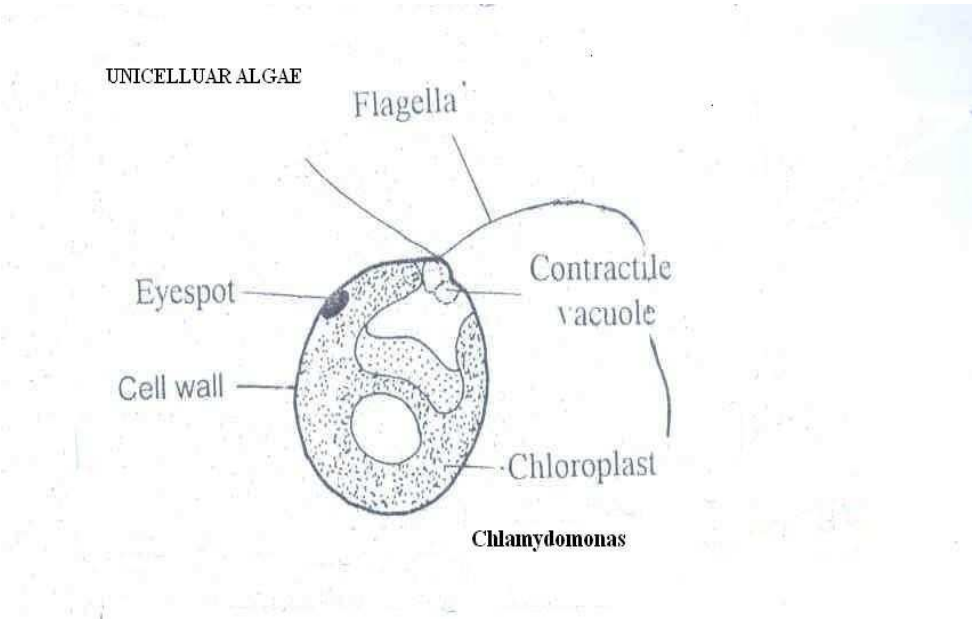
3.0 MAIN CONTENT

3.1 Algal Morphology

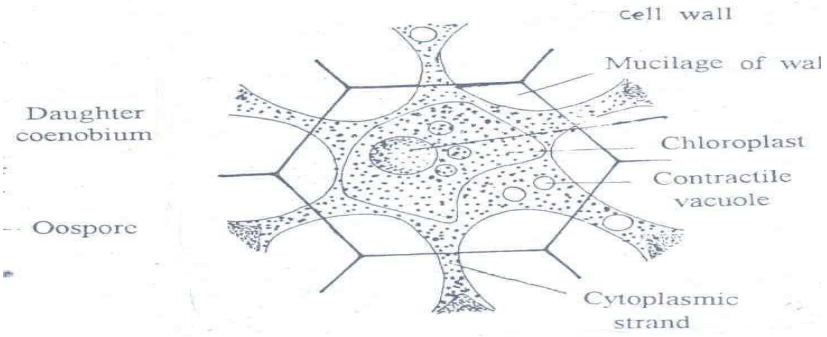
Morphologically, algae can be distinguished as unicellular, colonial, filamentous, heterotrichus, thalloid and polysiphoid forms. Examples of each of these types of algae are given below.

Table 2.1 Various Forms of Algae

1.	Unicellular Algae:	Example Anacystis Microcystis
2.	Colonial Algae	Microcystic Volvox
3.	Filamentions Algae	Nostoc} blue-green algae Ulothrix Oedogonium
4.	Heterotrichous Algae	Draparnaldiopsis Coleochaete Ectocarpus
5.	Thalloid	Ulva Fucus} Brown algae
6.	Polysiphonoid	Polysiphonia (Red algae)



Colonial Algae



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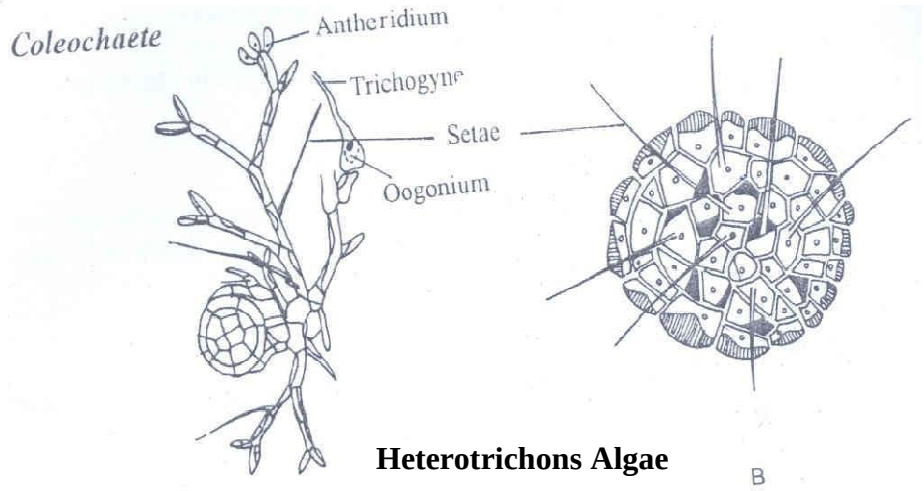
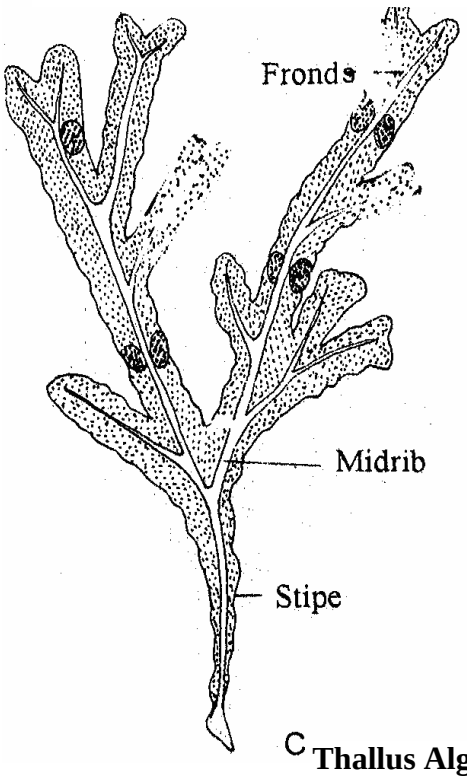
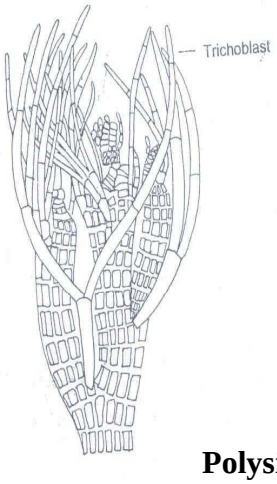


Heterotrichons Algae



C **Thallus Algae**



Polysiphonia Algae

trichoblasts which are simple or branched hair-like

3.2 Characteristic Forms of Algae

They are simple plants without roots, stems and leaves.
They have Chlorophyll. Some have blue, yellow, brown and red pigments with the chlorophyll.
Majority are uni-cellular while few are multicellular. Some, such as sea weeds are large.
They are mainly aquatic, with a few on damp soils and shady places examples are spirogyra, anabaena and Sargassum
The cell wall of algae is composed of a true celloulose.
Reserve carbohydrates are usually starch and not glycogen as in fungi.

3.3 Classification of Algae

Classification means grouping of organisms according to the simulating in their characters. It is not far fetched but true that organisms showing similar morphology, life cycle, physiology and biochemistry are genetically related from the evolutionary point of view. Therefore, Algae are classified into classes. These are:

1. Cyanophyta (prokaryotic algae) or blue-green algae eg. Including Nostoc, An abaena, Oscillatoria.
2. Chlorophyta (algae) eg. Chlamydomonas, Spirogyra, Chlorella
3. Phaeophyta (brown algae) eg. Fucus, Sargassum, laminaria.
4. Xantophyta (yellow –green algae) eg. Vaucheria, Botrydium
5. Chrysophyta (Golden-Brown algae) eg. Synura, Mallomonas, Chromalina.
6. Euglenophyta (Euglenoids) eg. Euglena, Trachelommas.
7. Dinophyta (Dinoflagellates) e.g. Ceratium, Peridinum.

8. Crytophyta(Crytomanads) e.g. Crytomones, Chroomonas.
9. Bucillariophyta (Diatoms) eg. Diatoma, fragilaria.

3.4 Spirogyra

Spirogyra a green algae belongs to the family Chlorophyceae and the order conjulaes or Zygnematales. It is a cosmopolitan plant which forms a tangled mass of filaments floratiny on stagnant fresh water, especially in ponds, ditches, springs and streams. Some species grow in running water. Such species produce a short unicellular organ of attachment, called hapteron, for anchorage on Sea weeds.

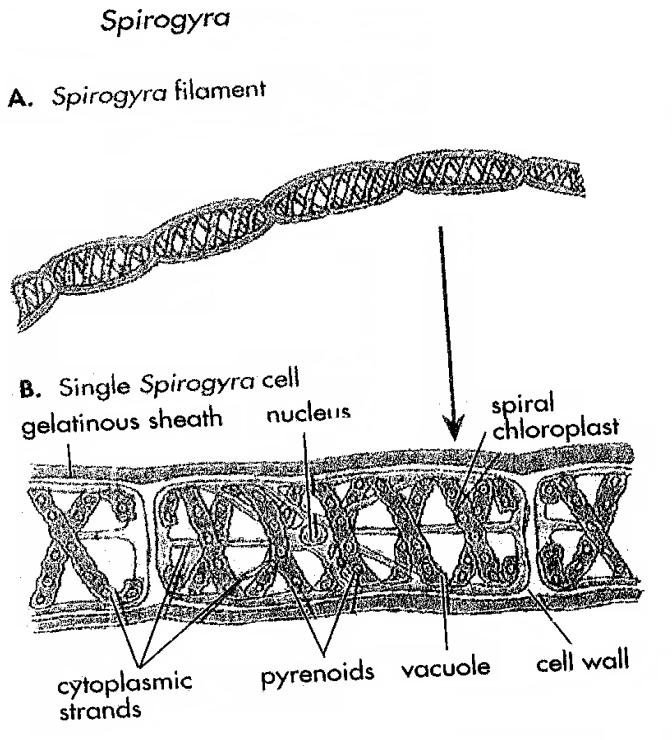
Spirogyra is commonly found as bright green masses of thread-like or filamentous structures on the surfaces of waters, and is often referred to as a “Pond Scum”.

3.5 Structure of a Spirogyra

Mature filament is unbranched and consists of single row of identical cylindrical cells joined end to end.
Cell wall is made of Cellulose and pectin
External cell wall is covered by mucilage, making it shinny.
Cyloplasm is a thin layer with spiral bands of chloroplast.
Nucleus is suspended at the centre by strands of Cytoplasm.
Chloroplast contains small nodular protoplasmic bodies called the pyrenoids.
Starch grains are deposited around each pyrenoid.

External Features of Spirogyra

3.6 Ecological Adaptation



Algae range from Unicellar (microscopic) to large (macroscopic) thalloid forms growing in variety of habitats almost all over the surface of earth. Wherever there is water, a little moisture or water vapours, and light, however feeble, Algae are sure to appear as green, yellow or brown patch. When several types of algae grow together under similar natural conditions we call them communities. The composition of a community is determines by the physical and chemical nature of the habitat. In many cases, the algal community indicates to us about the nature of the habitat, whether, it is rich or poor in nutrients or polluted etc., in other words it serves as an ecological indicator.

3.6.1 Aquatic Algae

Most of the algae grow in water; however, there are also sub-aerial algae. Depending on the concentration of salts there are various kinds of water bodies, such as fresh water brackish water, sea water, brine-salt lakes and salt pans. There habitats nowadays may contain many types of pollutants, like excessive organic metal, heavy metals, pesticides, industrial effluents which are produced and dumped into them by man. This greatly affects algae and other organisms present in the water.

3.6.2 Fresh Water Habitats

Fresh water habitats comprise of rivers, mountains streams, lakes and temporary rainwater puddles. Examples of Algae find here include green algae like oedogonium, diatoms, desmids, etc.

In slow flowing rivers with rocky shores, one may find many filamentous algae like spirogyra, oedogonium. The surface of submerged rocks also shows epiphytic algae like desmids and Cyanobacteria.

3.6.3 Marine Habitats

Sea inhabits largest number of algae collectively known as seaweed. Seacoast is periodically flooded and exposed to sun because of the feeds. The area between the high tide and low tide level is known as intertidal zone. The seaweed that grows in the intertidal zone face alternate drying and wetting. They are also firmily attached to the underlying rocks by means of hold fasts. At times they may get detached and found flowing in the open sea as in the case of Sargasso sea. Example of seaweed include Sargassum wightii (brown algae), Turbinaria, gracilaria edulis

3.6.4 Special Attributes

Algae are also found in special habitats where environmental conditions are in extreme such as Brines and salt lakes where cyano bacteria (Anabaeria) and Unicellulal green alga Dunaliella can be found; Thermal Regions (not water) thermal springs with temperatures ranging from 40° to 70 °c) inhabit alga like oscillareria, Mastigocladus and Cyanobacteria; Polar Regions (extremely cold climate conditions) where Nostoc, oscillatoria, can be found.

3.6.5 Soil and Subaerial Algae

Surface layers of soils provide a favourable substratum when wet for the growth of several types of algas. Terrestrial algae such anabaena, play a major role as primary colonizers on newly exposed areas.

Subaerial algae obtain their water from the moisture in air and grow if moisture is available. They are capable of enduring drought like the soil algae. One can see dark brown patches, sometimes with a velvelty carpet like cushions covering extensively the exposed surfaces of buildings, walls, finances, asbestos, roofs, rock surfaces and also tree trunks.

SELF ASSESSMENT EXERCISE

Give an example(s) of the following alga types:

1. Green Algae
2. Brown Algae
3. Golden – Brown Algae
4. Yellow-green Algae

4.0 CONCLUSION

Algae exhibit various forms and inhabit a different aquatic habitat which is well appreciated in this study.

5.0 SUMMARY

In this unit, you have learnt:

There are different forms of algae; hence they show great diversity in size and structure.
The body of an alga is known as thallus.
Algae can be grouped into different classes and these could be identified based on their external morphological pigment (colour)
Spirogyra is a common example of algae.

Generally, Algae are mostly aquatic in nature

6.0 TUTOR-MARKED ASSIGNMENT

1. Outline the general characteristic features of named Algae
2. Describe the structure of filamentous Algae

7.0 REFERENCES/FURTHER READINGS

Aina, J. O. Asu, P. and Ndu, F. O. C. (1999). *Senior Secondary School Biology I.*

Indra Ghandi National Open University (2002). Plant Diversity – 1B: *Algae.*

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Sarojini, T. R. (1993). *Modern Biology.* Senior Secondary Science Series.

UNIT 3 BRYOPHYTES

CONTENTS

1.0 INTRODUCTION

In the last Unit, we studied algal morphology and habits including their general characteristics. We have learnt that algae are mostly aquatic in habitat. In the course of evolution, the first land plants presumed to have evolved from green algae. In this unit, we shall be looking at Bryophytes which are considered to be the first land plants.

2.0 OBJECTIVES

After studying this unit, you should be able to:

highlight the general characteristics of Bryophytes
describe the Morphological features of Bryophytes
outline the Adaptive features of Bryophytes
name the two groups of Bryophytes and their examples.

3.0 MAIN CONTENT

3.1 Bryophytes

During the course of evolution, a change from aquatic habitat to terrestrial habitat occurred and the only primitive land plants evolved. These are known as bryophytes. Although bryophytes colonize terrestrial habitats but they are still dependent on water for completion of their life cycle. They produce motile male gametes which require a thin film of water for their motility to reach the non-motile female gamete to accomplish fertilization.

3.2 General Characteristics of Bryophytes

Bryophytes lack roots and do not have vascular system.

Some mosses have a primitive system of tubes that conduct water and food – conducting tubes are called leptoids.

A single plant is very small, hardly a few cm in size. It seldom grows large because of lack of supporting tissues.

Bryophytes show two distinct and well defined phases of life cycle, sexual and asexual which follow each other. The gametophyte is haploid and produces gametes. The Sporophytes is diploid and produces spore. The haploid generation alternates with diploid genetic known as Alternation of generation.

The gametophyte may be thalloid or has an axis differential into stem-like and leaf-like structures which have xylem and phloem.

The gametophyte is green, photosynthetic and nutritionally independent, and anchors to the soil by unicellular or multicellular filaments called rhizoids.

Rhizoids appear like roots but they lack vascular tissues.

Bryophytes are more abundant in moist tropical areas. They also grow in deserts, mountains. In dry areas, their growth and activity is restricted to wet season only.

3.3 Morphology of Bryophytes

Bryophyte is mostly divided into liverworts and mosses.

Liverworts

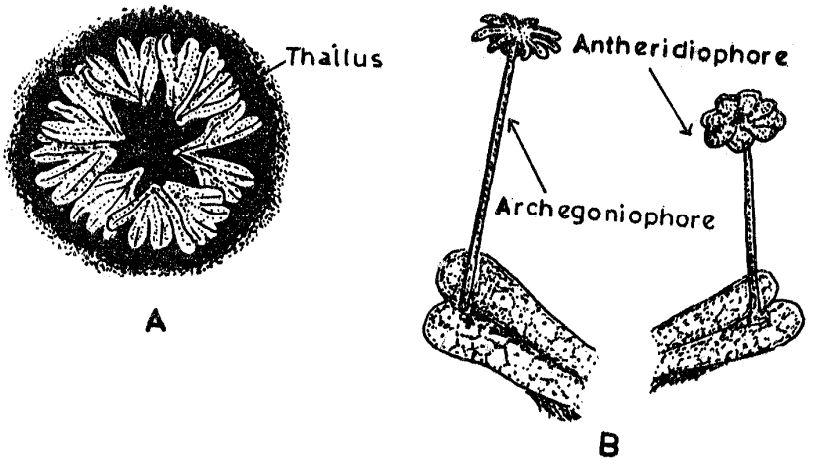
Gametophytes usually are close to the ground.
There are 2 forms of liverworts namely; thalloid liverworts (gametophyte) and is dorsi-ventral, with upper and lower surfaces.
Leafy liverworts (differentiated into leaf-like and stem-like structures).
Leaves of liverworts are without midribs.
Grows on moist ground or rocks that are also wet. (can be found in muddy areas.
Examples include Marchantia and Riccia.

Mosses

This is the largest class of Bryophytes.
They are divided into three subclasses: Sphagnidae (Reat mosses) Andreaide rock mosses) and Bryidae (true mosses).
Example includes funaria.

External Features of Marchantia

Marchantia (Liverwort)



Marchantia belongs to the family marchantiaceae.
The gametophyte bears archegonia on vertical stalked receptacles called archegoniophore.
It grows in cool moist places along with mosses and increases of burnt grounds.
It is deep green in colour
Has a prominent midrib which is marked on the dorsal surface by a shallow groove and in the ventral surface by a low ridge covered with rhizoids.
Marchantia is decorous.
The thallus of Marchantia is anchored to the surface by rhizoids which are of smooth walled.
Scales are also present on the ventral surface arranged on both side of the mid-rib.

External Features or Characteristics of Funaria (Mosses)

Funaria is a very common moss and widely distributed through out the world.
The adult gametophyte is the most conspicuous form of the moist plant.
It consist of a main erect axis bearing leaves which are arranged spirally
The adult gametophyte is called gametophine. It is small and about 1-3 cm high.
The leaves do not have a stalk but show a distinct midrib.

The gametophore is attached to substratum by means of rhizoids. They are multicellular, branched and have oblique septae.

The gametophyte bears sporophyte which has foot, seta and capsule.

The gametophore develops from a filamentous, green short-lived protomenue.

The protonema produces buds at certain stage of development, which inhate development of upring leafy green axis, the gametophore.

The species, Funaria hygrometrica is cosmopolitan and is the best know of all the mosses.

3.4 Adaptation of Bryophytes

Bryophytes are fixed to the soil by thread-like, small structures called Rhizoids.

Rhizoids are unicellular and unbranched in liverworts but multicellular and branched in mosses.

They fix the plant to the soil and absorb water and minerals from it.

The hydroids transfer water from rhizoids to the leaves at the apex and the food conducting leptoids transport sucrose.

In most other bryophytes, external capillary system takes care of the distribution of water to all parts of the plant body.

SELF ASSESSMENT EXERCISE

Having studied Algae in the past unit, outline the structural relationship between Algae and bryophytes.

4.0 CONCLUSION

Having looked at Bryophytes in this unit, bryophytes can be considered to be the first land plant.

5.0 SUMMARY

In this Unit, you have learnt that:

1. Bryophytes are simple non-vascular land plants and it is believe that they evolved from green algae because of several common characteristics.

2. Bryophytes shows two distinct and well defined phase of life cycle ie. The gametophyte phase and the sporophyte phase. The gametophyte produces the gamete while the sporophyte produces the spore.

3. The challenges of land environment for a plant are fixation to the ground conduction of water and dispersal of sperms and spores. Bryophytes take care of there by developing land adaptations such as epidermis, cuticles, stomata, air spores, rhizoids, etc.

4. Liverworts (Marchantia) and Mosses (Funaria) are example of Bryophytes.

6.0 TUTOR-MARKED ASSIGNMENT

State the general adaptation of land plants in relation to bryophytes.

7.0 REFERENCES/FURTHER READINGS

Indira Ghandi National Open University (2002). "Plant Diversity -3. *Bryophytes*".

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UNIT 4 PTERIDOPHYTES

CONTENTS

1.0 INTRODUCTION

Now we come to the last group of non-flowering plants, the Pteridophytes. The most familiar plants of this group are ferns which are commonly seen as house plants, in parks and also in house land scape along with ornamental plants. Ferns are rather small plants , often delicate compound leaves. Because of their beauty and difficulty in propagation, they are considered very precious plants. Pteridophytes are vascular plants and they posses root, stem and leaves. A common and widely distributed ferns is Dryopteris which grows in wet soil and under shade of trees. We also have Water fern, Azolta. There are also medium-sized tree ferns like cyathea. In this unit, you shall study the general characteristics, structure and morphology of a fern, and also the ecological adaptations of Pteridophytes.

2.0 OBJECTIVES

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

outline the general characteristics of pteridophytes
relate pteridophytes with other groups of plants such as bryophytes and flowering plants
outline the external features of a pteridophytes
state the adaptive features of pteridophytes.

3.0 MAIN CONTENT

3.1 General Characteristics of Pteridophytes

i. Pteridophytes have two distinct phases in the life cycle. These are Gametophyte and Sporophytes which follow each other in regular succession. The two generations look different.

ii. The sporophyte is the dominant generation, independent of the gametophyte; it possesses a vascular system and it is in a different habitat.

iii. Pteridophytes exhibit a great variation in form, size and structure.

iv. Most are herbaceous except a few woody tree ferns.

v. They may be dorsi-ventral or radial in symmetry.

vi. They have dichotomously or laterally branched stems that bear megaphyllous leaves.

vii. Roots are generally adventitious, the primary embryonic root being short-lived.

viii. Spores are produced in special structures called the sporangia that are invariably subtended by life-like appendages known as sporophylls.

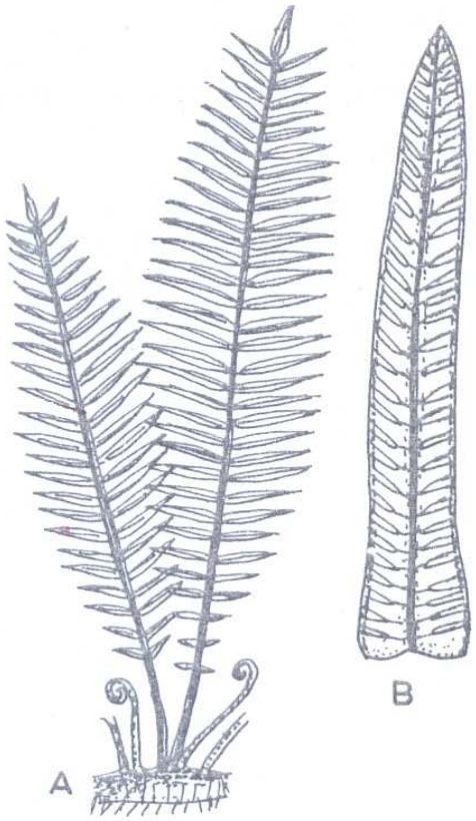
ix. In most cases, the sporangia are compacted to form distinct spore producing regions called the strobile. The sporangia in some cases, may be produced within specialized structures called the sporocarp.

x. The leaves of a fern plant is called frond.

xi. Pteridophytes, in general, are homophonous i.e. they produce only one-type of spores. However, a few species produce two types of spores (micro-spores and megaspores).

xii. They form green, dorsiventrally differential, thallose gametophytes with sex organs restricted to the ventral surface.

xiii. The female reproductive structure is archegonium and the male reproductive structure is antheridium.



Pteridophytes (External Features of Pteris vittata)

3.2 Relationship of Pteridophytes with Other Groups

3.2.1 Pteridophytes and Bryophytes

3.2.1.1 Similarities

1. Liverworts and Pteridophytes show similarity in vegetative structure of gametophytes.

2. Their female and male reproductive structures are archegonium and antheridium, respectively.

3. The opening of the mature sexual reproductive organs and the subsequent fertilizations are condition by the presence of water in liquid salt. ie both require water for fertilization.

4. They usually show a distinct and clearly defined heteromorphic alternative of generations and the two generations follow each other in regular succession.

5. The spores arise in the same manner in both groups.

6. Development of embryo occurs in the archegonium.

7. The young sporophyte or embryo is partially parasitic upon the gametophyte.

3.2.1.2 Differences

1. In Pteridophytes, the sporophyte is independent at maturity and is the dominant phase of life cycle instead of gametophyte as in bryophytes.

2. The Sporophyte has true roots, stems, and leaves and well developed conducting tissues-xylem and phloem, which are absent in bryophytes.

3. Some of the Pteridophyte is heterosporous but all the bryophytes are homosporous.

3.3 Pteridophytes and Flowering Plants

In Pteridophytes, plant body is not divided into root and shoots system, in flowering plants, plant body differentiated into distinct root and shoot system.

Vascular bundles are less developed in Pteridophytes, (tracheids) Flowering plants has well developed vascular bundles (xylem and phloem).

There is no pollen grain, pollen tube; in Pteridophytes following plant has pollen grain.

Pteridophytes have no seeds (but sori) white flowering plants produce seeds with cotyledons or endosperms.

3.4 Morphology of a Pteridophyte–Pteris vittata

Pteris is a widely distributed genus with about 250 species.

It grows abundantly in cool, damp and shady places in tropical and subtropical regions of the world.
Pteris Vittata is a low level fern which brings out new leaves throughout the year.

It is very common along mountain walls and grows up to 1200 metres above sea level.

All the species of pteris are terrestrial, perennial herbs with either creeping or semi erect rhizome covered by scales.

Roots arise either from the lower surface or all over the surface of rhizome.

Leaves are compound in most species, but a few have simple leaves eg. Pteris cretica.

The stalk of leaf continues as rachis and bears leaflets called pinnae.

In Pteris vittata, the pinnae present near the base are tips are smaller than those in the middle.

3.5 Condition for Adaptation

Sporophyte shows greater degree of complexity in structural organization.

It is organized into stem, root and leaves.

The Vascular tissues (xylem and Phloem) are developed only in the sporophyte.

The aerial parts are covered with a layer of cuticle.

On the Epidermis, there are stomata for the exchange of gases.

These anatomical complexities of the sporophyte of Pteridophytes helped in inhabiting a much wider range of environmental condition than the gametophyte could do.

SELF ASSESSMENT EXERCISE

State five general characteristics of a Fern.

4.0 CONCLUSION

The Study of Pteridophyte makes the beginning of the study of plants, therefore the study of Pteridophytes should be intensified because of its importance to man.

5.0 SUMMARY

In this Unit, you have learnt that:

In Pteridophyte, the sporophyte is the dominant generation which is independent of the gametophyte, unlike the Bryophytes where the reverse is the case.

Pteridophyte are termed heteromorphic because of their two distinct phases in life cycle ie. The gametophyte and the sporophyte which are independent of each other.

Pteridophytes body are not divided into true root and shoot system; the vascular bundle are less developed and they produce no seeds but what is known as sori.

In Pteridophytes, the vascular tissues are developed only in the sporophyte.

6.0 TUTOR-MARKED ASSIGNMENT

Outline the relationship between Pteridophytes and Bryophytes in respect to their similarities and Differences.

7.0 REFERENCES/FURTHER READINGS

Indria Ghandi National Open University (2002). Plant Diversity -4: *Pteridophytes.*

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UNIT 5 SEED PLANTS (GYMNOSPERM AND ANGIOSPERM)

CONTENTS

1.0 INTRODUCTION

Seed plants are seed producing vascular plants. They are also called Spermatophyte. They have well developed roots, stems and leaves. The seeds containing the embryo develops from a fertilize egg of a very small gametophyte which is completely dependent on the sporophytes, the plant form we see around us. The efficient seed dispersal of seed plants account for their continued existence and widespread occurrence. The fertilization of the egg is by the male gamete which is brought by pollination, followed by the growth of the pollen tube which carries the male gamete to the egg. Water is not needed in this process, hence the seed plants are true land plants. In this unit, we shall be looking at the seed plants: Gymnosperm and Angiosperms.

2.0 OBJECTIVES

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

list out general characteristics of seed plants
outline the specific characteristics features of gymnosperms and angiosperms
highlight morphological characteristic of a named gymnosperm and angiosperm

classify gymnosperms and angiosperm
highlight the terrestrial (ecological) of seed plants.

3.0 MAIN CONTENT

3.1 General Characteristics of Seed Plants

They are terrestrially adapted i.e they are land plants.
The gametophytes of seed plants become more reduced and dependent on the sporophytes.
They produce two types of spores (Megaspores and Microspores) ie. they are heterospores.
They undergo pollution which replaces swimming as the mechanism for delivering sperm to egg.
They produce seed.

3.2 Gymnosperms

3.2.1 Classification

Gymnosperms are generally classified into four divisions. These are

- Coniferophyta - the conifers
- Cycadeophyta - Cycads
- Ginkophyta - ginko
- Gnetophyta - gnetae.

3.2.2 Conifers

Among the gymnospems, the conifers are the most important. They have the following characteristics:

They are cone bearing plants with vascular tissue.
All are woody plants; the great majority been trees with just a few shrubs.
Species can be found growing naturally in almost all parts of the world.
They are frequently dominating plants in their habitats.
They are of immense value, primarily for timber and paper production.
The wood of conifers is known as softwood.
Examples are: Cedars, Cypresses, Pines, Redwoods etc.

3.2.3 External Morphology of Conifers

All are wood plants, and most are trees.

Majority has a monopocal growth (ie. a single, straight trunk with side branches) with optical dominance.

Size varies from less than a metre, to over 100 meters.

They are the world largest, tallest and oldest living things.

3.2.4 Ecological Adaptation of Conifer

The have distinctly scented pesin, which is secreted to protect the tree against insect infestation and fungal infection of woods.

They maintain high rates of photosynthesis at relatively low temperature.

Their needles (leaves) have thick warty coatings and sunken stomatas which prevent excessive loss.

The sapwood column is large and acts as a short-term reservoir that supplies water to foliage during drought periods.

Pine

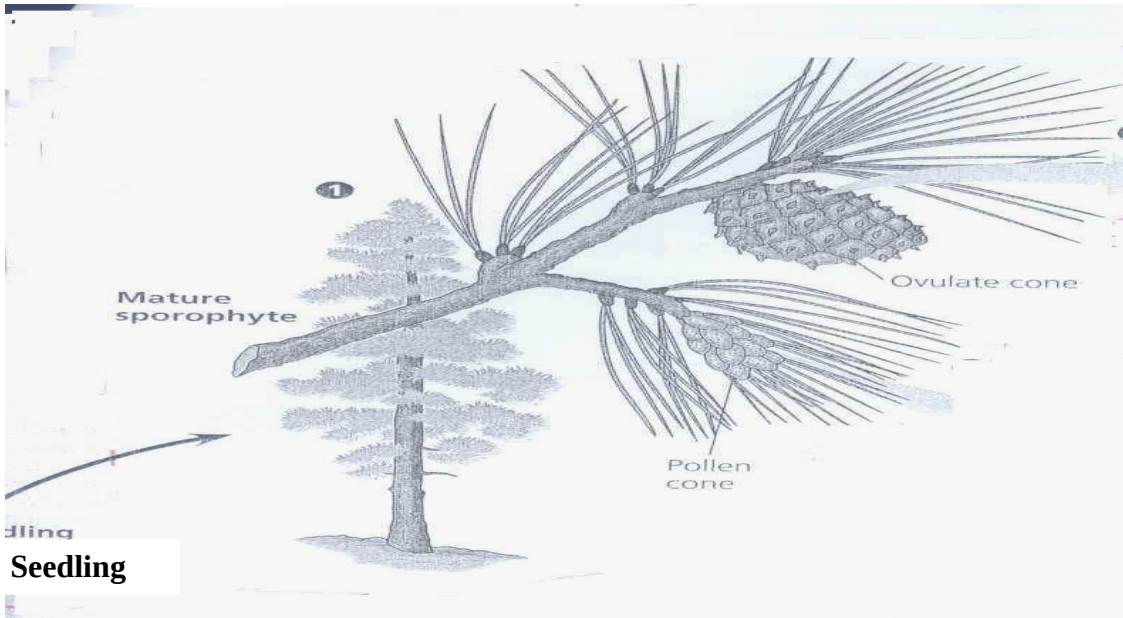


Fig. 1.5: Diagram of a Confer

3.3 Angiosperms

The angiosperms are also known as flowering plants. They occupy every habitat on earth except extreme environments. They live as epiphytes (i.e living on other plants); as floating and rooted aquatics in both fresh water and Marine habitats, and as terrestrial plants that vary tremendously in size, longevity and overall form. They can be small herbs, parasitic plants, shrubs, vines or giant trees. They are also sources for other important resources such as medicine and timber.

3.3.1 Classification

Angiosperm are generally classified into two (2). These are:

Monocotyledons (Monocots)
Dicotyledons (Dicots).

3.3.2 General features of Angiosperms

They could be photoautotroph, Saprobes or parasitic.

Mostly pollinated by insects, birds, and other animals, while some are by wind

They have vessels (xylem and phloem).

The monocots include lilies, grasses, corn, wheat, palms, while the dicots include roses, maples, oaks, peas, and beans.

Angiosperms posses certain external features that remarkably distinguish them from other seed plants. This feature includes:

1. Flowers

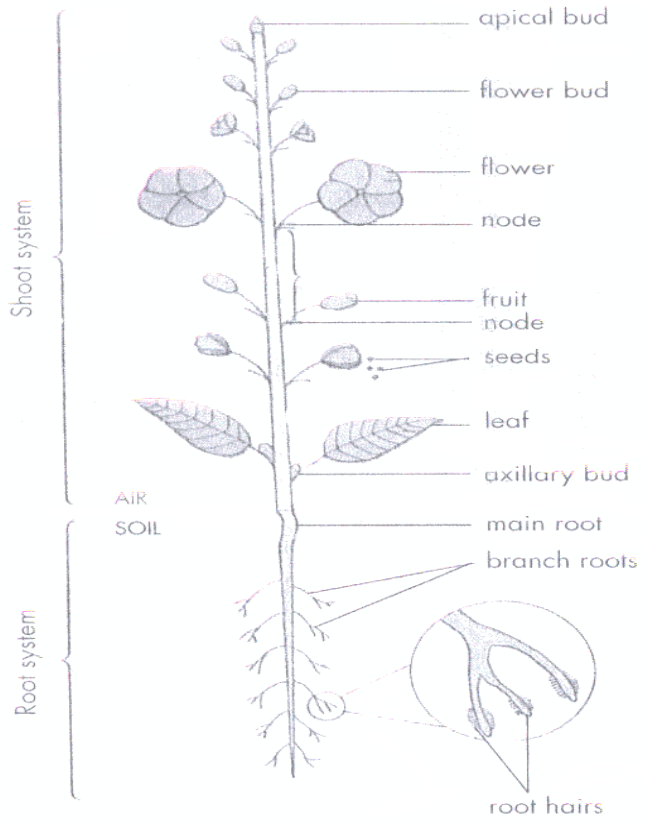
They have modified leaves
Has sepals – usually green
Petals –brightly colored and insect pollinated
Petals –drab – wind pollinated
Has carpels – female reproductive organ.
Has stamen- male reproductive organ.

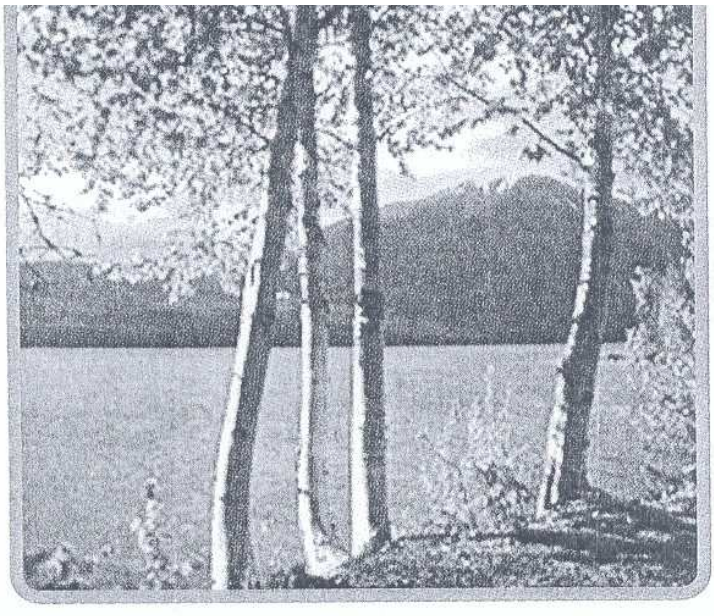
2. Fruits

It protects documents seeds.
They have mature ovary.
Simple fruit has single ovary flower (e.g. Pea pod, apple)

Aggregate fruit – produce from separate flowers (e.g pineapple)
Modifications for dispersal includes: attractive food, dispersal by wind, burns.

Diagram of a Flowering Plant





3.4 Terrestrial Adaptation of Vascular Plant (Seed Plants)

Possession of cuticle

They do not need immediate aquatic habitat.

Roots have no cuticle.

They are woody materials made of Cellulose and lignin.

Possession of vascular tissues (Xylem and Phloem).

SELF ASSESSMENT EXERCISE

List the characteristic features of a named gymnosperm.

4.0 CONCLUSION

Seed Plants are crucial for human existence. The vast majority of the world's crops are seed plants.

5.0 SUMMARY

In this Unit, you have learnt that:

Gymnosperms and angiosperms are seed producing vascular plants.

The efficient seed dispersal of seed plants accounts for their continued existence and widespread occurrence.

The distinguish features of Angiosperm in the possession of flower and fruits.

Gymnosperms are mostly woody plants.

Conifers are of immense economic value primary for timber and paper production.

Seed plants do not need immediate aquatic habitat.

6.0 TUTOR-MARKED ASSIGNMENT

1. Outline how conifers ate terrestrially adapted.
2. What are the distinguishing features of a flowering plant?

7.0 REFERENCES/FURTHER READINGS

Sarojini, T.R. (1993). *Modern Biology for Senior Secondary Schools*. AFRICANA – FEP Publishers Limited.

http://en.wikipedia.org/wikj/conifer

MODULE 2

UNIT 1 ANIMAL KINGDOM (INVERTEBRATES AND VERTEBRATES)

CONTENTS

1.0 INTRODUCTION

An animal is either a vertebrate or an Invertebrate. This categorization of animals is based on presence and absence of the vertebral column, usually referred to as BACKBONE or spine in highly evolved animals, The animals which posses vertebral column are called VETEBRATES. Conversely, those animals, which do not have the vertebral column are called INVERTEBRATES. In vertebrates, a Characteristics structure, the notochord, develop during their embryonic period and later on, the same in replaced by a series of vertebrate, firming the vertebral column. In Invertebrate animals, the notochord never develops. Therefore, these are very often also designated as non-chordates or achordates. In this unit, we shall be concerned about the general characteristics of invertebrates. We shall also be looking at the differences between Invertebrates and vertebrates. We shall also take a look at the first Phylum of Invertebrate, the phylum protozoa.

2.0 OBJECTIVES

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

outline the general characteristics of invertebrates
differentiate between invertebrates and vertebrates
outline the features of protozoas
highlight the morphological structure of a protozoa
explain different ecological adaptation of a protozoa based on its external morphology.

3.0 MAIN CONTENT

3.1 General Characteristics of Invertebrates

The Invertebrates animals abound in number very greatly, about 95 percent of the identified and described species of living species of animals are invertebrates.

They vary in size, some are microscopic e.g. Protozoans, while others are enormously large, e.g. some giant cephalopods.

Their shape is variable and they show different kinds of symmetry but considerable number is Asymmetrical as well.

Except protozoa other invertebrate phyla shows multicellularity.

They show different grades of body-organization; Protozoans and poriferans exhibit cellular grade of organism but coelenterates exhibit beginning of the tissue grade organization which has become more pronounced in higher invertebrates.

They integument of invertebrates is simple.

The gut may be entirely absent, or partially formed or fully formed. However, if present, it is always dorsal in position. Likewise, if heart is present, it is always dorsal in position. The nerve cord is ventral in position and solid in organization.

Circulatory system, if present in invertebrates, may be open type, or closed type or combination of both.

They show diversified excretory mechanisms, some takes place by general body surface, or by specialized cells as flame cells or

structure like nephridiaa, Malphighian tubules, green glands, kidneys. Etc.

They undergo different methods of reproduction such as fission, conjugation, parthenogenesis and gametic fusion.

All invertebrate animals are cold-blooded.

3.2 Difference between Invertebrates and Vertebrates

The Invertebrate animals differ from the vertebrate animals in many respects. These differences are summarily enumerated in table ……

S/N	Higher Invertebrate	Vertebrate
1.	Appendages if present are more than pairs.	There are never more than two pairs of appendages.
2.	May have non-living exoskeleton	There is always an endoskeleton, made of living tissues like cartilage and bones.
3.	The Central nervous system controls solid ganglia connected by nerve bones to form a chain.	The Central nervous system is in the form of a hallow thick-walled tube
4.	The nerve cord lies ventrally to the digestive tract.	The neutral tube lies dorsally to the digestive tract.
5.	The respiratory organs usually develop from the ectoderm.	The respiratory organs develop in relation to the wall of the pharynx and consist of gills or lungs, but gill clefts are present in the embryo of all vertebrates.
6.	The circulatory system is usually not closed.	The Circulatory system is a closed system with arteries, veins and capillaries.
7.	The heart is always dorsal in position.	The heart is always ventral and anterior.
8.	Respiratory pigment haemoglobin, if present, is dissolved in plasma.	Haemoglobin is contained in the red blood corpuscles.
9.	Blood flowing through the	Blood circulates through a closed

	arteries may pass freely into the body cavity.	system of vessels-arteries, capillaries and veins.
10.	True tail is not found. Anus is terminal and opens at the posterior end of the body.	A true tail which may be defined as the post anal continuation of the body axis may be present.
11.	Skin consists of only one layer.	Skin consists of two distinct layers, an outer epidermis overlying a thick dermis.
12.	Eyes develop from the skin and not from the brain. Compound eyes are often present.	Eyes develop as outgrowths of the brain compound eyes are never found.
13.	Alimentary canal present or absent	Alimentary canal always present.
14.	No gill slits.	Gill Slits present at least in the embryos.
15.	Reproduction sexual or asexual.	Reproduction is only sexual.

Phylum Protozoa

The term Protozoa refers to Unicellular or acellular animals of the *microscopic* size. They from the simplest of all the groups in the animals' kingdom. The name protozoa means "first animals" and has been derived from two Greek words, PROTOS, meaning first and zoon, meaning animal. They are looked upon as the most *primitive form of life, appearing* first in the evolutionary history. Structurally a protozoan is a one-called animal comparable with one cell or a METAZOAN but functionally it is an entire organisms, physiologically balanced and performs all the essential process of an animal, hence protozoans are called acellular or non-cellular organisms.

In this unit, we shall be looking at the distinguishing features of protozoans, the external features and how they are adapted to their environment.

3.3 Distinguishing Features of the Phylum Protozoa

i. The mode of life could be free-living or parasitic.
ii. The presence of moisture in their environment is an essential condition for their mode of life.
iii. Locomotry organs are finger – like **Pseudopodia** or whip-like **Flagella** or hair-like **Cilia** or absent.

Meganucleus) eg. Paramecium.

iv. Nutrition may be holozoic (animal-like), holophytic (Plant-like), **Sapro-phylic** or parasitic.
v. Respiration occurs through general surface of the body.
vi. Excretion occurs through general surface or through contractile vacumes which also serve for Osmo-regution.
vii. Reproduction takes place asexually by binary or multiple fission and budding, and sexually by conjugation of the adults or female gametes.
viii. Encystement commonly occurs to help in dispersal as well as to pass unfavourable condition.

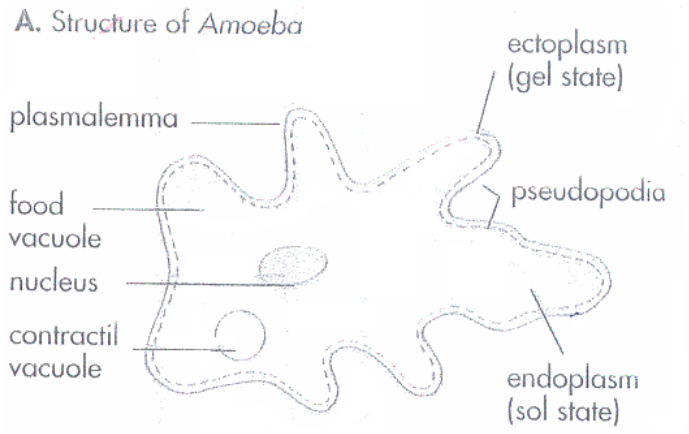
3.4 Classification of Protozoan

The classification of the Phylum Protozoa is based on locomotory Structure. The Phylum Protozoa is divided into sub-phylia;

i. Plasmodrome; Members have Pseudopodia (false feet) or flagella or no locomotory structure eg. Amoeba, Euglenas.

ii. Ciliophora: Members have cilia and more than one nucleus of which one is large (Meganucleus) eg. Paramecium.)

Amoeba	Phylum	-	Protozoa
	Subphylum	-	Plasmodroma
	Class	-	Rhizopods
	Order	-	Lobosa
	Genus	-	Amoeba



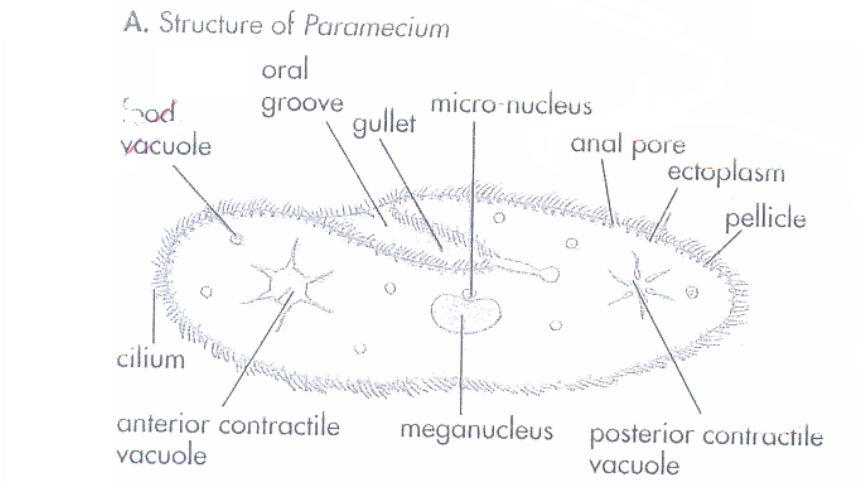


Diagram of Amoeba and Paramecium (External Features)

3.5 Morphological

Structure of Amoeba

Amoeba, a member of class Sarcodine is the common example of the simplest animal life and is usually universally studied as an:

Introduction to the Phylum Protozoa. The most common species is Amoeba proteus.

It measures about 0.25 to 0.60mm in size and is difficult to see without the aid of a microscope.

Under the microscope, it appears as a minute slate – coloured shining, irregular mass of a gelatin-like substance with study moving fine particles.

It has an irregular shape due to the fact that protrusions of its own substance and formed at its surface in different directions – the Pseudopodia and they are constantly changing in shape in the achieve animal by the protoplasm.

It consists of a very- thing elastic external plasma membrane or plasmallema

3.6 Habitat

The common Amoeba Proteus may be collected from a variety of places where condition of water, temperature and organic food are favourable such as debris from watering troughs, bottom of ponds, pools, drains, ditches, abandoned tanning pits and wherever there is abundant aquatic vegetation.

Locomotion

Pseudopodia are associated with ingestion of food and Locomotion- During Locomotion, it form one or more blunt finger-shaped processes or pseudopodia which continue to grow more and more by the flow of the protoplasm which is obviously withdrawn from somewhere else and, therefore, if the formation of the Pseudopodium is mainly in one-direction, the amoeba must change in position and it is in this way that locomotion is effected.

Irritability

This has a particular reference to the pseudopodia. If a pseudopodium, an extension, should come in contact with a foreign body, such as a grain of sand, it is retracted and a new one is pushed out in a changed direction. This implies that the generated Protoplasm of amoeba has the power to perceived nervous messages or stimuli over the whole of its surface, since at whatever point the pseudopodium is extended it will react to this reaction.

Food and Feeding

The aquatic environment of amoeba has tiny particles of various organic substances, suitable for food. This includes unicelluar plants, particular bacteria and diatoms, tiny filaments of algae, various protozoan species together with organic debris of many kinds. It is holozoic in nutrition,

that is, it ingests solid organic particle. This is with the aid of the pseudopodia.

Egestion

There is no specialized organelle in amoeba for throwing out the indigestible material. It leaves the animal through a temporary opening in the ectoplasm at the rear of the animal. The plasmallema ruptures at this point of contact with the vacuole and the feaces are egested or the animal flows away. New plasmalemma is formed at the ruptured area to stop the outflow of endoplasm.

Respiration

The process whereby the Carbondioxide leaving the protoplasm is exchange for oxygen entering it, is known as Respiration. In amoeba this exchange is carried on mainly through the general surface of the body. The water in which amoeba lives must contain dissolved oxygen in order that this diffusion may go on.

Osmo Regulation

Osmo regulation refers to the regulation of water content. The contractile vacuole is responsible for this function. The contractile vacuole is a clear space. It contains a fluid less dense than the surrounding protoplasm. At more or less regular intervals, it suddenly collapses, its walls having contracted, force out the fluid contents which is known to contain traces of urea and Carbon dioxide but mostly water.

Reproduction

Reproduction is asexual and is by the methods of:

i. Binary Fission
ii Sporulation
iii. Encystment

SELF ASSESSMENT EXERCISE

Classify Protozoan based on their Locomotory Structure.

4.0 CONCLUSION

The Locomotory structure of the Protozoan plays a paramount role not just in its classification, but also in its ecological adaptations.

5.0 SUMMARY

In this Unit, you have learnt that:

Protozoans forms the simplest of all the groups in the kingdom

Protozoans are called acellular or non-celluar organisms.

Protozoans mode of life could be free-living or parasitic

The Classification of the Phylum Protozoan is based on Locomotory structure.

Amoeba and Paramecium are examples of the phylum protozoa.

As a form of adaptation, the pseudopodia are associated with ingestion of food and locomotion.

The contractile vacuole is responsible for the regulation of water content in protozoans.

6.0 TUTOR-MARKED ASSIGNMENT

1. Draw an annotated diagram of a named Protozoa.
2. Outline the distinguishing features of a protozoon from other groups of animals.

7.0 REFERENCES/FURTHER READINGS

Indira Ghandi National Open University (1998). *Diversity of Animal Life*- 1(Organization).

UNIT 2 PHYLUM PORIFERA

CONTENTS

1.0 INTRODUCTION

Having studied the phylum protozoa in the last unit, in this unit, you shall be looking at the phylum porifera. The members of phylum Porifera are very interesting and are found widely distributed in both fresh and salt water. They vary considerably in size and shape; some reach a size of 80cm to 2 metres in diameter while others form a thin incrustation on rocks, sponges as porifera are also called, has a very large number of microscopic pores on the surface of their body through which water passes constantly in from this stream of water, the sponges are able to strains out the microscopic organisms, which are used as food. Because of the presence of million of "pores", this Phylum of animals has been called Porifera or Pore bearers.

2.0 OBJECTIVES

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

out line the distinguishing features of poriferas
draw the external features of a named porifera
classify the phylum porifera
outline the structure and ecological adaptation of porifera.

3.0 MAIN CONTENT

3.1 Distinguishing Features of Phylum Porifera

From the point of view of structure of multicellular animals, the poriferas also known as sponges are the simplest and the most primitive. The main distinguishing characters of the Phylum, which is also known as Parozoa are as follows:

i. They are asymmetrical

ii. Well developed tissues and organs are not present.

iii. Digestive system is absent and digestion of food is intracellular.

iv. The body wall surrounding the central cavity is only two layers the outer layer known as the dermal layer and the inner layer as the gastral layer.

v. The gastral layer contains flagellated collared cells or choanocytes. They do not have respiratory and excretory organs. Nerve cells are also absent. The pores or Ostia opening into the gastral cavity are surrounded by contractile cells.

vi. The entire outer surface of the body shows the presence of large number of Ostia through which a Constantly flowing stream of water is maintained.

3.2 Classification of Poriferas

The different kinds of spicules in the wall of Poriferas are used in Classification. Therefore Porifera is divided into the following classes:

i. CALCAREA OR CALCISPONGIAE eg. Leucosolenia, Scypha, Grantia, etc.

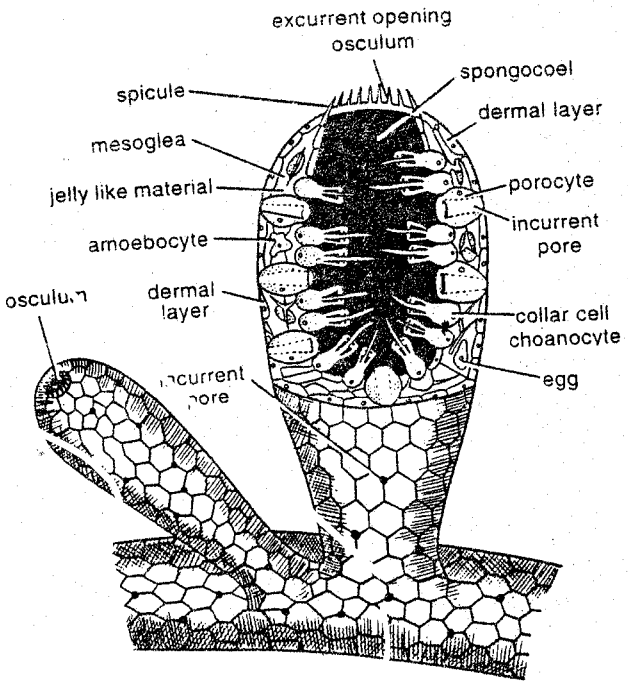
ii. HEXACTINELLIDA e.g. Euplectella, Hyalonema

iii. DEMOSPONGIA eg. Spondilla, Spongia

3.2.1 Leucosolenia (A Simple Coconial Sponge)

Phylum	-	Porifera
Class	-	Callerea
Order	-	Homocoela
Genus	-	Leucosolenia

Diagram of Leucosolenia: (External Features)



A part of *Leucosolenia*. The upper portion cut away to show the structure.

External Organizations

Leucosolenia is whitish or Yellow in colour.
Consists of a cluster of vase-shaped individuals

All individuals are connected to common horizontal branches with their base.

The individuals are free above and open to exterior by a large opening called osculum, present at their tip.

Osculum is surrounded by an oscular fringed which is composed of a circlet of monaxim catcareous spicules.

Each individual cylinder has many pores, called Ostia, in the surface and it may attain a height of about 25cm.

Ecological Adaptation

Habit and Habitat

Leucosolenia is a small, delicate branching, colonial marine springe. It is worldwide in distribution and found attached to stones and rocks of sea-shore water. For its life activities, it depends entirely on water.
Structural Adaptation of Leucosolenia

The body wall of leusolenia is very thin and unfolded consisting of two Layer (choanodern). These layers are separated by gelatinous layers of Mesoglea or Mensenchyme.

The dermal layer is a protective layer.

The constant movement of their flagella, situated in the gastral layer, set in continuous water current in one direction.

The Mesoglea contains types of cells which together form the Mesenchyme. The amoebocytes. Which are the most important cells in the mesenchyme performs the following functions:

They take food from the choanocytes and supply it to the other cells,

They carry on intracellular digestion of food and also help in the storage.
They carry on transport of waste matter.

They form scleroblasts which produce spicules or sponging fibre. These form the endoskeleton.

They also function as germ cells.

Sensitivity

Although the sponge has no nervous system but still they show response to contact, chemicals light and heat.

Reproduction

The sponges carry in reproduction by the following method:

1. Regeneration
2. Asexual reproduction
3. Sexual reproduction

Canal Systems in Sponges

The passages through which water travels from outside the body to the interior of the body and then outside again, form the canal systems in sponges. The canal system is advantageous as follows;
It brings a constant supply of water

The continuous current of water passing through a sponge furnishes an ample supply of oxygen for all the cells.

The continuous current water passing through a sponge carries away carbon dioxide and waste nitrogenous substances.

The water which leaves a sponge has been filtered off much of its food and oxygen and is loaded with poisonous waste resulting from metabolism.

SELF ASSESSMENT EXERCISE

Outline the general characteristic of the Phylum Porifera.

4.0 CONCLUSION

Phylum Porifera also known as sponges are simple aquatic invertebrates that do not move about, but are attached to rock or shells.

5.0 SUMMARY

In this Unit, you have learnt that:

Spronges are aquatic invertebrate.
They are asymmetrical.
Leucosolenia is an example of sponges.
Leucosolenia consist of a cluster of vase-shaped individuals.
Their dermal layer is a protective.
They depend on water for their life activities which includes: supply of food, oxygen and disposal of water materials.

6.0 TUTOR-MARKED ASSIGNMENT

1. Draw the external features of a named porifera.
2. What are the features that adapt the porifera to its environment?

7.0 REFERENCES/FURTHER READINGS

Indira Ghandi National Open University (1998). *Diversity of Animal Life* – 1.

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UNIT 3 PHYLUM COELENTERATA

CONTENTS

1.0INTRODUCTION

You have already seen in the last unit above, how sponges- phylum Porifera is organized. We shall now look at the phylum coelenterata. The coelenterates include more than 9000 living species, all aquatic, mostly marine but also some fresh water forms. They are a successful group of animals, though of great structural and functional simplicity among metazoans. Examples include jelly fishes, sea anemones, corals, hydroids etc

2.0OBJECTIVES

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

classify the phylum coelenterate
outline the characteristic features of coelenterates
mention the various classes of coelenterates with examples
make a labeled diagram of a named coelenterate- hydra
describe the external features of hydra
outline the adaptive features of hydra.

3.0MAIN CONTENT

3.1 Characteristic Features of Coelenterates

All are aquatic animals
They are radially or biradally symmetrical
They diploblastic, with an epidermis and a gastrodermis, and a less cellular or non-cellular, gelatinous mesoglea in between
They have no coelom, or separate excretory or respiratory system
Two individual forms of coelenterate exist: polyps and medusa

3.1.1 Forms of Coelenterate

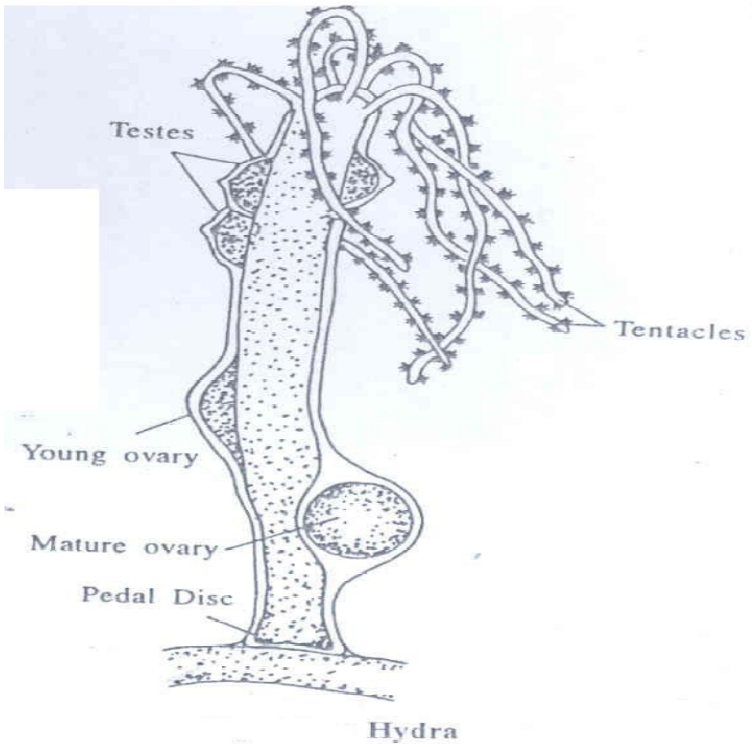
There are two forms of individuals in Coelenterates. These forms are:

Polyp
Medusa

Polyp is tubular, the oral end being free carrying a whorl of tentacles, and the aboral end attached to the sub stratum by the basal disc. The polyp is the sedentary, benthic form

The Medusa is the free swimming umbrella-like pelagic form, with mouth at the end of the manubrium on the subumbrellar side.

Fig 3.1 Diagram of Polyp and Medusa forms



3.2 Classification of Phylum Coelenterata (Cnidaria)

Depending mainly upon whether polyp or medusa is the dominant form in the life cycle, coelenterates are divided into four classes:

Hydrozoa
Scyphozoan
Cubozoa
Anthozoa

3.2.1 Class Hydrozoa

They may be solitary or colonial forms
There are asexual polyps and sexual medusae, though one type may be suppressed
Animals may be either fresh water or marine
Examples include Hydra and Obelia

3.2.2 Class Scyphozoa

They are solitary medusa
Polyp stage reduced or absent
Medusae do not have velum
All are marine
Aurelia is a typical example of this class

3.2.3 Class Cubozoa

They are solitary medusoid forms
They have reduced polyp stage
Medusa is square in cross section
All are marine animals
Example include Carybdea

3.2.4 Class Anthozoa

All are polyps
They are solitary or colonial
Gonads are gastrodermal
All are marine
Example include sea anemone

3.3 External Features of Hydra

Body resembles a narrow elastic tube, closed at one end and open at the other

The closed end of hydra is known as the foot or the basal disc refered to as the aboral end

Has a conical process, the Hypostome or the Oral Cone in the centre of which is situated an irregular or star shaped mouth

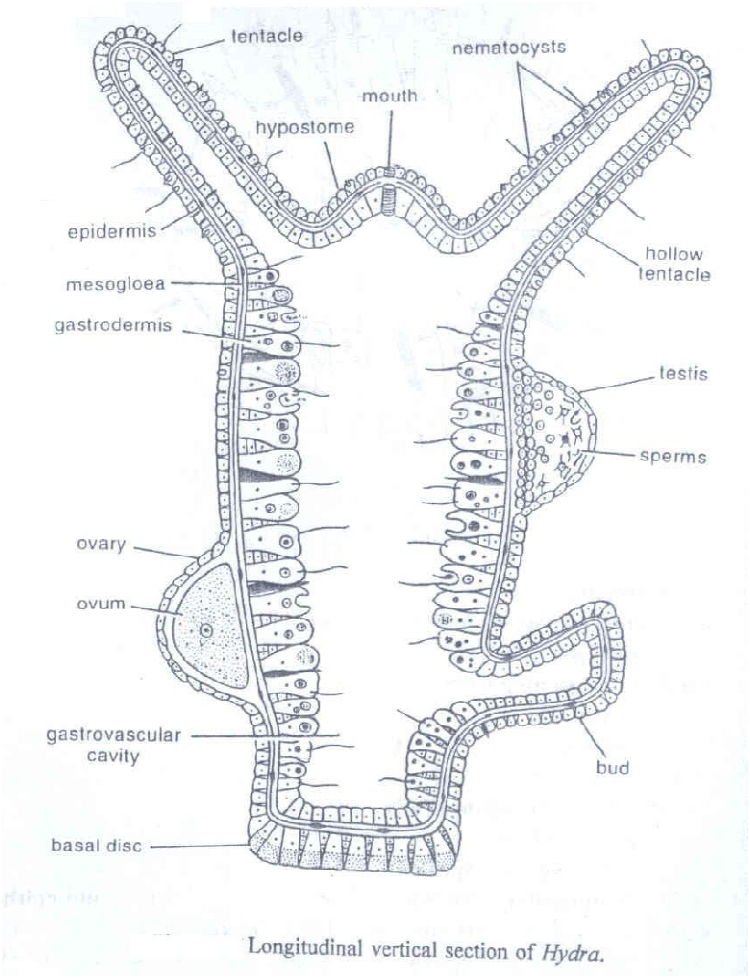
Has slender contractile and hollow tentacles between 6-10 in numbers

Body may attain a length of 20mm or more whe fully extended

Usually have small hydras known as buds attached to them when food supply is in abundance

They have rounded projections on their body which are sexual organs- testes and ovaries

Fig 3.1 Hydra



Longitudinal vertical section of *Hydra*.

3.4 Adaptive Features of Hydra

Foots secretes a sticky substance for Anchorage and Lcoomotion
Interstitial cells which is chief agent in regeneration, repairs, budding and reconstructing tissues in growth
Nematoblast helps in defence
Hydra usually remains attached by its basal disc or foot to objects under water
The movement of hydra are for: the capture of the prey; response to stimuli; locomotion
Swimming is facilitated by the wave-like movement of the tentacles
Hydra is a Carnivorous animal
Egestion is through the mouth
Gaseous exchange is made by almost direct diffusion through the cell membrane to the surrounding water

SELF ASSESSMENT EXERCISE

Outline the characteristic features of the phylum Cnidaria

4.0 CONCLUSION

The Coelenterate or Cnidaria is a successful group of animals, though of great structural and functional simplicity among metazoans.

5.0 SUMMARY

At the end of this unit, you have learnt that:

Coelenterates are all aquatic in nature
They are radially symmetrical
Coelenterates also known as Cnidaria is classified into four: hydrozoa, Scyphozoa, Cubozoa , and Anthozoa
Hydra, a typical example of the Coelenterates belong to the class Hydrozoa

6.0 TUTOR-MARKED ASSIGNMENT

With the aid of a labeled diagram, describe the external features of Hydra.

7.0 REFERENCES/FURTHER READINGS

Indira Ghandi National Open University (1998). *Diversity of Animal Life* – 1.

Sarojini, T. R. (1993). *Modern Biology for Senior Secondary School*. Africana – FEP Publishers.

UNIT 4 PHYLUM PLATYHELMINIHES

CONTENTS

1.0 INTRODUCTION

we have just studied diploblastic animals i.e. (coelentrates) animal where body is made up of only germ layers – the ectoderm and endoderm in the last 3 units. Now we shall proceed to study triploblastic animals which apart from the ectoderm and endoderm, has third germ layer known as the mesoderm. The first phylum among the triploblastic animals is the phylum playthelminthes. These animals range in size from less than a millimeter to a few metres in tapeworms. They include free-living and parasitic species. May live on land but some are fresh-water or marine, crawling in weeds and sediments.

2.0 OBJECTIVES

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

outline the characteristic features of platyhelminthes
classify the phylum platyhelminthes
draw and outline the external feature of a named platyhelminthes
outline the habitat of lives fluke
outline the adaptive feature of platyhelminthes.

3.0 MAIN CONTENT

3.1 General Characteristic Features of the Phylum Platyhelminthes

They are bilaterally symmetrical
Their body are dorsiventrally flattened; known as flatworms
Triploblastic animals – made up of three body layers
They lack body cavity hence called Acoelomate
They have complete reproductive organs
Digestive system is absent in some; and when present has only the mouth but no anus
Nervous system are ladder-like, with simple sense organs
They have no respiratory, circulatory or skeletal system
They have a proto-nephridial type of excretory system.

3.2 Classification of Platyheminthes

The phylum platyhelminthes is classified into three main classes. These are.

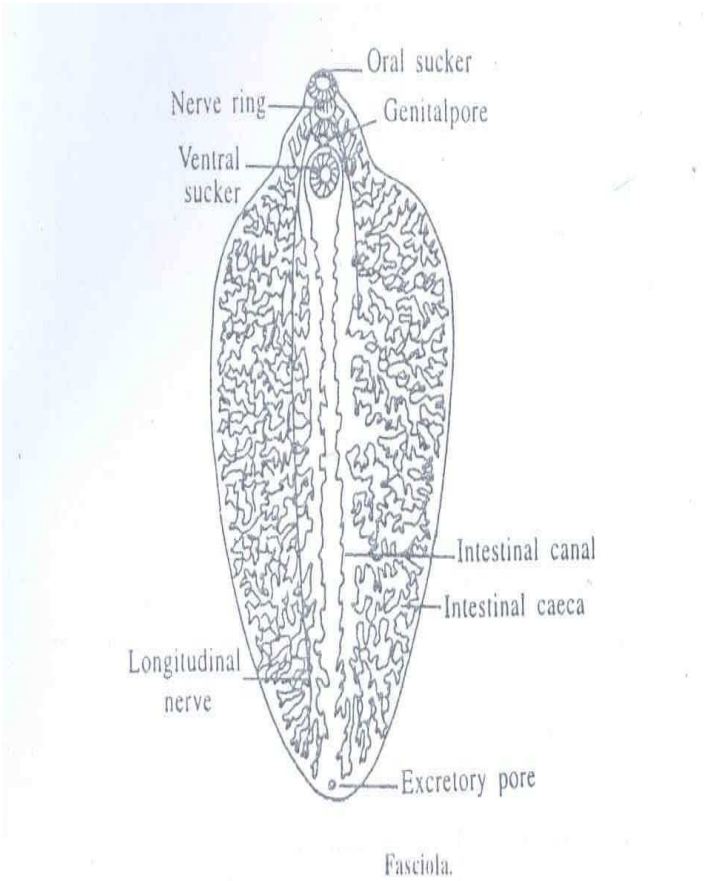
i. **Turbellaria:** mostly free-living and aquatic, with soft bodies and leaf like in form. They have body covered with cilias, some are terrestrial and confined to humid areas and with only one opening to the gut. Examples include planaria, etc.

ii. **Trematoda:** They are parasitic; lacking cilia; cuticle covering leaf like body with one or more suckers. Examples include faciola hepatica (also known as liver fluke) schistosoma, also known as blood fluke, etc.

iii. **Cestoda:** They are endoparasites (internal parasites), having no gut (digestive) system. There are parasites in the digestive tracts of various vertebrates. They are Ribbon – like in form made up of many segments (proglottids) with an anterior scolex carrying suckers and hooks to hest tissues. When mature, each prolothic has a complete set of reproductive organs of both sexes. Examples are the Tapeworms like Taenia solium, Taenia saginata etc.

3.3 Fasciola Hepatica (Sheep Liver–Fluke)

Fasciola hepatica is an example of trematode parasite. It requires two hurts to complete its life-cycle – a vertebrate as the primary hurt, and an invertebrate animal as the secondary hurt.



Hepatice

3.3.1 External Morphology

Body is soft and Pinkish – brown in colour
Elongated and dorso – ventrally flattened (leaf-like)
Appear to be oral in shape, measuring 1.8 – 3 cm in length and 0.4 – 1.5 cm in width.
Broad and rounded at the anterior end of the body; and bluntly pointed at the posterior end.
The anterior sucker acts as a auctorial organ for adhesion and ingestion.
Has a muscular bowel – like ventral or posterior sucker which is for adhesion only
Body has a minute gonopore or genital aperture mid-ventrally which is little in fruit of the posterior sucker.
Anus is absent.

3.3.2 Habitat

The adult Fasciola hepatica lives in the liver and bile pardges of the primary host which is the sheep but it may occur in some other venlebrales such as goat, dog ox deer, rabbit, elephant, man etc. A

primary hurt may harbour up to 200 adults of liver fluke in its liver which unbequently may stop to function (vidyartlic etal, 2005) causing liver not disease. The immature life-stages of the fluke occur in a mollusc, Limnea truncatula, which is a secondary or intermediate hurt, or in a specific species of planorbis. The liver-fluke is world-wide in distribution in sheep and cattle raising areas the infection of this fluke is also formed in man.

3.4 Structural Adaptation

The body-wall of the liver fluke is composed of only cuticle (and musculature) which covers the body as a thick and tough layer, proving protection to the fluke against chemicals of the hurt.

Digestive System: it sucks bite, blood, lymph etc. as food in its alimentary canal due to suctorial pharynx. The interlinary caecal distribute them to different parts of the body.

Excretory System: It has prolonephridial type of excretory system, which is composed of large number of excretory cells called flame cell. The excretory substances collected in the human of the flame cell are pushed into excretory capillaries and tubules due to vibration of cilia of the flame cells.

Respiratory System: It respires by general body surface.

Reproduction System: It is a hermaphrodite. The male and female reproductive organs are present in the same individual.

3.4.1 Parasitic Adaptation

Since they live well protected, with their hunger well satisfied without any need for change of position, there is no need of locomotory organ

Attaches themselves to the gut wall or bileducts by means of suckers and hooks or suckers alone.

In the intertive of the host, they can absorb the digested food through their soft skin

Sense organs are absent without any inconvenience as they live in perpetual darkness

Secretes certain antizymes which counteract or neutralizes the digestive juices of the host in order to prevent being digested

The intestinal parasites stimulate the intestinal will of the host to produce enormous amount of mucus which covers the thick cuticle of the parasite with a protective envelope.

The ostmotic pressure of the parasite's body fluids is nearly the same as that of the host, if not, the resulting exchange of water would set up serious disturbances

Their reproductive organs are enormously developed

Eggs are provided with thick shells and remain viable for a long time

They are hermaphrodite, ensuring that eggs and sperms re produced in one and the same individual

Paedogenesis or multiplication by the larval form by asexual means – this improves their chance of survival

SELF ASSESSMENT EXERCISE

Outline the general characteristic features of the phylum platyhelminthes.

4.0 CONCLUSION

The phylum platyhelminthes is made up of flatworms such as the planarians, flukes and tapeworms. They may be free-living, aquatic animals or parasitic in human beings and other animals.

5.0 SUMMARY

In this unit, you have learnt that:

The platyhelminthes are triploblastic animals, that is, they posses germ layers which consist of ectoderm, mesoderm and endoderm

Platyhelminthes are flatworms with bodies that are bilaterally symmetrical

Platyhelminthes lack body cavity

Platyhelminthes are classified into Turbellaris, Trematoda and cestoda

Fascule hepatica also known s liver-fluke, a tremtoda belongs to the phylum Platyhelminthes

The adult fascule hepatic lives in the liver and bile passages of the primary host – sheep

6.0 TUTOR-MARKED ASSIGNMENT

1. State the parasitic adaptive features of a named Platyhelminthes
2. Why are the Platyhelminthes said to be Triploblastic animals

7.0 REFERENCES/FURTHER READINGS

Indira Ghendi National Open University (2002). *Plan Diversity of Animal Life* – II (Classification) 2.

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UNIT 5 PHYLUM ASCHELMINTHES

CONTENTS

10 INTRODUCTION

You have learnt about the phylum platyleminthes in the last unit. In this unit, you are going to learn about the phylum Aschelminthes. Aschelminthes are popularly known as roundworm. They are a highly successful group of animal with about 12,000 species known. They are very widely distributed and occur in large numbers, both regards the species and individuals, in soil, fresh water, salt water and as parasites on plants and animals causing much damage to crops and farm animals.

2.0 OBJECTIVES

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

outline the characteristic features of aschelminthes
classify the phylum ascheminthes
draw and outline the external feature of ascarislumbricoides
outline the habits and habitats and the structural adaptive feature of the aschelminthes.

3.0 MAIN CONTENT

3.1 Characteristic Features of Aschelminthes

They are bilaterally symmetrical, but with a tendency to be radially symmetrical along the longitudinal axis.
Have circular cross sectional area; no segmentation or appendages

They have complex cuticle
Tissues and organs re present, and body has more than two harcell-layers
Circular muscles are absent in the body wall
Body cavity is pseudocoel, with body at high pressure
Gut (digestive system) extending from the mouth at the anterior and to anus
Muscles of the body wall are with peculiar features
They have no circulatory system, flame cells or nephridia. Have no cilia or flagella
These development is direct, with highly determinate type of cleavage
Growth in Aschelminthes involves increase in cell-size rather than cell number

3.2 Classification of Aschelminthes

The phylum Aschelminthes is divided into 5 (five) classes

These are:

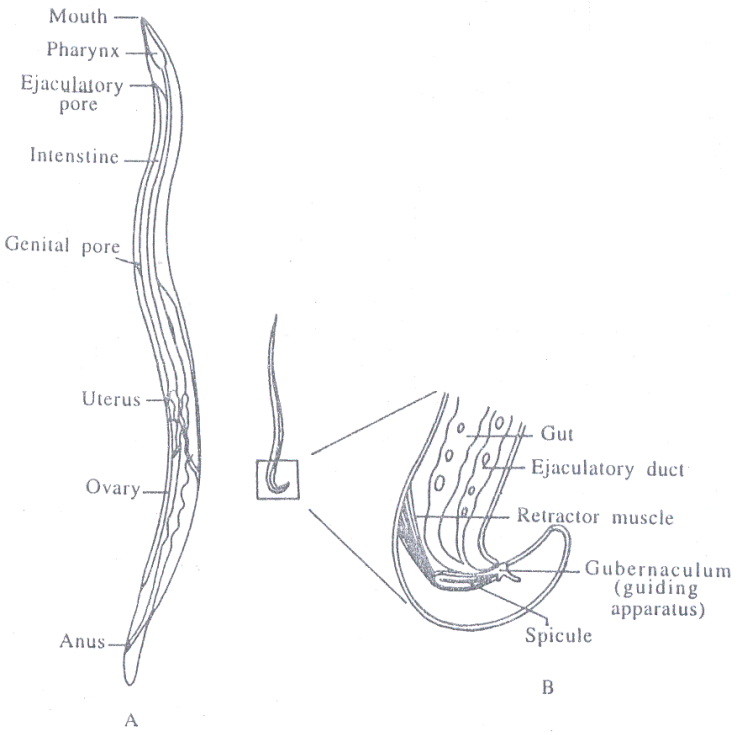
1. **Rotifera:** They are marine parasites, anterior end of body modifies into ciliary organ called corona. They may or may not share sexual dimorphision. Examples include Rotifers, Brachionus

2. **Gastrotricha:** are free living, unsegmented, found among algae and debris of stagnant fresh and salt water; mostly hermaphrodite or parthenogenetic female present. Example include chaetonotus

3. **Echinodera:** they are minute worm like marine animals, usually diecious. Example includes Echimoderes.

4. **Priapulide:** they are marine animals, their body is divided into probosus and trunk; are diecious. Example is priapulus.

5. **Nematode:** these are unsegmented roundworms with slender cylindrical body. Sexes are separate; and the males smaller than females. Examples include Oxyuris, Ascaris, Ancylostoma, Trichuris, etc.



A - Female Ascaris, B - Male Ascaris (Posterior part)

Ascaris Lumbricoides (A. Male and B. Female)

3.3 External Feature of Ascaris Lumbricoides

The body of Ascaris Lumbricoides is elongated and Cylindrical; tapering at two ends.

Its colour is usually whitish or yellowish with reddish tinge

The external body is covered with tough, elastic and semi transparent cutile.

It has a large body size; the female is 25-40cm in length and 4-6mm width, while the male is 15-30cm in length and 2-4 mm in width.

In the female, the posterior of the body is straight, while in the male the posterior end of the body is recurved ventrally.

In the male and female, the body show four longitudinal lines running from the anterior to the posterior end of the body

A tri-radiate mouth is present at the top pf the anterior end and it is bounded by three lips.

An-excretory pore is present mid-ventrally at a distance of 2mm from the anterior end of the body in the male and female.

In the female, a separate genital aperture, called goriopure or valva, is present mid-ventrally at anterior one – third length 9^{th} of the body

Anus is present mid-ventrally at a distance of 2-3mm from the porterior end of the body.
The male has a cloacal aperture, instead of anus, at the same position
The portion of the body behind the anus or the cloacal apertine is called the Tail.

3.4 Structural Adaptation

The outer muster layer of Ascan's Lumbricoides is formed by a thick transparent wrinkled shining cuticle, giving the animal a false segmented appearance. The cuticle protects it from the digestive juices of the host. The presence of cuticle can be said to be a parasitic adaptation.
It feeds on the contents of the alimentary canal of its host, much of which is partially or wholly digested.
The nutritive fluid in the psendoloel (space between the intestine and the muscular layer of the wall) propelled by the movement of the body, help in the distribution of food, oxygen and nitrogenous waster matter.
For its respiration, the animal goes into inactivity or becomes dormant when oxygen is in short supply, and when oxygen is in enormous supply, it becomes revived.
A single excretory cell becomes usually large in size and assumes a form of H – shaped structure with excretory canals. These canals collect nitrogenous waste matter in the form of urea
Zygote formal after fertilization is surrounded by a resistant shell of chitin. The uteri of single worm may contain as many as 27 million eggs at one time and each female lays about 15000 to 200,000 egg per day.
The nervous system is well developed and complicated, consisting of ganglia, ring and nerves.

3.4.1 Habitat and Habit

Roundworm Ascans Lumbricoides, is a parasite in the intestine of man
World wide is distribution, parasitizing more than 50 percent human population in tropical countries usually more in children than adults.
Usually lies in the intestinal cavity of man, surrounded by already digested food from which it obtains nutrients. It under goes holozoic mode of nutrition.
Causes lethargy, weakness, dizziness, vomiting, headache, anemia and winding pain in the intestine

Completes its life cycle in only one host, which is the man and reproduces sexually.

SELF ASSESSMENT EXERCISE

Outline the general characteristic feature of the phylum Aschelminthes.

4.0 CONCLUSION

The phylum Aschelminthes are commonly known as Nematodes. They are roundworms with cylindrical bodies, and they line as parasites in plants and Animals, or are free living in soil or water.

5.0 SUMMARY

In this unit, you have learnt that:

Phylum Aschelminthes are also known as roundworms
Aschelminthes are mostly bilaterally symmetrical
Aschelminthes can be clarified into Rotifera, Gstrotricha, Echinodera, Priapulida and Nematoda.
Ascans Lumbricoides is a common example of the phylum with an elongated and cylindrical body
They are parasitic in the intestine of man

6.0 TUTOR-MARKED ASSIGNMENT

1. State the external characteristic features of Ascan's lumbricoides.
2. How is Ascan's Lumbricoides adapted to its environment?

7.0 REFERENCES/FURTHER READINGS

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MODULE 3

Unit 1 Phylum Annelida
Unit 2 Phylum Mollusca
Unit 3 Arthropods
Unit 4 Phylum Echinodermata

UNIT 1 PHYLUM ANNELIDA

CONTENTS

1.0 INTRODUCTION

Having studied the Phylum Aschelminthes in the last unit, in this unit, we shall be looking at the first Coelomate Phylum, that is, the Phylum Annelida (Coelomate Implies animals with a cavity lined by an epithelium of cells derived from the embryonic mesoderm). Annelids have elongated body divided externally into a number of rings which represent a division of the internal parts into a series of segments.
Examples include Earthworms, Neanthes, Leeches, etc.

2.0 OBJECTIVES

After studying this unit, you should be able to:

outline the characters of the phylum annelida
name the classes under the phylum annelida
highlight the external features of a named annelids
show diagrammatically the external morphology of a named annelid
outline the adaptation of a named annelid to its environment.

3.0 MAIN CONTENT

3.1 Characteristic Features of the Phylum Annelida

They are mostly aquatic, some are terrestrial.

They are generally burning animals, some are sedentary or free living, and some are ectoparasites.

The body is vermiform, bilaterally symmetrical, and metamerically segmented.

They have straight tube alimentary canal, and undergo extra-cellular digestion.

Has segmentally arranged Locomotory organs, repeated groups of chitinous setae or chaetae. Leaches have no setae.

Respiration is generally through body surface or through a special projection of parapods.

Has well developed closed type blood vascular system.

Possesses Nephridia which is the excretory organs.

Nervous system consists of paired cerebral ganglia or brain, a double ventral nerve cord bearing segmental ganglia.

Gonads develop from the coelomic epithelium.

Sex may be separate or united, and development may be direct or indirect.

3.2 Classification of Phylum Annelida

The Phylum Annelids is generally divided into three classes. These are:

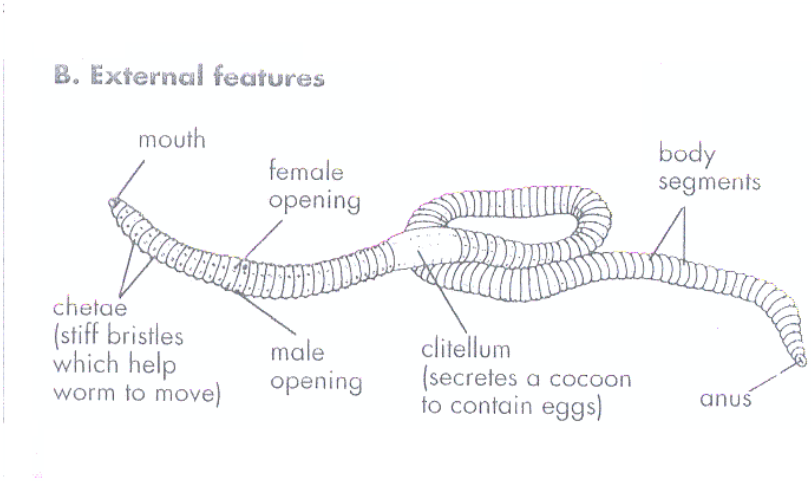
1. **Polychaeta:** Mostly marine forms, distinct head with eyes and tentacles, segmental with laterial projection of the body wall known as parapodia, do not have clitellum. Sexes are separate. Have no distinct or permanent sex organs. Many forms reproduce asexually by budding. Example of

2. **Oligochaeta:** Lives in soil, or in fresh water, body is conspicuously segmented but no distinct head; parapodia absent; they are hermaphrodites; has more complicated reproductive system with compact ovaries and testes but fewer in number clitellum is present ; no larva, and development is direct. Example is Earthworm.

3. **Hirundea** has fixed body segments numbering 34; some group may have only 31 or 17 segments; Anterior and posterior sucker present, Clitellum is present, no parapodia or setae.

They are hermaphrodites, has direct development; may be terrestrial fresh water or Marine. Examples are Leeches.

EARTHWORM



Earthworm (External Features)

- Body is elongated nearly cylindrical and tapering at both the ends.

- Mature Earthworm measures 150mm in length and 3-5 mm in width.

- It is rich brown in colour, the dorsal surface darker than the ventral.

- The metameric organization of the body is clearly indicated on the outside by the circular groves corresponding to body segments or metameres.

- The first segment where the mouth is situated is called peristonium.

- The preistomium projects forward a small sensory tube at the dorsal side which is known as Prostomium.

- In a mature worm there is the Clitellum lying about 20mm behind the anterior extremity, plays an important part in its reproduction.

- About the middle of each segment is a ring of Chitinous structures called Setae

- The first, the last and the three segments of the clitellar regions are without setae.

- A single female generative or oviduct aperture is present on the 14^{th} segment in level with the surface of the Clitellum, seen as a light coloured patch.

- The paired male generative or spermiducal apertures lie on the ventral surface of the 18^{th} segment.

- The genital or copulatory papillae are in the 17^{th} and 18^{th} segments.

STRUCTURAL ADAPTATION

- The body wall forms a protective covering for all the enclosed internal parts.

- The mucus in the epidermis underlying the body wall keeps the skin of the earthworm slimy and clean and does not carry any foreign germs to settle in it.

- The body wall serves as the only organ of respiration because of its thin pervious and highly vascularised nature.

- The skin serves as an efficient receptor organ.

- Mucus act as a cement for plastering the walls of the burrow.

- The setae aid in locomotion.

- The earthworm feeds in decaying leaves and humus present in the soil.

- The Earthworm excretes waste products with the aid of an organ known as Nephridia.

HABITS AND HABITAT

Earthworms are found is nearly all parts of the world,

Even in mountains up to a height of about 3,000 metres.

They eat their way through the ground and form burrows which they inhabit.

They form burrows by merely pushing in the body especially in soft soil their habit of swallowing soil also aids in the making of burrows especially in the compact soil.

Soil containing organic matter is digested and absorbed as food and the residual soil is ejected in a form known as CASTING

Earthworms exude a liquid which is antiseptic and protects the worm from any harmful bacterial that may be present in the soil or settle down on the body of the animal.

Burrows of the earthworm are usually 30-60cm deep and may be partly lined with dead leaves.
At the bottom of burrows, there is an enlargement where the worm can turn round and on top, the creature sometimes draws over the opening of some small pebbles for the purpose of keeping out water and enemies like centipede.

4.0 CONCLUSION

The earthworm belongs to the phylum Annelida which is a widely distributed group and has many species practically in every part of the world. The earthworm possesses a number of structural features that are of considerable importance in interpreting those of higher types of animal life and is, therefore an especially valuable form of study

5.0 SUMMARY

At the end of this unit, you have learnt that:

The phylum Annelida is the first coelomate (cavity-lined) phylum

Annelids have elongated body divided externally into a number of rings which represents a division of the internal parts into a series of segment

Annelids are mostly aquatic, some are sedentary or free living, while some are ectoparasites

Annelids are generally divided into three classes: Polychaeta, Oligochaeta, and Hirundea

Earthworm is a typical example of an annelid

6.0 TUTOR-MARKED ASSIGNMENT

Make a large labeled diagram of the external features of an earthworm

Enumerate some major difference between Annelida and Nematoda

7.0 REFERENCES/FURTHER READINGS

Indira Ghand, National Open University (2002). *Diversity of Animal life* – II (Classification) 2.

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UNIT 2 PHYLUM MOLLUSCA

CONTENTS

1.0 INTRODUCTION

You have studied the Phylum Annelida in the last unit. In this unit, we shall be looking at the Phylum Mollusca. This Phylum which includes Soft bodied animals with a shell is one of the largest Phyla among the invertebrates. Examples include snails, Clams etc. Majority of Molluscs are aquatic, occupying both fresh and marine waters, while some species live on land as well.

2.0 OBJECTIVES

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

list out the characteristic features of phylum mollusca
list the various classes of the phylum mollusca with examples
describe the external features of a named mollusca
highlight the ecological adaptation of this mollusca.

3.0 MAIN CONTENT

3.1 Characteristic Features of the Phylum Mollusca

They are bilaterally symmetrical
Generally, there is a distinct head and a muscular foot; the dorsal body wall forms the mantle folds which enclose the mantle only.
Uses gills and lungs for respiration,

A hard, calcareous shell secreted by mantle, protecting the body is common.
They have soft unsegmented bodies consisting of head, viscera mass and foot.

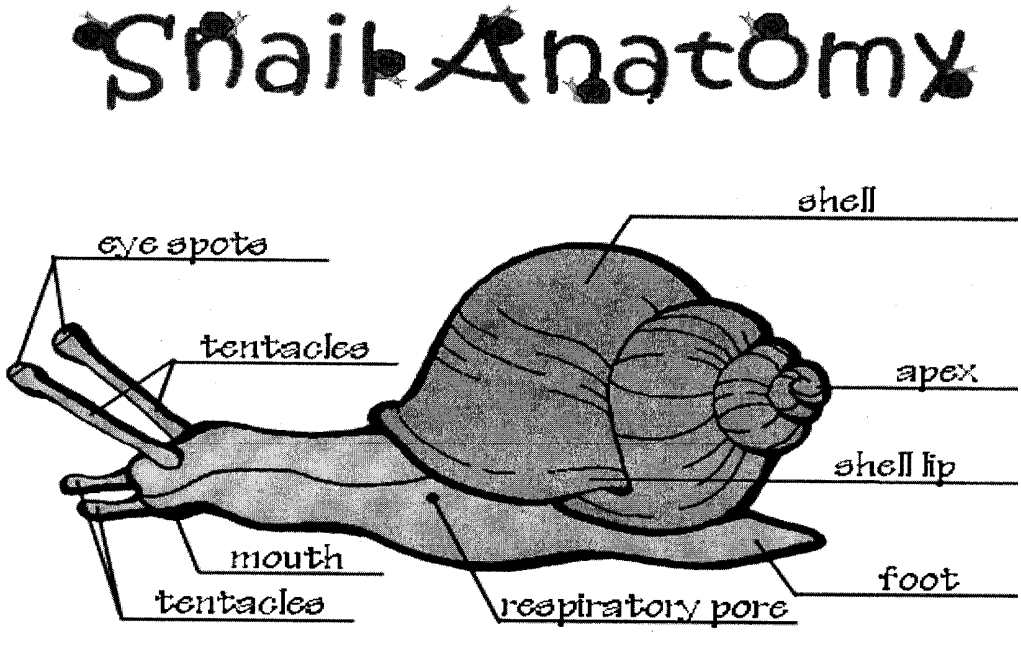
3.2 Classification of the Phylum Mollusca

There are three important classes of this phylum. These include:

Class pelecypoda or Lamelli branchiata or Bivalea. Example includes Oysters, Clams, and Mussels etc.
Class Cephalopoda. Examples include Octopus, Nautilus, Cuttefish, squids, etc.
Cypraca (cowrie) patella (unpet) etc.

Snails

Diagram of a Mollusca (Snail) Showing its external features.



Snails belong to the class gastropods which is the largest class of Mollusca.

They differ from other groups in four major ways based on their external features. These features are:

There is development of a distinct head
Body shows dorsoventral elongation.

A spiral asymmetrical shell that serves as a protective retreat for the animal

Visceral mass undergoes a 90 to 180 degree twist with respect to head and foot, a phenomenon known as torsion.

Adaptation of Gastropoda to Their Environment

Their foot is a flat creeping sole. Ciliated and the glad cells located in the foot secrete mucus over which the animal moves (Locomotion).

In burrowing forms, the foot acts like a plough and anchor

Limpets, slipper snails are adapted for clinging to rocks and shells.

In a group of pelagic gastropods (sea-butter fish), the foot is modified into effective fun-like swimming organs

The land snails among gastropod have their mantle highly vascularized and converted limbs a lung for purposes of gas exchange.

Gastropods exhibit a variety of feeding habits. There are herbivores, carnivores, scavengers, parasites.

Gastropods may be hermaphrodites or dioecious

Fertilization is mostly internal

Fertilized eggs may sometimes be enclosed in egg capsules

SELF ASSESSMENT EXERCISE

List out the general characteristic features of the phylum mollusca.

4.0 CONCLUSION

The Phylum mollusca are an important and interesting Phylum in animal Kingdom especially on their possession of exoskeleton which is in the form of a hard shell. More study should be carrying out on this Phylum.

5.0 SUMMARY

In this Unit you have studied that:

- This Phylum possesses a soft unsegmented body which is distinctly differentiated into head, visceral mass and a muscular food.

- There are three important classes of this phylum, namely; Bivalvea, Cephalopoda and Gastropoda.

- Snail is an example of the class Gastropoda and it distinctively undergoes a 90 to 180 degree twist, a phenomenon known as Torsion.

- Their foot is a flat creeping sole adapted for locomotion.
- Gastropoda exhibit a variety of feeding habits which includes herbivorous, carnivorous, Parasitic etc.

- Fertilization is internal which one of their adaptations in their environment is.

6.0 TUTOR–MARKED ASSIGNMENT

Outline the features or habits in the class Gastropoda that adapts them to their environment.

7.0 REFERENCES/FURTHER READINGS

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UNIT 3 ARTHROPODS

CONTENTS

1.0 INTRODUCTION

We have studied the phylum Mollusca in the last unit. In this Unit, we shall be looking at the Phylum Arthropoda.

The Phylum Arthropoda is the largest group of the animal Kingdom surpassing in the number of species of all the other phyla combined. It contains over 700,000 species. The animals belonging to this Phylum occur all over the globe at altitudes of over 6,500 metres on mountains to depths of over 6,000 metres in the sea. Different species are adapted for life in the air, on land, in soil and in fresh or salt waters. Some are parasites on plants and on or in the bodies of other animals. Some are gregarious (live in groups) and several kinds of colonial insects have evolved social organizations with division of members into different castes. Many members are of very great economics importance, such as large crabs, shrimps and lobsters, which are eaten by men.

2.0 OBJECTIVES

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

outline the general characteristic features of the phylum arthropoda
outline arthropoda into their various classes
show the external features of some arthropoda
outline the adaptive features of some arthropoda to their environment.

3.0 MAIN CONTENT

Characteristic features of Arthropoda

Distinguishing Features of Phylum Arthropoda

1. The body is usually segmented and bilaterally symmetrical.

2. Segments are fused to form head, thorax and abdomen.

3. Majority of the segments bear a pair of jointed appendages each.

4. A hardened, non-living exoskeleton containing chitin in secreted by the epidermis; it is periodically moulted as long as the animal continues to grow in size.

5. There is usually a highly developed muscular system, with numerous separate muscles, composed of finely striated and quickly contracting fibers.

6. The digestive tract is complete; the mouth parts are provided with lateral jaws, the mouth parts may be adapted for chewing or for piercing and sucking liquid food.

7. The cilia and flagella are absent.

8. The circulatory system is of 'open' type; the heart is dorsal, distributing blood by artery to organs and tissues, from where it returns through the body spaces (haemocoels) to the heart.

9 The coelom is greatly reduced.

10. The nervous system is of the annelidan type, consisting of paired dorsal ganglia over the mouth, a ring or collar round the gullet and a ventral chain of ganglia.

11. The sexes are usually separate and the male and female are easily distinguishable.

12. Fertilization is internal and most arthropods undergo a more or less extensive meta-

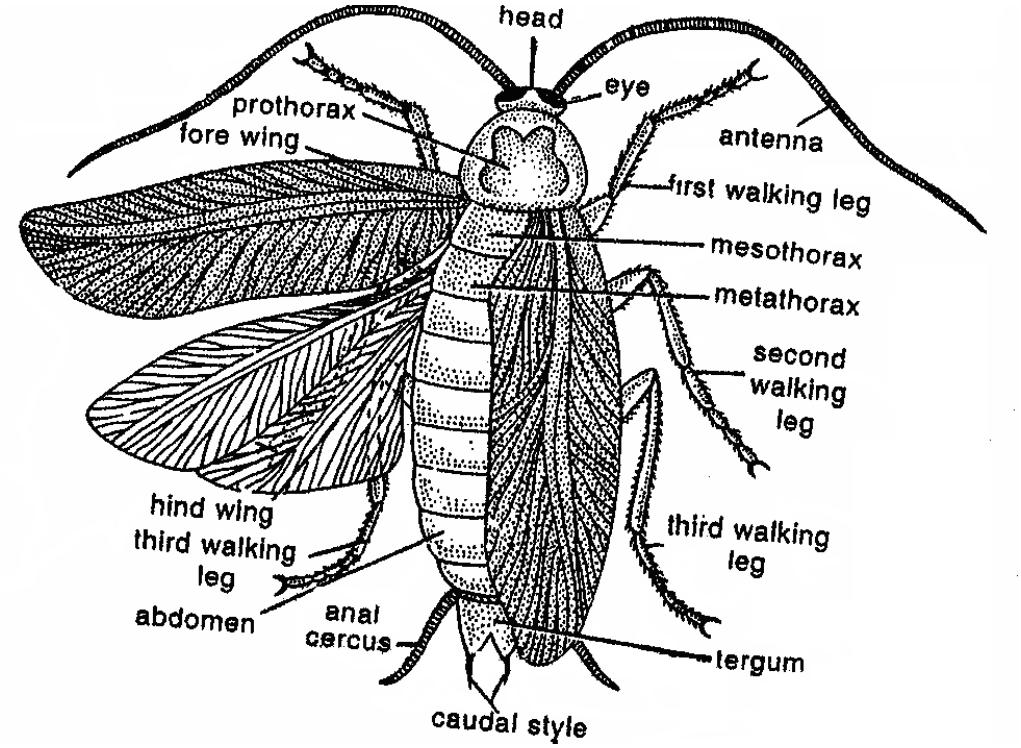
3.1 Classification of Arthropods

The Phylum arthropods are divided into the following classes.

a. Crustacean e.g. Crabs, Prawns, Lobsters etc.
b. Insecta e.g. grasshopper, cockroach, housefly etc.
c. Arachnida e.g. Spiders, Scorpions, mites, ticks etc.

d. Myriapoda e.g. Centipedes, Millipede

3.2 External features of Insects –Cockroach



3.2.1 Insecta

About 70% of all known species of animals are insects. Although they are mainly land animals, they are widespread and adapted to all types of environment. They are also the only invertebrates that can fly. Most insects feed on plant materials, while some feed on animal tissues and wastes. Insects include ants, beetles, aphids and grasshoppers;

An insect has a well-defined head, a thorax and an abdomen. An insect carries out gaseous exchange by means of a network of open airtubes or tracheae inside its body. These tubes have openings called spiracles to the exterior.

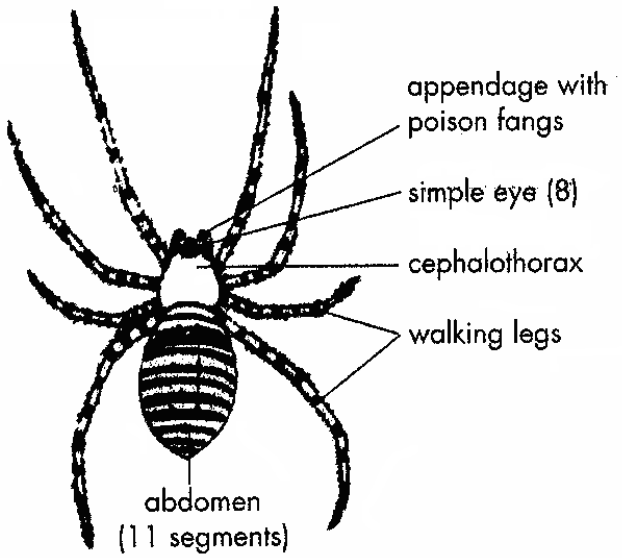
3.2.2 Habitat and Habit of a Cockroach

It is abundant in storehouses, restaurants, kitchens, bakeries, boilers and other situations where there is warmth, dampness and organic food. Cockroaches live in cracks and crevices in the walls.

The Cockroaches are nocturnal insects. During day time they remain inactive in their hiding places. But they become active during the night,

run here and there in search of food. They are omnivorous and devour any vegetable or animal substance. They may eat even non-living materials such as leather, paper, cloth etc. Besides, the cockroaches are cursorial. i.e they are fast runners and rarely fly.

3.3 External Features of Arachnid-Spider



An Arachnid has a body that is divided into two parts, a cephalothorax and an abdomen. The cephalothorax bears simple eyes, two pairs of appendages for feeding and four pairs of walking legs. An arachnid usually breathes by means of tracheae or book-lungs.

The spider is the most familiar arachnid glands to spin webs for trapping its prey. One pair of its feeding appendages has fangs connected to a poison gland. Another arachnid, the scorpion, has a sharp poison sting on its last abdominal segment.

3.4 Adaptive Features of the Arthropods

- Arthropods are one of the most successful animals. The success of the arthropods is due to some number of reasons. There reasons include:

- Posses exoskeleton which protects them from predators, and in terrestrial species, prevents water loss from the body surface.

- jointed limbs, capable of swift, complex movements;

- Specialization of segments and appendages for specific tasks such as sensory (antenna or feelers) and feeding (proboscis, mandibles, etc.)

- Specialized digestive system;

- Specialized respiratory system for different habitats, such as aquatic ones; and well-developed sensory organs, e.g. eyes (simple and compound) and antennae.

- Arthropods shed their exoskeletons at intervals to allow their bodies to increase in size. This is known as moulting or ecdysis.

SELF ASSESSMENT EXERCISE

Outline the general characteristic features of the Phylum Arthropods.

4.0 CONCLUSION

The Phylum Arthropods which means animals with jointed legs constitute 70 percentage of the known animal species. They are heterogeneous group and the largest group of animal kingdom.

5.0 SUMMARY

In this unit, you have learnt that:

The Arthropods constitute largest group in the animal kingdom.

The arthropods can be classified into Crustaean, Insects, Myriapods and Arachnids.

Cockroaches and Spiders are both arthropods belonging to the class insects and arachnids respectively.

The body of insect is divided into 3 parts the Heads, Thorax and abdomen.

Arthropod has jointed limbs.

Arthropods posses exoskeleton which prevents them against water loss for the terrestrial arthropods and predators.

6.0 TUTOR-MARKED ASSIGNMENT

1. Draw a well labeled diagram of a Cockroach showing its external features.
2. What makes the Arthropods a successful group of animal?

7.0 REFERENCES/FURTHER READINGS

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UNIT 4 PHYLUM ECHINODERMATA

CONTENTS

1.0 INTRODUCTION

In the last unit we have learnt about the Phylum Arthropoda. In this unit, we shall be looking at the Phylum Echinodermata. This group includes star fishes, sea urchins, sea-lilies and others, all of which live in the sea. Some of the Echinoderms crawl slowly in the shallow waters along the shore or lie partially concealed in the holes of the rooks while other like sea-lilies are found attached deep down at the bottom. The Phylum includes some 6000 species.

2.0 OBJECTIVES

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

state the characteristic features of the phylum echinodermata
outline the external feature of a named echinoderm
highlight the ecological adaptation of an echinoderm
list the different classes of the phylum echinoderm.

3.0 MAIN CONTENT

3.1 Characteristic Features of Phylum Echinodermata

i. All Echinoderms are marine animals, and the adults are mostly with Pentamerous radial symmetry (ie can be divided into 5 equal parts). Body is not metamerically segmented;

ii. Could be rounded, cylindrical or star shaped without head.

iii. They have no brain, only few specialized sense organs.

iv. They have a complete digestive system.

v. Locomotive is mainly by tube feet, in some by means of spines or by movement of arms.

vi. They have no olfactory organs.

vii. Sexes are separate, fertilization is external.

viii. They have indeterminate type of development.

ix. Respiration is by dermal branchiae, tube feet or respiratory trees.

x. They have an internal skeleton (endoskeleton) made up of plates of calcium carbonate, imbedded in the body wall.

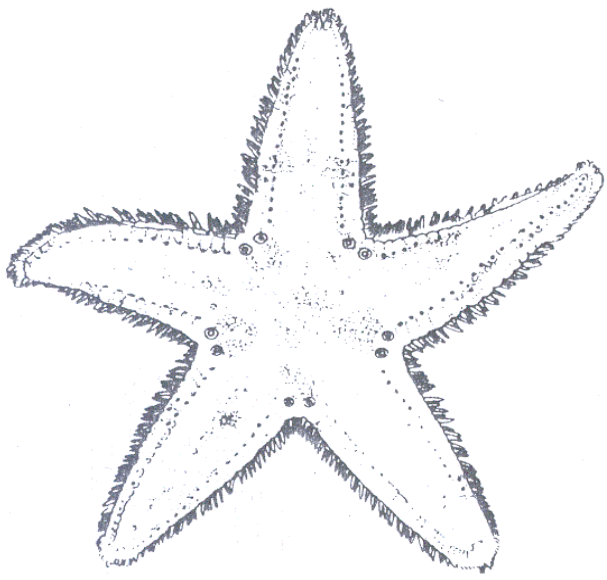
3.2 Classification of Echinoderms

The Phylum Echinodermata includes five classes. They are:

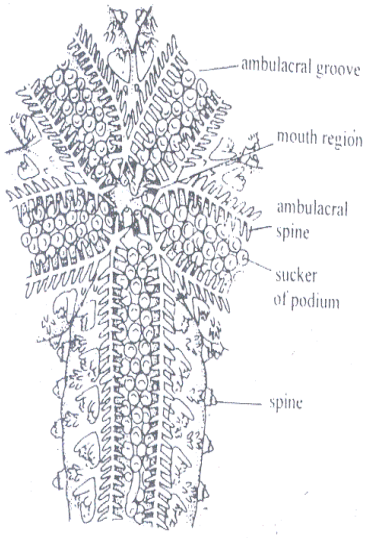
a. Class Asteroidea e.g. Star Fishes
b. Class Opliuroidea e.g. Brittle Stars
c. Class Echinoidea e.g. Sea Urchiris
d. Class Holothuroidea e.g. Sea-Cucumbers
e. Class Crinoides e.g. Sea Lilies

3.3 Starfish

3.3.1 External Features



Aboral view of seastar.



oral surface of starfish *Asterias*.

Diagram of Star Fish

- They are star shaped.
- Arms are not sharply demarcated from central disc;
- Tube feet are on oral side and with suckers
- Arms and Madreporite (a hole through which water enters the body) are on the aboral side (the upper surface of the animal)
- Pedicellaria are present (this are specialized jaw-like or pincer like appendages).

3.4 Ecological Adaptation

- Possession of specialized jaw-like or pincer like appendages on their body surface for the protection of the animals from small animals and larvae that try to settle on the sea stars.
- Possession of a well developed water vascular system which functions as a locomotor and for food gathering.
- The water vascular system also serves in respiration and excretion.
- Most are scavengers or carnivores feedings on snails, other echinoderms, fish, sponges, sea anemones etc. some feeds on plankton.

- Possession of Tube feet which also, principally serves as respiratory organs.

SELF ASSESSMENT EXERCISE

State the external features of a named-Echinoderm.

4.0 CONCLUSION

A condition which is responsible for the name of the phylum echinodermata is the possession of an endoskeleton made up of plates of calcium carbonate and these plates are equipped with spines.

5.0 SUMMARY

In this Unit, you have learnt that:

All Echinoderms are marine animals

Echinoderms are mostly Pentamerous, radially symmetrical in nature (i. e. they can be divided into 5 –equal parts).

There are basically 5 classes of echinoderms.

Echinoderms posses an endoskeleton made up of plates of Calcium Carbonate.

Echinoderms have a peculiar apparatus known as a vascular system.

Echinoderms posses tube feet which apart from its function in respiration, also help in locomotion and firm attachment.

6.0 TUTOR-MARKED ASSIGNMENT

The water vascular system is a peculiar and very important apparatus of the phylum Echinodermate. State its functions.

7.0 REFERENCES/FURTHER READINGS

Indira Ghandi National Open University (1996). *Diversity of Animal Life* – II (Classification) 2.

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MODULE 4

UNIT 1 VERTEBRATES/VERTEBRATA (FISHES)

CONTENTS

1.0 INTRODUCTION

In the last four units of the third module, we have been studying Invertebrates. In the next 4-5 units we shall be looking at the vertebrates. However, in this unit we shall be looking at the general features of vertebrate and the class of vertebrates known as Pisces (Fishes).

2.0 OBJECTIVES

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

outline the general characteristics or features of vertebrates
classify the phylum vertebrata
give the general characteristics of the fishes
draw a well labeled diagram of a bony fish
outline the adaptive features of fishes.

3.0 MAIN CONTENT

3.1 Vertebrata

The Vertebrata is a subphylum of the Phylum Chordata. The Chordates have a notochord, a flexible rod of tightly packed cells, a tubular nerve cord (dorsal) and gill slits at some stage in their life histories.

Note: a backbone or vertebral column replaces the notochord in vertebrates.

Characteristics

A bilaterally symmetrical body, divided into a head, a trunk and a tail. In Most vertebrates, a neck joins the head to the trunk.

An internal skeleton or endoskeleton of bone and cartilage, with a backbone or vertebral column made up of a series of small bones called vertebrae.

A well-developed central nervous system with a brain (within a brain case) and a spinal chord (dorsal position).

Well-developed sense organs.

A ‘closed’ blood system made up of a muscular heart (ventral position).

Two pairs of limbs (tetrapods.)

Kidneys for eliminating body wastes.

Skin may be naked or have a covering of scales, feathers or hairs.

Vertebrates are divided into five classes:

- Pisces
- Amphibia
- Reptilia
- Aves, and
- Mammalia.

3.2 Pisces (Fishes)

These are the fishes which are all aquatic. The jawless fishes like the hagfish and lamprey are the most primitive. They have sucker-like mouths and no paired fins. The cartilaginous fishes like sharks, skates and rays have jaws and paired fins, but their skeletons are made of cartilage like the jawless fishes. The bony fishes like the Tilapia and carp are the largest and most successful group features

It is a cold-blooded (poikilothermic) animal, i.e its body temperature varies with that of its surroundings.

Its body is covered with scales (absent in jawless fishes) and a layer of slime. A cartilaginous fish has sharp, tooth-like scales that do not overlap, while a bony fish has thin, flat rounded scales that overlap.
It has fins. The paired fins are adaptations of the fore-and hind limbs.

It carries out gaseous exchange by gills. A bony fish has gill covers while a cartilaginous fish does not.

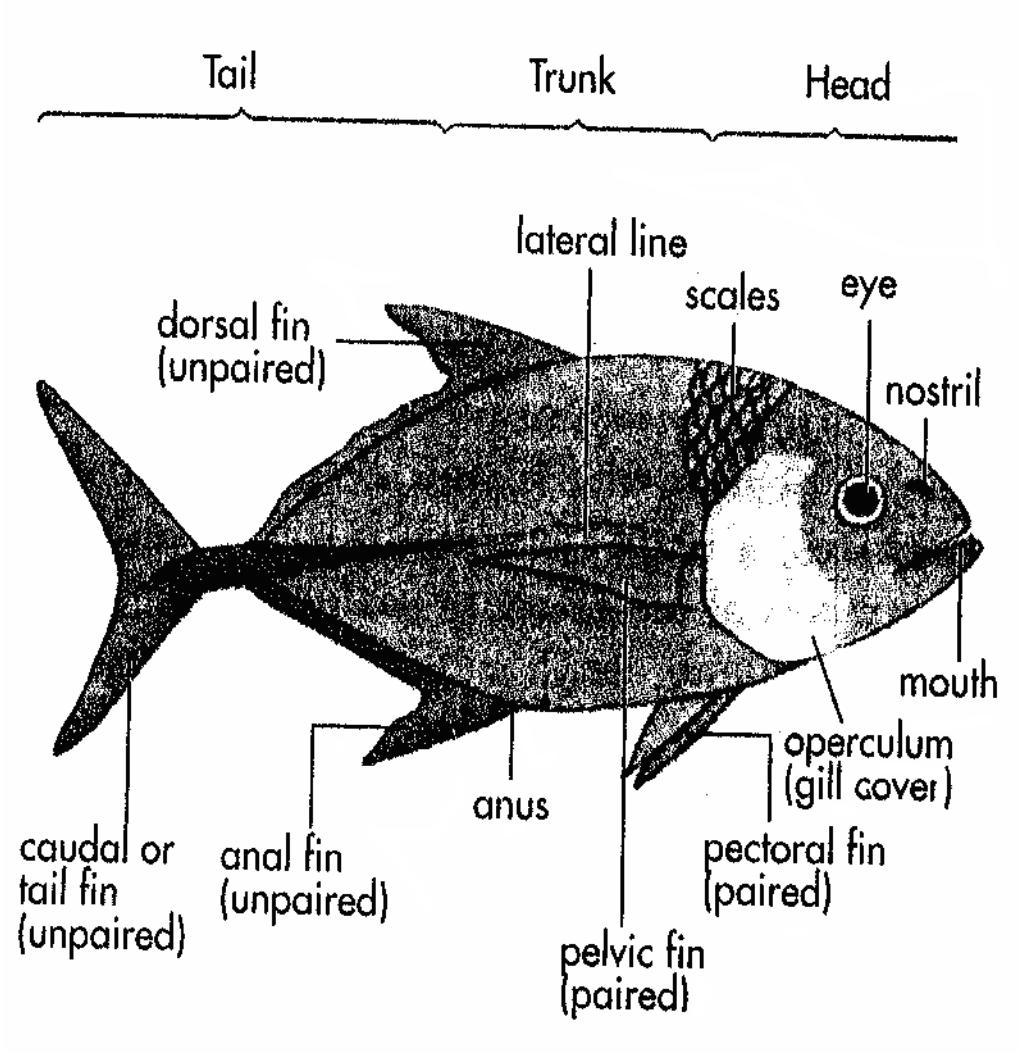
It has a well-developed sense of smell, and a lateral line system which enables it to detect movements and changes in water pressure. It only has inner ears.

A bony fish possesses a swim bladder, a gas-filled sac which allows it to regulate its density so that it can remain still at any depth in the water.

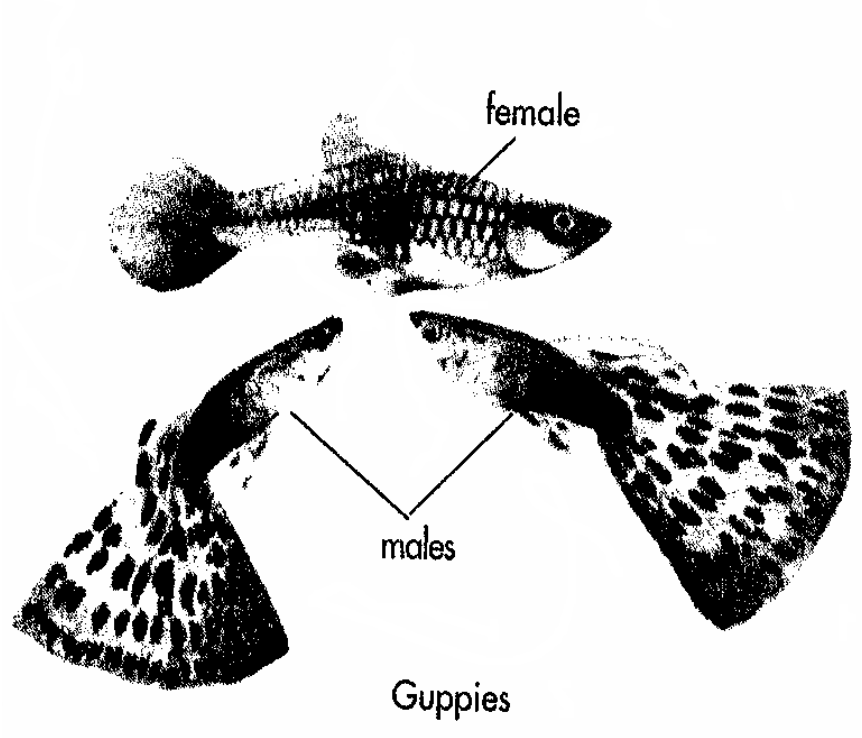
It has a two-chambered heart.

Fertilization is usually external. The eggs are tiny and may develop directly into a young fish or pass through a larval stage.

1. External Features of a bony fish



2. Males and females look different in most vertebrates



Adaptive Features of Fishes

Living organisms are found in many types of ecosystems. The environment in this ecosystem varies considerably. Generally, organisms show features that enable them to go live successfully and reproduce in a particular environment. These features may be structural, functional or behavioral. Such features are known as adaptations. Adaptations to a particular environment are evolved over a long period of time.

Nature of Medium

Water is a denser medium than air. It is difficult to move rapidly through it. As a result active aquatic animals like fish have streamlined bodies. Water, however, helps to support the body mass of large aquatic animals.

Osmoregulation and Water Loss

Most marine organisms have body fluids that are nearly the same concentration as the sea water in which they live. So the rate at which water enters and leaves the body cells is the same. However, the body fluids of freshwater organisms are at a much higher concentration than the surrounding water. So much water enters the body cells than leaves them. Successful freshwater organisms have osmoregulatory structures that get rid of the excess water that enters the body cells.

Bony fishes are the most successful aquatic organisms. The Body fluid of the marine bony fish is less concentrated than its surrounding water, while the body fluid of the freshwater bony fish is more concentrated. Fig- shows

Osmoregulatory Adaptation of freshwater and marine bony fishes.

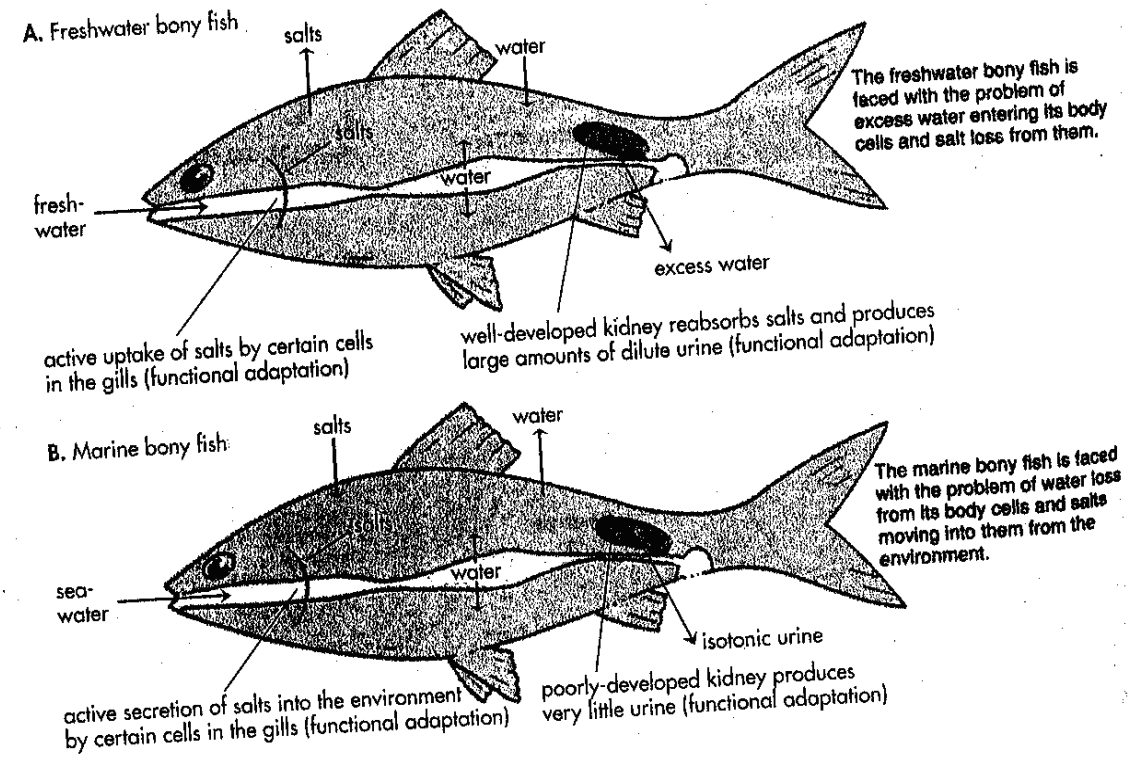


Figure shows how each has adapted successfully to its environment. The adaptations are mainly functional.

Thus, to conserve water, terrestrial organisms had to adapt both structurally and functional.

NOTE: In aquatic organisms where there is no need to conserve water, gaseous exchange occurs through the whole body surface or through special structures called gills.

Movement

Aquatic organisms that move actively use appendages like fins which are modified for swimming.

Adaptations of the Fish

The fish show the following structural adaptations to life in water.

Have a streamlined body shape without a neck that enables them to move easily through water.

The tail and tail fin of a fish are special adaptive structures for swimming.

Gills are gaseous exchange organs that are adapted for an aquatic environment. They are found in the fish.

SELF ASSESSMENT EXERCISE

Why are Vertebrates different from invertebrates?

4.0 CONCLUSION

Fishes are the first vertebrate organisms and they especially the bony fishes are the most successful aquatic organisms.

5.0 SUMMARY

In this unit, you have learnt that:

Vertebrates are bilaterally symmetrical, have well developed nervous systems and sense organs.

Vertebrates are generally grouped into five classes.

Pisces or fishes are cold-blooded organism with the possession of fins, scales, swim bladders, etc.

Fishes has a stream-line body, fins and lateral lines which aided their adaptation to the aquatic environment.

6.0 TUTOR-MARKED ASSIGNMENT

1. Draw an annotated diagram of a bony fish.
2. What characteristic of the Pisces aids their ecological adaptation?

7.0 REFERENCES/FURTHER READINGS

Sarojini, T. R. (1993). *Modern Biology for Senior Secondary Schools*. AFRICANA – Fep Publishers Limited.

Vidyarthi, R. D; Pandey, P.N (1978). *A Textbook of Zoology*. New Delhi: S Chand Company Ltd.

UNIT 2 AMPHIBIA

CONTENTS

1.0 INTRODUCTION

In the last unit, we learnt about the general characteristics and their classification. Also, the external features of a bony fish and how they adapt to their environment were also studied. In this unit, we shall be looking at the Amphibians.

The Amphibians made the first transition from the aquatic to the terrestrial mode of life; they were the first to venture out of the water and live on land. Examples of amphibians include the frogs, toads, Newts and Salamanders. Most of them live in moist environments and return to water to breed.

2.0 OBJECTIVES

External features of the frog

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

give the characteristic features of amphibians
outline the external features of a named amphibian
list the adaptive features of an amphibian
draw a well labeled diagram of a toad
differentiate between toads and frogs.

3.0 MAIN CONTENT

3.1 Characteristics Features of Amphibians

An amphibian has these features

i. It is cold-blooded.

ii. It has paired fore-and hind limbs in the adult stage.

iii. It has a naked, moist skin.

iv. It has a sticky tongue which can be protruded and retracted quickly.

v. It has inner and middle ears.

vi. It carries out gaseous exchange by gills, lungs, skin or mouth lining, separately or in combination. Gills are present at some stage in its life cycle.

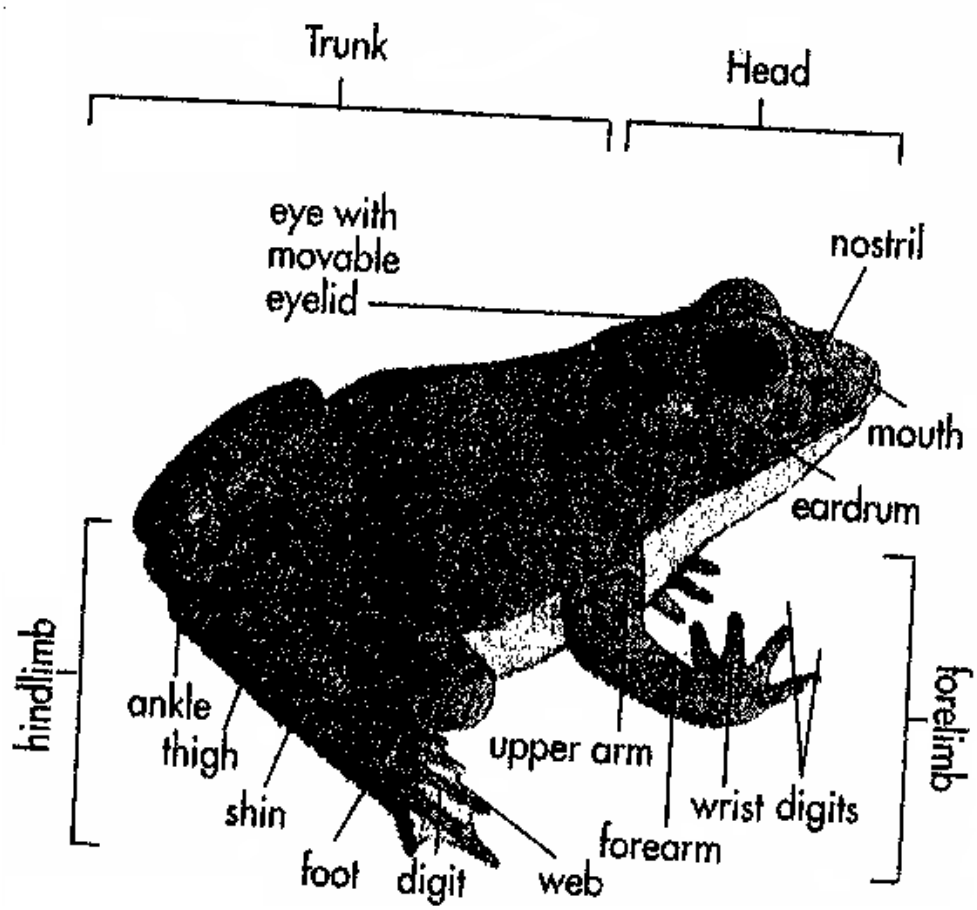
vii. It has a three-chambered heart.

viii. Fertilization is external. The eggs are small.

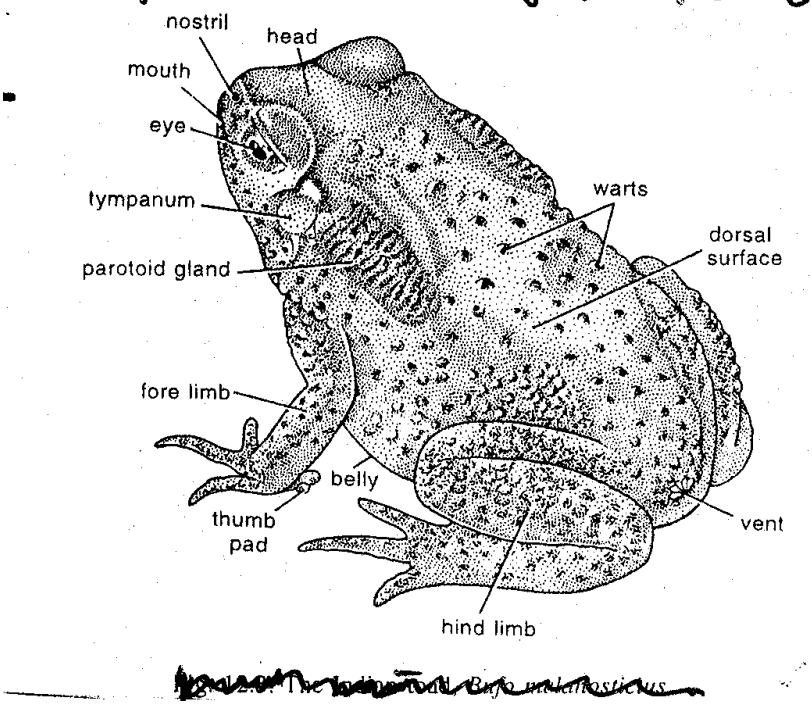
ix. An aquatic larval stage is usually present.

Extracted from Modern Biology for Senior Secondary Schools (1993) by Sarojini, T. R.

Draw the external features of a toad and frog.



External features of the Toad



External Features of a Toad and Frog

Toads are clumsily built creatures, usually 10cm long but at times growing to larger size. They have brown, wrinkled and warty skin with darker spots and markings on the upper surface and white undersurface. There are swellings like rough warts over the eyes. The legs are shorter than the frogs; the hind legs being a little longer than the body. They do not posses teeth. The tongue, which is attached in front of the mouth but is free behind, is only slightly cleft at the tip but still it is an insect-catching apparatus of great perfection. The male toad is smaller than the female.

Toads are terrestrial and nocturnal in habit. During day time they generally lie concealed under stones or in other damp and shady localities and come out only towards evening.

3.2 Difference between Frog and Toad

S/N	FROG	TOAD
1.	It is mainly aquatic	It lives on land among stones in damp places.
2.	It is diurnal in habit, that is, it comes out mainly during the day time.	It is mainly nocturnal.
3.	It does not possess good sense of locality.	As it has a good sense it can keep within a certain locality for a long time.
4.	It shows quick and nervous movement.	It shows sluggish creeping movements, which seem to be carried on with greater sense of security.
5.	The skin is smooth and slippery.	The skin is always rough, nearly dry, wrinkled and warty.
6.	Skin is provided with relatively few poison glands.	Skin is abundantly supplied with poison glands and irregularities of the skin are mainly caused by the large number of poison glands contained in them.

Extracted from A textbook of Zoology (1978) by Vivyarthi, R.D. etal.

Ecological Adaptation of Amphibians

The amphibians are as class, typically furnished with five fingered limbs which are adapted for locomotion both on land as well as in water. They are cold –blooded or poikilothermic animals of jumping and swimming habits. Their skin is smooth, clammy and naked, that is without scales. There is remarkable difference between the young and the adults; the limbless but tailed young forms or tadpoles, as they are called, live in water and breathe by gills while almost in every case the adults breathe by lungs and can live both on land as well as in water and hence the name amphibian. The skin is usually soft and moist in order to carry on the important functions of skin or cutaneous respiration and this is the reason why the presence of moisture is essential for the well being of all amphibians.

The tailless amphibians, such as frogs and toads, numbering some thousand species, have a world wide distribution. They are most abundantly found in tropical countries. Bu it is remarkable that notwithstanding their natural inclination to live in and around water no amphibian has been discovered to live in salt and marine waters.

3.2.1 Outline of Adaptive Features

Skin secretes substances that scare away enemies (other animals) e.g. Snakes from attack.

The tongue is an insect-catching apparatus which aids feeding.

Have five (5) fingered limbs for locomotion.

Has webbed feet for swimming

Has powerful hind –legs for jumping/leaping.

Soft, moist skin for skin or cutaneous respiration.

The young ones, Tadpoles lives in water and breathe by gills.

The tadpoles have a streamline body.

The tadpole has a fin-like tail that aids swimming

Adults breathe by lungs hence can live in land and water.

SELF ASSESSMENT EXERCISE

Highlight the differences and similarities between a toad and a frog.

4.0CONCLUSION

Frogs and Toads are the largest group of amphibians. The young ones (tadpoles) live in water, and breathe by gills while the adults, almost in every case, breathe by lungs and can live both in land and water and hence, the name Amphibians.

5.0 SUMMARY

In this Unit, you have learnt that:

The amphibians made the first transition from the aquatic (water)

To the terrestrial (land) mode of life.

Amphibians are cold-blooded animals.

While frogs are mainly aquatic, toads' lives mostly on land among stones in damp places are nocturnal animals.

Amphibians have five fingered limbs, with webbed feet used for swimming.

The young amphibians are known as tadpoles and they live in water, breathing by the aid of gills.

The adult amphibians have lungs for breathing.

Amphibians have stout bodies with powerful hind legs for leaping /jumping.

6.0 TUTOR-MARKED ASSIGNMENT

1. Give a diagram of a toad showing its external features.
2. The amphibian, toad is known to be both aquatic and terrestrial.
3. What features enable it to live in water?

7.0 REFERENCES/FURTHER READINGS

Sarojini, T. R. (1993). *Modern Biology for Senior Secondary Schools*. AFRICANA- Fep Publshers Limited.

Vidyarthi, R. D. Pandey, P. N. (1978). *A Textbook of Zoology*. New Delhi: S. Chand & Company Ltd.

UNIT 3 REPTILES

CONTENTS

1.0 INTRODUCTION

In the last unit, we learnt, about the amphibians, and their ability to live in water and on land. In this unit, we shall be looking at the class Reptiles. Reptiles are the first group of vertebrates to have become completely adapted to life on land. There are four main groups of reptiles namely: Lizards, snakes, crocodiles and turtles. Lizards and their close relatives, the snakes, are the dominant reptiles today.

2.0 OBJECTIVES

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

give the characteristic feature of reptiles
draw a well labeled diagram of a named reptile showing the external features
online the adaptive features of a Reptile.

3.0 MAIN CONTENT

3.1 Characteristic Features of Reptiles

The name Reptile (L. repere – to crawl), by which these animals are collectively known, indicate one of the main characteristics of the typical members of this group, their crawling method of locomotion. They are the lowest vertebrates which are truly terrestrial and as a class they are neither well adapted for walking nor for running. Their body is covered with scales which are, however, very different from those of

fishes: they are developed only from the outer layers of the skin, having connection with blood vessels and nerves.
The whole skin is characterized by being dry and devoid of glands. They are poikilothermic and most of them have imperfectly four-chambered heart.

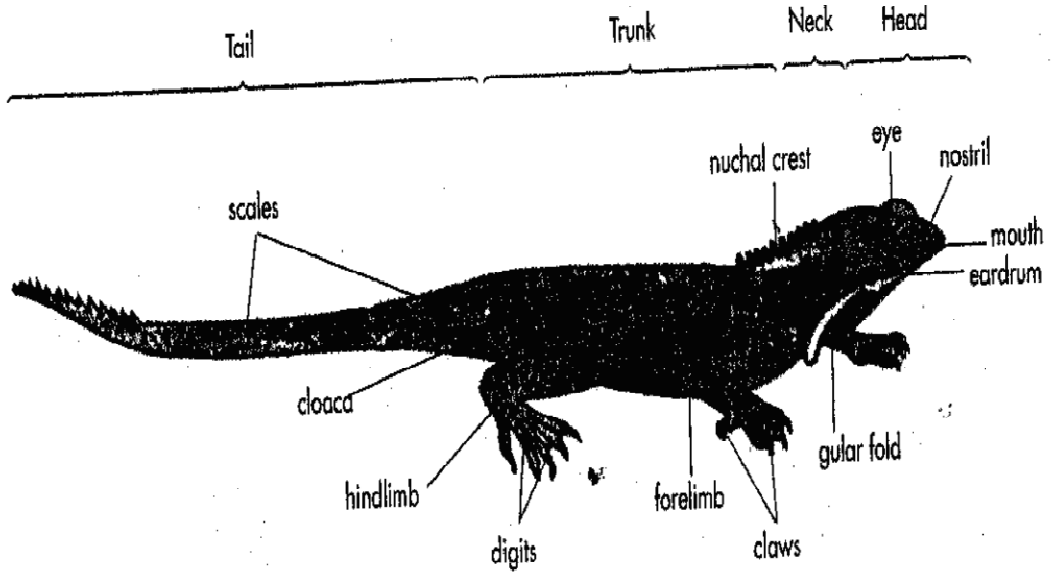
The reptiles have become independent of water due to the development of embryonic membranes. The embryo always lies in a fluid-filled sac known as **amnion**. The **allantois** arises as an outgrowth from the hinder part of the gut and serves as a receptacle for the storage of embryonic urine. Part of the allantois becomes closely applied to the shell for respiration. Gills are absent and the lungs form the respiratory organs.

Extract from a text book of Zoology (1978) by Vidyarthi, R. D. Etal

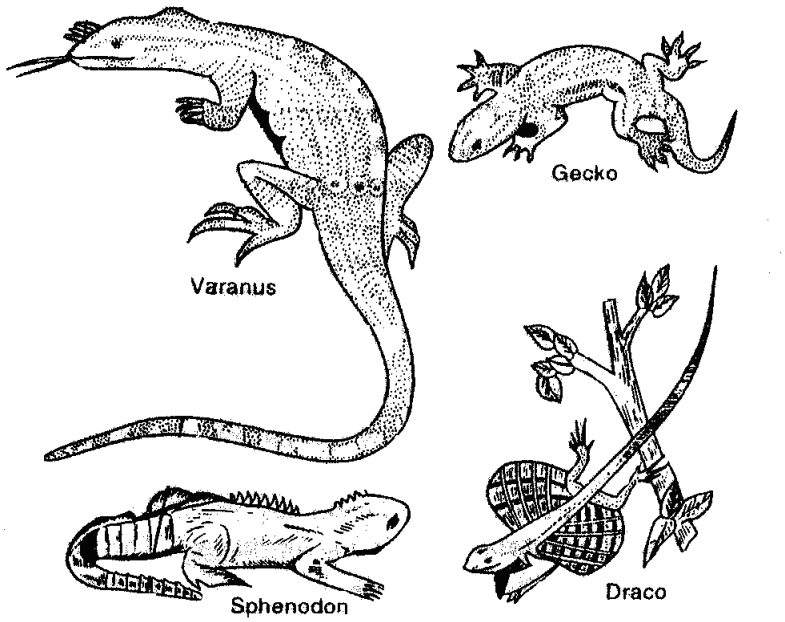
3.1.1 Lizard

Lizard is a typical example of reptilian. They are typically dry-land animals, loving the sun and its heat. They are very common reptiles most of them are four-legged animals and are capable of very active movement. They are usually rather small and slender creatures. The common garden lizard has a very long tail.

External features of the Agama Lizard



3.2 Ecological Adaptation



Different types of Lizards

The ordinary wall lizards or Geckos are equipped with vacuum –cupped toes which enable them to chase insects along vertical walls and ceilings of rooms. A very interesting protective feature, possessed by some of these lizards, is the power to break off their tail automatically. They have a peculiar kind of joint between two of their caudal vertebrae, which enables them in an emergency to break off the tail. The part of the tail thus sacrificed continues for some time to move about, thus tending to divert the attention of the pursuing enemy and thereby giving a chance to the lizard to escape. It can grow a new tail in due course of time. This power of automatically breaking off certain parts of the body is called autonomy.

Other adaptive features as follows:

i. They are cold blooded animals.

ii. Has a well developed tongue which can be protruted and retracted

iii. Quickly.

iv. Its jaws have teeth of the same kind embedded in sockets.

v. It usually has paired fore and hind limbs each with five toes ending in claws.

vi. It has inner and middle ears.

vii. It has a skin that is covered with scales.

viii. It carries out gaseous exchange through its lungs.

ix. Fertilization is internal. The females lay large fertilized eggs in land. Even aquatic reptiles return to the land to lay eggs.

SELF ASSESSMENT EXERCISE

Outline the adaptive features of reptiles.

4.0 CONCLUSION

Reptiles are the lowest vertebrates which are truly terrestrial i.e. They live on land.

5.0 SUMMARY

In this unit, you have learnt, that:

Reptiles are the first group of vertebrates to have become completely adapted to life on land.

6.0 TUTOR-MARKED ASSIGNMENT

1. Make an annotated diagram of a named reptile.
2. How do Reptiles differ from Amphibians?

7.0 REFERENCES/FURTHER READINGS

Sarojini, T. R. (1993). *Modern Biology for Senior Secondary Schools*. AFRICANA- Fep Publshers Limited.

Vidyarthi, R. D. Pandey, P. N. (1978). *A Textbook of Zoology*. New Delhi: S. Chand & Company Ltd.

UNIT 4 AVES (BIRDS)

CONTENTS

1.0 INTRODUCTION

In the last unit, we learnt about Reptilia, including their characteristic features, external features, adaptive features, among others.
In this unit, we shall be looking at the class Aves.

The aves or bird are warm-blooded vertebrates specially adapted for flight. Their body is covered with soft feathers which are epidermal outgrowths like the scales of reptiles and their hairs of mammals. Scales are also present on the lower part of the legs and on the feet. They have a **four-chambered heart.** The fore limbs are modified to form wing axes (in flying birds) or reduced in non- flying birds. The hind limbs have clawed digits which are variously modified for walking, perching, hopping, running or swimming. The head is usually small and rounded, the neck is well marked and the whole body is oval and streamlined. Tail is short and the caudal vertebrae are fused to form a pygostyle. The jaw bones are modified in relation to the back and are devoid of teeth.

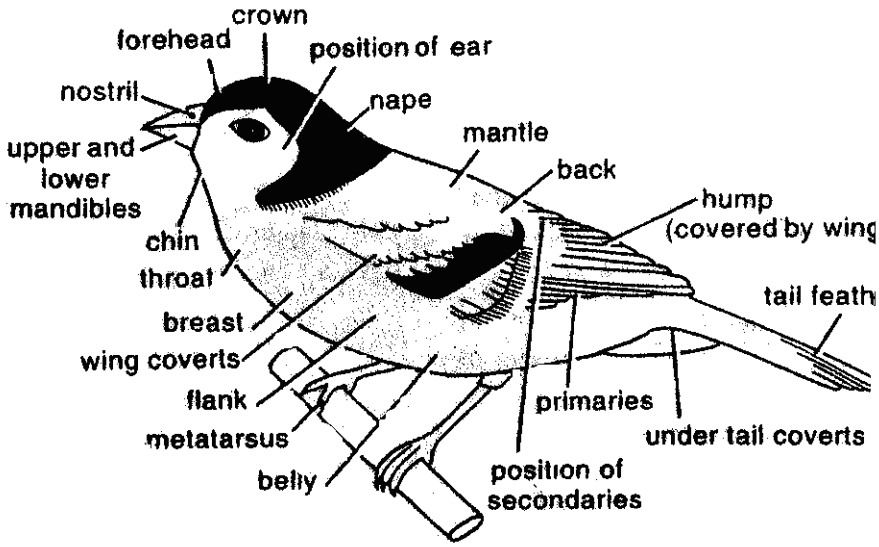
2.0 OBJECTIVES

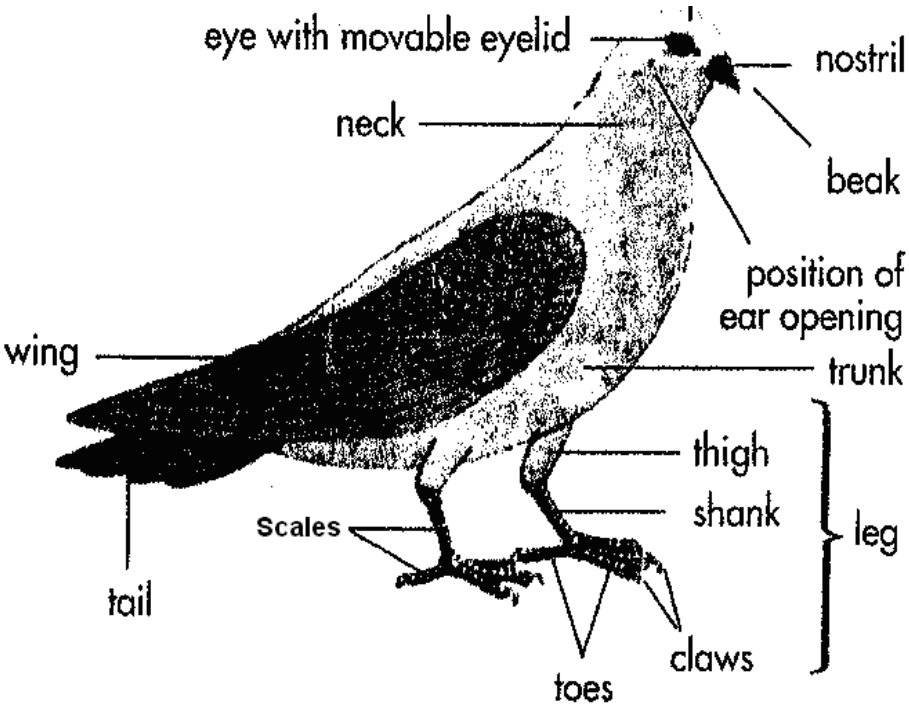
At the end of this unit, you should be able to:

give the characteristic features of birds
outline the external features of birds
draw a well labeled diagram of a bird
outline the adaptive features of birds to their environment.

3.0 MAIN CONTENT

3.1 External Features of Birds



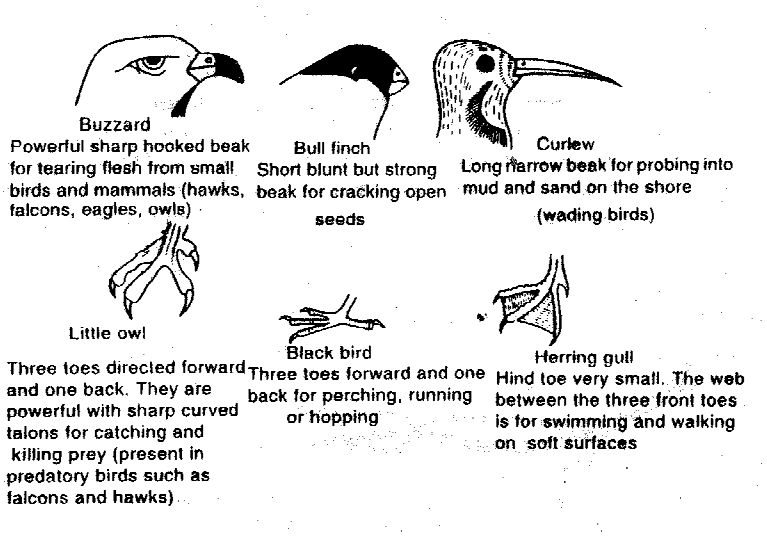


The body of the birds is **steamlined** or **spindle-shaped** well adapted for aerial life. The neck is usually long and flexible. The head is rounded and the facial portion is produced into **beak.** Close to the base of the beak are two slit-like nostrils. The eyes of the bird are of considerable size for the sense of smell seems to be feebly developed but the power-vision is correspondingly advanced, especially in some birds of prey.

Each eye is provided with three eyelids: the upper and lower eyelids are like fold of skin while the third eyelid, the nictitating membrane, is a delicate transparent membrane which can be drawn across the eye. Usually the lower lid is movable. On each side of the head there is a small aperture with a short passage leading to the ear-drum. It lies behind and below the eyes and is usually hidden by the features. Unlike mammals, the external ears are absent.

From a textbook of Zoology (1978) *Vidyarthi, R. D. Ethy*

3.2 Adaptive Features of Birds to Their Environment



The fore limbs form the wings which are organs of flight while the hind limbs are adapted for bearing the entire weight of the body when walking. For this purpose the hind limbs are usually attached some what for forward and the skeleton is also modified to this end. The legs are covered with scales. The cloaca lies on the ventral surface at the root of the tail and on the dorsal surface of the same region is an oil-gland. Its oily secretion is used for preening feathers.

The **feet, break** and the tongue present very large number of variations of form which are closely associated with the habits of the birds. The typical number of the toes is four, of which, three are directed forwards and one backwards. In perching birds the toes are adapted for grasping and automatically clutching the support. Three toes are directed forwards and one backwards. The same arrangement of the toes is also found in birds of prey which use their feet for seizing. The claws form great talons as in the eagles, hawks, kites, falcons, etc. The legs of the wading birds are usually very long and partly or completely unfeathered up to the tibial region. They have very long toes. Swimming birds like ducks have webbed feet which serve as paddles.

From a textbook of Zoology (1978) by Vidyarthi R. D. etal.

3.2.1 Outline of Adaptive Features of Flight

1. The wings act as propeller.

2. The streamlined body is well adapted for movement through the air.

3. There is considerable shifting of the weight of the body from the periphery to the centre due to the loss of teeth; moreover as the wings are placed high up on the trunk the body is prevented from turning over.

4. The skull is very light and most of the bones are welded together.

5. Feathers which clothe a bird, hold a blanket of enveloping air next to the body; since this air is warmed by the body and is consequently lighter than the surrounding air, it adds somewhat to the buoyancy of the bird.

6. The rectum where the faeces is carried is very much reduced in length. Since flying birds would be greatly handicapped by the presence of too much of faecal matter there.

SELF ASSESSMENT EXERCISE

Outline the general characteristics features of birds.

4.0 CONCLUSION

The aves or birds are warm blooded vertebrates specially adapted for flight.

5.0 SUMMARY

In this unit, you have learnt that:

The body of birds is covered with soft feathers.

The fore limbs are modified to form wings.

The body of the birds is streamlined or spindle shaped.

The hind-limbs of birds are adapted for bearing the entire weight of the body when walking.
Swimming birds like ducks have webbed feet which serve as paddles.

6.0 TUTOR-MARKED ASSIGNMENT

1. Diagrammatically show the external features of birds.
2. Outline the adaptive features of birds to their environment.

7.0 REFERENCES/FURTHER READINGS

Sarojimi, J. R. (1993). *Modern Biology for Senior Secondary Schools*. AFRICANA – Fep Publishers Limited.

Vidyarthi, R. D. Pandey, P. N. (1978). *A Text Book of Zoology*. New Delhi: S. Chand & Company Ltd. .

UNIT 5 MAMMALIA

CONTENTS

1.0 INTRODUCTION

In the last unit, we studied the class Aves; their external features and how they are specially adapted to flight. In this Unit, you shall be looking at the Mammals.

The class mammalia is made up of the most advanced animals which include Man, Rabbit etc.

Mammals, of which there are three to four thousand species, have attained the most complete structural, developmental and physiological adaptations to the terrestrial mode of life. They are characterized by their great activity, high metabolism, intelligence and by the display of their parental care – a feature in which they are only rivaled by birds. Various mammals live in all sorts of habitat from Polar Regions to tropics and from the sea to the densest forests and driest deserts. Many are of the retiring habits or nocturnal so that they are seldom seen. They are a dominant group and play leading role in the present day world. Mammals generally are of great aesthetic interest, some wild species are hunted as game and others for their fur. Some rodents and flesh eaters damage man's crop and livestock and certain species are reservoirs of disease-germs. The domestic mammals provide man with food clothing and means of transport.

As a matter of fact the mammals represent the top of the evolution of the living animals and this claim rests almost exclusively on the superiority of their nervous system.

2.0 OBJECTIVES

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

give the main distinguishing characteristics of mammals
outline the external features of a named mammal
list the adaptive features of a named mammal
draw a well labeled diagram of a rabbit showing the external features.

3.0 MAIN CONTENT

3.1 Characteristic Features of a Mammal

The main Characteristics of a mammal are as follows:

It is warm-blooded.

Its skin has sweat and sebaceous glands and a covering of hairs.

It has different types of teeth, with each type carrying out a specific function.

It has external ears called pinnae.

Its body cavity is separated into two by a muscular sheet called a diaphragm. The upper thoracic cavity contains the lungs and the heart while the lower abdominal cavity contains the alimentary canal, the Kidneys and the reproductive organs.

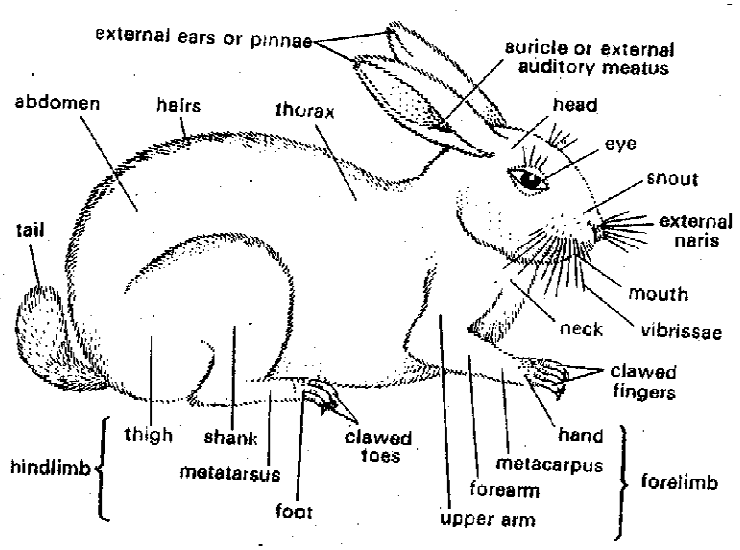
It has a well-developed heart.

It has a well-developed brain.

Fertilization is internal. In most mammals, the tiny fertilized egg develops inside the body of the female parent for a period. During this time, the young is attached to the mother by a placenta, an organ through which it obtains nourishment from the mother. The young is born alive (Vivipary) and feeds on the milk secreted by the mother's mammary glands. It is looked after by the parents until it learns to be independent.

3.2 External Feature of a Rabbit

Rabbit, a typical example of the class mammalian, is taken as a convenient type of mammals for a detailed study.



The head of the rabbit is large and spherical behind but is pomtal anteriorly to form the snout.

At sides of the snout are long stiff sensory hairs called whiskers or vibrissae.

Has a pair of large and protuberant immobile eyes.

Have two long erect external ears or pinnae situated at the spherical top of the head.

The head is followed by a very short neck which passes abruptly behind to the trunk.

The truck consists of a narrow chest or thorax.

Has short and rigid fore limbs divided into upper arm, fore arm wrist and hand

The hind limbs are much longer, divided into thigh, shank, ankle, and foot.

An anus and urinogenital aperture are present at the posterior end of the trunk.

Has a short bush tail at the posterior end of the trunk.

3.3 Adaptation to Their Ecological Environment

The wild rabbit has no end of enemies from man to rats, foxes, jackals, badgers, cat, hawks, owls, etc. In fact, it has the maximum number of enemies and yet it is able to live and thrive. Its survival against so many odds is not because of its wits, for it is not a clever creature, and it is also not because of weapons, for it is not armed and its teeth are not suitable for biting. The real reason for its being able to hold out its own is to be found in its general habits such as:

a. great fertility

b. burrowing habits

c. crepuscular nature, and

d. the care of the young ones and their early education by the mother.

The adaptation of rabbits which enable them to live and thrive, inspite of their numerous enemies, may be summed up as follows:

a. Wide field of vision.(large and protuberant immobile eye).

b. Acute sense of smell and hearing.

c. Protective colouration. (hair or fur)

d. Their alertness in recognizing enemies and their swiftness and sureness in running.

e. Possession of thirteen pairs of ribs which enable them to breath better during a run for life.

f. Their burrowing habits and crepuscular nature.

g. Their wide range of appetite.

h. Their ability to live in different climates.

i. Their extreme fertility and attachment of the mother to its young ones.

SELF ASSESSMENT EXERCISE

What are the general characteristics of the class mammalian?

4.0 CONCLUSION

As a matter of fact, the mammals represent the top of the evolution of the living animals. They are characterized by their great activity, high metabolism, intelligence and a display of their parental care.

5.0 SUMMARY

In this unit, you have learnt that:

Mammals have attained the most complete structural, developmental and physiological adaptation to the terrestrial mode of life.

Mammals are warm blood animals.

The skin of mammals has sweat and sebaceous glands and a covering of hairs.

Rabbit is a typical example of mammals.

6.0 TUTOR-MARKED ASSIGNMENT

1. Show clearly the external features of a named Mammal.
2. What characteristic(s) of the Rabbit facilitates its survival in its environment?

7.0 REFERENCES/FURTHER READINGS

Sarojini, T. R. (1993). *Modern Biology for Senior Secondary Schools*. AFRICANA – Fep Publishers Limited.

Vidyarthi, R. D. Pandey, P. N. (1978). *A Text Book of Zoology*. New Delhi: S. Chand & Company Ltd.