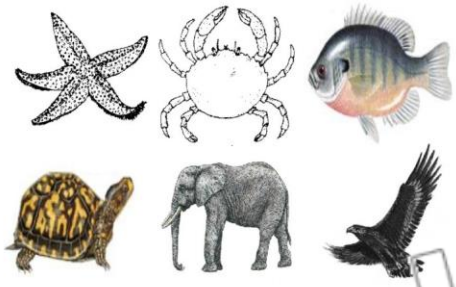


Chapter 10
Kingdom Animalia

10.1 INTRODUCTION

Kingdom animalia includes all the animals.

Meaning

The name animalia is derived from Latin word ***'anima'*** meaning 'breath or soul'.

CLASSIFICATION OF ANIMALS

According to Two-Kingdom Classification

According to this traditional system of classification, animals were classified into two group's i.e.

1. ***Metazoa***: Containing all multicellular animals.
2. ***Protozoa***: Containing all unicellular animals.

According to Five-Kingdom Classification

Now a days, five-kingdom classification of Robert Whittaker is used. According to this system;

- Traditional protozoans are placed in ***Kingdom Protoctista***.
- Multicellular animals are placed in ***Kingdom Animalia***.

Features of Animals

Kingdom Animalia consists of all animals, which are;

- Multicellular
- Diploid
- Eukaryotic
- Ingestive heterotrophs
- Developed from two dissimilar haploid gametes, a large egg and a smaller sperm.

Origin of Animals

Animals are considered to be evolved from protoctists.

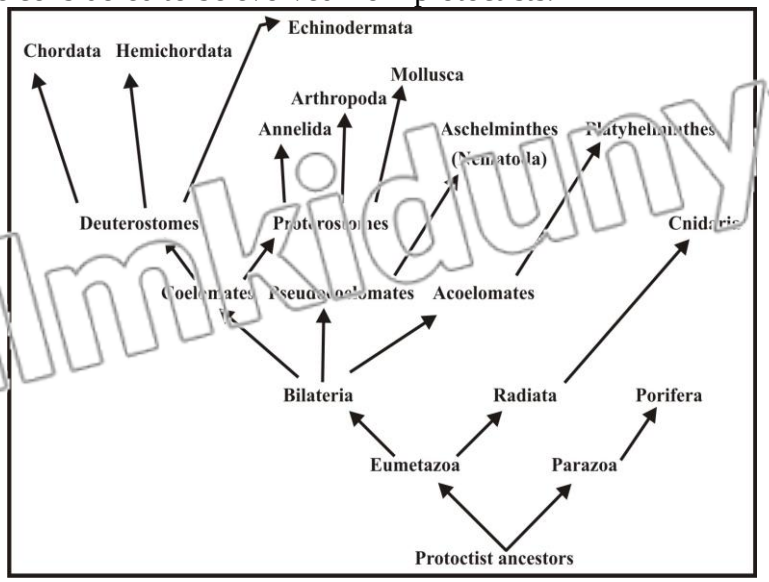


Table: 10.1 The relationship of different phyla

10.2 DEVELOPMENT OF COMPLEXITY IN ANIMALS

Although multicellularity is found in all the kingdoms, fungi, Plantae and Animalia but it has developed most impressively in animals. Their cells are joined by complex junctions, which ensure control of communications and flow of materials between cells.

Classification of Animals

The animals are a diverse group distinct in their form.

- The smallest are microscopic, which are smaller than many ***protoctists***
- Largest are whales (sea mammals), included in phylum ***chordata***.

Different groups present in Kingdom Animalia are as follows.

Parazoa

The simplest of the animals belong to subkingdom parazoa (phylum porifera).

These animals lack tissues organized into organs and have indeterminate shape and are asymmetrical.

Eumetazoa

The subkingdom Eumatazoa includes animals of other phyla. These animals have tissues organized into organs and organ systems.

Eumatazoa consists of nearly ***29 phyla*** of animal kingdom and is divided into two grades i.e. grade radiata and grade bilateria.

Grade Radiata

Grade Radiata includes simplest of the Eumatazoa (phylum cnidaria) with radial symmetry. They are much simpler in their organization compared to the animals belonging to other eumatazoa.

Grade Bilateria

Animals present in this grade have bilateral symmetry. These animals have been divided into three groups on the basis of presence, absence of type of body cavity found in them.

- The animals, which do not have a body cavity, have been grouped under ***Acoelomata***.
- The animals, which have a false coelom, the pseudocoel, have been grouped under ***Pseudocoelomata***.
- The animals, which have a true coelom, have been grouped under ***Coelomata***.

10.3 GRADE RADIATA

Introduction

In this group, animals with ***radial symmetry*** are present.

Features

- All the animals, which are present in this group, are ***diploblastic***.
- ***Body parts*** are arranged around a central axis in such a way that any plane passing through the central axis divides the animal in halves that are almost mirror image of each other.

Example

Example is animals of cnidaria (coelonterata). The cylindrical body of a sea-anemone can be cut in two equal halves vertically in any plane.

10.4 GRADE BILATERIA

Introduction

This group contains ***bilaterally symmetrical*** animals.

Features

- The animals have ***bilateral symmetry***.
- The animal can be divided into two equal parts by an imaginary line in one plane.
- The animal has right side which is approximately the same as the left side and where there is a distinct anterior end.
- In most multicellular animals, there is a clearly differentiated head present at the anterior end and a distinct posterior end.
- There are clearly defined dorsal and ventral surfaces.
- All the animals are ***triploblastic***. These may be acoelomate, pseudocoelomate and coelomate.

Example

- The animals belonging to phyla, Platyhelminthes, Nematoda, Annelida, Mollusca, Arthropoda, Echinodermata, Hemichordata and Chordata are included in this grade.
- Animals belonging to phylum Echinodermata have developed bilateral symmetry during their larval stage, however the adult Echinoderms have secondarily developed radial symmetry, due to their special mode of life.

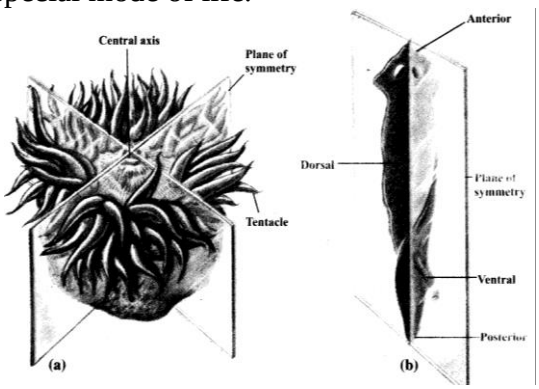


Fig. 10.1 (a) Radial (b) Bilateral symmetry

Difference between Proterostomes and Deuterostomes

Difference	Series Proterostomia (Proterostomes)	Series Deuterostomia (Deuterostomes)
Cleavage	Cleavage or division of the zygote is spiral and determinate.	Cleavage is radial and indeterminate.
Mesoderm	Mesoderm is derived from cells of lip of blastopore.	Mesoderm is derived from wall of developing gut (archenteron).
Mouth & Anus	During development process, the mouth in these animals arises from the blastopore or from its anterior margin.	During embryonic development, mouth is formed at some distance anterior to the blastopore and blastopore forms the anus.
Coelom	Coelom or body cavity is formed due to splitting of mesoderm (Schizocoelous).	Coelom is developed as an outpouching of archenterons (Enterocoelous).
Examples	This series proterostomia includes animals belonging to phyla, annelida, mollusca and arthropoda.	This series deuterostomia includes animals belonging to phyla echinodermata, hemichordata and chordata.

Spiral Cleavage

A spiral and determinate cleavage is that in which;

- The lines or planes of cleavage are not symmetrical between poles.
- Lines are diagonal to the polar axis and produce unequal cells around the axis of polarity.
- All the blastomeres have determined role to play in the formation of embryo. The fate of each blastomere is foretold.

Radial Cleavage

A radial or indeterminate cleavage is that in which;

- The planes of cleavage are symmetrical to the polar axis.
- These lines produce tiers of cells on top of each other.
- Fate of blastomere is not pre-determined. In some, anyone blastomere can produce a complete embryo.

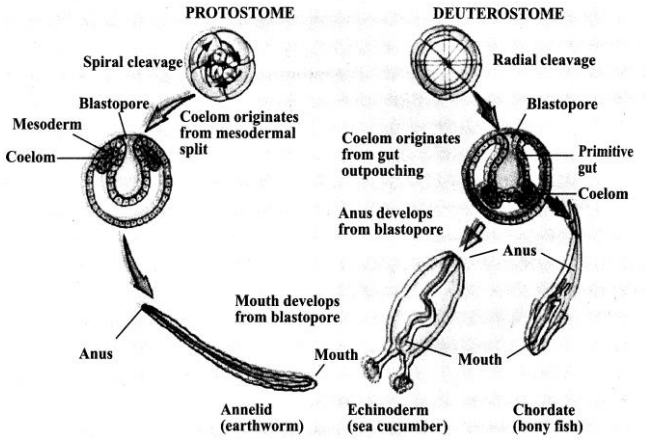


Fig 10.2: Patterns of embryonic development of coelom and of egg cleavage in protostomes and deuterostomes.

QUESTION RELATED TO ABOVE ARTICLE

Distinguish between by giving examples. **(Exercise Question x)**

(a) Radial and bilateral symmetry

10.5 DIPLOBLASTIC AND TRIPLOBLASTIC ORGANIZATIONS

DIPLOBLASTIC ORGANIZATION

Definition

Such an organization of body, in which there are two body layers is called diploblastic organization and such animals are called diploblastic animals.

Features

- Diploblastic animals belong to division ***radiata***.
- The body of these animals consists of two layers of cells i.e. ***ectoderm*** and ***endoderm***.
- There is jelly-like non-cellular ***mesenchyma or mesoglea*** present between these two layers.
- These animals have ***radial symmetry***.
- These animals show ***lesser degree of specialization*** and ***do not form specialized organs.***
- There is no special transport system in these animals. Most substances are distributed within their body by process of diffusion.
- There is ***no central nervous system*** in these animals. A neuron net is present.
- There is only one cavity in the body called ***gastrovascular cavity***, which has only mouth, which serves for the entry of food and water and also for the removal of wastes alongwith water. This is known as sac-like digestive system.

Example

Diploblastic animals are included in phylum Cnidaria (coelenterata).

TRIPLOBLASTIC ORGANIZATION

Definition

Such an organization in which there are three body layers is called triploblastic organization and such animals are called triploblastic animals.

Features

- Triploblastic animals are placed in ***grade bilateria***.
- The body of these animals is made up of three layers i.e. ***ectoderm, mesoderm*** and ***endoderm***. After embryonic development, these layers in most animals are not distinct as separate layers of cells, but are represented by the structures formed from them.
- The cells of these animals show ***greater degree of specialization***. They have specialized organs and systems.
- Special transport system i.e. blood vascular system is present in most of the cases.
- ***Ectoderm*** gives rise to integumentary and nervous systems.
- ***Mesoderm*** gives rise to muscular, skeletal and reproductive systems.
- ***Endoderm*** forms the lining of digestive tract and forms other glands of digestive system such as liver.
- The ***digestive system is of tube-type*** i.e. having mouth at the anterior end and the anus at the posterior end.
- These animals may be acoelomate, pseudocoelomate or coelomate.

Examples

All the animals of grade bilateria belong to this group.

QUESTION RELATED TO ABOVE ARTICLE

Distinguish between by giving examples. (Exercise Question x)

(a) Diploblastic and Triploblastic animals

10.6 ACOELOMATES, PSEUDOCOELOMATES AND COELOMATES

These are explained as follows;

10.6.1 Acoelomates

Such animals in which there is ***no body cavity*** or coelom are called acoelomates.

Features

- In them, mesoderm forms a loose, cellular tissue called ***mesenchyma or parenchyma***, which fills the space between the ectoderm and endoderm
- Mesenchyma or parenchyma forms a packing around the internal organs of the animals to support and protect them.
- Gut is ***sac-type***
- There is no special transport system.
- Excretory system is developed for the transport of excretory products. This system consists of ***flame cells, excretory ducts*** and ***excretory pores.***
- Nervous system is well developed.

Examples

Animals of phylum Platyhelminthes are acoelomates.

10.6.2 Pseudocoelomates

Animals in which false body cavity or ***pseudocoelom*** is present are called pseudocoelomates.

Features

- In these animals, space between the body wall and the digestive tube is called pseudocoelom.
- Pseudocoelom is not homologous to true coelom because it is not lined by coelomic epithelium.
- It has no relation with the reproductive and excretory organs.
- It develops from the blastocoel of the embryo.
- It is bounded externally by the muscles and internally by the cuticle of the intestine.

Examples

Animals of phylum Aschelminthes are pseudocoelomates.

10.6.3 Coelomates

Animals, which have ***true body cavity or coelom*** are called coelomates.

Features

- This cavity is present between the body wall and the alimentary canal and is lined by mesoderm.
- The mesoderm splits into outer parietal layer, which underlies the body wall and the visceral layer, which covers the alimentary canal and the cavity between them is the true coelom.
- Coelom is filled with coelomic fluid.
- Gut attains more complexity.
- Neurosensory, excretory, circulatory, respiratory and reproductive systems are well developed.

Examples

Animals from annelids to chordates are coelomates.

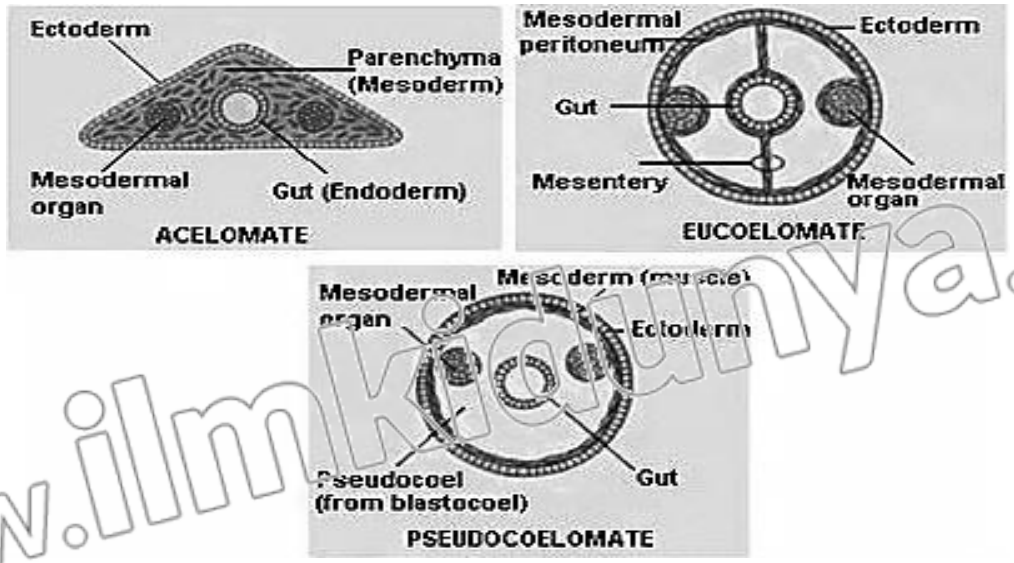


Fig. 10.3 General body plan of acoelomate, pseudocoelomate and coelomate

QUESTION RELATED TO ABOVE ARTICLE

Differentiate between Proterostomes and Deuterostomes.

Differentiate between ceolomate, pseudoceolmate and Aceolomate.

10.7 PARAZOA

10.7.1 Phylum Porifera: The Most Primitive Animals

Introduction

The word 'porifera' is derived from Latin ***'porus'*** meaning 'pore' and ***'ferra'*** meaning 'to bear'.

Thus they are ***pore-bearing animals***, commonly called the sponges.

10.7.1 (a) General Characteristics

Habitat

All animals are aquatic. Out of total 5000 species, ***150*** species live in ***fresh water*** while all others are marine.

Size

The poriferans range in size from few millimeter wide to more than one meter tall. They are macroscopic i.e. can be seen with naked eye.

Mode of Life

The adult sponges are ***stationary***, spending their lives attached to the rocks at the bottom or other solid objects. However, their larvae are able to move.

Scolymastra joubini, a barrel-like glass sponge of Antarctica is more than a meter tall.

Body Structure

- The animals are made up of ***many cells***, but there is ***no tissue organization*** and have no organs.
- They ***lack symmetry***.
- In most sponges, the body wall is formed of an outer layer, ***pinacoderm***, made up of cells called ***pinacocytes*** and an inner layer, ***choanoderm***, made up of flagellated collar cells called ***choanocytes.*** Between these two layers is present gelatinous mesenchyma, which may contain amoeboid cells and spicules or spongin fibers.
- There is single cavity inside the body, ***the spongocoel***. In most sponges, it may be divided into flagellated chambers or canals, lined by flagellated choanocytes.
- The ***skeleton*** is in the form of variously shaped needle-like structures called ***spicules***. These may be calcareous or siliceous. The bath sponge has a skeleton of spongin fibers. The skeleton is present among pinacocytes and provides support. Spicules are also present around osculum and ostia.

Body Systems

- There are ***no respiratory or circulatory systems***.
- There is ***water vascular system***, which is made up of numerous pores present in the body wall. The pores, through which water enters the body are called ***ostia*** and pore through which water leaves the body is known as ***osculum*** (main opening).
- There is ***no definite nervous system***, however neurosensory and neuron cells are probably present, which seem to coordinate the flow of water.

Feeding and Excretion

- As sponges are sessile, so they depend upon food coming to them along with water currents brought about by movement of flagella of choanocytes. This includes small animals (zooplanktons) and plants (phytoplankton), which constitute about 20% of their food. 80% of their food consists of detrital organic particles. The food enters the spongocoel through ostia. It is ingested by the flagellated cells, the choanocytes.
- The waste products either diffuse out of the sponges directly through the body wall or flow out through osculum.

Reproduction

Sponges reproduce both asexually and sexually.

- The ***asexual*** reproduction in sponges is by budding. The buds may be external or internal. The internal buds are called gemmules. Both types of buds develop into new sponges.
- Some sponge species reproduce ***sexually***. These are mostly **hermaphrodite**, mostly **protandrous** i.e. male sex cells develop first. In some sponges, the sexes are separate. Sperms released in water are carried to the egg by amoeboid cells. Fertilization occurs in mesenchyma and zygote is formed. The embryo development includes blastula and larval stages.

Examples

Examples of sponges are:

i) ***Sycon***: It is a typical marine sponge.

ii) ***Leucosolenia***: A sponge that consists of group of erect branches.

iii) ***Euplectella***: It is beautiful and delicate sponge made up of glassy framework. It is commonly called *Venus Flower Basket*.

iv) ***Spongilla***: It is fresh water sponge.

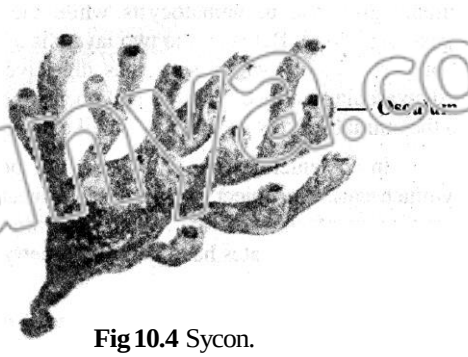


Fig 10.4 Sycon.

Importance

- The skeleton of sponges have long been used by man mostly for washing and bathing.
- They have great capacity to absorb water. Thus they are used in surgical operations for absorbing fluids and blood.
- They are also used for sound absorption in buildings.
- The best commercial sponges are found in the warm waters of Mediterranean Sea.

QUESTION RELATED TO ABOVE ARTICLE

Describe the general characteristics of phylum porifera.

10.8 GRADE RADIATA

10.8.1 Phylum Coelenterata / Cnidaria Diploblastic Animals

Introduction

The name Cnidaria has been given to this group of animals due to the presence of special cells called ***cnidocytes***. These cells give rise to nematocysts (the stinging cells), which are characteristic of this group.

General Characteristics

Habitat

The coelenterates are aquatic, found both in marine and fresh water.

Size

The coelonterates range in size from microscopic Hydra to macroscopic Branchioceranthus, a hydrozoan polyp that may reach two meters in length.

Body Structure

- Cnidarian have double layer organization and are therefore ***diploblastic*** having tissue grade organization and have organs.
- During the development, two germinal layers are formed. Outer layer is ectoderm and inner is endoderm.
- Ectoderm forms outer covering and some cells of this layer in most animals give rise to nematocyctes. Endoderm becomes specialized for digestion of food. Between the two layers is a ***jelly-like mesoglea***.
- In these animals, there is only one cavity, which serves as digestive as well as body cavity. This cavity is called gastrovascular cavity or ***enteron*** and opens to the outside by only one opening the mouth. So the animals of this group have sac-like digestive cavity.
- The mouth is surrounded by a series of ***tentacles***. These bear stinging cells or nematocysts, which are organs of defense and offense.
- These animals are ***radially symmetrical***.
- Many colonial coelonterates such as corals produce a hard ***exoskeleton*** formed of calcium carbonate ($CaCO_3$). It is ***secreted by epidermal cells*** that take lime from sea water. The skeleton of coral is responsible for formation of small coral islands or large coral reefs.

Mode of life Style

Most species are sessile, for example hydra, obelia, sea-anemone and corals, while other are free living and motile e.g. jelly fishes etc.

Many live as solitary individuals e.g. Hydra, jelly fishes and sea anemones and quite a large number are colonial e.g. physalia, velella etc.

A colony is an aggregation of individuals or zooids that perform different functions for the colony.

Presence of Zooids

Cnidarian are found in two basic forms, the polyps and the medusae, which are called zooids.

- *Polyps* are cylindrical animals, which in most cases are nutritive in function, hence named as gastrozooids.
- The ***medusae*** are umbrella-like in form. These are free swimming and are involved in sexual reproduction as they have gonads.

Types of zooids

Some of the colonial members have upto five different types of zooids performing different functions for colony e.g. *Physalia* (Portuguese man of war).

Body Systems

- The ***nervous system*** is in the form of a network of neuron cells forming an irregular net or plexus in the body wall. There is ***no central nervous system.***
- ***Digestive system*** is sac-like.
- They have no specific ***circulatory and respiratory systems***.

Feeding

The coelonterates are carnivores and feed upon small organisms, which come into contact with them. These organisms are immobilized by nematocycts and taken into the digestive cavity as food, which is then digested and then distributed by diffusion.

Reproduction

In coelenterates, reproduction takes place by asexual as well as sexual means.

- Hydra reproduces asexually by the formation of buds on its surface.
- Obelia reproduces both asexually as well as sexually. It has a kind of zooid known as blastostyle, which gives rise to individual zooids called medusae by asexual method. The medusae when released in water develop reproductive organ, which gives rise to gametes that unite to form zygote from which Obelia colony is again formed.

Alternation of Generations

The life cycle of coelonterates is characterized by the presence of alternation of generations. There are two generations, one reproduces by sexual means and the other by asexual means. Both generations are diploid. Often the two generations consists of one free-living and one attached stage. Therefore asexual generation and sexual generations alternate with one another. This is known as alternation of generations e.g. Obelia.

10.8.1 (a) Polymorphism: A Characteristic Feature of Coelenterates (Cnidaria)

"The occurrence of structurally and functionally more than two different types of individuals, called zooids within the same organism is called polymorphism."

For example:

In Obelia

- Feeding individuals (zooids) are ***gastrozooids***.
- Asexually reproducing zooids called ***gonozooids*** (blastostyle).
- Free-living sexually reproducing zooids called the ***medusae***.

Examples

The common examples of coelonterates are:

i) ***Hydra***: A freshwater coelonterate. It exists only in polyp form, therefore alternation of generation is absent.

ii) ***Obelia***: A marine coelonterate that exhibits alternation of generation.

iii) ***Aurelia*** (Jelly fish): The polyp is reduced and medusa is dominant in jelly fish.

iv) ***Actinia*** (Sea anemone): The body consists of polyp only. Enteron is divided by large partitions called mesenteries.

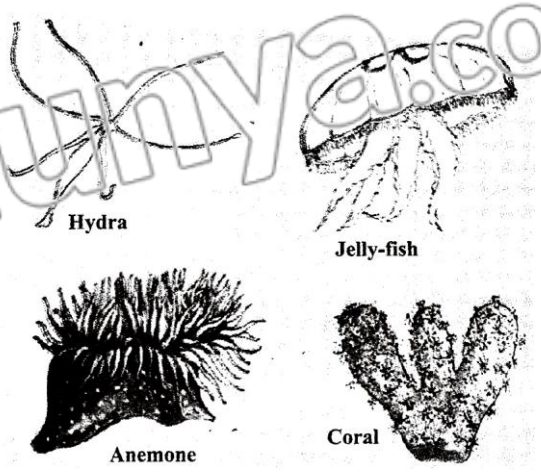


Fig 10.5 Coelenterates (Cnidarians)

v) ***Madrepore*** (Corals): The body is covered with hard calcareous skeleton formed of calcium carbonate. The skeleton forms large coral reefs and even small islands.

10.8.1 (b) Coral reefs

- Corals are formed from the secretions produced by specialized polyps that are present in certain coelenterates. These polyps become covered by stony cups due to hardening of their secretions. From the mouth of stony cup a polyp can pass out its tentacle for the purpose of feeding and withdraw itself when not feeding.
- Most such coelenterates are colonial. The stony network or mass of such coelenterates are called corals.
- Living polyps are found on the surface layer of corals whereas underneath the mass are dead stony structures only and there are no polyps inside.
- The stony masses that are formed in this way are called coral reefs. These are mostly formed of calcium carbonate (lime stone).
- Coral reefs are found in the coastal waters of Florida, West Indies, East Coasts of Africa, Australia and Island of Coral Sea.

Living place for sea life
The corals because of their massive structure, they serve as living place for a variety of sea life.

Importance

i) Corals are basic source of chalk and limestone.

QUESTION RELATED TO ABOVE ARTICLE

Explain in detail the characteristics of phylum coelenterata.

What are Cnidaria? Explain the diploblastic origin and alternation of generation in cnidaria.

What are Cnidaria? Explain the diploblastic origin and alternation of generation in Cnidaria. **(Exercise Question iii)**

10.9 GRADE-BILATERIA

10.9.1 Triploblastic Animals-The Acoelomates

Phylum: Platyhelminthes-The Flatworms

Introduction

These animals are commonly called as ***flatworms***.

10.9.1 (a) General Characteristics

Size

Their size ranges from few millimeters (10 mm in case of Planaria) to several meters.

Mode of Life

- With few exceptions Platyhelminthes are ***parasites***, mostly Endoparasite (which live inside their host). The most common examples are *Taenia solium* (tapeworm), *Fasciola hepatica* (liver fluke) and *Schistosoma* (blood fluke).
  Parasites are more common in tropics. In these species, movement is restricted. Some of these cause diseases in humans.
- A few species are ***free living*** and found in freshwater, for example *Dugesia* (planaria). The free-living forms are motile. They move by cilia present on their underside e.g. as in Planaria.

Body Structure

- The body of these animals is ***soft*** and ***dorsoventrally compressed***.
- These are ***triploblastic acoelomates***.
- There is development of third layer, the ***mesoderm***, which separates the ectoderm from endoderm.
- These animals exhibit ***bilateral symmetry*** and body is ***unsegmented***.

Body Systems

- Much of the space in these animals is taken up by a branching sac type ***digestive system***. The digestive system is poorly developed in some species or may be absent as in tapeworms.
- The ***excretory system*** consists of branching tubes ending in bulb-like cells called ***flame cells.***
- A well developed ***nervous system*** is present in Platyhelminthes. It is in the form of either a network of nerves or ganglia. The sense organs are present at the anterior end.
- ***Respiratory and circulatory system*** are absent.

Feeding

The parasitic species absorb nutrients from the host. The free-living species (Planaria) feed on small animals and bodies of dead and decaying animals.

Reproduction

The Platyhelminthes reproduce both by ***sexual*** and ***asexual*** means of reproduction.

- ***Asexual reproduction*** is by fission in which the animal constricts in the middle into two pieces, each of which regenerates the missing part.
- The ***sexually*** reproducing species are **hermaphrodite** i.e. both male and female reproductive organs are present in the same individual. Larval form is sometimes present.

Examples

The common examples of flatworms are:

i) ***Dugesia* (Planaria):** a free-living flateworm with a ciliated outer surface.

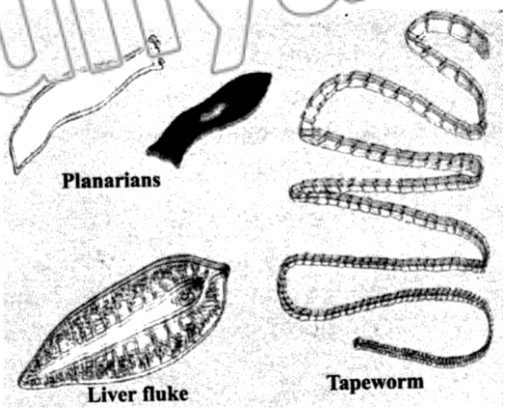


Fig. 10.6 Examples of animals of Platyhelminthes

ii) ***Fasciola*** **(Liver fluke):** It is an endoparasite in sheep and occasionally in human beings. It has suckers used for attachment to host tissue. It completes its life cycle in two hosts, a snail and sheep or man. It lives in the ***bile duct of its hosts.***

iii) ***Taenia*** **(Tapeworm):** An Endoparasite of humans,
Cattle and pig that completes its life cycle in two hosts. The ***intermediate host is pig or cattle.***
The body is ribbon-like and divided into segments called **progiottids**, which contain mainly sex organs. The segments continue to break off and are passed out from the intestine alongwith faeces.

10.9.1 (b) Adaptations for Parasitic Mode of Life

The parasitic Platyhelminthes have completely adapted themselves to parasitic mode of life by the development of the following characteristics:

1. The epidermis is absent and there is formation of ***resistant cuticle*** for protection.
2. They have developed ***adhesive organs***, such as suckers and hooks, for attachment to the host.
3. There is ***degeneration of muscular system and nervous system***.
4. The ***digestive system has become simplified*** due to increased dependence on host.
5. The ***reproductive systems are complicated*** and the ova are produced in huge numbers to ensure continuity of the species.
6. The ***complexity of life cycle*** and presence of more than one host during the life cycle is also an important parasitic adaptation.

10 .9.1 (c) Infestation

- In ***Taenia*** (tape worm), the development of the zygote begins while it is still inside the uterus of female. The last segments or proglottids and their uteri contain completely developed embryo.
- The fully mature proglottids break off from the body and pass out of the body of man alongwith faeces (undigested waste).
- The embryo inside the egg is round in shape and has six chitinous hooks. It shows limited movement of contraction. In order to develop further, it must reach a second host, which may be a cow.
- The parasite remains embedded in the voluntary muscles of cow.
- If an improperly cooked beef is eaten by a person, the parasite which has not been killed begins to develop further in the intestine of man.

10.9.1 (d) Disinfestation

- Once the parasite has entered the intestine of man, it is difficult to remove it completely. Care must be taken to cook beef properly before eating it, so that there is no chance of the parasite entering the digestive system.
- If parasite has entered then certain medicines are taken to remove it. Its complete removal is necessary because if only head remains inside the intestine it can grow into new tape worm once again.
- Besides treatment with drugs, physician also give anema to the patient to fully remove the parasite.

QUESTION RELATED TO ABOVE ARTICLE

Describe the five characteristics of phylum platyhelminthes.
Explain the adaptations for parasitic mode of life in platyhelminthes.
Describe the parasitic adaptation in phylum platyhelminthes. How tapeworms affect a person? (Exercise Question vi)

10.9.2 Triploblastic Animals – Pseudocoelomates

Aschelminthes (phylum Nematoda) – The Round Worms

The name 'Nematoda' means 'pointed ends'. The animals included in this group have elongated worm like body with pointed ends.
These are also called as ***round worms***.

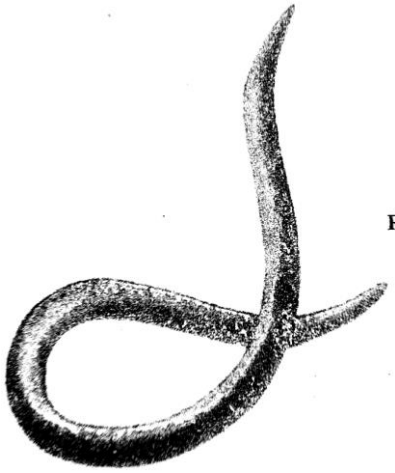
10.9.2 (a) General Characteristics

Size

The nematodes range from small microscopic forms to some form reaching a length of upto one meter.

Body Structure

- They exhibit ***bilateral symmetry***. One end of body is anterior, however the head is not clearly marked and there are no special sense organs at this end.
- The nematodes are ***triploblastic***.
- They are ***pseudocoelomates***. Body cavity or **pseudocoelom** is derived from the hollow space, the **blastocoel**, situated in the **blastula** and not from mesoderm. It consists of a number of vacuolated cells filled with a protein-rich fluid which develop high hydrostatic pressure.
- A ***fluid filled space*** is present between the body wall and alimentary canal. It provides 'tube within tube' type structure in nematodes.
- The body is ***unsegmented***.



Roundworm

Body Systems

- The ***digestive system*** is in the form of ***alimentary canal with two openings***. The opening at the anterior end is mouth and at the posterior end is the anus. In parasitic nematodes, the digestive system is simple.
- The ***excretory system*** consists of two longitudinally running ***excretory canals,*** which unite at the anterior end to form a single canal that opens to the exterior through an excretory pore on the ventral surface.
- There is a ***nerve ring*** around the pharynx, which gives rise to dorsal, ventral and lateral nerve cords running throughout the length of the worms. The sense organs are in the form of sensory **papillae** present on the lips at the anterior end.
- The ***circulatory and respiratory systems*** are absent. The gaseous exchange take place through general body surface.
- ***Locomotion*** is by undulating waves of contraction and relaxation of muscles. These muscles are arranged in four bands, two dorso-lateral and two ventro-lateral. The circular muscles are absent, therefore the bending is dorso-ventral only.

Reproduction

The ***sexes are separate***. The female gonads are ovaries and these produce eggs. The male gonads are testes, which produce sperms. A ***larval stage*** is present in the life cycle.

10.9.2 (b) Importance-Parasitic Diseases

Round worms are important from the point of view of its parasites of which it has a great variety causing some very serious diseases in man and plants.

Ascaris lumbericoides is an intestinal parasite of man.

The genus ***Rhabditis*** contains numerous species normally found in soil, organic matter or water and faeces of man or animals.

Enterobius vermicularis commonly known as ***pinworm*** is cosmopolitan but more common in Europe and America. Pinworms are parasites in the human caecum, colon and appendix. Their movement cause intense itching of anus, inflammation of mucous membrane of colon and appendix resulting in insomnia and loss of appetite.

Round worms are everywhere outdoors, where they play an important role in breading down organic matter. A single rotting apple may contain 90,000 worms. Billions thrive in each acre of topsoil.

Anyclostoma duodenale is commonly known as ***hook worm.*** It is a parasite of human small intestine in Asia, North Africa and Europe. It is very dangerous because it holds the villi of intestine and sucks blood and body fluids. During feeding they produce an anticoagulant to prevent clotting of blood and after feeding leave the wound bleeding. In children it can cause severe anemia and retard physical and mental growth.

QUESTION RELATED TO ABOVE ARTICLE

Describe the general characteristics of phylum nematoda.

Give the significance of phylum nematoda.

Give the symptoms for the disease caused by certain nematods. (Exercise Question v)

10.9.3 Triplobiastic Animals- Coelomates

Phylum: Annelida – The segmented Worms

Most of the worms with which we are familiar are included in this phylum. They are segmented and commonly called annelids (from Latin word for 'little ring').

10.9.3 (a) General Characteristics

Habitat

Annelids may be ***marine*** (*Neries*), ***fresh water*** (*stylaria*) or found in ***damp soil*** (earthworm).

Mode of Life

- Mostly are ***free living*** e.g. earthworm.
- Some are ***parasites*** e.g. *Hirudo* (leech).

Body Structure

- The body is ***metamerically segmented***. The body becomes divided transversely into a number of similar parts or segments.

  The subdivisions may be indicated externally by constrictions of the body surface and internally by septa extending across the coelom.

  However the various systems of the body such as gut, blood vessels and nerve cord are continuous throughout the length of body penetrating each individual segment.
- They show ***bilateral symmetry***.
- They are ***triploblastic and coelomate***.
- They have ***true coelom*** i.e. the mesoderm splits into parietal layer, which lines the body wall and visceral layer which covers the alimentary canal. The space between the two layers of mesoderm is coelom, which is filled in by coelomic fluid, which serves as hydrostatic skeleton also.

Body Systems

The annelids show specialization of body structures. The organ systems are well developed.

- ***Digestive system*** is in the form of alimentary canal, which is divided into distinct parts, each performing a specific function. It has two openings, the mouth at the anterior end and anus at the posterior end. The mouth is overhung by a lobed structure, the **prostomium**. In parasitic species, the digestive system is poorly developed.
- ***Excretion*** takes place by specialized structures called **nephridia**. These are ciliated organs present in each segment in the body cavity.
- A well developed central ***nervous system*** is present in annelids. It comprises of a simple brain and a solid double, longitudinal, ventral nerve cord. Nerves arise in each segment from the nerve cord.
- They have ***closed circulatory system*** (annelids being first group of invertebrates developing closed circulatory system). It is a system in which a circulatory fluid called blood flows in a network of vessels known as blood vessels. It transports gases and nutrients.
- The ***respiratory system*** is absent. The exchange of gases is by diffusion through the skin into blood capillaries. The skin is kept moist by mucous and coelomic fluid.
- The body wall contains ***muscles***, which help in locomotion. The muscles are of two types:

a. ***Circular Muscles***: These are arranged along the radius of the body.

b. ***Longitudinal Muscles***: These are arranged along the length of the body.

Locomotion

The ***locomotion*** is brought about by the interaction of muscles and hydrostatic skeleton.

Contraction of circular muscle produces a pressure in the coelomic fluid that forces the body to elongate.

Contraction of longitudinal muscles produce a pressure in the coelomic fluid that would cause the body to widen. (Muscular System)

The organs of locomotion in annelids are chitinous cheatae or setae embedded in sacs (earthworm) or parapodia present in the body wall e.g. Neries. The chaetae are absent in leech.

Reproduction

The common mode of reproduction is ***sexual***.

- Most annelids (earthworm, leech) are ***hermaphrodite***.
- Some annelids (Neries) are ***unisexual*** i.e. sexes are separate.

Fertilization is external and a free-swimming ***trochophore larva*** is produced during the life cycle.

Importance

- Burrowing activity of earthworm permits greater penetration of air into the soil, and improves drainage capacity of the soil. It also enable the roots to grow downward through the soil more easily.
- Mixing and churning of the soil is brought about when earth containing inorganic particles is brought up to the surface from lower regions.

Earthworm is perhaps more active segmented worm in churning the soil, therefore it is commonly termed as natural plough.

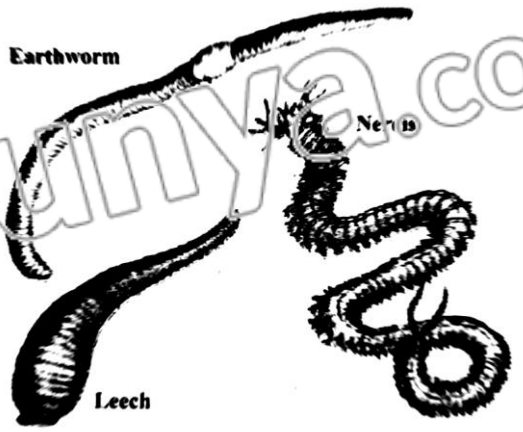


Fig 10.7. examples of animals belonging tophylum Annelida

Classification

Phylum annelida comprises of three important classes:

1. Class Polychaeteae.
2. Class Oligochaeteae.
3. Class Hirudineae.

Class Polychaeta

These have a distinct head region with eyes and structure known as palps and tentacles. Sexes are usually separate. The organs of locomotion are parapodia. They are mostly aquatic (marine).

During development these give rise to a trochophore larva. Important examples are **Nereis, Chaetopterus.**

Class Oligochaeta

These animals have internal and external segmentation. Organs of locomotion are setae. Head region not prominent or distinct. They are hermaphrodite (bisexual). No larva formed during development e.g. Lumbricus terrestris, pheretima posthuma and other earth worms. They may be terrestrial or aquatic.

Class Hirudinea

They have body with fixed number of segments. Each segment has additional circular rings or markings called annuli. They do not have organs of locomotion and move due to the contraction of their body and with the help of suckers. Mostly hermaphrodite and trochophore larva is formed during development. They are aquatic. No distinct head is present but leeches have chitinous jaws for making a puncture in the skin of the host. They also have an anticoagulant secretion which is passed into the wound to allow smooth flow of blood into its digestive system where it can be stored for a long time e.g. ***Hirudo medicinalis*** (medicinal leech).

QUESTION RELATED TO ABOVE ARTICLE

Explain the general characteristics of phylum annelida.

Explain the various classes of phylum annelida.

10.9.4 Phylum Arthropoda – Animals with Jointed Legs

They are commonly called arthropods or ***joint-footed animals*** (arthros = jointed + pods = feet).

- This phylum contains more species than any other phylum.
- Insects (cockroaches, grasshoppers, butterflies, mosquitoes) are most common arthropods on the earth.

Similarities with Annelids

Arthropods are believed to have common origin with annelids because both have some common characteristics such as

- Segmented body.
- Appendages.
- Cuticle.

10.9.4. (a) General Characteristics

Habitat

Arthropods have exploited ***every type of habitat*** on land and in water. The aquatic species include both freshwater and marine. Many of these can fly, therefore visit air periodically.

Body Structure

- Arthropods are ***structurally variable***. Some are worm-like e.g. centipedes while others are flying insects with the body divided into distinct regions, head, thorax and abdomen.
- The body is ***segmented***. Each segment is attached to its neighbor by means of a modified portion of cuticle, which is thin and flexible.
- They possess ***jointed appendages***, which have been modified for specialized functions.
- Their body is covered with waterproof chitinous cuticle secreted by the epidermis. It forms an outer covering acting as ***exoskeleton***. This cuticle is light in weight and is formed chiefly of chitin. It provides surface for the attachment of muscles, which help in locomotion.
- ***Coelom*** is not present as main body cavity. Instead a haemocoel has developed. It is reduced coelom and communicates with blood vascular system.

Body Systems

- The ***digestive system*** is in the form of alimentary canal with two openings, the mouth and anus. It is divided into different parts each performing a specific function. The food comprises of small plants and animals.
- A well developed ***excretory system*** comprising of Malpighian tubules. The nitrogenous wastes are excreted in the form of solid uric acid.
- A highly developed ***nervous system*** is present. It consists of paired ganglia (simple brain) connected to a ventral double nerve cord. A ganglion is present in each segment. Nerves arise from these ganglia. Sensory organs are usually a pair of compound eyes and antennae.
- Most arthropods possess an extensive ***tracheal system*** formed of air tubes called trachea for the exchange of gases. Main tubes open to the exterior through openings called spiracles. Aquatic arthropods respire through gills.
- The blood ***circulatory system*** in arthropods is unique. It is open circulatory. The blood flows in the body cavity bathing the tissues of the body. However, there is a primitive heart and a main blood vessel. Blood is colourless as it is without hemoglobin.

Locomotion

The arthropods exhibit active and swift movements. They swim, crawl or fly dependent upon the habitat, they occupy. The organs of locomotion are paired appendages and same case in paired wings also.

10.9.4 (b) Reproduction and Life History

The sexes are separate. The testes and ovaries produce sperms and eggs respectively.

10.9.4 (c) Metamorphosis

Life history of insects is characterized by metamorphosis (meta = change, morph = form).

Metamorphosis is an abrupt change of form or structure during the life cycle.

- In complete metamorphosis, there are three morphologically distinct stages in the life cycle; the egg finally develops into larva, which is converted into pupa that finally develops into an adult.

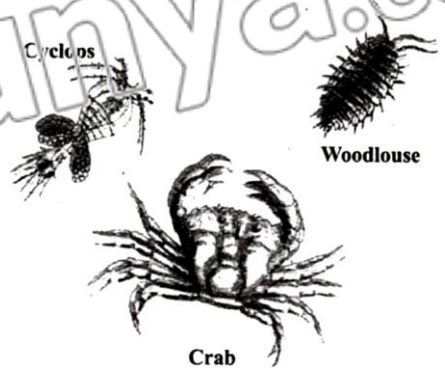


Fig 10.8 Example of class crustacea

- In some primitive insects, the metamorphosis is incomplete. The larva resembles adult and called nymph or instar. It lives in the same habitat as adult.

10.9.4 (d) Classification

Phylum arthropoda is a large group consisting of great variety among them. Some of its important classes are as follows.

1. Class Crustacea

Some of their important features are:

- These are ***aquatic*** and have gills for respiration.
- On dorsal side of the cephalothorax, the exoskeleton is in the form of ***carapace***. In the exoskeleton, the deposition of salts in addition to chitin makes it firmer.
- The ***appendages*** are modified for capturing food, walking, swimming, respiration and reproduction.
- Coelom is reduced and ***hemocoel*** is present.
- ***Head*** has two pairs of antennal appendages, one pair of mandibles (jaws) and two pairs of maxillae.
- ***Sexes*** are mostly separate.

Examples are:

Daphnia, *Cyclops*, *Crabs*, *Lobsters*, *Prawns*, *Wood louse* etc.

2. Class Insecta

- This is the *largest group*, not only of Arthropoda but of all the animal kingdom and has great variety. Insects are found everywhere, many show social behaviuor.
- Some of their important features are:
  Body is divided in ***three regions***, head, thorax and abdomen.
- The ***head*** is vertical to the body and jaws are ventrally placed.
  There are a pair of ***antennae*** and ***compounds eyes*** on the head.
- The ***thorax*** has three segments in which are present three pairs of jointed legs and in many one or two pairs of wings.
- ***Abdomen*** has varying number of segments.
- ***Brain*** is formed of fused ganglia and double ventral nerve cord is present.
- ***Sexes*** are separate and animals are oviparous.
- ***Metamorphosis*** takes place during development.

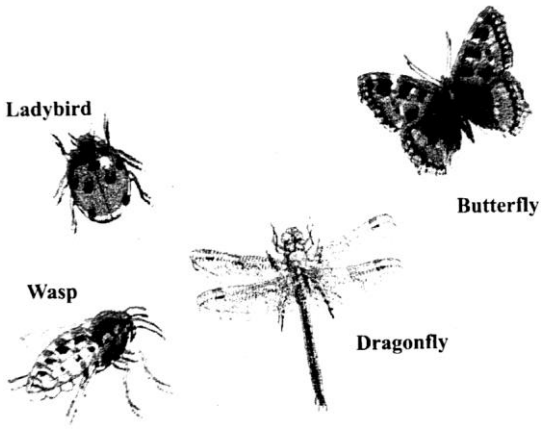


Fig. 10.9 Insects

Examples are

Dragonfly, Mosquito, Butterflies, Moths, Wasps, Beetles etc.

3. Class Arachnida

Some of their important features are:

- Body has the anterior segments that are fused to form a ***combined cephalothorax***.
- With cephalothorax, some structures are present i.e. a pair of appendages called ***chelicerae*** with claws, two pairs as ***pedipalps*** and four pairs of legs.
- There are ***no antennae*** and no true jaws.
- ***Abdomen*** may be segmented or unsegmented with or without appendages.
- ***Respiration*** is by gills, lungs or special structures called book lungs.
- ***Excretion*** is by malpighian tubules.
- ***Eyes*** are simple.
- ***Sexes*** are separate.
- They are ***oviparous*** (lay eggs) and there is no true metamorphosis.

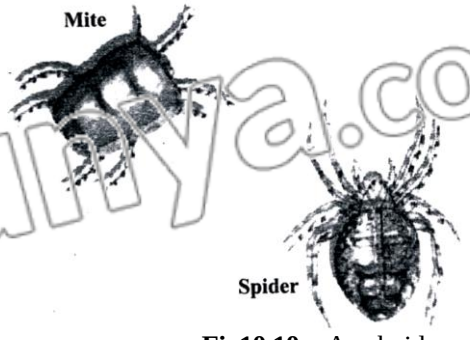


Fig10.10 : Arachnids

Examples are:

Scorpions, Spiders, Mites, Ticks.

4. Class Myriapoda

Some of their important features are:

- The body is divided into ***large number of segments***, each having a pair of legs.
- A pair of ***antennae*** and a pair of ***eyes*** is present on head

Examples are:

Centipedes, Millipedes etc.

QUESTION RELATED TO ABOVE ARTICLE

Give an account of the major groups of Arthropods. What is the economic importance of insects? (Exercise Question vi)

10.9.4 (e) General Organization of Arthropods

Arthropods have characteristics of higher forms such as bilateral symmetry, triploblastic, coelomic cavity and organ systems and have reached the peak of invertebrates' evolution.

Similarities and Differences with Annelids

Similarities of arthropods with annelids are segmented body, presence of cuticle and appendages.

Differences of arthropods from annelids are that in them, there is no metamerical segmentation, organs are not repeated in each segment and there are jointed appendages.

Main Achievements of Arthropods

Two main achievements of arthropods are:

i) Chitinous exoskeleton

ii) Locomotory organs

i) Chitinous Exoskeleton

Chitin is non-living, non-cellular and secreted by the underlying epidermis. It is a protein-carbohydrate compound. On the outer side, there is waxy layer.

In some Arthropods, chitin is soft and flexible while in others it is hard.

Main functions performed by this structure are:

- Protection.
- Serving as lever for the movement of muscles of jointed limbs.
- For biting and crushing as food (as present in jaws).
- Forming lens of the compound eyes.
- Forming copulatory organ and organs for offense and defense.

In the young Arthropods such as insect larva, chitinous exoskeleton is shed from time to time to allow the growth of the larva. This process of shedding of exoskeleton is called moulting or ecdysis.In short the exoskeleton of chitin in the Arthropods in one of the primary factors in the success of arthropods as it helps them to adapt to a wide variety of habitat.

ii) Locomotory Organs

Each somite typically is provided with a pair of jointed appendages. But this arrangement is often modified with both segments and appendages specialized for different functions in different habitats. However, in all kinds of habitat the jointed appendages provides an efficient means of locomotion, offence and defence and also help in reproduction.

10.9.4 (f) Economic Importance

Man and insects have been at war for the same food and same place to live in. Out of all arthropods, insects are of great importance to mankind because of their harmful and beneficial aspects.

1. Harmful Aspects

Acting as Carrier for Disease Causing Germs

Many types of mosquitoes, flies, fleas, lice and bugs transmit disease-causing organisms to man and domestic animals. Some of the most familiar examples are as follows.

- Female of genus Anopheles mosquito transmits Plasmodium that causes malaria in man.
- The Tsetse fly of African countries transmits Trypanosoma, the cause of sleeping sickness and skin diseases. Some species of Trypanosoma cause diseases in cattle also.
- The common housefly carries disease-causing organisms to contaminate food and cause cholera, hepatitis etc.

Food Spoilage

A number of insects lay eggs on fruits and other commercial crops such as sugar-cane, maize, and cotton and also on vegetables etc. The larvae of these insects damage fruits and the crops resulting in economic loss to farmers.

The locusts that move in large numbers from country to country cause damage to standing crops and other plants.

2. Beneficial Aspects

Some of the useful insects are as follows;

- Honeybee provides honey and some wax to man.
- Silkworm provides us silk
- Some insects are predaceous on other harmful insects.
- Some insects are scavengers and they eat up dead animals and vegetable matter.
- Insects' larvae are source of food for fish.

QUESTION RELATED TO ABOVE ARTICLE

State the general characters of Phylum Arthropoda and discuss the classification & economic importance of insects.

Explain the economic importance of insects.

Give an account of the major groups of Arthropods. What is the economic importance of insects? (Exercise Question vi)

10.9.5 PHYLUM MOLLUSCA (L. Molluscus – soft)

The phylum includes over ***50'000*** living species and is the second largest phylum of invertebrates. Giant squid is the largest invertebrate animal. These are also called as ***'soft-bodied animals' or shelled-animals'***.

10.9.5.(a) General Characteristics

Habitat

Molluscs are widely distributed. Some groups are ***exclusively aquatic***, freshwater or marine e.g. cephalopoda. Others include terrestrial animals (land snail) living on moist places mostly.

Body Structure

Molluscs show a great variety of form but all are built on the same basic plan.

- They are ***triploblastic, coelomates*** with ***bilateral symmetry***.
- Body is ***soft*** and ***unsegmented***.
- Body can be divided into ***head, a ventral muscular foot*** and a ***dorsal visceral mass*** containing most of the internal organs.
- The body is covered by a glandular epithelial envelope called ***mantle***.
- Mantle secretes a ***calcareous shell***. The space between the shell and mantle cavity contains gills in some animals.
- In the mouth cavity of many molluscs, there is a rasping tongue-like ***radula*** provided with many horny teeth.

Body Systems

The body is highly organized with complex digestive, respiratory, circulatory, excretory, nervous and reproductive systems.

- ***Digestive system*** consists of gut with two openings, mouth and anus.
- The excretory organs are paired ***nephridia***.
- There is open ***circulatory system*** except group cephalopoda. The coelom is divided into sinuses or blood spaces. Heart pumps the blood into the sinuses. A blue coloured respiratory pigment **hemocyanin** is present.
- ***Gaseous exchange*** is by gills mostly. In some cases such as snail, the mantle cavity is converted into a lung.
- ***Nervous system*** consists of three pairs of interconnected ganglia present in the head, foot and body regions.

Locomotion

The organ of locomotion is a ***muscular foot***, however in many species the movement is slow. The others are sessile i.e. unable to move.

Reproduction

Sexes are separate. Trochophore larva develops during embryological development.

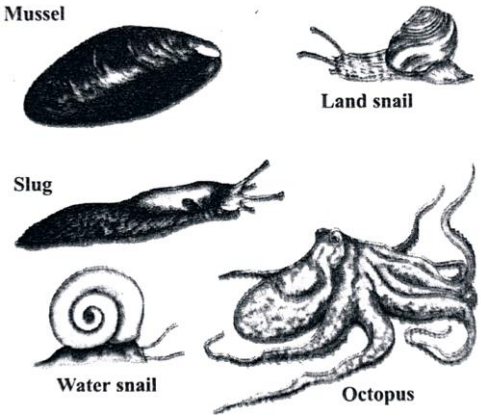


Fig 10.11 Example of Molluscs

10.9.5 (b) Classification

The molluscs are classified into six classes. The major classes are:

i) Gastropod

Some of their features are:

- These are ***asymmetrical***.
- Their body is covered with usually ***single coiled shell***. The animal can withdraw itself into the shell.
- Both ***aquatic and terrestrial*** species are included in this class.
- The aquatic species have gills while in land forms the mantle cavity is converted into lungs.

The common examples are:

- ***Helix aspersa***, which is commonly termed garden snail.
- ***Limax*** (the slug)

ii) Bivalvia (Pelecypoda)

Some of their features are:

- These animals are ***bilaterally symmetrical*** and ***aquatic***.
- The body is ***laterally compressed***.
- Body is enclosed by ***two pieces of shells*** hence the name bivalves.
- They respire by plate-like gills.

The common examples are:

- ***Mytilus*** (marine mussel)
- ***Anodonta*** (freshwater mussel)
- ***Ostrea*** (oyster)

> ***Loligo* (squid)**
> The giant squid is the largest invertebrate animal reaching a length of 15 meters (almost 50 feet), including tentacles or arms.

iii) Cephalopoda

Some of their features are:

- The members of this class are ***bilaterally symmetrical*** with ***dorso-ventrally flattened body.***
- All species are ***aquatic***.
- The ***shell*** is much ***reduced*** and internal. In most cases, it is absent.
- The animals are ***highly developed*** and active.

The common example is:

- ***Sepia*** (cuttlefish)

10.9.5 (c) Economic Importance of Mollusca

Some insects are indirectly harmful to man but most of them are beneficial.

Harmful Aspects

The harmful molluscs are slug and shipworms.

- Slugs are injurious in gardens and cultivations. They not only eat leaves but also destroy plants by cutting up their roots and stems.
- Teredo, a shipworm damages wooden parts of ships.

Octopus

The brain of octopus is exceptionally large and complex for an invertebrate brain. It is enclosed in a shell-like case of cartilage and endows the octopus with highly developed capabilities to learn and remember. In laboratory, octopus can rapidly learn to associate certain symbols and can open a screw cap jar to obtain food.

Beneficial Aspects

- Many molluscs are great source of food for man in many parts of world. Large quantity of clams, oysters and mussels are eaten in Fareast, Europe and America. Oysters are regarded as delicacy.
- Shells of freshwater mussels are used in button industry.
- Shells of oysters are mixed with tar for making roads in America.
- Shells in certain parts of the world are also used for making ornaments.
- Some oysters make valuable pearls e.g. the pearl oyster.

QUESTION RELATED TO ABOVE ARTICLE

Describe six characteristics of phylum mollusca.

Explain the characteristics of various classes of phylum mollusca.

10.9.6 PHYLUM ECHINODERMATA- The Spiny Skinned Animals

These are also called ***'spiny-skinned animals'***. There are over 5,000 known species of echinoderms.

10.9.6 (a) General Characteristics

Habitat

They are ***exclusively marine*** and most of them are found at the bottom along shorelines in shallow seas. Most species are free-living, however some are attached to the substratum

Body Structure

- The body may be flattened like biscuit (cake urchin), star-shaped with short arms (starfish), globular (sea urchin), star-shaped with long arms (brittle star) or elongated (sea cucumber).
- They are ***triploblastic, coelomate*** and exhibit ***radial symmetry***.
- There is a ***central disc*** from which arms radiate.
- ***Mouth*** is on lower surface (oral) and anus is on upper surface (aboral).
- The body is covered by ***delicate epidermis***. The mesodermal cells develop a firm calcareous exoskeleton. Because of its origin from mesoderm, it may be called endoskeleton.

Body Systems

The echinoderms exhibit low degree of organization.

- ***Digestive and reproductive systems*** are well developed with specialized organs.
- ***Respiratory, excretory, nervous and circulatory systems*** are poorly developed with no specialized organs.
- In ***nervous system***, there is no brain, however a nerve ring is present around the pharyngeal region.
- The most unique characteristic of echinoderms is that a ***water vascular system*** is present in their coelom. It is complex system of tubes and spaces surrounding the mouth and passing into the arms and tube feet. Water circulates through these channels. Water enters these canals through a sieve-like plate called ***madreporite*** present on the aboral body surface.

Reproduction

The sexes are separate and fertilization is external. The larvae such as bipinnaria and brachiolaria are complex, exhibit bilateral symmetry and resemble those of chordates.

Regenaration

Regenaration (the ability to reform lost organs) is common among echinoderms especially starfish, sea cucumber, sea lily, brittle star and sea-urchin.

Locomotion

Free-living species move with the help of tube feet. Each foot is a soft sac-like structure present along the edges of grooves present in the arms.

Examples

The common examples are *Asterias* (starfish), sea urchin, sea cucumber, cake urchin, brittle star etc.

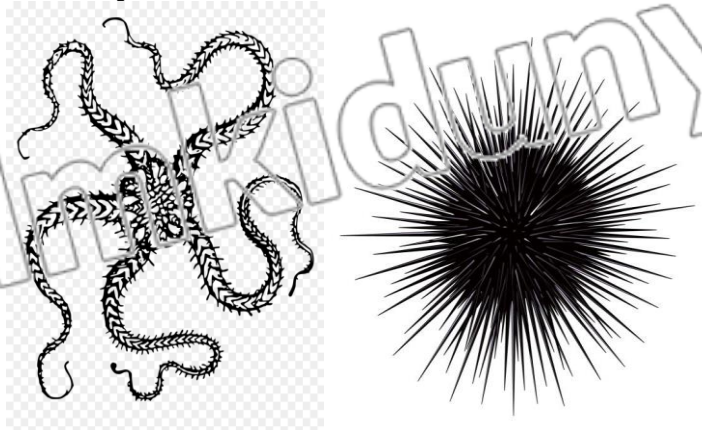
Similarities with Chordates.

The echinoderms are comparatively simple in structure, organization and physiology and deserve a place slightly below the annelid worms. However these are placed at the top of the list of invertebrate phyla. This is because, there are a number of striking resemblances, between the echinoderms and chordates especially to hemichordates. Some of their resemblances are given below.

(a) There is radial cleavage during the development of embryos in both phyla.

(b) The blastopore forms the anus in echinoderms as well in chordates (Deuterostomes).

(c) There are certain common biochemical peculiarities among echinoderms and chordates e.g. phosphocreatin is present in both.



Brittle star Sea Urchin

Fig 10.12: Examples of Echinoderms.

10.9.6 (b) Echinodermata/Affinities

Echinodermata do not show close relationship to most invertebrates, but they do show affinities with hemichordate. Both these have a number of common features among which are the formation of coelom and retention of blastopore as the site for future anus. In both mesoderm is derived form the cells close to the blastopore. Both possess mesodermal endskeleton where as the exoskeleton is ectodermal in orgin while in invertebtrates the blastopore develops into mouth.

The above resemblances between two phyla are neither accidernal nor due to convergent evolution but are because the two are closely related and both emerged form the same (common) ancestor. Echinoderms also show very close resemblance with chordates because both have mesoedermal skeleton, are deuterostomous, in both lower chordates and echinoderms the early development is almost similar. That is why they have been placed closest to phylum chordate.

QUESTION RELATED TO ABOVE ARTICLE

Describe general characteristics of phylum echinodermata.

10.9.7 Phylum Hemichordata

It is a group that is present in between echinoderms and chordates.

Hemichordates have a combination of both invertebrates (echinoderms) and chordates characteristics. Hemichordates, echinoderms and chordates belong to the group deuterostoma.

Because of their close relationship to chordates, these animals are also called as pre-chordates.

10.9.7 (a) General Characters

1. Soft bodied animals which are worm-like.
2. Body is divided into an anterior proboscis, collar and trunk.
3. Body wall is made of unicellular epidermis with mucus-secreting cells.
4. Digestive tract is straight and may show variations.
5. Coelomic cavities correspond to each of the three body regions. Coelomic pouches are also present.
6. Circulatory system consists of a median dorsal and a median ventral vessel.
7. Respiratory system is composed of gill slits forming a dorsal row behind collar.
8. Excretory system has single glomerulus connected to blood vessels.
9. Nervous system has a sub-epidermal plexus of cells and fibers.

Examples

The common examples of this phylum are ***Balanoglossus*** and ***Saccoglossus*****.**

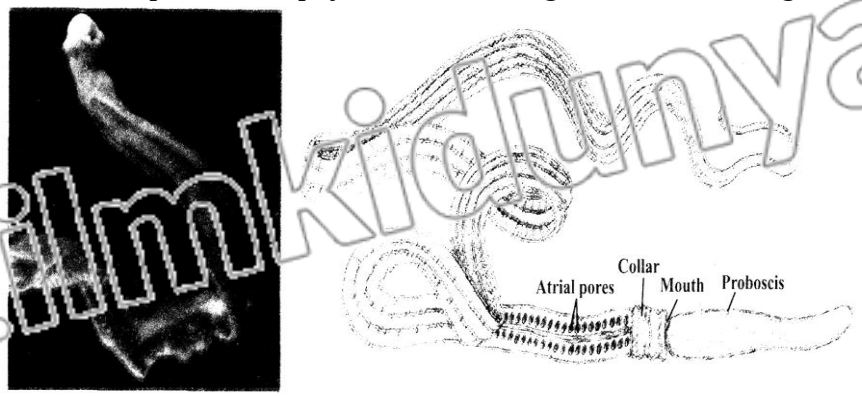


Fig. 10.13 A Balanoglossus and Saccoglossus

QUESTION RELATED TO ABOVE ARTICLE

Describe briefly phylum hemichordate.

10.10 PHYLUM CHORDATA

- This great phylum derives its name form one of the few common characteristics of the group – the notochord.
- This structure is possessed by all members of the phylum either in the larval or embryonic stages or throughout life.
- The notochord is a rod-like semi rigid body of vacuolated cells which are filled with proteinaceous material which extends in most cases the length of the body between enteric canal and the dorsal hollow central nervous system.
- Its primary purpose is to support and to stiffen the body that is to act as skeletal axis. It seems that the endoskeleton is the chief basic factor in the development and specialization of higher animals.
- The animals most familiar to us belong to the chordates including man himself.
- The chordates show great variety and inhabit all kinds of habitat. All chordates possess three basic characters which are as follows:

1. As already mentioned all possess the notochord.
2. All chordates have central nervous system that is dorsal in position and is hollow.
3. All chordates develop paired gill openings in embryonic stage. In some these are non-functional, while in other they are functional for some period in their life history e.g. frogs etc. in still other these are functional throughout life e.g. amphioxus, and fishes etc.

CLASSIFICATION OF CHORDATES

Chordates have been divided into lower chordates, e.g. Amphioxus etc. and higher chordates which are the vertebrates in which the notochord is replaced by the vertebral column and a bony brain case cranium is also formed due to which they are also called craniates. Phylum chordate has been sub divided as follows:

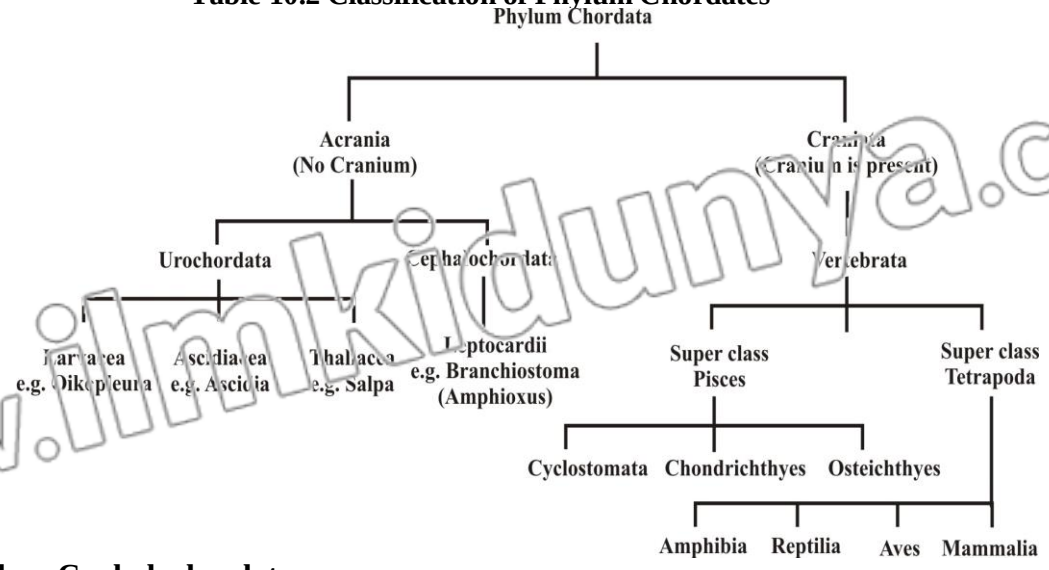
10.10 (a) Protochordata (Acrania) (Lower Chordates)

i) Subphylum Urochordata

Notochord and nerve cord are present only in free-swimming larvae. Adults are sessile and enclosed in a covering called tunic. Therefore they are also called ***tunicata***.

For example ***Molgula*.**

Table 10.2 Classification of Phylum Chordates



ii) Subphylum Cephalochordata

Notochord and nerve cord extend along the length of the body and persists throughout life.
For example *Amphioxus*.

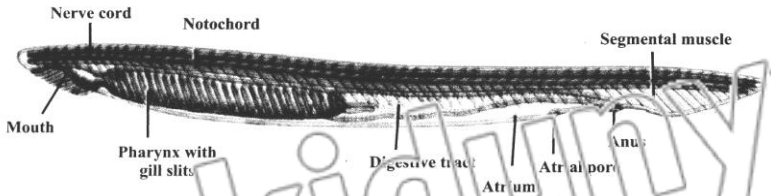


Fig 10.14: Amphioxus

QUESTION RELATED TO ABOVE ARTICLE

Explain the classification of chordata.

10.10. (b) Sub-phylum Vertebrata (Craniata) (Higher chordates)

This group includes animals, which have cranium enclosing brain and vertebral column. It is customary to place vertebrates into two super classes;

1) Pisces (Fishes), which are strictly aquatic forms.

2) Tetrapods (Four footed), which are mostly land dwelling.

Vertebrates may be divided into amniotes, having foetal membranes (reptilia, aves, mammals) and anamniotes, without foetal membranes (amphibia and pisces).

10.10.1 Superclass Pisces

This super class includes three important classes;

- Cysclostomata
- Chondrichthyes
- Osteichthyes

10.10.1 (a) Class Cyclostomata

This class includes ***most primitive*** fishes, which are also called as ***jawless fishes***.

Characteristics

- Body is long, ***eel-like***.
- ***Scales*** are absent.
- There are no paired ***appendages***.
- There is cartilaginous ***skeleton***.
- There is ventral suctorial ***mouth***.
- ***Heart*** is with one auricle.
- There are six to fourteen pairs of ***gills***.
- ***Digestive system*** lacks stomach.
- ***Sexes*** are separate in lampreys. Hagfishes are hermaphrodite.
- ***Fertilization*** is external and long larval period is present in lamprey.

Examples

This group is represented by ***lampreys*** and ***hagfish***.

Fig 10.15: Lamprey

10.10.1 (b) Class Chondrichthyes

Fishes present in this group have cartilaginous endoskeleton, so also called as ***cartilaginous fishes***.

Characteristics.

- ***Body*** is fusiform.
- ***Mouth*** is ventral and olfactory sacs are not connected to mouth cavity.
- Placoid ***scales*** are present on body.
- ***Endoskeleton*** is entirely cartilaginous.
- There is J-shaped stomach in ***digestive system***.
- ***Circulatory system*** has many pairs of aortic arches.
- Respiration is by means of 5-7 pairs of ***gills***.
- There is ***no swim bladder***.
- ***Sexes*** are separate.
- They may be ***oviparous or viviparous***.

Examples

Most common examples are sharks, skates and rays.

- With the exception of whale, skarks are the largest living vertebrate reaching nearly 30-50 feet in length. They are of economic importance. Most are highly destructive to lobsters and crabs. In some parts of the world, they are used as food by man. Commercially shark liver oil is extracted and used in medicine as a source of vitamin A and D. Shark skin leather is used for making articles.

  The skates and rays are bottom dwelling fishes. In these the anterior pairs of fins (pectoral fins) are much enlarged and are used for swimming like wings.
- In sting rays, tail is long and whip like and has sharp spines, which can inflict very dangerous wounds.
- Electric rays have certain dorsal muscles modified into powerful electric organs, which can give severe shocks and stun their prey.

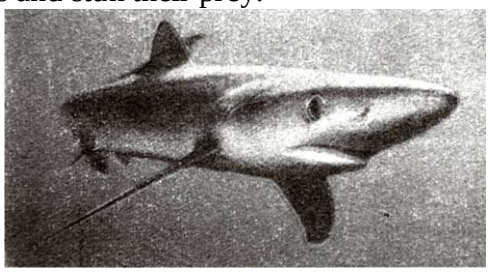


Fig 10.16: Shark

10.10.1 (c) Class Osteichthyes: (Bony Fishes)

Fishes present in this group have bony skeleton, so also called as ***bony fishes***.

Characteristics

Following are the characteristics of bony fishes.

- They have more or less ***bony skeleton***, which has replaced the cartilaginous skeleton.
- ***Notochord*** may persist in parts.
- ***Skin*** has embedded dermal scales, which may be ganoid, cycloid or ctenoid. Placoid scales are absent.
- Both types of ***fins*** i.e. single median and paired are present. These fins also have fin rays of cartilage or bone.
- ***Mouth*** is terminal. Jaws are either with or without teeth.
- ***Respiration*** is by gills, which are supported by gill arches and covered by operculum.
- A ***swim bladder*** is usually present with or without connection with the pharynx. This helps in buoyancy.
- There is ***two chambered heart*** with one atrium and one ventricle. Blood has nucleated red cells.
- ***Brain*** is present with 10 pairs of cranial nerves.
- ***Sexes*** are separate, gonads are paired and fertilization is usually external.

10.10.1 (d) Adaptations to Aquatic Life

The major adaptations in fish for the aquatic mode of life are as follows:

1. Streamlined Body

Their body is boat shaped. This type of body offers little resistance to water while swimming.

2. Swim Bladder

This is found in most bony fishes except a few. It may or may not be connected to pharynx. It is mainly a hydrostatic organ and can change the gravity of fish by filling itself with gas. The fish can thus float high or sink lower in water. The gases that fill the swim bladder are either oxygen, carbon dioxide or nitrogen. These are secreted by the glands present in swim bladder. Fishes in which bladder is connected to pharynx, the bladder may be filled by gulping of air.

3. Fins

There are two types of fins.

- ***Paired fins*** (pectoral and pelvic)
- ***Unpaired fins*** (dorsal, caudal (tail) and anal).

Fins help in swimming as they keep balance of fish in water.

4. Circulatory System

There is two chambered heart with afferent and efferent branchial system.

5. Respiratory System

In most fishes, respiratory organs are gills, adapted to receive oxygen dissolved in water and remove carbon dioxide in water as the gills have network of blood capillaries.

6. Excretory Organs

Kidneys of fish are also modified for excretion in the aquatic environment.

COMPARISON OF WATER AND LAND HABITATS

Fishes are adapted to strict aquatic life. The group of ancient fish known as **dipnoi** showed modifications of aquatic breathing system to meet the conditions of terrestrial life by developing lungs. But this case is only and incident in the transition to land. There are a number of differences between water and land habitats.

1. ***Oxygen*** is more in air than in water.
2. ***Dissolved substances*** e.g. different kinds of salts are present in water.
3. ***Temperature changes*** are more drastic in terrestrial environment.
4. A great variety of ***cover and shelter*** is provided by land habitat than aquatic habitat.
5. As a medium water provides greater ***support*** to the body than air.
6. There is a great variety of ***breeding places*** on land than in water.

ADAPTATIONS TO LAND HABITAT

In transition from aquatic to land environment, animals had to undergo modifications or adaptations to cope with the above conditions on land. This includes:

1. ***Development of skin*** for protection against dry conditions of land.
2. The ***eggs*** of land animals are protected by ***shells*** from drying and mechanical injury. Size of egg is also large to provide space for storage of food.
3. They developed ***lungs*** in place of gills, which could take oxygen from the air.
4. In connection with development of lungs, there are corresponding changes in the ***circulatory system*** to take oxygen from the air.
5. For ***locomotion***, paddle-like fins are replaced by jointed appendages modified for walking, running, climbing and flying.
6. ***Sensory organs*** have become more advance and specialized.

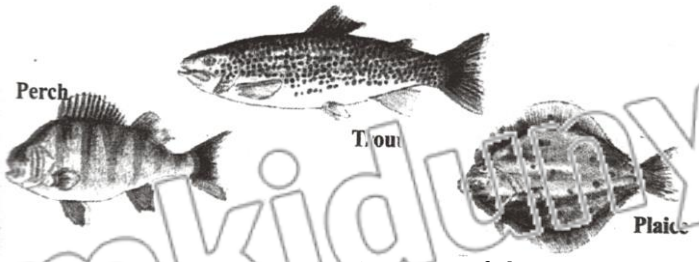


Fig 10.17: Bony fishes

QUESTION RELATED TO ABOVE ARTICLE

Explain the aquatic mode of life adaptations.
Explain the various classes of pisces.
Give the two major classes of the pisces and explain adaptations of aquatic mode of life in fishes. (Exercise Question viii)

10.11 Super class Tetrapoda: These have 2 pairs of jointed limbs (tetrapods)

Amphibians are on the border line between aquatic and true terrestrial animals. Fossil evidence from the Devonian period of earth history suggests that a large population of fish belonging to the group lobe-finned (dipnoi) came to live in shallow fresh water. Some of these crawled from one pool to another and therefore spent more time on land. This gave rise to the group that we recognized as amphibians, which are the first vertebrate to come on land.

Although amphibians have acquired certain characters enabling them to live on land but at the same time they have retained some aquatic characters as the result of their dependence on aquatic habitat. This double life is expressed in their name.

Structurally they are between fish on one hand and reptiles on the other hand.

In transition from water to land amphibians have developed certain changes.

- They have developed ***limb*** in place of fins.
- ***Lungs*** have replaced gills.
- Some changes occurred in ***skin***.
- ***Circulatory system*** has been modified for lung circulation but it retained link with gills and digestive system in correspondence with aquatic life.

Because of their dependence on water, they are not a very successful group of vertebrates and are confined to areas only where they can find water or moist conditions.

10.11.1 Class Amphibia

Characteristic Features

The characteristic features of amphibians are:

1. ***Skin*** is smooth and moist with many glands. In some glands are poisonous. Pigment cells (chromatophores) are present in skin. Scales are absent.
2. ***Skeleton*** is mostly bony. Body form varies greatly in the different amphibians, tailed or without tail.
3. ***Limbs*** are usually four but some are legless e.g. caecilians. Webbed feet are often present.
4. ***Respiration*** is by gills in larval stages and by lungs and skin in the adult.
5. ***Heart*** is three chambered with respect to atria and ventricle. Sinus venosus and truncus arteriosus are also present. Double circulation takes place through the heart.
6. ***Sexes*** are separate, fertilization is external and larval stages are present.
7. Changes into adult by metamorphosis. Amphibians are anamniotes.
8. They are ***cold blooded*** (poikilothermic) and hibernate in winter.

Examples

Frog, Toads and salamanders are common examples.

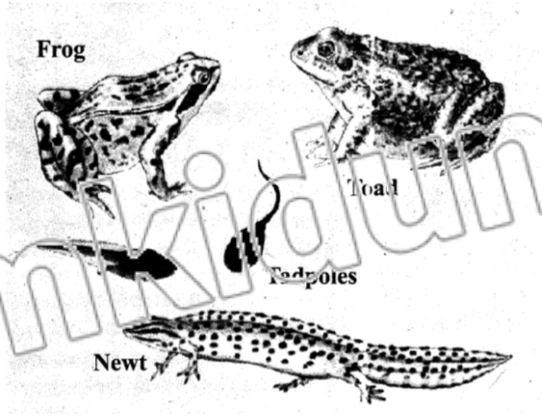


Fig: 10.18 (a) Amphibians

QUESTION RELATED TO ABOVE ARTICLE

Explain the general character of class amphibia.

Give the characteristics features of amphibians.

10.11.2 Class Reptilia

Reptiles are adapted for complete existence on land in contrast to amphibians that are still tied more or less to water or moist habitat. This indicates that reptiles have certain adaptations not found in amphibians.

Characteristic Features

Some of the advancements shown by reptiles are their characteristic feature. These are as below:

1. They have ***dry scaly skin***, which is adapted to life on land.
2. ***Heart*** is four chambered with incompletely partitioned ventricle. In crocodiles, ventricles are completely partitioned into two. These changes ensure more oxygen supply through blood circulation to all parts of the body.
3. Most reptiles have better developed ***limbs***, well adapted for efficient locomotion.
4. Reptiles have developed some sort of ***copulatory organ*** necessary for internal fertilization.
5. In amniotic eggs of reptiles, ***shell*** is leathery, which can resist dryness and injury. They have large yolky eggs.
6. They have ***protective embryonic membranes*** called amnion, allantios and chorion.
7. They are also ***cold blooded*** (poikilothermic) and hibernate in winter.

The above characteristics are for terrestrial habitat in which most of the reptiles live. However it is determined fact that reptiles have evolved from amphibians by undergoing the above changes and have become fully terrestrial.

Reptiles in Time

Reptiles flourished throughout ***Mesozoic period*** (225-65 million years age). Climate, which was favourable for them, became less favourable in tertiary period. So most of them became extinct. The existing reptiles belong to four, out of dozen or more main lines that have existed.

Examples

The modern reptiles for the most part live in temperate and tropical zone, indeed they flourished in the latter.

Most common examples are lizard, snake, sphenodon, crocodile etc.

Reptiles of today have been derived from dinosaurs of Jurassic (195-136 million years) and Cretaceous period (136-65 million years).

Birds are considered to be evolved from crocodile.

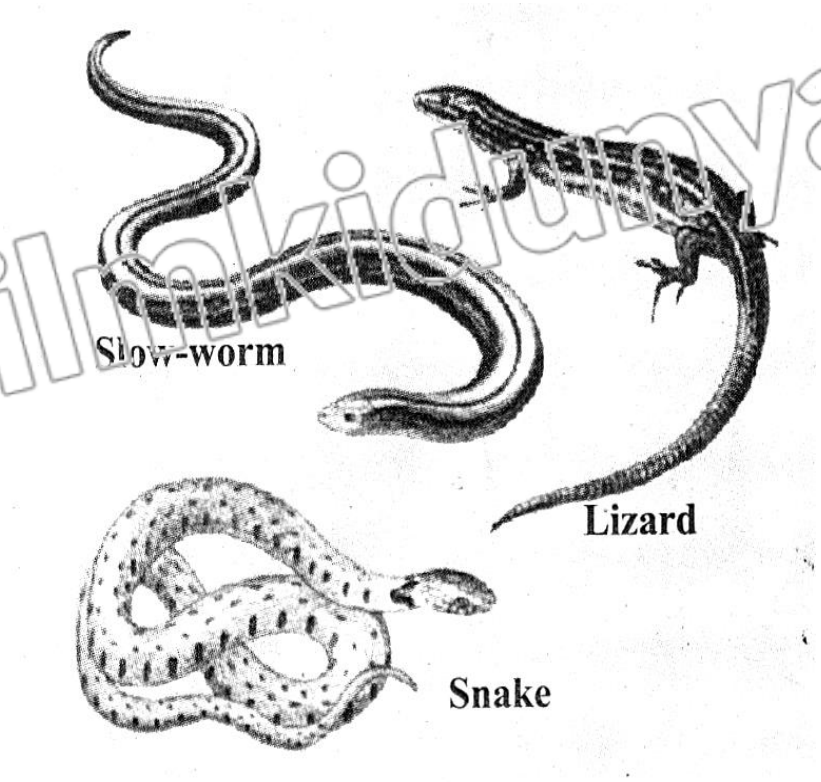


Fig 10.18 (b): Reptiles

QUESTION RELATED TO ABOVE ARTICLE

Give general characteristics of class reptilia.

Distinguish between by giving examples. **(Exercise Question ix)**

a) Anamniotes and amniotes

10.11.3 Class Aves-Birds

Birds are one of the most interesting and most widely known group of animals. Birds share with mammals the highest development in the animal kingdom.

Evolution of Birds

It is believed that birds and mammals have evolved from reptiles along different lines.

The earliest known bird fossil is that of ***archaeopteryx***, two species of which have been found from the rocks of ***Jurrasic period*** of earth's history.

According to its fossils, it is found that

- It was about the size of a crow.
- Skull was similar to present day birds.
- Jaws extended into a beak and there was a long tail.
- It had bony teeth in jaw socket unlike modern birds, which do not have teeth.
- Each wing had three claws.

With the exception of feathers, these birds showed resemblance with the dinosaurs. Many fossils of birds from later eras of earth history have also been found that had teeth.

The above evidence suggests that birds evolved from reptilian ancestors. The archaeopteryx and other had characteristics of both reptiles and birds and therefore form a connecting link between the two distinct groups.

In eagle both ovaries and oviducts are functional.

Fig 10.19 (a): Archaeopteryx

10.11.3 (a) Characters of Birds

1. ***Body*** is stream-lined and spindle shaped with four divisions i.e. head, neck, trunk and tail.
2. ***Limbs*** are adapted for flying. The forelimbs are modified into wings and hind limbs for perching and in some birds for running as in ostrich.
3. There is epidermal exoskeleton of ***feathers***. Legs bear scales.
4. The skeleton is light due to ***air spaces***, which is an adaptation for flight.
5. The ***skull*** has large sockets, jaws extend into horny beak, teeth are absent.
6. The organ of voice is called ***syrinx***, it is situated at the lower end of trachea near the origin of the two bronchi.
7. As birds do not have teeth, they have developed a thick muscular structure called ***Gizzard***, which is used for crushing food.
8. The circulatory system has ***4-chambered heart*** and there is only ***right aorta*** which curves to the right side and then bends backwards.
9. The ***lungs*** have extensions known as air-sacs, which extend into the bones also.
10. ***Excretory system*** does not have a bladder. Urine is semisolid.
11. ***Sexes*** are separate. Fertilization is internal and eggs are of large size with much yolk. Only one ovary and oviduct is functional.
12. They are ***warm-blooded*** (homeothermic).
13. Some birds have secondarily lost the power of flight and are called ***running birds*** e.g. Ostrich, Kiwi etc.

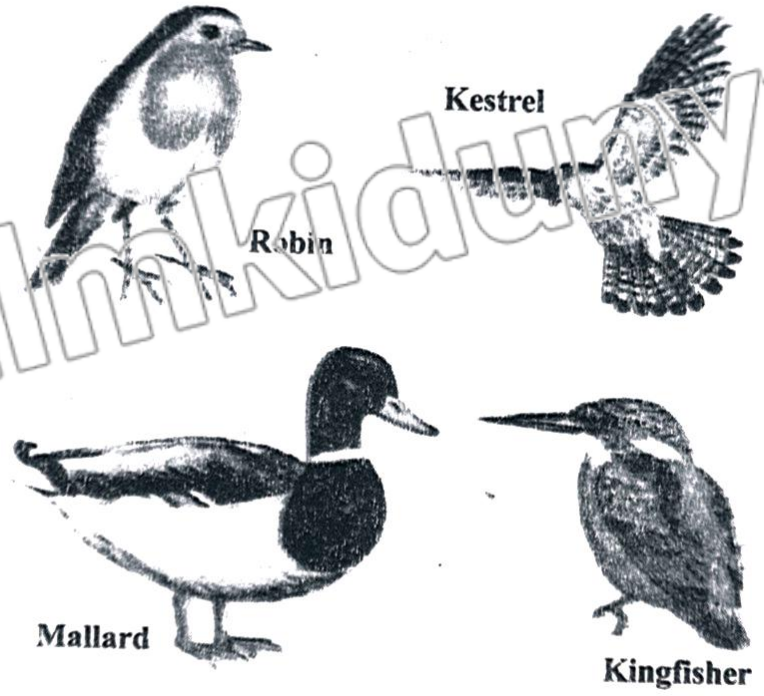


Fig. 10.19 (b): Birds

Examples

Most common examples are pigeon, robin, sparrows etc.

QUESTION RELATED TO ABOVE ARTICLE

Explain the general characteristics of class aves.

Give the adaptations for aerial mode of life in birds. What is their origin?

(Exercise Question vi)

10.11.4 Class Mammalia-Mammals

The term mammal was given by Linnaeus to that group of animals, which are nourished by milk from the breast of mother. The group is considered to be the highest in the animal kingdom.

Evolution of Mammals

Most important advancement is the evolution and development of their brain (nervous system).

It is universally accepted by biologist that mammals have evolved from reptilian ancestor, the ***cotylosaurs***. This has been determined on the basis of the fossil record, which is easily available due to preservation of hard bones.

The ancestors of mammals lived simultaneously alongwith reptiles in Jurrasic times and have been called mammal-like reptiles.

Some were only the size of mice and lived on trees. One of these early reptiles was **varanope** that was found as fossil in Texas.

Probably at least five groups of such mammal like reptiles developed mammalian characters and were 50% mammals. Mammals became dominant in the **Cenozoic period.**

Fig 10.20: Mammals

10.11.4 (a) General Characters of Mammals

Although mammals have evolved from reptiles they show many important structural differences. These differences are in fact the general characters of mammals which are as follows:

1. They are very ***successful group*** living in all kind of habitat i.e. land, freshwater, sea water and air.
2. They have body covering of ***hair*** instead of scales.
3. There is ***muscular diaphragm*** that separates the thoracic and abdominal cavities. This structure is not found in any previous group.
4. The ***lower jaw*** in mammals is composed of only one large bone and articulates directly with skull.
5. ***External ear or pinna*** is present. There is a chain of three bones in middle ear i.e. **Incus**, **Malleus** and Stapes.
6. Some mammals have deciduous and permanent ***teeth*** e.g. in man teeth are in two sets, one in early life (milk teeth) and other in later life (permanent teeth).
7. They have ***4-chambered heart*** and there is ***left aortic arch***.
8. They are ***warm-blooded*** animals.
9. The ***red blood cells are non-nucleated***.
10. They have developed voice apparatus, the ***larynx and epiglottis***.
11. Most give ***birth*** to young ones.
12. They feed their young ones on milk produced by ***mammary glands*** of mother.

Classification of Mammals

Mammals are classified into three sub-classes.

1) Prototheria
2) Metatheria
3) Eutheria

1) **Sub-Class Prototheria**

Prototherians are also called ***egg-laying mammals***.

Characteristics

They have characteristics of both reptiles and mammals and therefore form a connecting link between the two. They also provide evidence about evolution of reptiles into mammals.

Reptilian Features

- They lay ***eggs***.
- They have ***cloaca*** and cloacal opening instead of separate opening for digestive system and urinogenital opening.

Mammalian Features

- ***Hairs*** are present on body in form of thick fur.
- Females feed their young ones with ***milk*** after hatching.

Examples

- ***Duck-bill platypus*** is found in aquatic habitat. It has a bill similar to that of duck and has webbed toes. It has thick fur on body.
- ***Spiny ant-eater*** (Echidna) which has structures for ant eating habit.
  Both examples are found in Australia.

2) Sub –Class Metatheria

Metatherians are also called ***pouched mammals or marsupials***.

Characteristics

- These are most ***primitive*** mammals
- They have an abdominal pouch called ***marsupium*** where they rear young ones.
- ***Immature young ones*** are born and are carried by mother in marsupium till they develop to their maximum. During this period they are fed on the milk produced by the milk glands of mother, the nipples of which are in the marsupium.

Examples

Opossum, Kangroo **and** ***Tasmanian wolf*** of Australia and America are common examples.

3) Sub – Class Eutheria

Eutherians are also called ***placental or typical mammals***.

Characteristics

- Young ones are fully developed in the body of mother (due to large size). During development, ***placenta*** is formed between foetus and mother through which foetus is nourished. Placenta also has endocrine function i.e. produces hormones.
- They have ***maximum mammalian characters***. In some, ***scales*** (pangolin) and spines (porcupine) are found.

Examples

Examples are man, whale, elephant, horse, cat, mice, bat, dolphin etc.
Mammals beings a very successful group live in all kinds of habitat i.e. land, fresh water and sea for which their bodies are modified.

QUESTION RELATED TO ABOVE ARTICLE

Give general characters of mammal.
Explain the different groups of mammals.
What are the general characteristics of mammals? How do the three subclasses prototheria, metatheria and eutheria differ from one another?
What are the general characteristics of mammals? How do the three subclasses prototheria, metatheria and eutheria differ from one another? **(Exercise Question vii)**

Key points

Coelom:

True Coelomate:

The coelom formed from mesoderm is called true coelom. It is formed by the splitting of mesoderm into two layers. Outer layer is called parietal layer and inner layer is called visceral layer and the cavity between them is called coelom. It is present in most annelids and chordates.

Acoelomate:

In this case, the space between outer epidermis and inner gut (endoderm) is filled by loose mesodermal cells called mesenchyma. It is present in phylum Platyhelminthes.

Pseudocoel:

It is not a true coelom. It is the remaining part of blastocoel. Blastocoel is cavity present in blastula stage in embryo. Blastocoel is closed in all other animals. This coelom is not formed of mesoderm. It is formed form endoderm. So this is not a true coelom. It is present in Nematodes.

Haemocoel:

In this case, the body cavity or coelom is filled with blood. So it is called Haemocoel (Haem = blood). It is formed of mesoderm. So it is also a type of true coelom: It is present in phylum Arthropoda, Mollusca and some Echinodermata

Cleavage:

The divisions of zygote during embryo formation are called cleavage. These divisions are mitosis but these divisions take place at much faster than normal mitosis.

Spiral and Determinate Cleavage:

In this case, the plane of division is diagonal (cross) to the vertical axis. At eight cell stage, the small cells lie in the groove between larger underling cells. It is a determined cleavage. It means that the fate of each dividing cell is determined (what organ it has to make) at very early stage. If the cells of the embryo are separated at two, four or any later stage, each separated cell do not form complete embryo.

Radial and Indeterminate Cleavage:

In this case, the plane of cleavage is parallel to the vertical axis of the egg. It is indeterminate cleavage. In this case, the fate of the dividing cells is not determined at early stage. Each cell can develop complete embryo. It can produce identical twins, the dividing cells get separated.

Protostomata:

(Proto= first and Stoma =mouth)

In these animals, blastopore forms mouth. So the end with blastopore becomes anterior end and the other end becomes posterior end. Blastopore is an opening thorough which cells migrate inward. Anus is formed as separate opening towards posterior end. It is present in all invertebrates, expect echinoderms.

Deuterostomata:

(deutro= later and stoma=mouth)

In these animals, blastopore forms anus. So the end with blastopore become posterior end and the other end become anterior end. Mouth is formed as a separate opening towards anterior end. It is present in all the chordates and echinoderms.

Coelom formation:

Schizocoelous:

(schizo = broken and coelous = coelom)

In this case, coelom is formed by the splitting of mesoderm. The mesoderm breaks at certain point. A cavity is produced between the broken cells. It is called coelom.

Enterocoelous:

(entero = enteron or gut)

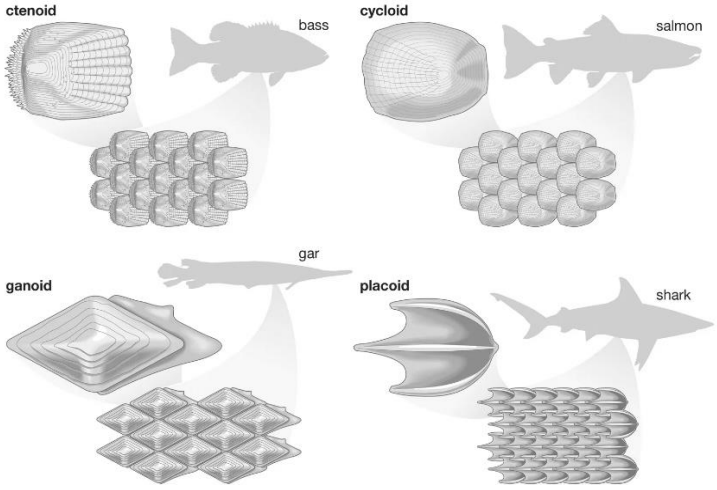
In this case, two small outpouching or pouches are produced in the dorsal wall of enteron (archenteron). These pouches separate from the enteron. The cavity inside the pouch becomes coelom.

Hermaphrodite:

In this case, the male and female reproductive organs are present on the same animal.

Phosphocreatin:

It is a substance presents in the muscles of chordates and echinoderms. It is an energy storing compound. All other invertebrates have energy storing compound Phosphoarginine.



Types of Fish Scales:

Scales in fishes:

(1) Placoid Scale:
These scales have a basal plate. A spine is arisen from this plate. These are present in sharks.

(2) Ganoid scales:
They are diamond shaped scales. These scales have a layer of a substance ganoine.

(3) Cycloid Scales:
These scales have several rounded growth lines.

(4) Ctenoid scales:
These scales have teeth like spines called ctenia.

Cold blooded animals (Poikilothermic):

So their body temperature changes according to temperature of surrounding. E.g. amphibians and reptiles

Warm blood animals (homeothermic):

The animals which maintain their body temperature constant is called cold blooded or pokilothermic. E.g. **bird and mammals.**

Difference between frog and toad

Frog	Toad
1. They have large size	**1.** They have small size
2. Their forelimbs are smaller than the hind limbs.	**2.** All their limbs are equals
3. Mostly they live near water.	**3.** They live in terrestrial condition e.g. houses and only go to water for reproduction
4. They have transparent skin	**4.** Their skin is rough with many glands.

Placenta:

The physiological contact between the maternal and foetal tissues for exchange of material is called placenta.

EXERCISE

Q.1. Fill in the Blanks

i) Protozoa have been placed in a separate kingdom known as _____.

ii) The sponges do not have any symmetry and are therefore called _____.

iii) Between ectoderm and endoderm, the coelenterate have a non-cellular _____.

iv) Taenia solium has _____ and _____ for attachment to the intestine of host.

v) In annelids, the body segmentation is of the type known as _____.

vi) In insects, there are _____ pairs of legs present in the _____ region of the body.

vii) The organ of locomotion in molluscs is _____.

viii) In animals, where there are definite left and right sides of the symmetry is _____.

ix) The system in which water moves inside the body of an echinoderm is called _____.

x) Coelom is the body cavity formed from the _____ layer.

Ans: i) Protista ii) Asymmetrical
iii) Mesoglea iv) Sucker, Hook
v) Metamerical segmented
vi) Three, Thorax
vii) Muscular foot
viii) Bilateral Symmetry
ix) Water vascular system
x) Mesoderm

Q.2. Encircle the correct answer from the multiple choices.

i) Vertebrates that develop embryonic membranes around their embryo are called:
(a) Amniotes
(b) Anamniotes
(c) Both a & b
(d) None of these

ii) In animals the bodies of which can be divided in two equal halves only in one plane are:
(a) Asymmetrical
(b) Bilaterally symmetrical
(c) Radially symmetrical
(d) None of these

iii) Animals have their body cavity filled with parenchyma are:
(a) Acoelomates
(b) Coelomates
(c) Pseudocoelomates
(d) None of these

iv) The vertebrates in which placenta is formed during the development of fetus are:
(a) Pisces **(b)** Aves
(c) Mammals **(d)** None of these

v) In amphibians the necessary requirements to spend their life history are:
(a) Land **(b)** Water
(c) Both **(d)** None of these

vi) Trypanosoma causes the disease:
(a) Malaria
(b) Sleeping sickness
(c) Cholera
(d) None of these

vii) In Annelids, the organs for excretion are:
(a) Flame cells
(b) Nephridia
(c) Kidneys
(d) None of these

viii) In molluscs, the foot is used for:
(a) Capturing prey
(b) Locomotion
(c) Both
(d) None of these

Answer key

i	a	**iv**	c	**vii**	b
ii	b	**v**	b	**viii**	b
Iii	a	**vi**	b		

Q.3. Extensive Questions.

i) What are Cnidaria? Explain the diploblastic origin and alternation of generation in Cnidaria.

Ans: (See article 10.8.1)

ii) Describe the parasitic adaptation in phylum platyhelminthes. How tapeworms affect a person?

Ans: (See article 10.9.1)

iii) Give the symptoms for the disease caused by certain nematods.

Ans: (See article 10.9.2 (b)

iv) Give an account of the major groups of Arthropods. What is the economic importance of insects?

Ans: (See article 10.9.4 (d)

v) Give the adaptations for aerial mode of life in birds. What is their origin?

Ans: (See article 10.11.3)

vi) Give the two major classes of the pisces and explain adaptations of aquatic mode of life in fishes.

Ans: (See article 10.10.1)

vii) What are the general characteristics of mammals? How do the three subclasses prototheria, metatheria and eutheria differ from one another?

Ans: (See article 10.11.4)

viii) Distinguish between by giving examples.

(a) Radial and Bilateral Symmetry.

Ans: (See article 10.3 & 10.4)

(b) Diploblastic and Triploblastic Animals.

Ans: (See article 10.5)

(c) Anamniotes and Amniotes.

Ans: (See article 10.11.1 & 10.11.2)