

Chapter 10

KINGDOM ANIMALIA

Q.1 Basic and key terms of Animalia.

Ans. **ANIMAL**

A *multicellular heterotrophic* organism which is developed from haploid (IN) non-motile egg and haploid motile sperm while originated from protista is known as animal.

Heterotroph + Multicellular + Multicellular sex organs + Embryo = Animal

Invertebrates: The *lower* animals **without notochord** or *vertebral column* are called invertebrates.

Vertebrates: The *lower* animals which belong to sub-phylum vertebrate of phylum chordata in which notochord replaced in adult stage by a vertebral column.

Chordates: Those animals which belong to phylum chordata and possess notochord in their life history are called chordates.

Example: Fishes, Amphibians (frog), Reptiles, Aves, Mammals.

Protochordates: The animals **without cranium** are called protochordates.

Vertebral Column: The backbone which is a series of vertebrae and made up of bones or cartilages.

Notochord: The longitudinal running which lies between the dorsal nerve tube and gut for internal support. In most chordates, it is replaced by vertebral column.

Symmetry: The geometrical view of an organism is called symmetry.

(a) **Radial Symmetry:** The arrangement of body parts around a central axis and without left and right sides, they have identical two halves by cutting of any diameter.

(b) **Bilateral Symmetry:** The arrangement of body parts in which left and right sides, anterior and posterior ends, dorsal and ventral surfaces are found.

Dorsal: Dorsal means *upper surface* of the body.

Ventral: Ventral means *lower surface* of the body.

Diploblastic: The simple body plan consists of outer *ectoderm* and inner *endoderm* and has *Mesoglea* between the derms.

Triploblastic: The complex body plan consists of *three* germinal layers i.e. endoderm, mesoderm and ectoderm.

Coelom: (کولم) The *body cavity* of an individual is called coelom.

Enteron: A body cavity with a *single opening* to the environment is called enteron.

Tissue: A group of cells, often similar in structure and origin and perform specific function is called tissue.

Q.2 *Introduce the kingdom which includes animals.*

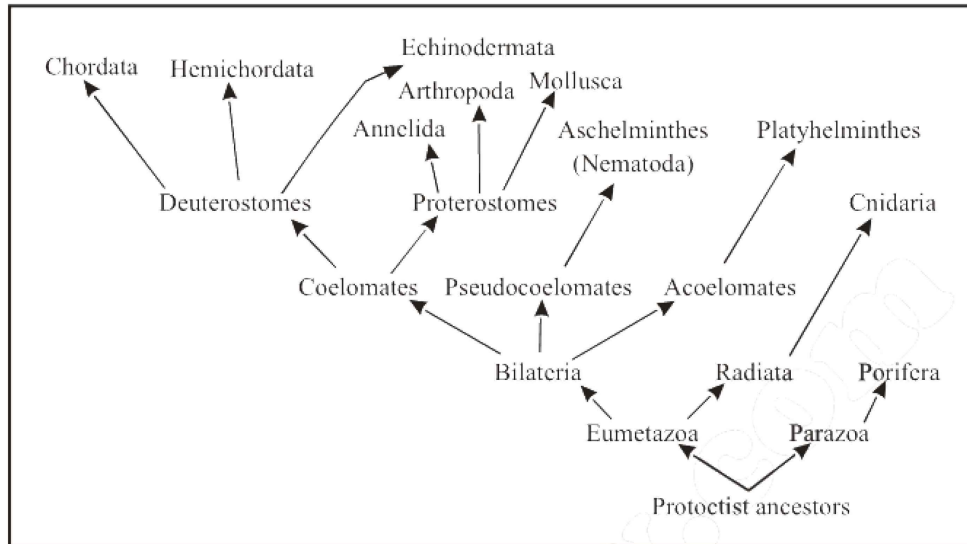
Ans. Animals are included in Kingdom Animalia (*Latin, anima – breath or soul*). Traditionally there are two kingdom systems i.e. *Protozoa* including unicellular animals and *Metazoa* including multicellular animals. According to *Whittakar* Protozoa belong to kingdom prototista.

KINGDOM ANIMALIA

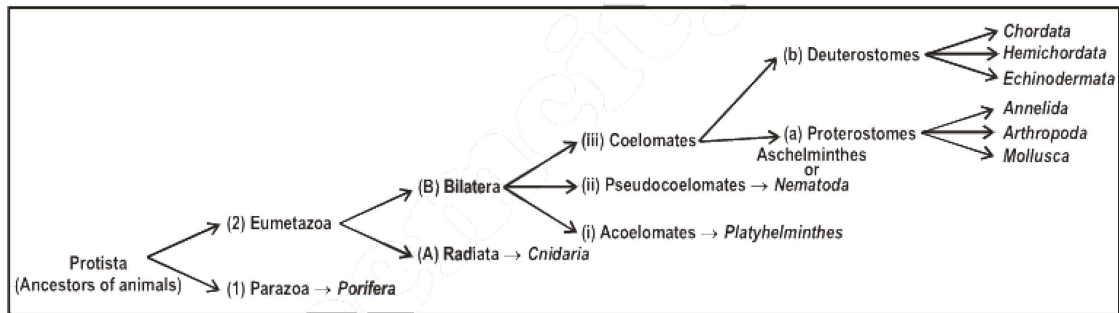
It includes animals which are *heterotrophs* and develop from two dissimilar haploid gametes i.e. large *immotile egg* and small *motile sperm*.

Most of the biologists believe that animals evolved from prototists. But many questions are still unanswered about the origin of different animals.

The Relationship of Different Phyla



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HELP LINE

Q.3 Discuss in detail the development of complexity in animals.

Ans. Both the kingdoms, Fungi and Plantae are multicellular like kingdom Animalia but in Animalia the cells are joined by complex functions which are involved in the transportation and communication through the cells. The animals include microscopic to largest sea mammals such as Whale.

Kingdom Animalia include two subkingdoms i.e.:

- (a) Subkingdom Parazoa.
- (b) Subkingdom Eumetazoa.

(a) Subkingdom Parazoa (Phylum Porifera):

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

(b) Subkingdom Eumetazoa:

These have organs and systems with *radial symmetry* (grade Radiata) or *bilateral symmetry* (grade Bilateria) Eumetazoa are divided into *three* groups on the basis of presence, absence or type of body cavity in them.

Acoelomate: They include animals which do *not have a body cavity*.

Pseudocoelomata: They include animals which include *false coelom*.

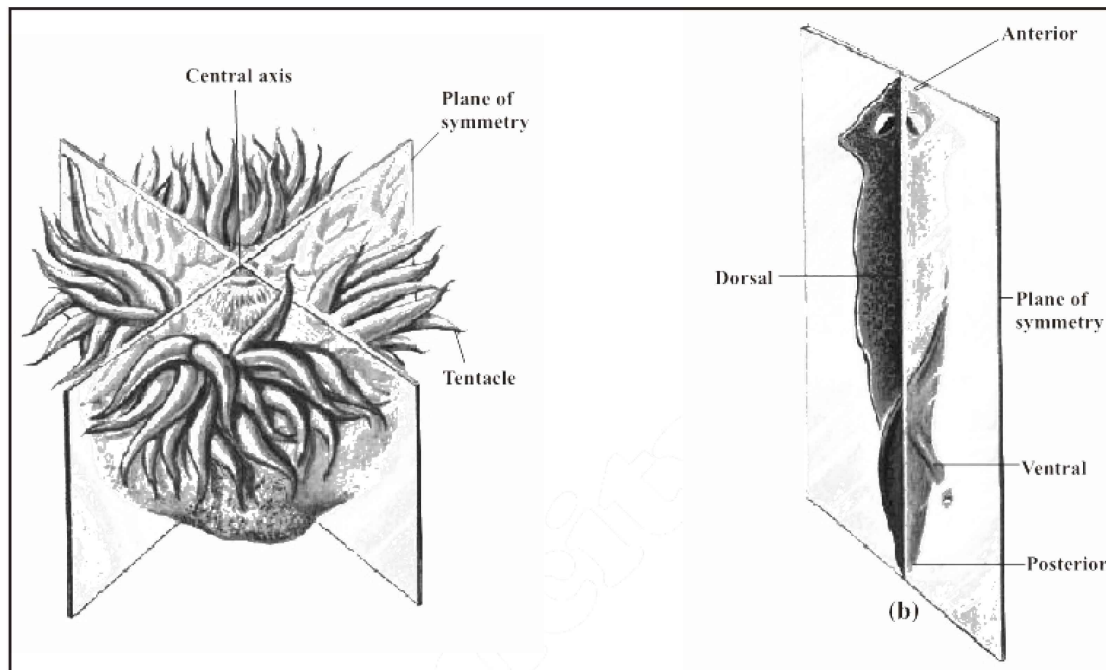
GRADE RADIATA:

- (i) These have **radial symmetry**.
- (ii) They are *diploblastic*.
- (iii) The 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 e.g., *Cnidaria Coelentrata*).
- (iv) In Sea anemone cylindrical *body can be cut in two equal halves vertically in any plane*.

GRADE BILATERIA:

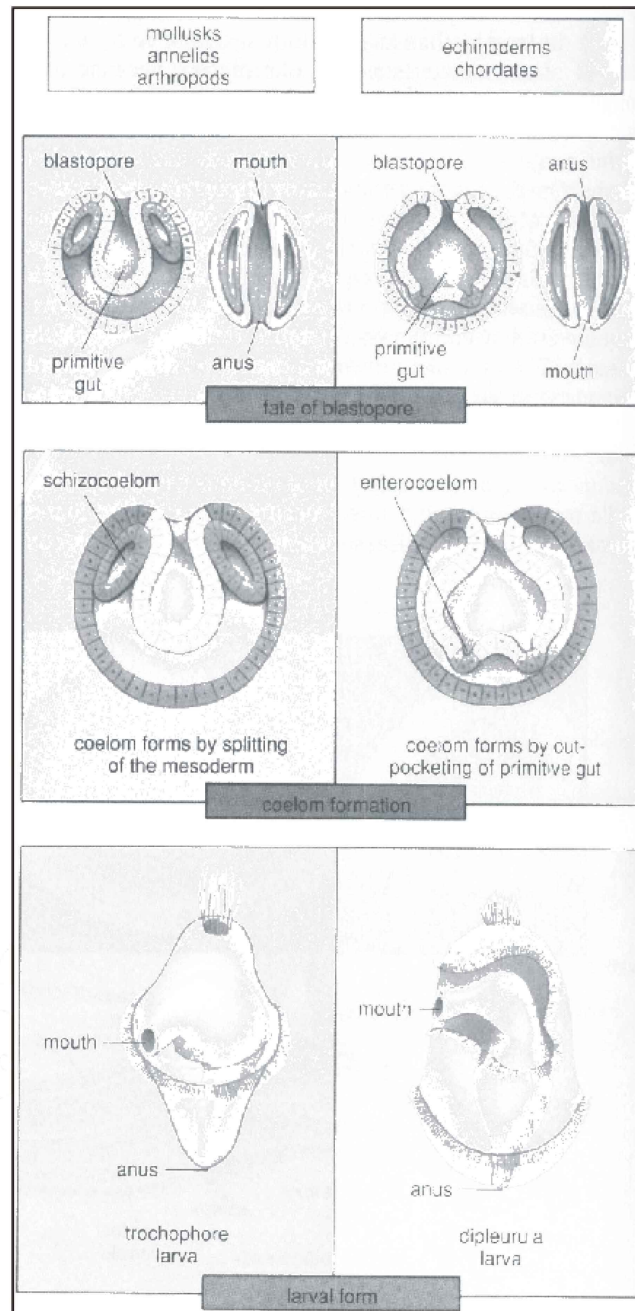
- (i) These include *bilateral symmetrical* animals i.e., the animal is divided into two equal halves, *right and left* on drawing imaginary line.
- (ii) The animals have *distinct anterior and posterior end*.
- (iii) The body has *distinct dorsal and ventral surface*.
- (iv) The grade bilateria includes phyla **Platyhelminthes, Nematoda, Annelida, Mollusca, Arthropoda, Echinodermata, Hemichordata and Chordata**.

- (v) The larva of Echinoderms have **bilateral symmetry**.
- (vi) The animals have **triploblastic** organization.
- (vii) The animals included in bilateria may be **acoelomata**, **pseudocoelomata** or **coelomata**.



Series Proterostomia (<i>Protostomes</i>)	Series Deuterostomia (<i>Deuterostomes</i>)
<ol style="list-style-type: none"> 1. Cleavage or division of the zygote is spiral and <i>determinate</i>. 2. During development process the <i>mouth</i> in these animals <i>arises</i> from the <i>blastopore</i> or from its anterior margin. 3. Coelom or body cavity is formed due to splitting of mesoderm (<i>Schizocoelous</i>). 4. Mesoderm is derived from cells on lip of blastopore. 5. This series proterostomia includes animals belonging to phyla Aschelminthes (Nematode), Annelida, Mollusca and Arthropoda. 	<ol style="list-style-type: none"> 1. Cleavage is <i>radial and indeterminate</i>. 2. During embryonic development mouth is formed at some distance anterior to the blastopore and <i>blastopore</i> forms the anus. 3. Coelom is developed as an outpouching of archenterons (<i>Enterocoelous</i>). 4. Mesoderm is derived from wall of developing gut (Archenteron). 5. This series includes animals belonging to phyla Echinodermata, Hemichordata and Chordata.

HELP LINE



Q.4 Give a comparison of protostomes and deuterostomes:

Ans. Consult above.

Q.5 (a) What do you mean by symmetry: give examples.

Ans. **SYMMETRY**

The geometrical view of an organism is called symmetry.

- (i) **Radial Symmetry:** The arrangement of body parts around a central axis and without left and right sides, they have identical two halves by cutting of any diameter.
- (ii) **Bilateral Symmetry:** The arrangement of body parts in which left and right sides, anterior and posterior ends, dorsal and ventral surfaces are found.

Q.5 (b) Define the followings.

Dorsal: Dorsal means *upper surface* of the body.

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Diploblastic: The simple body plan consists of outer ectoderm and inner endoderm and has *mesoglea* between the derms.

Triploblastic: The complex body plan consists of *three germinal layers* i.e. endoderm, mesoderm and ectoderm.

Coelom: The *body cavity* of an individual is called coelom.

Enteron: A *body cavity with a single opening* to the environment is called enteron.

Tissue: A *group of cells*, often similar in structure and origin and perform specific function is called tissue.

Q.6 (a) What is bilateral symmetry? Give examples:

Ans. See Q.5 (ii).

Q.6 (b) Explain spiral and radial cleavages.

Ans. (i) **Spiral and Determinate Cleavage**

In this case lines or planes of cleavage are not symmetrical between poles instead these are diagonal to the polar axis and produce unequal cells around the axis of polarity and all the blastomeres have determinate role involved in embryo formation.

(ii) **Radial and Indeterminate Cleavage**

In this case the cleavage are symmetrical to the polar axis and produce tiers of cells on top of each other and the fate of each blastomere is not pre-determined. In certain cases any one blastomere can produce a complete embryo.

Q.6 (c) Differentiate between diploblastic and triploblastic.**Ans.**

Diploblastic	Triploblastic
1. They belong to division <i>radiata</i> .	1. They belong to division <i>bilateria</i> .
2. The body is divided into two layers i.e., ectoderm and endoderm and have a non-cellular jelly like mesenchyma or mesogloea.	2. Thy body is divided into three layers i.e., ectoderm, endoderm and mesoderm. Ectoderm forms integument and nervous system, mesoderm forms muscles, skeleton and reproductive system, and endoderm forms digestive system like liver.
3. They have no spectralized transport system.	3. They have specialized organs and system for various activities.
4. Transportatio mostly occurs by diffusion.	4. Transportation occurs by blood vascular system .
5. They have no specialized nervous system rather have network of nervous.	5. They have cerebral ganglia or brain.
6. They have radial symmetry .	6. They have radial or bilateral symmetry and may be a coelomate, pseudocoelomate or coelomate.
7. They have gastrovascular cavity with single opening called mouth, through which ingestion and egestion occurs. Thus have sac-like digestive system phylum cnidaria or coelentrata.	7. They have well developed digestive system i.e. tubular digestive system.

Q.6 (d) Differentiate between the followings.**Ans. Differences between Acoelomate, Pseudocoelomate and Coelomate:**

Acoelomate	Pseudocoelomate	Coelomate
1. They do not have body cavity or coelom.	They possess false coelom or pseudocoelom.	In these coelom is a cavity present between the body wall and the alimentary canal and is lined by mesoderm.
2. Phylum <i>Platyhelminthes</i> are acoelomate.	<i>Aschelminthes</i> have pseudocoelom.	These include animals from <i>Annelids</i> to <i>Chordates</i> .
3. The mesoderm forms a loose, cellular tissue called mesenchyma or parenchyma .	Pseudocoeloms is not homologuos to coelom and is not lined by coelomic epithelium and have no relation with reproductive or excretory organ.	The mesoderm splits into outer parietal layer and inner visceral layer (زیر لای).

<p>4. In these have sac-type gut with no special transport system.</p>	<p>These develop from the blastocoel of the embryo and it is bounded externally by the muscles and internally by the cuticle of the intestine.</p>	<p>The animals which possess coelom or true body cavity are called coelomates e.g., Annelids to Chordates.</p>
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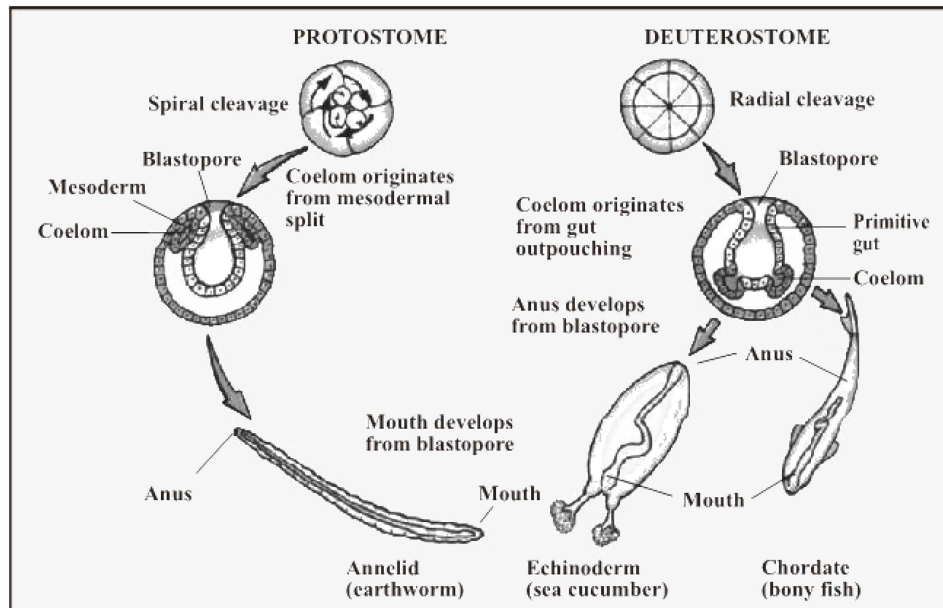
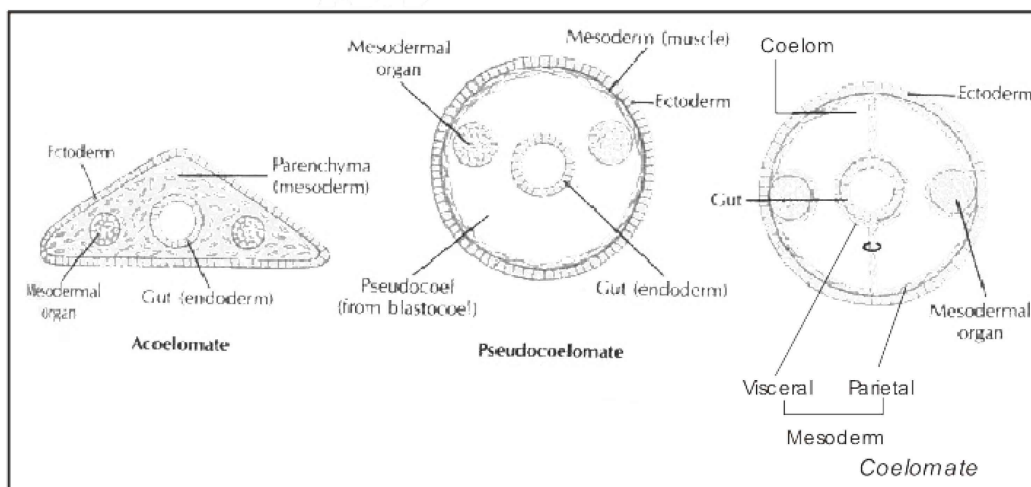


Fig. Patterns of embryonic development of coelom and of egg cleavage in protostomes and deuterostomes



Q.7 Write down the general characters of phylum proifera (Parazoa).

Ans. Proifera is derived from Latin word *porus* – *pore* and *ferra* – *to bear*. Thus Porifera are *pore bearing animals* and are called *Sponges*. The phylum includes 5000 species and out of it, 150 species are fresh water.

GENERAL CHARACERISTICS OF PORIFERA

- (1) These are **multicellular aquatic** animals with organized tissues or organs.
- (2) Sponges **lack symmetry**.
- (3) The body wall is differentiated into **two layers** outer and inner called **pinacoderm** and **choanoderm** respectively. The middle layer is gelatinous **mesenchyma**.
- (4) Pinacoderm is formed of cells called **pinacocytes** choanderm is formed of flagellated collar cell (**choanocytes**) and mesenchyma is formed of **amoeboid cells** with **spicules** or **spongifibres**.
- (5) The size the of animals **ranges from few millimeter wide** to more than one meter e.g., *Scolymastra joubini* a barrel like glass ponge of Antarctica is more than metre tall.
- (6) There is a **single cavity** inside the body, the **spongocoel** (سپنجوکیل) which in most sponges is divided into flagellated chambers or canals, lined by flagellated choanocytes.
- (7) **The pores (ostia)** are present on the body wall which are involved in water circulation.
- (8) Sponges are **sessile**, therefore **food come into contact through water** currents and moved in by flagella of choanoeytes.
- (9) They **depend 20% on zooplankton**, phytoplankton and **80% on detrital organic particles for food**.

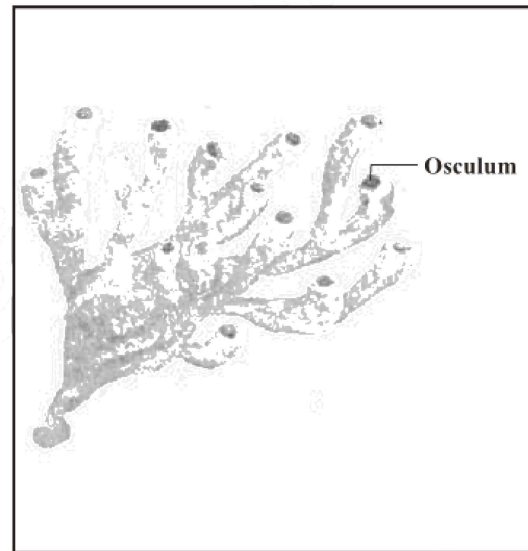
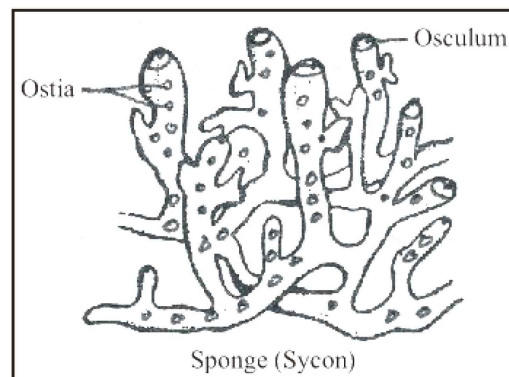


Fig. Sycon



- (10) The **waste material** either **diffuse** out of the sponge directly through the body wall **or flow out** through **osculum**.
- (11) The **larva are motile**.
- (12) They do not have well defined nervous system. But **neurosensory** and neuron cells help to coordinate the flow of water.
- (13) The skeleton is formed of needle like structures called **spicules** of which may be calcareous or siliceous. The skeleton of both Sponge is formed of sponging fibres. Osculum and ostia also possess spicules.
- (14) **Asexual reproduction** in sponges occur by **budding the buds** may be internal or external. The internal buds are called **gemmules**.
- (15) Sponges can also **reproduce sexually**. Mostly they are **hermaphrodite** i.e., possess both male and female sex organs in the same individual.
- (16) Mostly poriferans are **protandrous** i.e. **male sex develops before the female**.
- (17) The poriferans in which **sexes are separate**, sperms are released in water and carried to egg by amoeboid cells.
- (18) Fertilization takes place **in mesenchyma and zygote forms**.
- (19) **Embryo develops into blastula and larva**.

Examples:

- | | | | |
|-------|--------------|---------------|---|
| (i) | Sycon | (سالی کان) | — Marine sponge |
| (ii) | Leucosolenia | (لیکوسولینیا) | — Formed of group of erect tubes |
| (iii) | Euplectella | (یوپلکٹلا) | — A delicate sponge made of glassy frame work also known as venus flower basket . |
| (iv) | Spongilla | (سپانجیلا) | — Fresh water sponge |

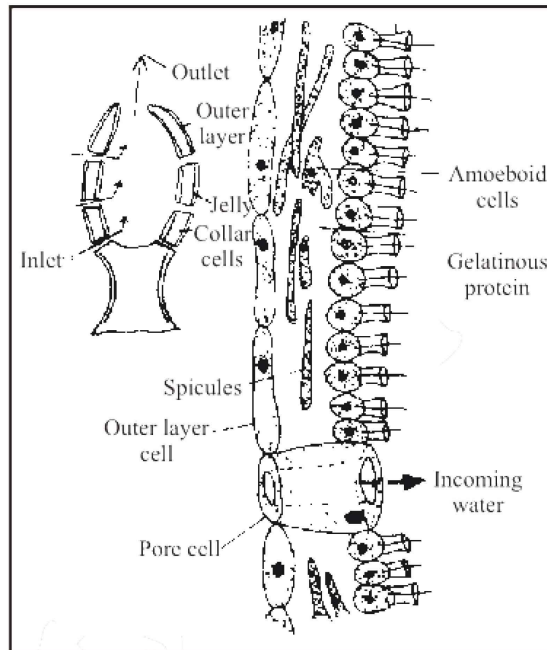


Fig. Arrangement of water circulation and cells of a sponge

Q.8 Discuss the importance of sponges.

Ans. (1) The skeleton of sponges can be **used for washing** and bathing by man.

- (2) Synthetic material can be used for making artificial sponges.
- (3) Natural sponges are still the demand of many factories.
- (4) Mediterranean sea is the source of best commercial sponges.
- (5) Sponges can absorb water to great extent.
- (6) In surgical operations they are used to absorb fluids and blood.
- (7) Sponges are used in building which make them sound proof.

Q.9 Discuss the general characters of phylum coelenterata.

OR

What are the general characteristics of cnidaria?

Ans. COELENTERATA

- (1) Coelenterate are also known as *Cnidaria* due to the presences of special cells called **cnidocytes** which give rise to **nematocysts** or **stinging cells** present in the **tentacles**.
- (2) Cnidarians are **diploblastic** i.e., have outer **ectoderm** and inner **endoderm**.
- (3) Ectoderm give rises to nematocyst and endoderm cells are involved in digestion of food.
- (4) **Mesoglea** (مزاجي) is jelly – like between the ectoderm and endoderm.
- (5) Coelentrates possess **gastrovascular cavity** or **enteron** with a single opening called mouth thus the animals have **sac like digestive system**.
- (6) Coelentrates have **radial symmetry**.
- (7) The members belonging to the phylum may be **microscopic** (like hydra) to **macroscopic** Branchiocranthus, a hydrozoan polyp having two meters.
- (8) They may occur in two basic forms, the **polyps** and **medusae**.
- (9) Polyps are cylindrical and **nutritive in function** thus called **gastrozooids**.
- (10) Medusae are **umbrella like**, free **swimming** and involved in sexual reproduction due to the **presence of gonads**.
- (11) Tentacles are present on the anterior part of the animal surrounding **mouth**. These bear nematocyst or **stinging cells** which are involved in offense and defense.
- (12) They are **Carnivorous** and feed on crustaceans like Cyclop, Daphnia etc. Tentacles trap the animal due to nematocyst and moved towards mouth and later the process of digestion occurs in the enteron.
- (13) There is **no central nervous system** rather the nerves which are irregular net or **plexus** in the body wall.
- (14) Most of the **corals** have hard **exoskeleton** formed of **calcium carbonate** (CaCO_3) secreted from epidermal cells. They form small coral islands or large **coral reefs**.

- (15) Some colonial coelentrates have upto five different types of **zooids**, involved in different functions for colony e.g., *Physalia* (فانیس).
- (16) Most species are **sessile** like *Hydra*, *Obelia*, Corals etc., some are colonial like Sea fans, while others are free – living and motile e.g., **jelly fish**.
- (17) They can reproduce both asexually and sexually.
- (18) **Asexual reproduction** occurs by budding which develops into new individual after getting detached from the parental animal.
- (19) **Obelia** reproduce both **asexually** and **sexually**. The animal produces zooids (*blastostyle*) which gives rise to medusae when released in water develop reproductive organs which give rise to **gametes** that unite to form zygote later obelia colony forms from it.
- (20) They have **alternation of generation**, one reproduces by sexual means and other by asexual means, both the generation are diploid. One is free living and other in attached.
- (21) The occurrence of structurally and functionally more than two different types of individuals, (called zooids) within the same organism is called **polymorphism**.

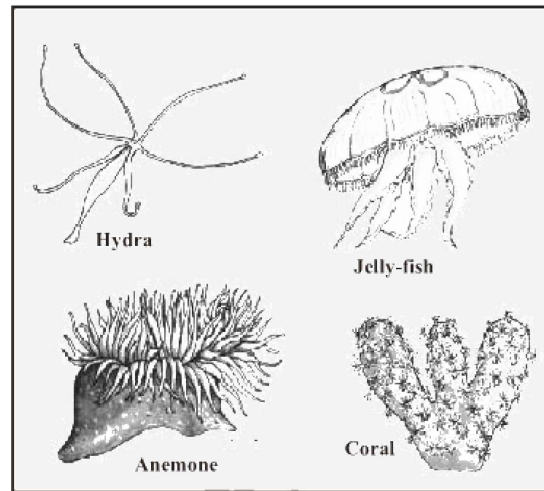


Fig. Coelenterates (Cnidarians)

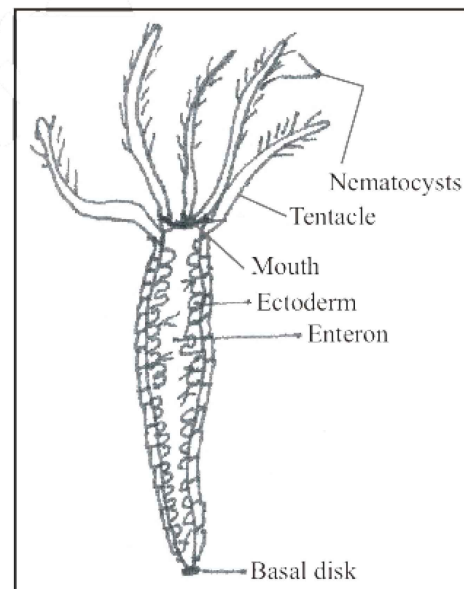
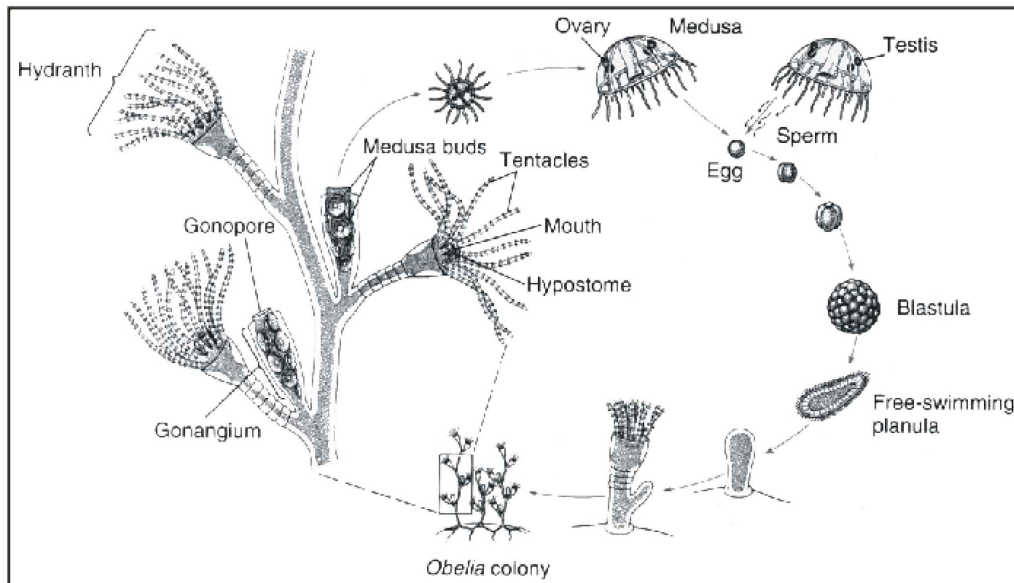
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Fig. Hydra

HELP LINE**Examples:**

- (i) **Hydra:** The organism live in **fresh water** exist in **polyp** form and **alternation of generation is absent**.
- (ii) **Obelia:** The animal is **marine** in habitat and **have alternation of generation**.
- (iii) **Aurelia:** The animal is commonly called **Jelly fish**. The polyp form is reduced and medusa is dominant in it.
- (iv) **Actinia:** The animal is known as **Sea Anemone**. It has **only polyp** form. **Enteron** is divided by large partitions called **mesenteries** (مغزى).
- (v) **Madrepore:** The animal body is covered of calcium carbonate. The animals are commonly called **corals**. The skeleton forms large coral reefs and even small coral islands.

Q.10 Write short note on coral reefs.

Ans. **CORALS**

Corals forms from the secretions produced by specialized polyp which are covered and involved in cups.

Tentacles are **involved in feeding** and withdraw itself within mouth when not feeding. The coral occur in the form of **colonies** and form a **stony network or mass**.

Living polyps are present on the surface layer of corals and the underneath mass are dead stony structures without any polyps, forms coral reefs. These are chemically formed of **calcium carbonates (limestone)**.

Corals provide *place for variety of sea life*.

OCCURRENCE:

Coral reefs are formed in the coastal waters of **Florida**, West Indies, East coast of Africa, Australia Island of **Coral sea**.

Q.11 Discuss its general characteristic of phylum platyhelminthes with suitable examples?

Ans. **GENERAL CHARACTERISTICS OF PHYLUM PLATYHELMINTHES**

- (1) They are **commonly called flatworm** having soft **dorsoventrally compressed** body.
- (2) They are **triploblastic acoelomate** i.e., the body is differentiated into three layers called *ectoderm*, *mesoderm* and *endoderm*.
- (3) They have **bilateral symmetry**.
- (4) The animals belonging to the phylum have **unsegmented body**.
- (5) Mostly the animals are **endoparasites** e.g., **Taenia solium** (tapeworm) **Fasciola hepatica (liver fluke)** and **Schistosoma (blood fluke)**.
- (6) Some of these species cause **human diseases**.
- (7) Few are **free living** and found in freshwater e.g., **Dugesia** (planaria).
- (8) The size of the animals range from **few millimeters** i.e., **10 mm** in case of planaria to **several meters** like worm.
- (9) **Digestive system is poorly developed** or may be absent as in the tape worm.
- (10) **Excretory system consists of branching** tubes ending in bulb – like cells, the **flame cells**.
- (11) Nervous system is well developed have an anterior **cerebral ganglia** or **brain** with a network of neuron over the body.
- (12) They do not possess respiratory and circulatory system.
- (13) The **parasite species** absorb nutrients from the living host i.e., liver fluke.
- (14) The **free – living species** like planaria feed on small animals and decayed dead bodies.

- (15) In free – living forms planaria are motile due to the presence of **cilia** on their undersides.
- (16) In parasitic forms the movement is restricted.
- (17) They can reproduce both **asexually** and **sexually**.
- (18) Asexually the species reproduce by **fission** in which the animal constricts in the middle into two pieces, each of which **regenerate** the lost part.
- (19) Sexually reproducing species are **hermaphrodite** i.e., both male and female sex organs are present in the same individual.
- (20) Sometimes **larval form** exist.

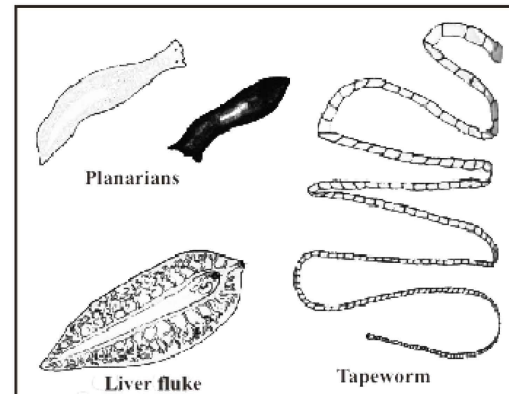


Fig. Examples of animals platyhelminthes

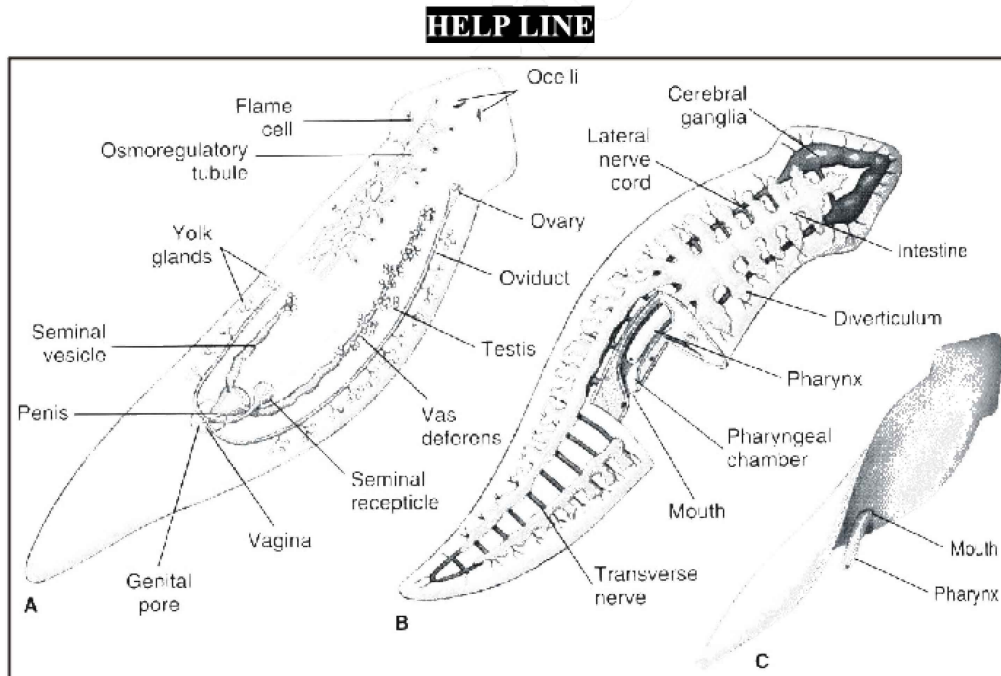
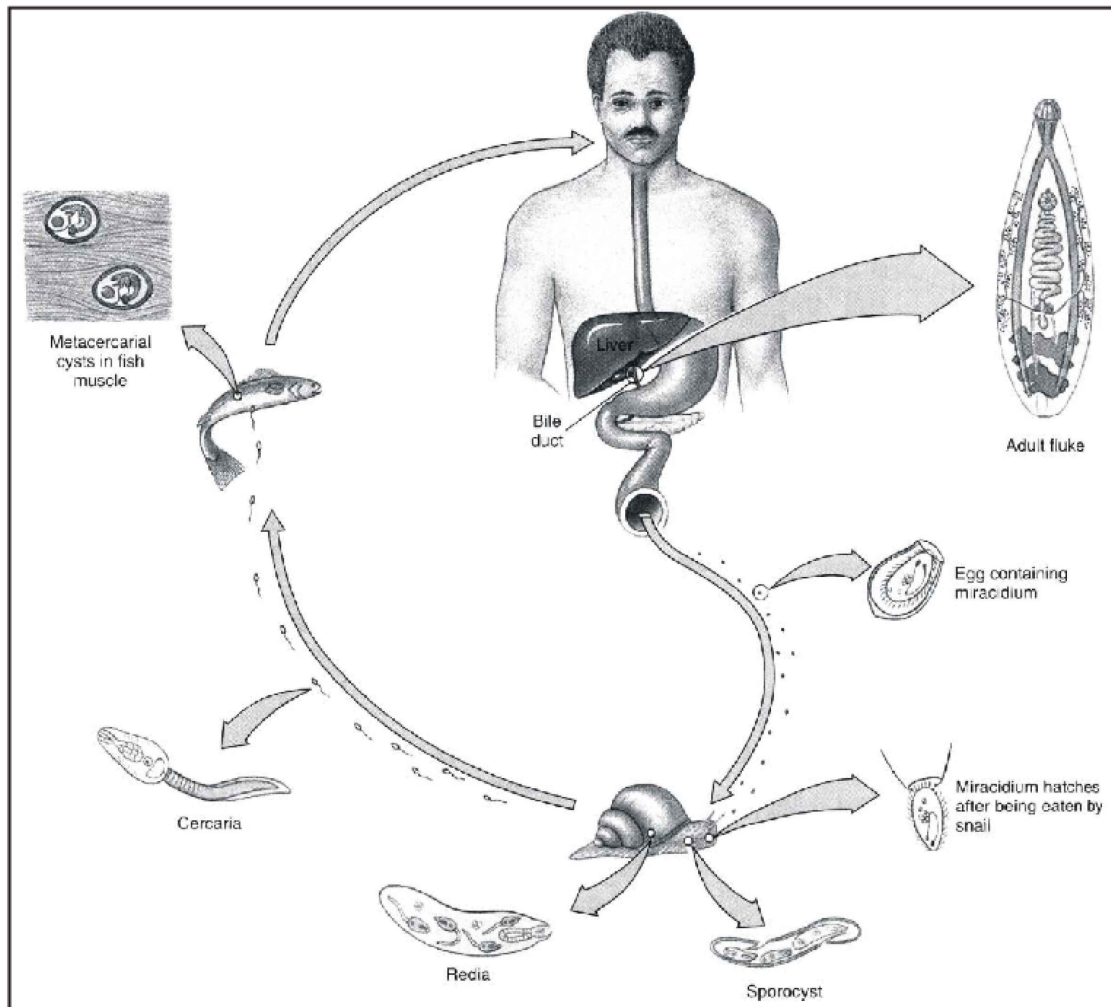


Fig. Structure of a planarian. A, Reproductive and excretory systems, shown in part. Inset at left is enlargement of a flame cell. B, Digestive tract and ladder-type nervous system. Pharynx shown in resting position. C, Pharynx extended through ventral mouth.

Examples:

- (i) **Dugesia (Planaria):** It is free – living with a ciliated outer surface.
- (ii) **Fasciola (Liverfluke):** The animal is an **endoparasite** live in **sheep** and occasionally in human beings. It attached to the host tissue by means of sucker. It completes its life cycle in **two hosts**, a **snail** and **sheep or man**. It lives in the bile duct of its host.

HELP LINE**Fig. Life cycle of human liver fluke**

- (iii) **Taenia (Tapeworm):** It is also an **endoparasite** complete life cycle in two hosts i.e., **human cattle or pig** is an intermediate host. Their body is **ribbon – like** and divided into segments called proglottids having sex organs. The segments continue to break off and are excreted from the intestine along with faeces.

Q.12 What are various adaptation for parasitic mode of life?

Ans. **ADAPTATIVE CHARACTERS OF PARASITIC PLATYHELMINTHES**

Following are the various characters of parasitic platyhelminthes:

- (1) They *do not have epidermis* but possess *resistant cuticle* over the body that protects the animal.
- (2) They have *adhesive organs* like *suckers* and *hooks* meant for the attachment to the host.
- (3) They have *degenerated muscular and nervous system*.
- (4) They have *simple digestive system* due to their *dependence on host*.
- (5) They have *complex reproductive system*. The ova are produced in large number which ensures the survival chance of the animal.
- (6) They have *complex life cycle* and have two or more host.

Q.13 Write short note on infestation and disinfestations.

Ans. (a) **INFESTATION**

The life cycle of Taenia (Tapeworm) completes into two hosts i.e., man and cow. Man as a host in man the development of Taenia's zygote begins while it is same the uterus of female. The last segments or proglottids and their uteri contain completely developed embryo, later mature proglottides break off from the body and pass out body of man along with faeces.

Embryo:

The embryo inside the egg is round in shape and has six chitinous hooks which show limited movement of contraction.

Cow as a Host:

Further development of Taenia completes in a second host i.e., Cow. The parasite remains embedded in the voluntary muscles of a cow. If an improperly cooked beef is eaten by a person, the parasite which survived further develops in the man intestine.

(b) **DISINFESTATION**

If the parasite enter the intestine of man it is difficult to remove it completely. Therefore beef should be *cooked properly* before eating it. If the parasite once enters in the digestive system certain *medicines* are recommended to remove it completely.

Platyhelminthes parasites have the ability of **regeneration and if only head remains inside** the intestine it can grow into new tapeworm. For the complete removal of parasite in addition to drugs physician also give *anema* to the patient.

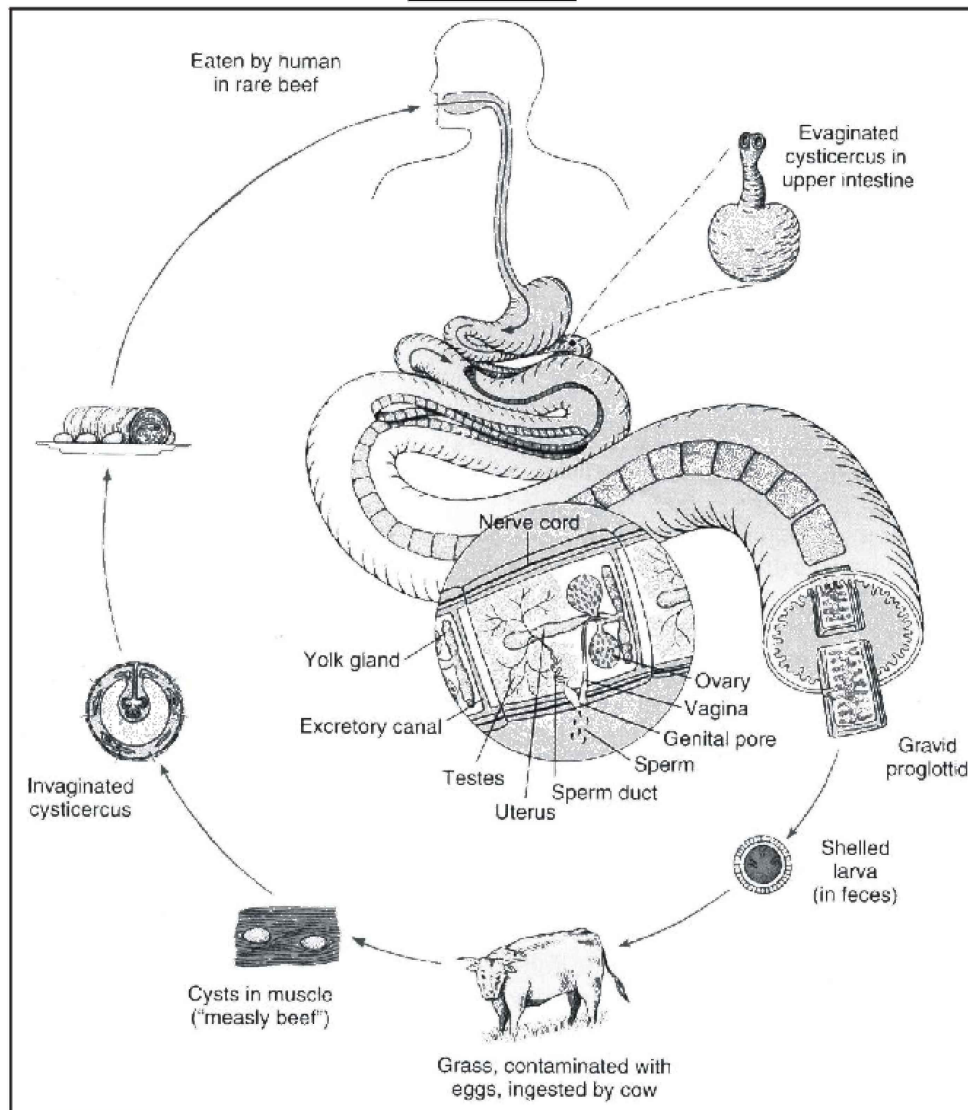
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Fig. Life cycle of the beef tapeworm, *Taeniarhynchus*. Ripe proglottids break off in the human intestine, pass out in the feces, crawl out of the feces onto grass, and are ingested by cattle. The larva hatch in the cow's intestine, freeing oncospheres, which penetrate into muscles and encyst, developing into "bladder worm". A human eats infected rare beef, and the cysticercus is freed in the intestine, where it attaches to the intestine wall, forms a strobila, and matures.

Q.14 Write down the general characteristics of *Aschelminthes*.

Ans. **GENERAL CHARACTERISTICS OF ASCHELMINTHES**

- (1) This is also known as phylum *Nematoda* commonly called **Roundworm** due to rounded body of the animal.
- (2) They are **triploblastic** animals having distinct three layers ectoderm, mesoderm and endoderm.
- (3) They are **pseudocoelomate** because the body cavity is pseudocoelom which is formed from hollow space, the blastocoel present in the blastula.
- (4) They include elongated worms with pointed ends. The name Nematoda means "**pointed ends**".
- (5) The animal have mouth at without anterior end with a **distinct head** without any special sense organs. Whereas posterior end possess an **anus**.
- (6) They have a number of vacuolated cells filled with a protein-rich fluid which develop high **hydrostatic pressure**.
- (7) They range they range in size from microscopic forms to length of up to one metre.
- (8) They have **tube like digestive system**. A fluid filled space is present between the body wall and alimentary canal. It provides "tube within tube" type structure in nematodes.
- (9) 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.
- (10) They have ring around the **pharynx**, which give rise to dorsal, ventral and lateral **nerve cords** running throughout the length of the worms.
- (11) The sense organs are in the form of **sensory papillae** –present on the lips at the anterior end.
- (12) The **circulatory** and **respiratory** systems are **absent**.
- (13) **Respiration** occurs through general **body surface**.
- (14) **Locomotion** is by **undulating waves** of contraction and relaxation of muscles. Which are arranged in four bands, two dorso-lateral and two ventro lateral.
- (15) They do not have circular muscles thus the **bending is dorso-ventral** only.
- (16) The species included in the phylum are **unisexual**.
- (17) The female gonads are called **ovaries** that produce egg and male gonads are called **testes** producing sperms.
- (18) They have **larval stage** in their life cycle.

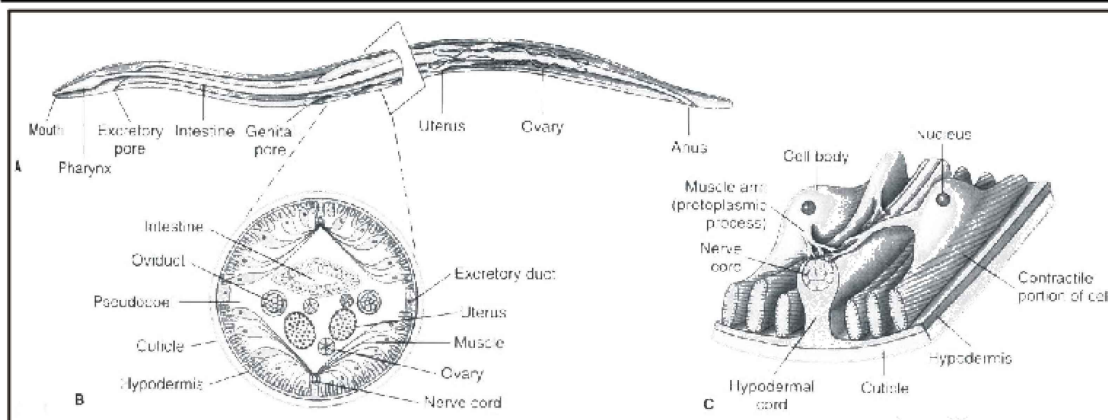


Fig. A, Structure of a nematode as illustrated by an *Ascaris* female. *Ascaris* has two ovaries and uteri, which open to the outside by a common genital pore. B, Cross section. C, Relationship of muscle cells to hypodermis and hypodermal cord.

Q.15 Discuss the various diseases caused by different genera of Phylum Nematoda.

Ans. The members of phylum Nematoda are **parasite** causing certain diseases in man and plants

***Ascaris lumbricoides*:** It is an intestinal parasite of man.

***Rhabditis*:** The number of species of the genus are often found in soil, organic matter, water, faces of **man** and **animals**.

***Enterobius vermicularis* (Pinworms):** This nematode is cosmopolitan but found commonly in Europe and America. They live in the large intestine of man i.e., caecum, colon and appendix.

The major **symptoms** caused due to their movement are:

- Intense itching of anus.
- Inflammation of mucous membrane of colon and appendix.
- Insomnia and loss of appetite.

***Acyclostoma duodenale* (Hookworm):** The worm lives as a parasite in man small intestine, results in holding the villi of intestine and sucks blood and body fluid. During feeding they produce an anticoagulant to prevent clotting of blood and after feeding leave the wound bleeding. In children they cause anemia and retard mental and physical growth. Round worms are present everywhere especially in the soil and cause breaking down of organic matter. Billions thrive in each acre of topsoil. A single rotting apple may contain **90,000** worms.

Q.16 Discuss the general characteristics of the segmented worms.**Ans. GENERAL CHARACTERISTICS OF ANNELIDA**

- (1) They include metamerically **segmented** worms. The word annelid is from Latin word meaning '*little ring*'.
- (2) The subdivisions may be indicated externally by constrictions of the body surface. Internally the segments are separated from each other by *septa* extending across the coelom.
- (3) The *gut*, *blood vessels* and *nerve cord* are continuous throughout the length of body penetrating each segment.
- (4) The species included in the phylum are *triploblastic* in organization.
- (5) The animal included in the phylum have *bilateral symmetry*.
- (6) They have well developed alimentary canal having a distinct mouth at end. The mouth is overhung by a lobed structure, the **prostomium**.
- (7) Digestive system is poorly developed in parasite species.
- (8) They are called **coelomate** due to true coelom i.e., the mesoderm splits into parietal layer of which lines the body wall, and the visceral layer which covers the alimentary canal, the space between the two layers of mesoderm, is the coelom, and is filled in by coelom fluid, which act as hydrostatic skeleton.
- (9) Excretion occurs by specialized structures called *nephridia* which are ciliated organs present in each segment in the body cavity.
- (10) They have well developed *central nervous system* having single *brain* with soild double, longitudinal, ventral *nerve cord*. The nerves arise in each segment from the nerve cord.
- (11) They have **closed circulatory system** i.e., blood flow in a *network of vessels* called blood vessels. Through it gaseous and nutrient exchange occurs.
- (12) They do not have respiratory system gaseous exchange occurs by means of *diffusion through the skin* into blood capillaries. The skin is kept moist by mucous, and coelomic fluid.
- (13) The body wall is formed of *two* types of muscles i.e., *circular and longitudinal muscles*. The former are arranged along the radius of the body and the later are arranged along the length of the body.
- (14) Locomotion results 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. Similarly contraction of longitudinal muscles produce a pressure in the coelomic fluid that would cause the body to widen. The organs of locomotion in annelids are *chitinous chaetae or setae* embedded in sacs earthworm

- or **parapodia** present in the body wall (Nereis). The chaetae are absent in leech.
- (15) Reproduction takes place by sexual method.
 - (16) Mostly the annelids are **hermaphrodite** i.e., male and female sexes are present in the same animal e.g. earthworm and leech.
 - (17) In some annelids like Nereis sexes are separate.

External fertilization occurs and produce a free swimming **trochophore larva**.

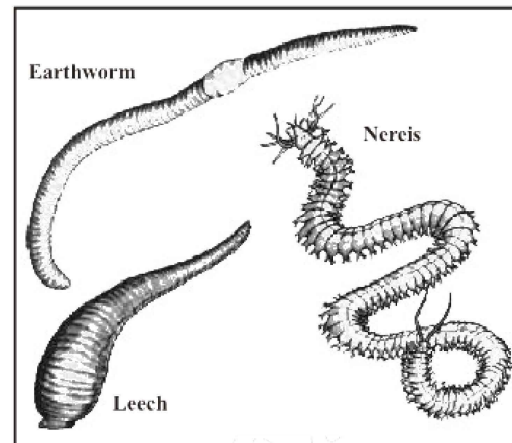
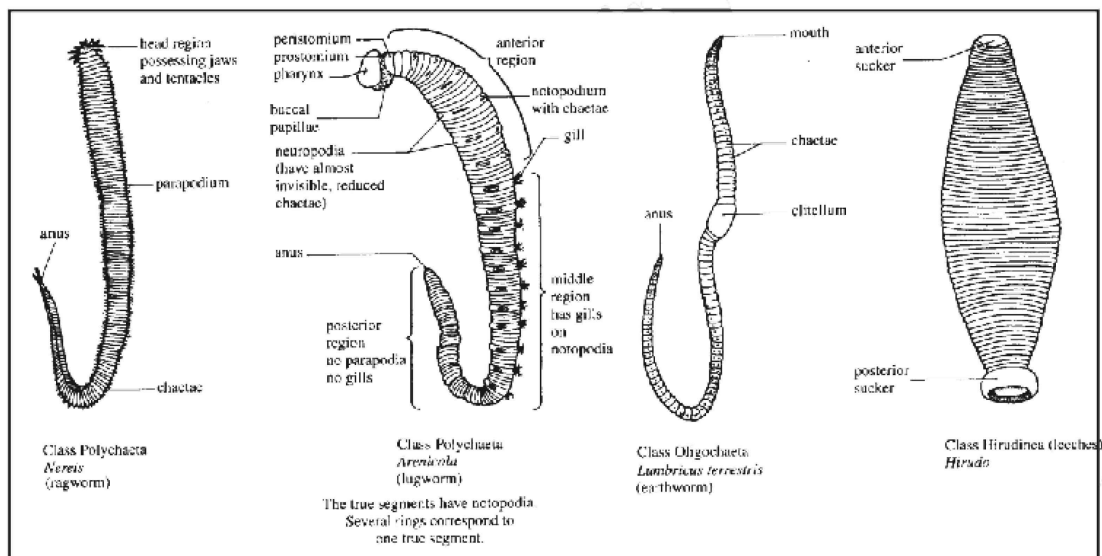


Fig. Example of animals belonging to Phylum annelida

ITEMS FOR SPECIAL ATTRACTION



Example:

Organisms	Habitat
Nereis	marine
Stylaria	fresh water
Earthworm	damp soil
Hirudo (Leech)	ectoparasite

Q.17 Write short note on the importance of Earthworm in improving the fertility of the soil?

Ans. Earthworm burrow itself in the soil thus permits greater penetration of air into the soil and **improves drainage capacity** of the soil. Plant roots can easily penetrate through such soil. When earthworm moves in and out of the soil, **mixing and churning of soil** occurs and thus the inorganic particles are brought up to the surface from lower region. Therefore earthworm is known as the **natural plough**.

Q.18 How many classes are found in Annelida? Write short note on each of them.

Ans. Phylum Annelida can be divided into *three* classes:

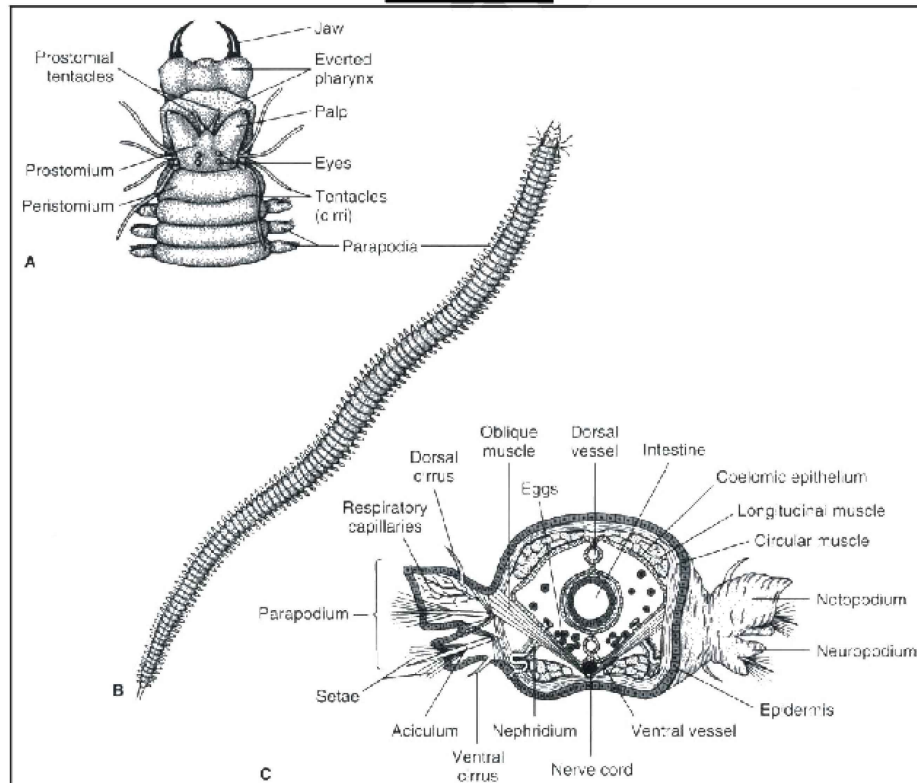
(1) Class Polychaeta (2) Class Oligochaeta (3) Class Hirudinea

(I) CLASS POLYCHAETA (Chaeta means long hair):

- (i) The members of this class have distinct head region with eyes and structure known as **palps** and **tentacles**.
- (ii) The animals include in the class are **unisexual**.
- (iii) Locomotory organs are called **parapodia**.
- (iv) They are aquatic in habitat **mostly marine**.
- (v) During their life cycle they form **Trochophore larva**.

Examples: Nereis, Chaetopterus

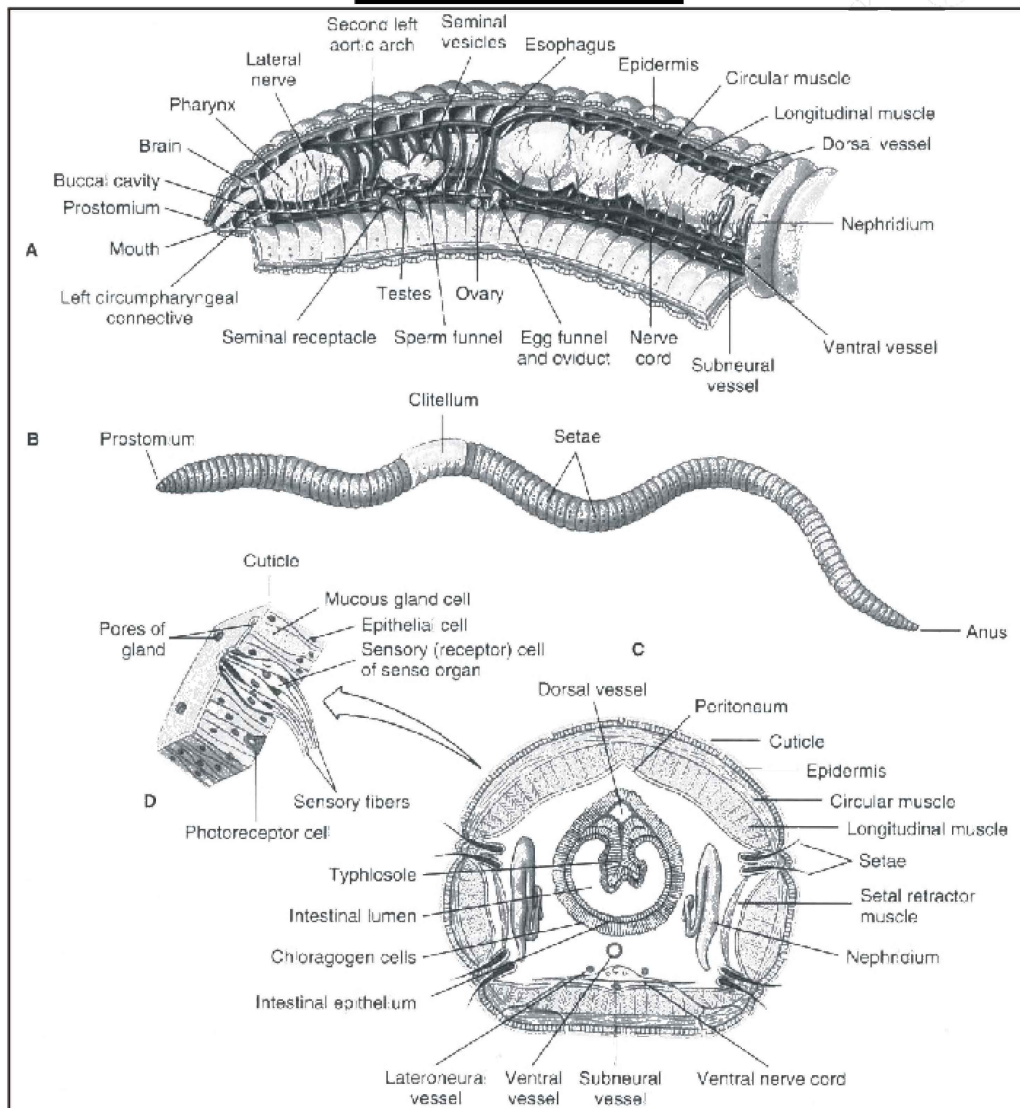
HELP LINE



(2) **CLASS OLIGOCHAETA:**

- (i) The members of this class have internal and *external segmentation*.
- (ii) They do not have distinct or prominent *head region*.
- (iii) The animals included in the class are *hermaphrodite* (male and female sex organs are in the same animal).
- (iv) They do not produce any *larva* during their life cycle.
- (v) They may be *terrestrial or aquatic* in habitat.

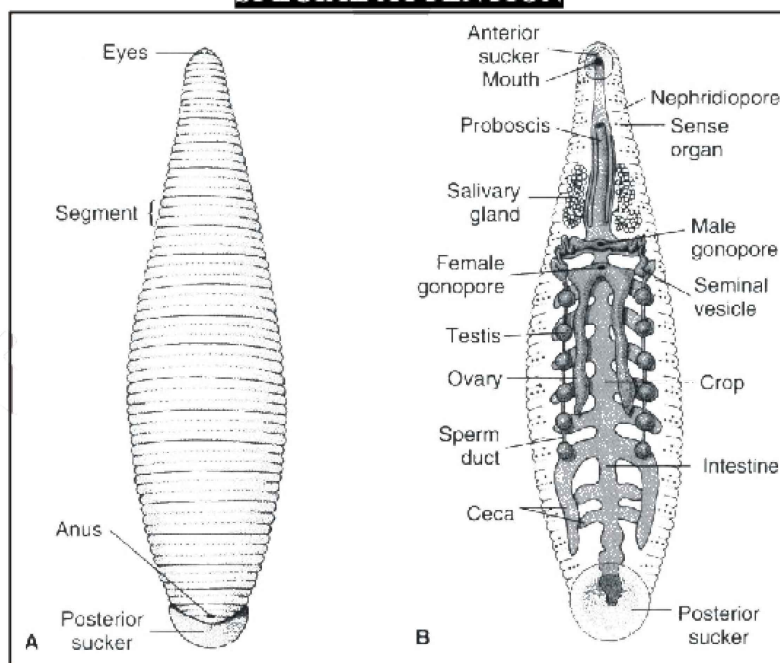
Example: Lumbricus terrestris, Pheretima posthuma.

SPECIAL ATTENTION

(3) CLASS HIRUDINEA:

- (i) They have body with **fixed number of segments**, with additional *circular rings* or markings called *annuli* on each segment.
- (ii) They do not have locomotory organs and move due to contraction of the body and with the help of *suckers*.
- (iii) The animals included in the class are *hermaphrodite*.
- (iv) They produce *trochophore larva* during their life cycle.
- (v) They do not have *distinct head*.
- (vi) In *leech* chitinous **jaws** are present meant for puncturing the skin of the host. They 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.

Example: *Hirudo medicinalis*.

SPECIAL ATTENTION

Q.19 (a) Give an account of the major groups of Arthropods?

(b) Classify arthropoda.

(c) What is the economic importance of insects?

Ans. (a) **PHYLUM: ARTHROPODA** – *Animals with Jointed Legs:*

General Characteristics:

- This phylum contains more species than any other phylum.
- The **body is segmented**.
Each segment is attached to its neighbour by means of a modified portion of **cuticle** which is thin and flexible.
They possess **jointed appendages**. These appendages have been modified for specialized functions.
- These are believed to have **common origin with annelids** because both have some common characteristics such as segmented body, appendages and cuticle.
- 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.
- Arthropods are variable structurally. Some are **worm-like centipedes, flying insects** with the body divided into distinct **regions, the head, thorax and abdomen**.
The body is covered with **waterproof chitinous cuticle** secreted by the epidermis.
- The coelom is not present as the main body cavity. Instead a **haemocoel** has developed. It is reduced coelom and communicates with blood vascular system.
- The digestive system is in the form of **alimentary canal with two opening, 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 **Malapighian tubules** is present in arthropods.
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.

The **sensory organs** are usually a pair of **compound** eyes and **antennae**.

- Most arthropods possess an extensive **tracheal system** formed of air tubes called tracheae 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.

The primitive heart and a main blood vessel.

Blood is colourless as it is **without haemoglobin**.

- The **skeleton** is external, i.e., *exoskeleton*.

It is in the form of an outer covering, the cuticle light in weight; and is formed chiefly of **chitin**. It provides surface for the attachment of muscles which help in locomotion.

- The arthropods exhibit **active and swift movements**.

They swim, crawl or fly depending upon the habitat they occupy.

The organs of locomotion are paired appendages and some cases paired wings also.

- The **sexes are separate**.

The **testes and ovaries**, produce **sperm** and **eggs** respectively.

- Life history has the process of metamorphosis i.e., different structural changes during lifecycle.

(b) **CLASSES OF ARTHROPODA**

Phylum Arthropoda is the *largest* group having great diversity in them. Some important classes are:

(a) Class Crustacea

(b) Class Insecta

(c) Class Arachnida

(d) Class Myriapoda

(i) **Class Crustacea**

- (i) There are about 26,000 species of crustaceans.
- (ii) These are *aquatic arthropods* and have gills for respiration.
- (iii) In *cephalothorax*, on the dorsal side the exoskeleton have the deposition of salt in addition to chitin which makes it more firm. The exoskeleton is called **carapace** (hard chitinous plates).

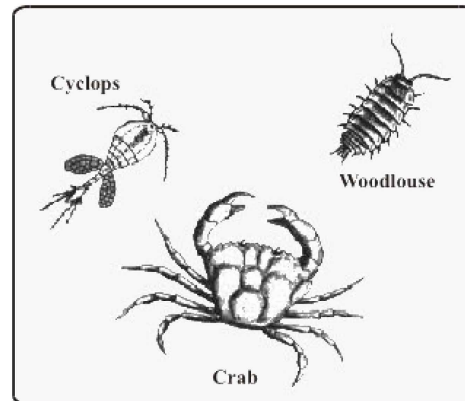


Fig. Example of Class Crustacea

- (iv) Their major functions of appendages are to capture food, walking, swimming, respiration.
- (v) Coelom is reduced and *haemocoel* is present.
- (vi) Two pairs of antennae are present on the head region.
- (vii) Pair of *mandibles* (jaws) and two pairs of maxillae are present.
- (viii) The organisms are *unisexual*.

Examples: Daphnia, Cyclops, Crabs, Lobsters, Prawn, Wood Louse etc.

(ii) **Class Insecta**

- (i) Around 70% of all known species of animals are insects.
- (ii) ***They are the only invertebrates that can fly and survive to a large extent away from water.*** They are widely distributed including the hot, burning sands of deserts, the cold, icy regions of poles, hot springs.
- (iii) Most insects are **herbivorous**, feeding on all sorts of plant material while a large number are **carnivorous**.

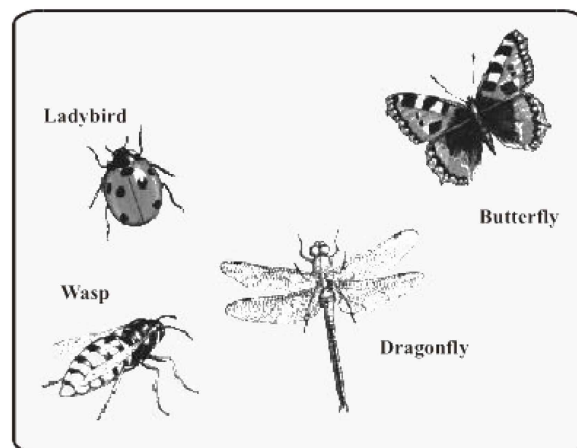
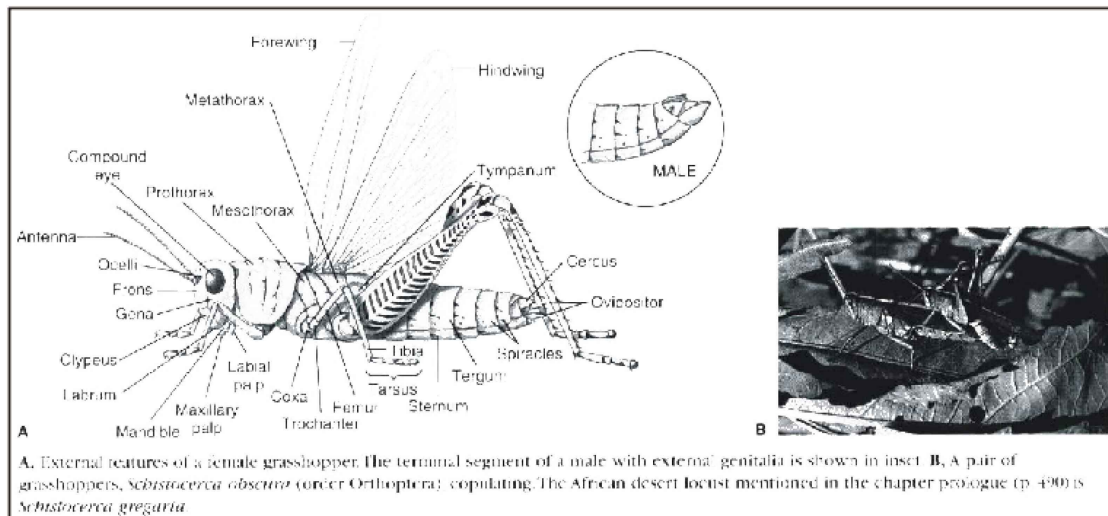


Fig. Example of Insects

SPECIAL ATTENTION

- (iv) Insects have segmented body divided into **three** parts, i.e., **head, thorax and abdomen**. Mostly segments of the head are fused and cannot be discerned. **Thorax** is formed of three segments and **Abdomen** has eight to eleven.
- (v) The entire body is covered by **exoskeleton** of **chitin** called **cuticle** which provides mechanical support to the muscles. **The cuticle is replaced by a process of moulting called ecdysis.**
- (vi) They have joined appendages attached to different parts of the body.
- (vii) The head bears pair of joined feelers called antennae.
- (viii) The thorax possess **three** pairs of walking legs. Sensory and reproductive structures are present in the abdomen.
- (ix) They bear two pairs of wings attached to the last two thoracic segments.
- (x) Insects undergoes various development stages such as egg, larva, pupa and adult. These changes are called **metamorphosis**. In some metamorphosis is incomplete. The larva resembles adult and called **nymph** or in star. It lives in the same habitat as adult.

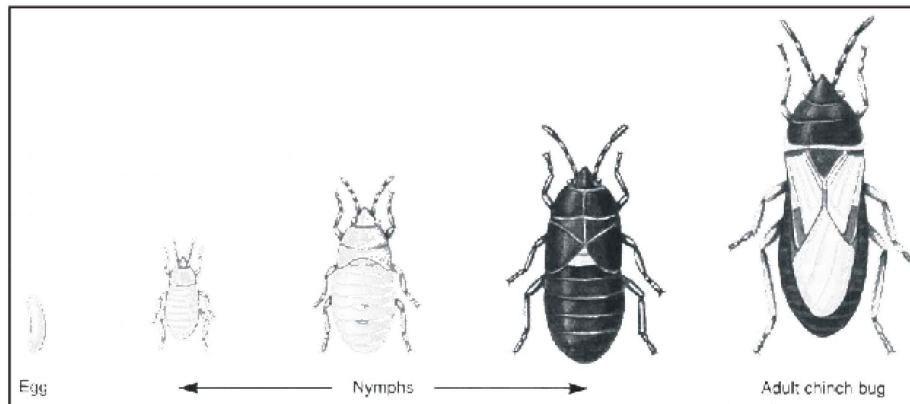
CONCEPTUAL VIEW

Fig. Life history of a hemimetabolous insect.

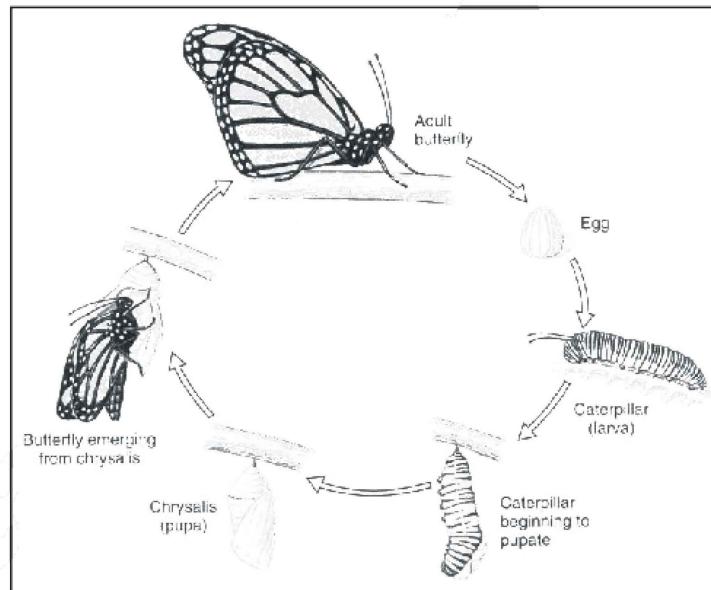
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Fig. Holometabolous (complete) metamorphosis in a butterfly, Danaus plexippus (order Lepidoptera). Eggs hatch to produce first of several larval instars. The last larval instar molts to become a pupa. The adult emerges at the pupal molt.

(iii) Class Arachnida

- (i) These invertebrates have their body divided into *two* parts i.e., cephalothorax which consists of the head jointed to the thorax, and the abdomen.
- (ii) They possess *four pairs of legs* attached with cephalothorax.
- (iii) Respiration occurs by means of *gills*, lungs or special structures called book lungs. Excretion takes place by means of *malpighian tubules*.
- (iv) They possess *simple eyes*.
- (v) They are *unisexual*.
- (vi) They lack metamorphosis.

Examples: Scorpions, Spider, Mites, Ticks etc.

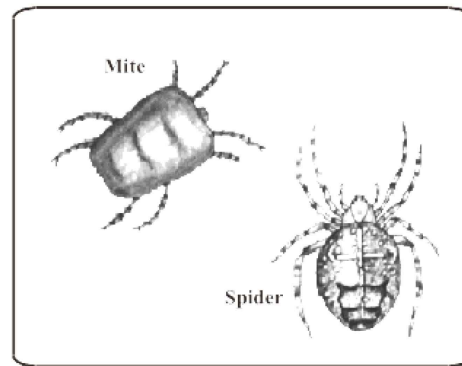


Fig. Arachinds

(iv) Class Myriapoda

- (i) These are *land* animals usually found under logs, rocks and soil.
- (ii) They possess many walking legs and *long segmeneted bodies*.
- (iii) The exoskeleton is hard like insects Myriapod *breath by tracheal system*.
- (iv) The paired legs on the first segment are modified into *poison claws*.

Examples: Millipede, Centipedes etc.

(c) ECONOMIC IMPORTANCE

- (i) **Grasshoppers** feed on leafy vegetation and attach various cultivated valuable corps and garden plants.
- (ii) **Cockroach** destroys food, clothes, shoes, cardboard boxes etc.
These are also responsible for carrying dirt and germs of plague, leprosy, cholera, dysentery, tuberculosis on its body as well as in the alimentary canal.
- (iii) **Trypanosoma** get into the blood stream of man or cattle and cause sleeping *sickness*.
- (iv) **Mosquitoes, houseflies** are insect vectors of diseases.
- (v) **Termites** are very destructive insects as they feed on both dead wood and living plants.
- (vi) **Locust** cause vast damage to standing crops.
Housefly contaminates food and cause cholera, hepatitis etc.

BENEFICIAL EFFECTS

- (i) *Silkworm* feeds on mulberry leaves and *produces silk* of high quality.
- (ii) *Butterfly* caterpillars prey scale insects thus are beneficial for *destruction of insect* pests.
- (iii) Insects help in *cross pollination*.
- (iv) *Honey Bees* are important for the *production of honey*.
- (v) *Spiders* are useful to man as they *feed on various insect* pests.
- (vi) Some insects act as *scavengers* and eat up dead animals and vegetable matter. Fish depend on certain insect larva for food.

Q. Define metamorphosis. How is this found in arthropods?

Ans. METAMORPHOSIS

“The process during which an animal under goes a rapid change from larval to adult stage”.

Life history of insects is characterized by metamorphosis (meta = change + morphe = form). *This is an abrupt change of form or structure during the life cycle.* There are three morphologically distinct stages in the life cycle, the egg finally develops into **larva** which is converted into motionless **pupa** that finally develops into an **adult**. 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.

Q.20 Discuss in detail the general characteristics and classification of Phylum Mollusca.

Ans. MOLLUSCA

- (1) The phylum consists of diverse group of organisms such as *slow-moving snails and slug, bivalved* clams and highly *active cephalopods*.
- (2) They include over 50,000 living species being the second largest invertebrates.
- (3) **Among molluscs Gaint Squid is the largest invertebrate.**
- (4) These are **triploblastic coelomates** having **bilateral symmetry**.
- (5) The body is enclosed by a **glandular epithelial envelope called mantle** which secretes *calcareous shell*. So exoskeleton is calcareous. They protect the body but cause hindrance in locomotion, therefore, some active mollusks show reduction or loss.
- (6) Some are *exclusively aquatic e.g., cephalopoda*. Some are terrestrial living in moist places.
- (7) The body is short and **unsegmented**.

- (8) Their body is divided into **head**, a **ventral muscular foot** of internal organs.
- (9) The space between the shell and mantle cavity contains **gills**.
- (10) In the mouth cavity of many molluscs, **rasping tongue – like radula** having many **horny teeth**.
- (11) Excretion occurs by specialized structures called **nephridia**.
- (12) **Open circulatory system** is present except in **cephalopoda**.
- (13) The members of the phylum have **complex digestive, respiratory, circulatory, excretory, nervous and reproductive systems**.
- (14) The digestive system has two openings i.e., **mouth and anus**.
- (15) The **coelom** is divided into **sinuses** or blood spaces.
- (16) **Heart** pumps the blood into the **sinuses**.
- (17) A respiratory pigment of blue in colour, called **haemocyanin** is present.
- (18) **Respiration** occurs *by gills*. “In some *snails*, the mantle cavity is converted into a lung”.
- (19) **Nervous system** consists of three pairs of interconnected **ganglia** in the head, foot and body region.
- (20) **Locomotion** is by means of **muscular foot**. Some members are **sessile** i.e., unable to move.
- (21) Molluscs are **unisexual**.
- (22) The larva is called **Trochophore**.
- (23) The **brain of octopus** is large and complex enclosed in a shell – like case of cartilage. Octopus has got great ability of learning.

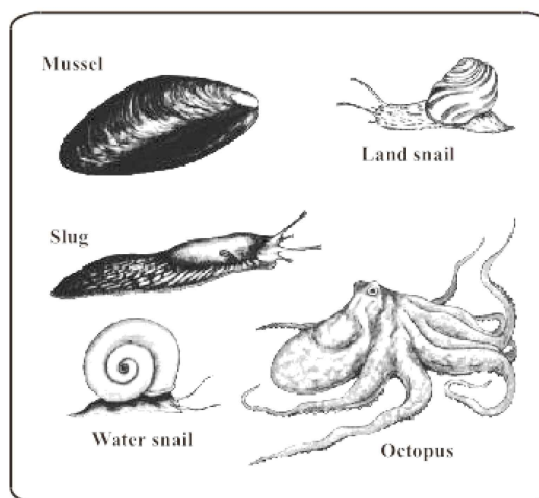
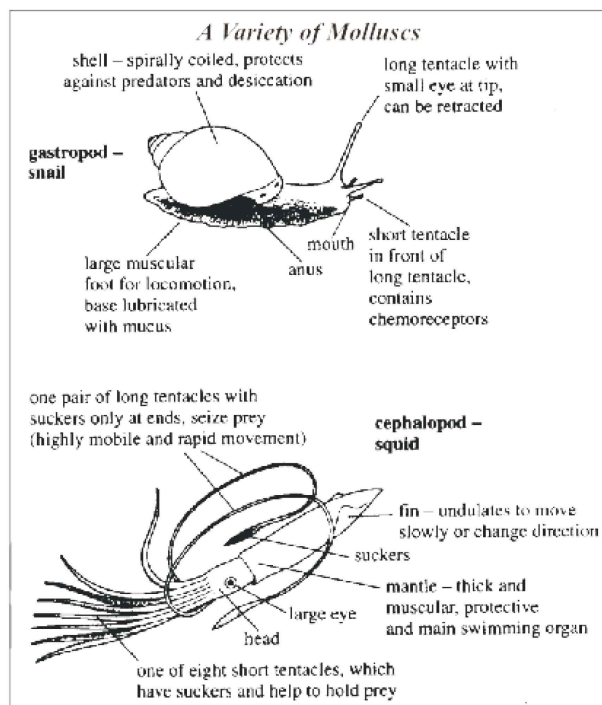


Fig. Example of mollusks

Q.21 Which is the largest invertebrate?

Ans. Giant Squid.

Q.22 How many classes are found in Mollusca? Write short notes on it.

Ans. **CLASSES OF MOLLUSCA**

Phylum Mollusca are divided into **six** classes. The major three classes are:

- (a) Gastropoda
- (b) Bivalvia (Pelecypoda)
- (c) Cephalopoda

(a) Gastropoda:

- (i) The members of the class are *asymmetrical*.
- (ii) The body is covered with coiled *one piece shell*.
- (iii) The animal can defend itself by withdrawing its body into the shell.
- (iv) The class includes both *aquatic* and *terrestrial* animals.
- (v) The aquatic species possess lungs but in land form the mantle cavity is covered by lungs.

Examples: *Helix aspersa* (garden snail) *Limad.* (slug).

(b) Bivalvia (Pelecypoda):

- (i) The members belonging to this class have *bilateral symmetry*.
- (ii) The body is laterally compressed and enclosed into two *pieces of shells*. Thus called *bivalves*. *Respiration* is by *plate-like gills*.

Example: *Mytilus* (marine mussel), *Anodonata* (fresh water mussel), *Ostrea* (oyster).

(c) Cephalopoda:

- (i) These also have *bilateral symmetry* with *dorso-ventral body*.
- (ii) All species are aquatic.
- (iii) The shell in these species is much reduced and internal. In some cases shell is absent.
- (iv) The membranes belonging to the class are **highly developed** and **active**.

Example: *Loligo* (squid), the giant squid is the largest invertebrate i.e., 15 meters (about soft) including tentacles or arms.

Q.23 Write short note on the Economic Importance of Phylum Mollusca.**Ans. BENEFICIAL EFFECT**

- (i) Some members of Molluscs are great *source of food* for man in many parts of the world.
- (ii) Large quantity of clams, oysters and mussels are eaten in Far east, Europe and America.
- (iii) Oysters are regarded as *delicacy*.
- (iv) *In button industry* shells of fresh water mussels are used.
- (v) Shells of oysters are mixed with tar *for making roads* in America. Shells of mussels are also used for making ornaments especially some oysters are used for making the *valuable pearls* e.g., the pearl oyster. Some kinds like the Achatina are edible.

HARMFUL EFFECTS

- (i) **Slugs** and **shipworms** are harmful molluscs.
- (ii) Slugs are *injurious in gardens* and cultivation.
- (iii) They eat leaves and *destroy plant* roots and stems.
- (iv) *Teredo*, a shipworm *damages wooden parts* of ship.
- (v) Some snails like the water snails are carrier of the *disease bilharzia*.

Q.24 Discuss the general characters of phylum Echinodermata. (GRWO4)**Ans. GENERAL CHARACTERISTICS OF PHYLUM ECHINODERMATA**

- (1) Echinoderms include about **5,000** species.
- (2) They are *exclusively marine*, most are *free living* and some are *sessile*.
- (3) The body is covered by delicate epidermis.
- (4) **Exoskeleton** is formed of calcium developed from mesoderm.
- (5) Echinoderms are triploblastic coelomates having *radial symmetry* but the *larva have bilateral symmetry*.
- (6) **Lower surface (oral)** possess mouth and anus is on upper surface (**aboral**).

- (7) The body may be flattened like biscuit (cake urchin), *star-shaped* with short arm (star fish) globular (sea urchin) star-shaped with long arms (brittle star) or *elongated* (sea cucumber).
- (8) They have *water vascular system* (coelomic compartment) in their coelom consisting of complex system of tubes and spaces surrounding the mouth and passing into the arms and tube feet. Circulation of water occurs through these channels. Water moves through three canals through a sieve-like plate called *madreporite* present on the upper surface.
- (9) **Locomotion** is by means of *tube feet* which is soft present along the edges of grooves in the arms.
- (10) Echinoderms are less specialized but have specialized organs for digestion and reproduction.
- (11) *Nervous system* is poorly developed and *lack brain* but have *nerve ring* around the pharyngeal region.
- (12) Respiratory excretory and circulatory systems are poorly developed.
- (13) Animals belonging to phylum are *unisexual* and *fertilization is external*.
- (14) The larva e.g., *bipinnaria* and *brachiolaria* are complex having bilateral symmetry like chordates.
- (15) The ability to produce the lost parts (*regeneration*) is common in them.
- (16) Echinoderms have single structural and physiological organization, therefore, *deserve to be placed below annelids but due to following characters are placed before chordates*.

Similarities between Chordata and Echinodermata:

- (a) Both chordates and echinoderms have radial cleavage during embryonic development.
- (b) The *blastopore* forms, the arms in echinoderms and chordates (Deuterostomes).
- (c) *Phosphocreatin* is present in both. It is

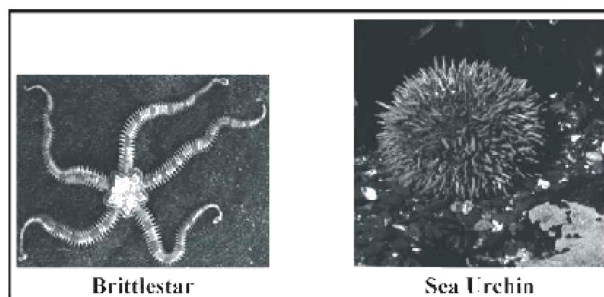
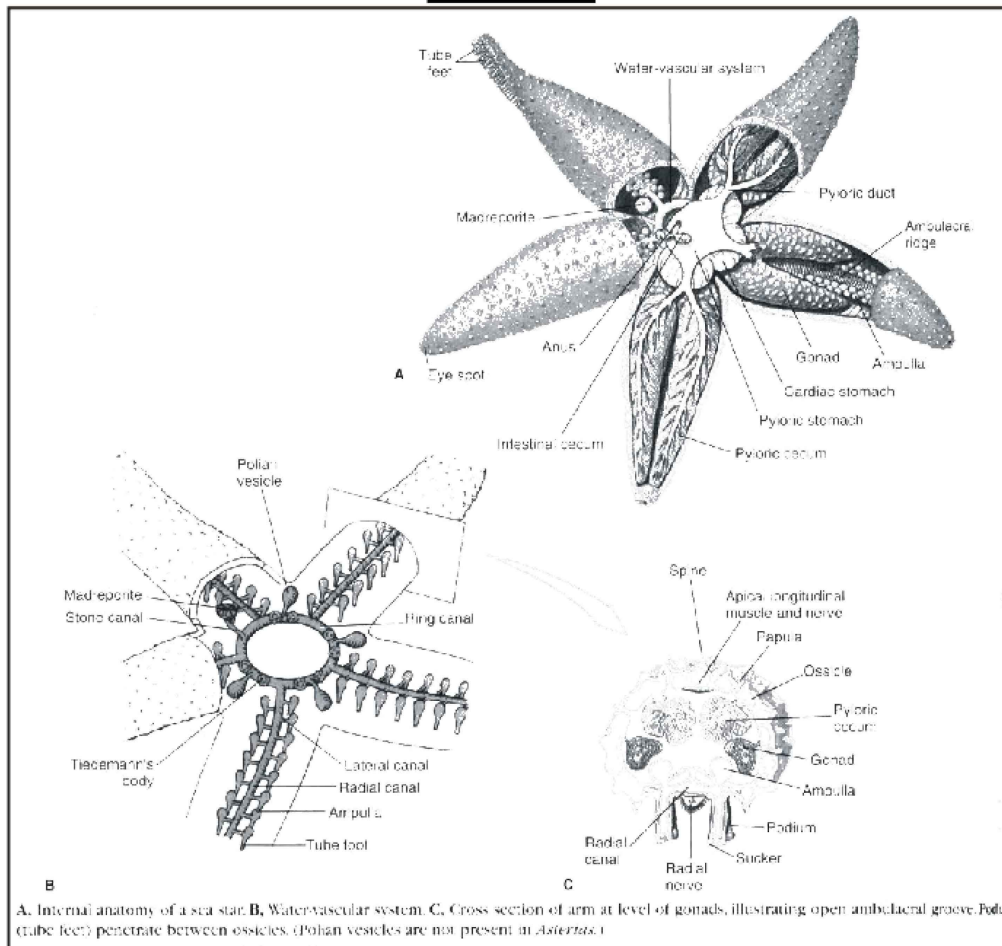


Fig. Examples of Echinoderms

Example: *Asterias* (starfish), *Sea urchin* (sea cucumber), *Cake urchin*, *Brittle star*.

HELP LINE**Q.25 (a) Discuss the affinities of Echinoderms with Hemichordata?**

Ans. Echinodermata are placed near to Hemichordata because they have no close relationship with most of invertebrates rather show some close similarities with Hemichordata. Following are the common features:

- (i) Formation of coelom and **retention of blastopore** as the site for future anus.
- (ii) Mesoderm is derived from the cells close to the blastopore.
- (iii) They have **mesodermal exoskeleton** which is ectodermal in origin while in invertebrates the blastopore develops into mouth.

According to the findings the above mentioned resemblance between Hemichordata are neither accidental nor due to convergent evolution because the two are closely related and both emerged from the same (common) ancestors.

- a. Echinoderms also show great close resemblance with Chordates because both having mesodermal skeleton are deuterostomous (branch of animal kingdom).
- b. Both lower Chordates and Echinoderms have similar early development.

Q.25 (b) Why Echinodermata is not placed after annelida? (OR) Why Echinodermata is placed before chordata?

Ans. See (16) of Q.24.

Q.26 Write down the general characteristics of phylum Hemichordata?

Ans. **GENERAL CHARACTERS OF HEMICHORDATA**

- (1) They have a close resemblance with both Echinodermata and Chordata.
- (2) Both Echinodermata and Hemichordata belong to the group **Deuterostome** the branch of Animal kingdom.
- (3) They are also called **Prechordates**.
- (4) The animals included in the phylum have **soft bodies** and **worm-like**.
- (5) Their body is divided into an anterior **proboscis**, **collar** and **trunk**.
- (6) Their body wall is made of **unicellular epidermis** with mucus-secreting cells.
- (7) They possess **straight digestive tract** but may show variation.
- (8) The **coelomic cavities** are related to the *three* body regions i.e. proboscis, collar coelomic pouches.
- (9) The circulatory consists of a **median dorsal** and **ventral vessel**.
- (10) **Gill slits** forming a dorsal row behind collar form the respiratory system.
- (11) The excretory system has a single **glomerulus** connected to blood vessels.
- (12) The nervous system has a **sub-epidermal plexus** of cells and fibres.

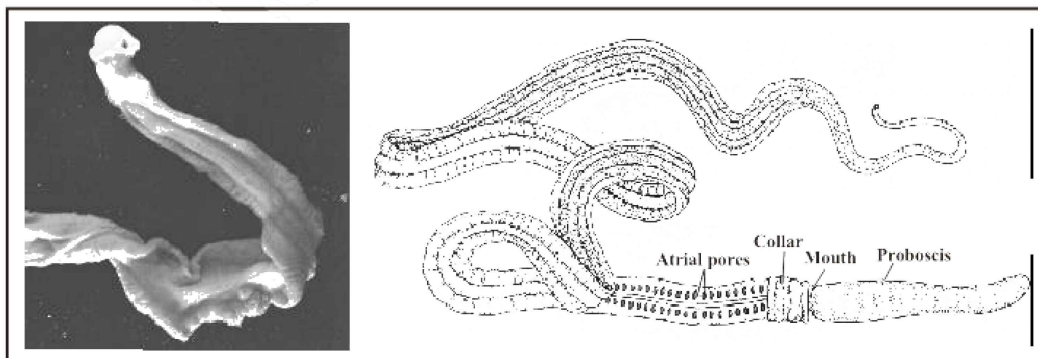


Fig. Balanoglossus and saccoglossus

Examples: *Balanoglossus*, *Saccoglossus* etc.

HELP LINE**Position in Animal Kingdom**

1. Hemichordates belong to the deuterostome branch of the animal kingdom and are enterocoelous coelomates with radial cleavage.
2. Hemichordates show some of both echinoderm and chordate characteristics.
3. A chordate plan of structure is suggested by gill slits and a restricted dorsal tubular nerve cord.
4. Similarity to the echinoderms is shown in larval characteristics.

Biological Contributions

1. A tubular dorsal nerve cord in the collar zone may represent an early stage of the conditions in chordates; a diffused net of nerve cells is similar to the uncentralized, subepithelial plexus of echinoderms.
2. The gill slits in the pharynx, also characteristic of chordates, serve primarily for filter feeding and only secondarily for breathing and are thus comparable to gill slits in the protochordates.

Q.27 Discuss the salient features/diagnostic features of phylum chordata?

Ans. **PHYLUM CHORDATA**

Classification of Phylum Chordata**Phylum Chordata****Group Protochordata Acrania**

- (1) **Subphylum Urochordata** (u'ro-kor-da'ta) (Gr. *oura*, tail, + L. *chorda*, + *ata*, characterized by)

(Tunicata): tunicates.

Notochord and nerve cord in free-swimming larva only; ascidian adults sessile, encased in tunic.

- (2) **Subphylum Cephalochordata**

(set' a-lo-kor-da'ta) (Gr. *kephalē*, head, + L. *chorda*, cord): **lancelets (amphioxus)**. Notochord and nerve cord found along entire length of body and persist throughout life; fishlike in form.

Superclass Gnathostomata (na'tho-sto'ma-ta) (Gr. *gnathos*, jaw + *stoma*, mouth): **jawed fishes, all tetrapods**. With jaws and (usually) paired appendages.

Class Chondrichthyes (kon-drik'thee-eez) (Gr. *chondros*, cartilage, + *ichthys*, a fish): **sharks, skates, rays, chimaeras**. Streamlined body with heterocercal tail; cartilaginous skeleton: five to seven gills with separate openings, no operculum, no swim bladder.

Class Osteichthyes (os'e-ik'thee-eez) (Gr. *osteon*, bone, + *ichthys*, a fish): **bony fishes**. Primitively fusiform body but variously modified; mostly ossified skeleton; single gill opening on each side covered with operculum; usually swim bladder or lung. A paraphyletic group.

Group Craniata**(3) Subphylum Vertebrata** (ver'te-bra'ta)

(L. *vertebrates*, backbone). Bony or cartilaginous vertebrae surrounding spinal cord (vertebrae absent in agnathans); notochord only in embryonic stages, persisting in some fishes; also may be divided into two groups (superclasses) according to presence of jaws.

Superclass Agnatha (ag'na-tha) (Gr. *a*, without, + *gnathos*, jaw) (Cyclostomata): hagfishes, lampreys. **Without true jaws or paired appendages. Probably a paraphyletic group.**

Class Myxini (mik-sin'y) (Gr. *mysa*, slime): **hagfishes**. Terminal mouth with four pairs of tentacles; buccal funnel absent; nasal sac with duct to pharynx; 5 to 15 pairs of gill pouches; partially hermaphroditic.

Class Cephalaspidomorphi (sef-al-less'pe-do-morf'e) (Gr. *kephalē*, head, + *aspidos*, shield, *morphē*, form) (Petromyzones): lampreys. **Suctorial mouth with horny teeth; nasal sac not connected to mouth; seven pairs of gill pouches.**

Phylum chordata have three major diagnostic features:

- (1) *Notochord*
- (2) *Hollow Dorsal nerve Cord*
- (3) *Gills*

Class Amphibia (am-fib'e-a) (Gr. *amphi*, both or double, + *bios*, life): **amphibians**. Ectothermic tetrapods; respiration by lungs, gills, or skin; development through larval stage; skin moist, containing mucous glands, and lacking scales.

Class Reptilia (rep-til'e-a) (Gr. *amphi*, both or double, + *bios*, life): **amphibians**. Ectothermic tetrapods; respiration by lungs; embryo develops within shelled egg; no larval stage; skin dry, lacking mucous glands, and covered by epidermal scales. A paraphyletic group.

Class Aves (ay'veez) (L. pl. of *avis*, bird): **birds**. Endothermic vertebrates with front limbs modified for flight; body covered with feathers; scales on feet.

Class Mammalia (ma-may'lee-a) (L. *mamma*, breast): **mammals**. Endothermic vertebrates possessing mammary glands; body more or less covered with hair; well-developed neocerebrum.

(1) Notochord:

The phylum derives its name due to the presence of notochord. It is present in all Chordates either in the larval or embryonic or throughout life.

Notochord is a rod-like semiarid body with *vacuolated cells* which are filled with proteinaceous material. It is present in most cases along the length of the body between enteric canal and the dorsal hollow central nervous system. Its function is to *support and to stiffen the body* that is to act **as skeletal axis**.

The endoskeleton is the chief basic factor in development and specialization of higher animals. *The notochord is replaced by vertebral column in higher chordates.*

(2) Hollow Dorsal Nerve Cord:

This forms the central nervous system.

It is **dorsal** in position and **hollow**.

This is involved in controlling various metabolic activities of the body.

In higher chordates brain forms enclosed in a bony case called skull.

(3) Gills:

In the embryonic stage all the chordates **develop** paired gills, in some there are non-functional, in others these are functional for some period in their life history e.g., frogs.

In some these are functional throughout their life e.g. *Amphioxus*, fish etc.

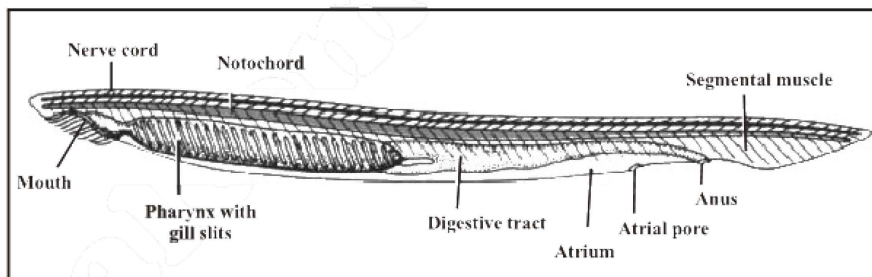


Fig. Amphioxus

Q.28 Protochordata is divided into how many sub-phyla?

Ans. PROTOCHORDATA (ACRANIA – WITHOUT CRANIUM):

Protochordata is divided into three sub-phyla:

- (1) Sub phylum *Urochordata*
- (2) Sub phylum *Cephalochordata*
- (3) Sub phylum *Vertebrata*

URO	—	means tail
CEPHALO	—	means head
VERTE	—	means backbone

(1) **Urochordata:**

They possess **notochord** and nerve.

Adults are sessile and enclosed in a covering called **tunic** or **tunic**.

Thus are called **tunicata** e.g. **Molgula**.

(2) **Cephalochordata:**

In this sub phylum notochord and nerve cord extend along the entire length of the body and persist throughout life e.g., **Amphioxus**.

(3) **Vertebrata or Craniata:**

They have cranium (skull) in which animals have vertebral column.

Q.29 *How many super class are found in vertebrates? Discuss the characteristics of different classes of Pisces?*

Most fishes today are ray-finned fishes. They have the following characteristics.

- bony skeleton
- gills
- two-chambered heart
- skin with scales
- swim bladder
- jaws

Ans. The sub phylum vertebrata is divided into *two super classes*.

(1) *Pisces (Fishes)*

(2) *Tetrapods (four footed)*

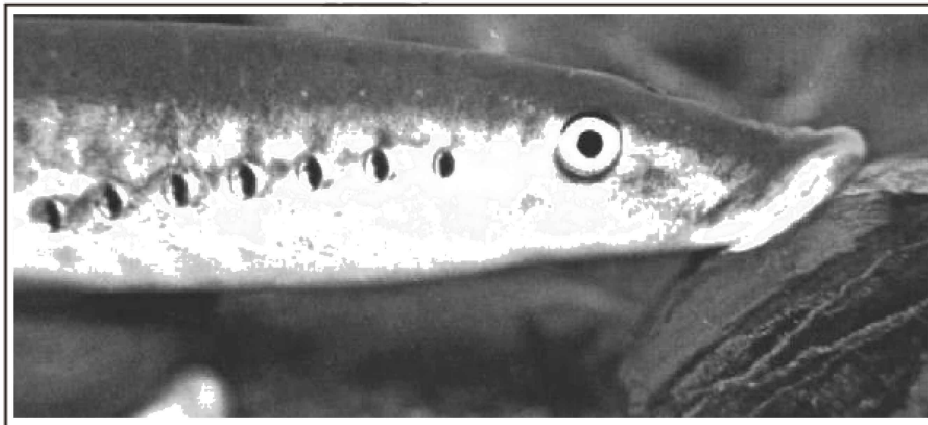


Fig. Lamprey

(1) **PISCES**

It includes *three* classes i.e. *cyclostomata*, *chondrichthyes* and *osteichthyes*.

“Theyes means fishes”.

CLASS CYCLOSTOMATA (Jawless Fishes):

- (1) They include **jawless fishes**.
- (2) Body is **long eel-like**.
- (3) *Paired appendages are absent*.
- (4) Ventral *suitainial* mouth.
- (5) *Six to fourteen pairs* of gills.
- (6) Sexes may be separate i.e., *Lamprey* or they may be hermaphrodite like *Hagfish*.
- (7) Scales are absent.
- (8) Skeleton is **cartilaginous** (ہڈی نمائیزم و چھدر).
- (9) Heart has **one auricle**.
- (10) *Stomach is absent* in digestive system.
- (11) **Fertilization occurs externally** and have long larval period e.g. **Lamprey**.

CLASS CHONDRICHTHYES: (کوڈرک حیمیر) (Cartilaginous Fishes)

They have the following characters:

- (1) Body is **fusiform**.
- (2) **Mouth ventral** and **olfactory sacs** not connected to mouth cavity.
- (3) **Placoid scales** are present on the body.
- (4) Endoskeleton is entirely **cartilaginous**.
- (5) Digestive system with **J-shaped stomach**.
- (6) Circulatory system has many **pairs of aortic arches**.
- (7) Respiration occurs with the help of **5 – 7 pairs of gills** with the covering i.e., **operculum**.
- (8) Swim bladder is absent.
- (9) **Sexes are separate**.
- (10) May be **oviparous** (lay eggs) or **viviparous** (give birth).

Second largest vertebrate is shark ranging **30 – 50** feet in length.

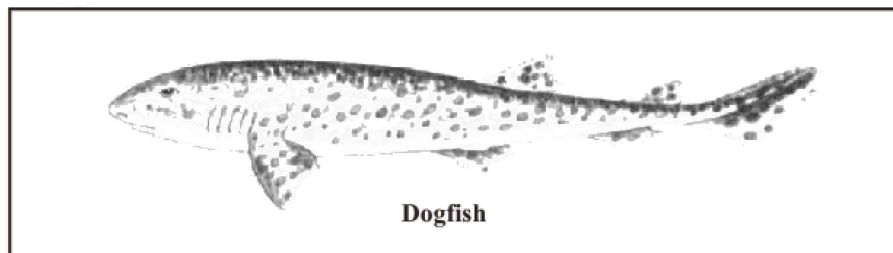
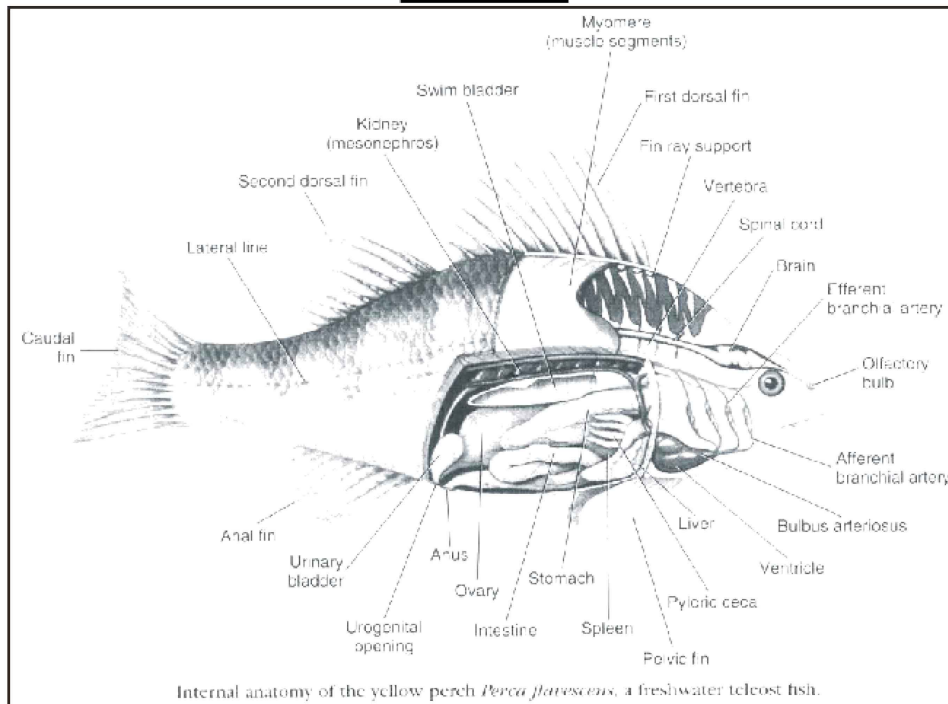


Fig. Cartilage fish

HELP LINE**Skates and Rays:**

- (i) These are **bottom dwelling fishes**. The anterior pairs of fins (**pectoral fins**) are much enlarged and are used for swimming like wings e.g., Sting and Electric Rays.
- (ii) The Sting Rays have **long and whip-like** tail has sharp spines which can inflict dangerous wounds.
- (iii) The Electric Ray have certain **absorbed muscles** modified into powerful **electric organ** which can give several shocks and stun their prey.

Economic Importance of Sharks:

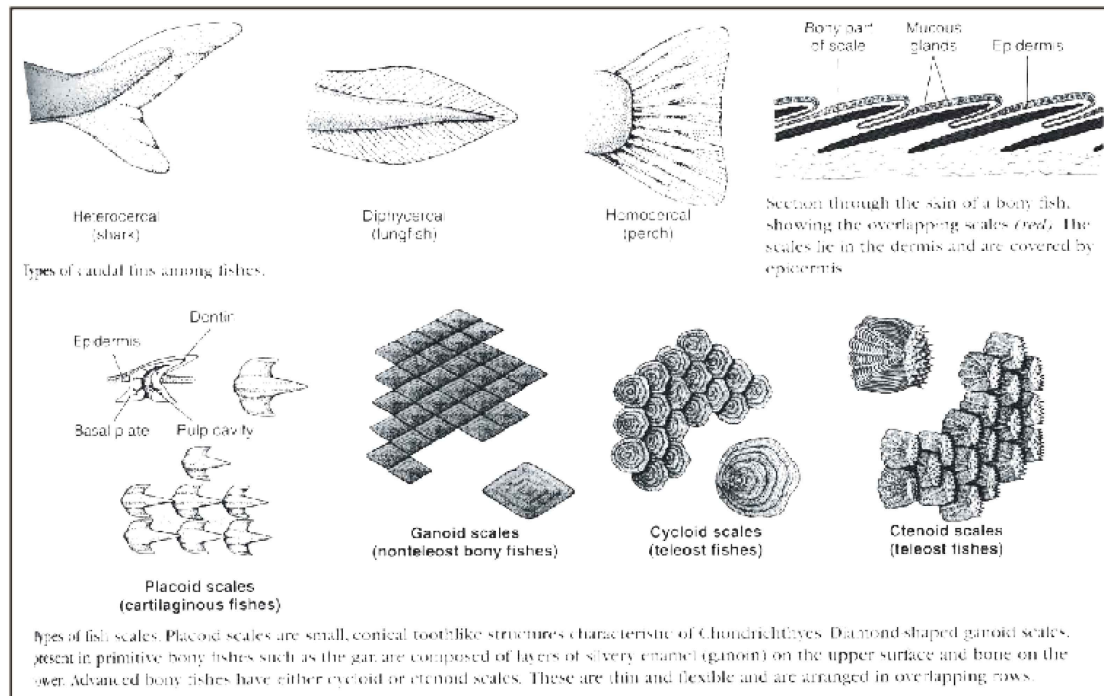
- (1) These sharks are highly destructive to fish Lobsters and Crabs.
- (2) They are used as a food in certain countries by man.
- (3) Commercially the oil is extracted from the liver of shark and is used in medicine as a source of **Vitamin A and D**.
- (4) **Leather goods** can be made from the skin of shark.

CLASS OSTEICHTHYES: (اوسیک تھیوز) (Bony Fishes)

These are also known as **bony fishes**. They have the following characteristic features:

- (1) Cartilaginous skeleton is replaced by **bony skeleton**.
- (2) **Notochord** may persist in parts.
- (3) The skin possess embedded **dermal scales** whole may be **ganoid, cycloid** or **ctenoid** scales. Placoid scales were absent.

HELP LINE



- (4) Fins both, median (single) or paired and have fin rays of cartilage on bone.
- (5) **Terminal mouth**, jaws may or may not have teeth.
- (6) Both median (single) or **paired fins** are present. Fin rays of cartilage or bone.
- (7) **Respiration is by gills** in addition to bony gill arches and covered by operculum.
- (8) **A swim bladder** is usually present with or without connection with the pharynx. Thus helps in *buoyancy*.
- (9) **Heart is two chambered** with an atrium and ventricle.
- (10) "Blood has nucleated red cells".
- (11) Brain with **10 pairs of cranial nerves**.
- (12) Sexes are separate with **paired gonads**.
- (13) *Fertilization is usually external*.

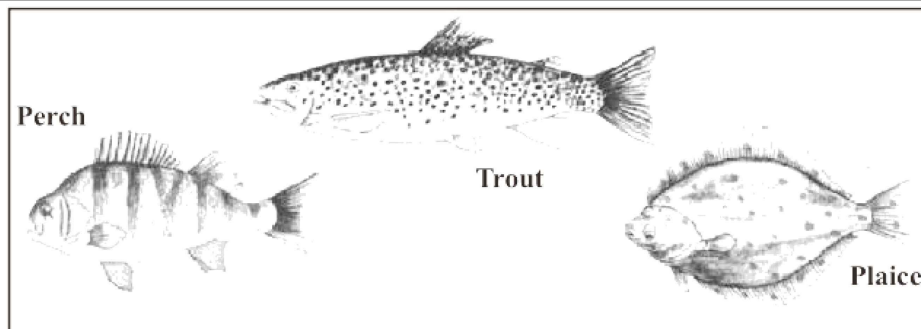


Fig. Bony fishes

Q.30 Highlight the different adaptive characters developed in the animals living in aquatic habitat.

Ans. **ADAPTATIONS IN AQUATIC HABITAT**

Following are the most **common adaptative characters in the animals** living in aquatic habitat:

- | | |
|------------------------|------------------------|
| (1) Stream-lined body | (2) Swim bladder |
| (3) Fins | (4) Circulatory system |
| (5) Respiratory system | (6) Excretory organs |
| (7) Lungs | |

(1) Stream-lined Body:

This means *boat shaped structure*. Such structure offers *little resistance to water* while swimming.

(2) Swim Bladder:

That is present in most bony fishes it may or may not be connected to the pharynx. It is **hydrostatic organ** and helps in changing the gravity of fish by filling it self with gas. *Due to it fish can easily float or swim deep in water.*

The **gases** that fill the swim bladder are either *oxygen*, *carbondioxide* and *nitrogen* which may be secreted by the glands in the swim bladder. The fishes in which the swim bladder is connected to pharynx the bladder may be filled by gulping of air.

(3) Fins:

They may be paired i.e., **pectoral** and **pelvic** or unpaired present on the dorsal, caudal (tail) and portion. Fins play important role in keeping the balance of fish thus *help in swimming.*

(4) Circulatory System:

Heart is divided into *two chambers*, with afferent and efferent bronchial system.

(5) Respiratory System:

Gills are the respiratory organs meant for receiving oxygen dissolved in water and remove carbon dioxide in water as the gills have network of blood carbon dioxide in water as the gills have network of blood capillaries.

(6) Excretory Organs:

Kidneys are present in fish involved in the process of excretion.

(7) Lungs:

in ancient fish like Dipnoi showed modification of aquatic breathing system to meet the conditions of terrestrial life by developing lungs.

Q.31 What are the differences between water and land habitats?

Ans. **DIFFERENCES BETWEEN AQUATIC AND LAND HABITATS**

- (1) The concentration of **oxygen is more in air** than in water.
- (2) Water contains different kinds of **salts dissolved in water**.
- (1) **Temperature** habitat is more protected as compared to the aquatic habitat.
- (2) Water provides more **support** to the body as compared to the air.
- (3) Land provides great variety of **breeding places** than does water.

Q.32 What are the different adaptative characters which animals developed, when they invaded on land?

Ans. **ADJUSTMENTS ON LAND**

Following are the different adaptative characters which animals developed when they invaded on land:

- (1) **They developed skin** for the protection of the body against dry conditions of land.
- (2) **The eggs are protected** by shells from drying and mechanical injury. The egg is large in size which provides enough space for the storage of food.
- (3) **They have developed lungs** for respiration instead of gills.
- (4) **Circulatory system is well developed** may be open or close type. Heart is divided into *three* or more chambers.
- (5) **They have developed limbs** i.e., fore limb and hind limb for walking, running, climbing, flying. In birds forelimbs are modified into wings and in man fore limbs are meant for taking in food.
- (6) **Sensory organs** have become more advance and specialized.

Q.33 What are the different evolutionary changes in the organs of the amphibian in contrast to the fishes?

Ans. **EVOLUTIONARY CHANGES IN AMPHIBIANS FISHES**

Amphibian include the animals which can *live both in the aquatic and terrestrial* conditions. *Fossil record of Devonian period provides evidences that large population of lobe-fined fishes (dipnoi) came to live in shallow fresh water. Some of them used to crawl from one pool to another and therefore spent sometime on land. From this group amphibians have arisen.* Amphibians have certain characters of aquatic animals and have developed number of characters which were necessary for terrestrial life. Thus they have transition stage between the Fish and Reptiles.

Q.34 Classify tetrapods. Discuss the characteristic features of Amphibia?

SUMMARY

These features in particular distinguish amphibians:

- usually tetrapods
- usually lung in adult
- metamorphosis
- smooth and moist skin
- three-chambered heart

Ans. Tetrapods are divided into four major classes:

- | | |
|------------------|--------------|
| (1) Amphibia | (2) Reptilia |
| (3) Aves (Birds) | (4) Mammalia |

Characteristic Features of Amphibia

- (1) They possess **bony skeleton**. Animals may have **tail or without tail**.
- (2) They are **tetrapods** having fore limb and hind limb but some are *legless* (e.g. caecilians) *webbed feet* are often present.
- (3) They have **smooth and moist and glandular skin**. In some glands are *poisonous*, pigment cells (chromatophores) are present. Scales are absent.
- (4) Animals belonging to the class **respire by gills at larval stage** but in adults respiration occurs by means of **lungs** (pulmonary) and skin (cutaneous respiration).
- (5) **Heart is three chambered** i.e., two auricles and a ventricle but in frog in addition to it sinus venosus, truncus arteriosus are also present. Double circulation takes place through the heart.
- (6) **Sexes are separate**, *fertilization is external*, larval stage exist in them.
- (7) The process of **metamorphosis** occur in them.

- (8) Amphibians are *anamniotes*.
 (9) Amphibians are *cold blooded (Poikilothermic)*.
 (10) **Hibernation** during winter occurs in them.

Example: Frogs, Toads, Salamander

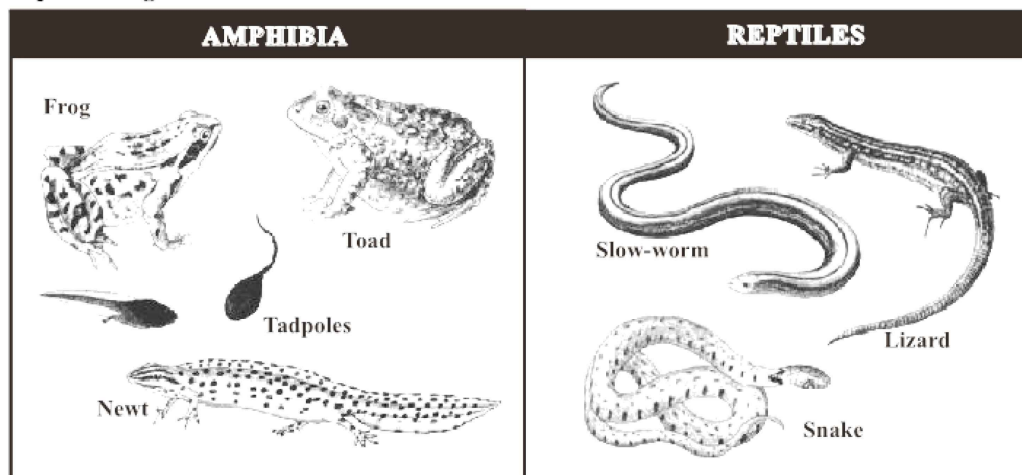


Fig. Amphibians and Reptiles

Q.35 Discuss the characteristic features of class Reptilia?

Ans. **REPTILIA**

Reptiles have the following characteristic features:

- (1) They are *cold blooded (Poikilothermic)* and hibernate in winter like amphibian.
- (2) They have developed better limbs for **efficient locomotion**.
- (3) They have dry **scaly skin**.
- (4) **The ventricle of heart is incompletely partitioned** ensuring more oxygen supply through blood circulation to all parts of the body. In crocodiles ventricle is completely partitioned into two.
- (5) They have some sort of **copulatory organ** necessary for internal fertilization.
- (6) The **amniotic eggs** of reptiles the shell is leathery which can resist dryness and injury. They have large yolkly eggs.
- (7) They have **three embryonic membranes** i.e. *amnion*, *allantois* and *chorion*.

HELP LINE

These features in particular distinguish reptiles:

- usually tetrapods
- lungs with expandable rib cage
- shelled egg
- dry, scaly skin

Q.36 Discuss the evolutionary links of reptiles?**Ans. EVOLUTIONARY LINKS OF REPTILES**

They were found in **Mesozoic period (225.65 million years)**. The climatic conditions became less suitable in tertiary period. Therefore they became extinct. The existing reptiles belong to four, out of a dozen or more main lines that have existed.

The lizards and snakes of the present day are the reptiles which occupied earth first of all, secondary the tuatara (sphenodon) of New Zealand, which have survived upto today with little change.

Modern birds are thought to be evolved from the third presently occurring reptile i.e., crocodile.

Present day reptiles have been derived from dinosaurs of Jurassic (136 – 195) million years) and **Cretaceous (136 – 165) million years)** period.

Modern reptiles are present in the temperate and tropical zone. They flourished most in tropical region.

Q.37 Discuss the evolution of Birds (aves).**Ans. EVOLUTION OF BIRDS**

Birds are world wide in distribution, like mammals, birds possess highest development in the animal kingdom. ***It is believed that both of these have evolved from reptiles*** along different lines. Archaeopteryx was the earliest known bird fossil. Their two species were found from the rocks of **Jurassic period** of earth's history.

Archaeopteryx was about the size of **a crow with skull** similar to the present day birds. It had **bony teeth** in the **jaw socket** unlike modern birds which do not have teeth. Jaws extended into a beak with long tail. Each wing had three claws. They (gaint reptiles of the past) with the exception of feather. Fossil record shows that certain other birds also posses teeth. From the above discussion it is quite evident that birds have evolved from reptiles.

Q.38 Write down the characteristic features of Aves.**Ans. CHARACTERISTIC FEATURES OF AVES**

- (1) The body of birds is **stream – lined and spindle shaped** with four division **head, neck, trunk and tail**.
- (2) They are **warm blooded (Homeothermic)**.
- (3) Fore – limbs are modified into **wings** which are adapted for flying. Hind limbs are meant for perching and in some like ostrich are involved in running.
- (4) There is the **epidermal exoskeleton** of feathers. Legs bear **scales**.

- (5) They have **light skeleton with air spaces** which is an adaptation for flying.
- (6) The **skull has large sockets**, jaws extend into **horny beak**.
- (7) Teeth are absent.
- (8) They have **well developed circulatory system**, have **four chambered heart** with only right **aorta** which curves to the right side and then bends backward.
- (9) The **lungs have extensions** known as **air sacs** which extend into the bones also.
- (10) **Syrinx** is the **organ of voice** present at the lower end of trachea near the origin of the two bronchi.
- (11) Bladder is absent, **urine is semi solid**.
- (12) Birds are **unisexual**.
- (13) **Fertilization is internal**.
- (14) **Eggs** are of large size with **much yolk**.
- (15) **Only one ovary** and **oviduct is functional**.
- (16) Present birds do not possess teeth rather have developed a thick muscular structure (**gizzard**) which is used for crushing food.
- (17) In certain **wings** are **vestigial organ** and have lost the power of flight. Thus are called **running birds** e.g., **Ostrich, Kiwi, Rhea**.

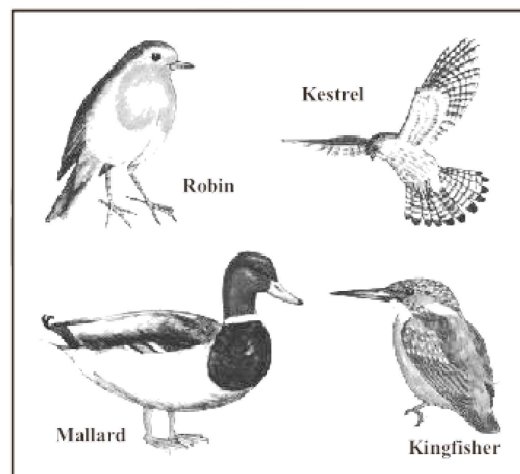


Fig. Birds

Q.39 Discuss the evolutionary trends of class mammalia.

Ans. **EVOLUTION IN MAMMALS**

According to Linnaeus the animals which nourish their young ones on mother milk are considered to be mammals. **Mammals are said to be the most advanced and developed group of animals because they have well developed brain.**

Mammals have **evolved from reptilian ancestors**, the **cotylosaurs** whose fossilized bones in preserved form give such evidences about the evolution of mammals. The ancestors of reptiles were found in the **jurassic period** along with the reptiles and therefore have been called mammal-like reptiles. Some were of the size of mice and lived

on trees. One of these early reptile was varanope that was formed as fossil in Texas. Mammal – like reptiles comprises at least *five* groups of Mammals became dominant in the **Cenozoic period**.

Q.40 Write down the general characteristics of Mammals?

Ans. MAMMALIA

Mammals possess the following general characteristics:

- (1) Scales are absent mostly they have *hair* on their body.
- (2) They have *muscular diaphragm* that separates the thoracic and abdominal cavities. This is the unique character of this class.
- (3) The **lower jaw** is composed of only one large bone and articulates directly with skull.
- (4) External ear or **pinna** is present. Ear possess a chain of three bones i.e., *Incus*, *Malleus* and *Stapes*.
- (5) They have **deciduous (worn out) and permanent teeth** in some mammals e.g., man have two sets of teeth in whole life milk teeth in early age and permanent teeth take place after they are worn out.
- (6) They have **four chambered** heart with only *left aortic arch* (in birds it is right).
- (7) They are **homeothermic** (warm blooded) animals.
- (8) Nucleus is absent in *red blood cells* (Erythrocytes).
- (9) The mammals have well developed voice apparatus the *larynx* and *epiglottis*.
- (10) Mostly mammals give birth to the young ones (*viviparous*) but some lay eggs like birds (*oviparous*).
- (11) Mammals feed their young ones produced from the *mammary glands* of the mother.
- (12) Mammals are **world wide** in distribution i.e., on land, water, air (e.g. Bat).

Q.41 Classify mammalia. Write short note on each of them.

Ans. SUB CLASSES OF MAMMALIA

Class mammalian is divided into *three* sub-classes.

- (1) Prototheria (*Egg laying mammals*).
- (2) Metatheria (*Pouched mammals*).
- (3) Eutheria (*Placental mammals*)

(1) **SUB CLASS PROTOTHERIA** (*Egg Laying Mammals*):

They have the characteristic of both reptiles and mammals.

They provide evidences that mammals have originated or *evolved from reptilians*.

Some are adaptive for aquatic life e.g., **Duck-Bill Platypus** which has a bill similar to that of a duck and webbed toes.

It has **thick fur** on its body. The female has mammary glands to feed the young ones.

They have **cloaca** and **cloacal opening instead of separate opening for digestive system and urinogenital systems**. Reptilian also possess these two later characters.

Examples: Duckbill platypus, Echidna (spiny ant eater) found in Australia.

(2) **SUB CLASS METATHERIA** (*Pouched Mammals*):

They are also known as pouched or *marsupial mammals*.

The marsupium or **abdominal pouch** is present where they rear their young when they are born at immature stage.

They feed on the milk produced from the mammary glands present in the marsupium.

Example: Opossum, Kangaroo and Tasmanian Wolf found in Australia & America.

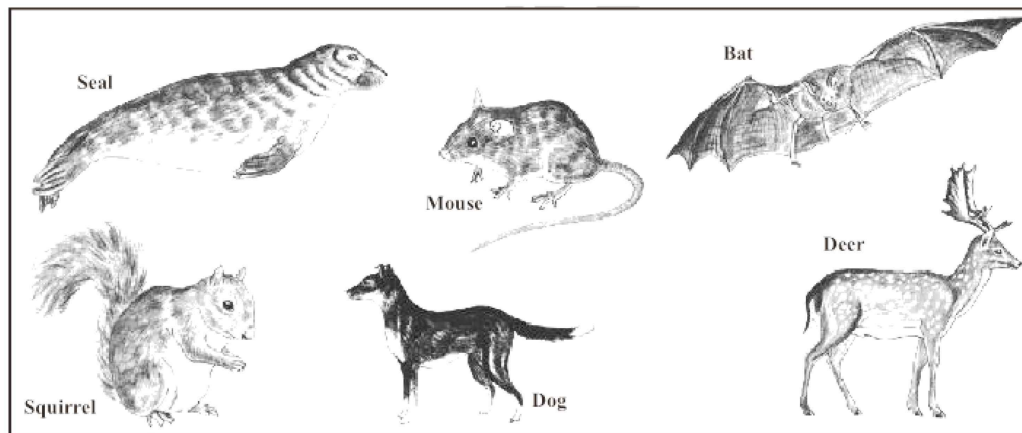


Fig. Mammals

(3) **SUB CLASS EUTHERIA** (*Placental Mammals*):

The subclass is also known as *placental mammals*.

Placenta formation occurs between the mother uterus and foetus, placenta has endocrine in function i.e., produce **certain hormones (Estrogen and Progesterone)**.

It is maximum advance. Hairs is a well developed character. In **Pangolin hairs** have modified into scales and in Porcupine spines.

Examples: Man, Whale, Elephant, Horse, Rat, Bat, etc.