

EXTENSIVE QUESTIONS

27. Describe the general characteristics of animals.

Ans: Animals: "Animals are eukaryotic, Multicellular heterotrophs that lack cell walls"

Characteristics of Animals:

Occurrence: Animals are found almost in all types of habitat. They may be free living motile, sessile or a parasite.

Size: They range in **size** from worms only seen with a microscope to blue whales. Most animals have cells specialized to form tissue and organs.

Symmetry and geometry:

Body may be soft or hard, radial symmetry or bilateral symmetry, diploblastic or triploblastic segmented. Body may be covered by shell, chitin, scales and furs. Animals may be acoelomate, pseudocoelomate and coelomate.

Mode of nutrition and digestive system:

All animals are **heterotrophy** and usually acquire food by ingestion followed by digestion. Animals may have no **definite digestive** system e.g. sponges, it is a saclike gastrovascular cavity e.g. *Hydra*, or it may be rudimentary, e.g. tapeworm. Digestive **system** may have one opening e.g. planaria. The tube-like digestive system has two openings, e.g. nematodes to mammals.

Excretory system:

Excretory system may be absent in sponges, cnidarians. It is like branching tubes in flatworms. Excretory system is present in nematodes to mammals.

Nervous system:

There is no definite **nervous system** in sponges, and cnidarians. Nervous system is present in nematodes to chordates. Most animals have sense organs.

Respiratory system:

All animals respire but a **respiratory system** is absent in sponges, cnidarians, flatworms, nematodes (roundworms) and annelids. Respiratory system is present in arthropods to chordates.

Skeleton system:

Skeleton is present in all animals. Spicules are present in sponges. Hydro-skeleton is present in worms and annelids. Skeleton may be exoskeleton in arthropods, mollusks (mollusks), and chordates or it may be endoskeleton in mollusks e.g. sepia, echinoderms, chordates and highly developed in vertebrates. Most animals are capable of locomotion at some time during their life cycle.

Circulatory system:

Circulatory system is absent in sponges, cnidarians, roundworms and flatworm. It is present in annelids to chordates.

Reproductive system:

Reproductive cells, organs or **reproductive system** is present in all the animals. Asexual reproduction is seen in sponges, cnidarians, sexual reproduction takes place in all other groups of animals and produces an embryo that undergoes specific stages of development.

Mode of life:

Animals have a **life cycle** in which the adult is always diploid. The life

cycle may have larval stages, e.g. sponges, annelids, arthropods, mollusks, echinoderms and amphibians.

Regeneration:

Regeneration is exhibited by sponges, some cnidarians, annelids, crustaceans (arthropods) and echinoderms.

28. Describe the criteria of animal classification.

Ans: Criteria for Animal Classification:

Animals can be classified according to:

- | | |
|------------------------------------|-----------------------------|
| (a) Presence or absence of tissues | (b) Number of tissue layers |
| (c) Body symmetry | (d) Body cavity |

(a) Presence or absence of tissues:

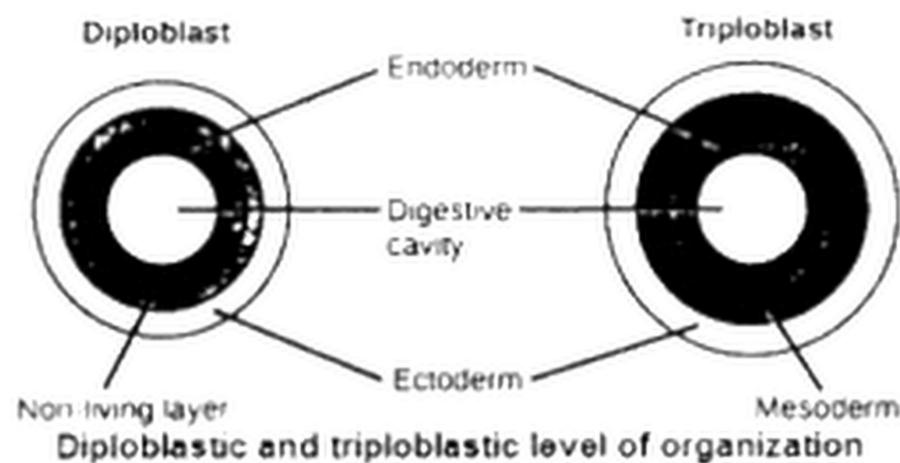
Animals can be classified according to the presence or absence of tissues into two subkingdoms, **Parazoa and Eumetazoa**. Parazoa includes the simplest multicellular animals that show the cellular grade of organization in which cells demonstrate division of labour but are not strongly associated to perform a specific collective function. They are asymmetrical. It includes all the sponges.

In Eumetazoa – similar cells are grouped together into a highly coordinated unit called **tissue**. The tissues are assembled into larger functional unit called **organs**. Different organs operate together as **organ system**.

(b) Number of tissue layers:

Animals can be classified according to **number of tissue layers** as diploblastic and triploblastic animals. The body of **diploblastic animals** consists of two germ layers of cells, the **ectoderm and endoderm**. Such animals have

tissue level of organization. There is a jelly like mesoglea, between the two germ layers. There are no specialized organs. A neuron net is present. There is only one cavity called **gastrovascular cavity** with only one opening. The examples are animals of phylum cnidaria. The body of the **triploblastic animals** consists of three germ layers ectoderm, mesoderm and endoderm. After embryonic development these layers in most triploblastic animals are not distinct as separate layers of cells, but are represented by the structures formed from them. The animals have specialized cells, organs and organ systems.

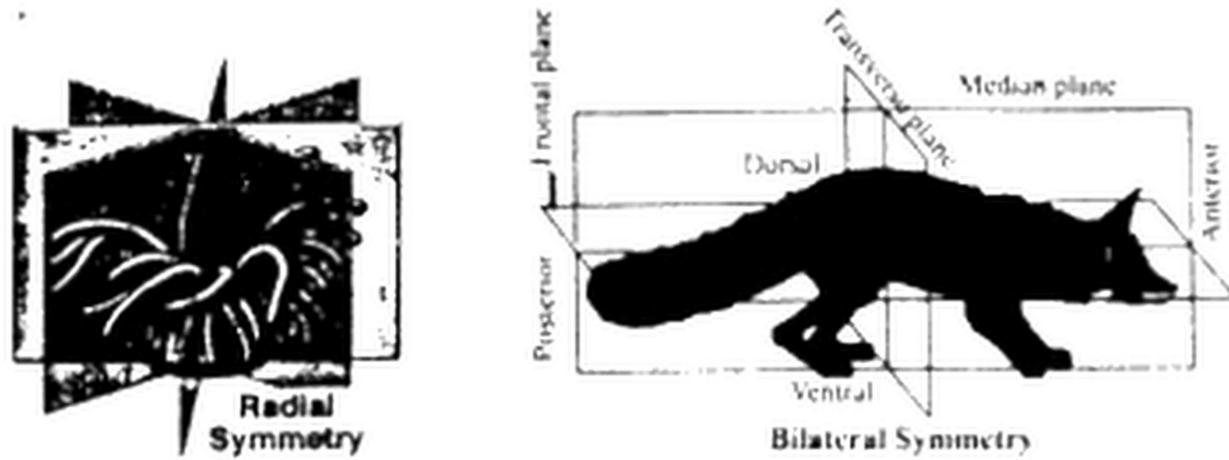


(c) **Body symmetry:**

Animals can be classified according to body symmetry. The subkingdoms Eumetazoa are divided into grade Radiata and grade Bilateria,

Grade Radiata:

It includes all the animals with **radial symmetry** having a top and bottom and similar body parts are arranged spokes or radiate from a central body axis. e.g. Jelly fish sea anemone. Radial symmetry is considered for a sessile life.

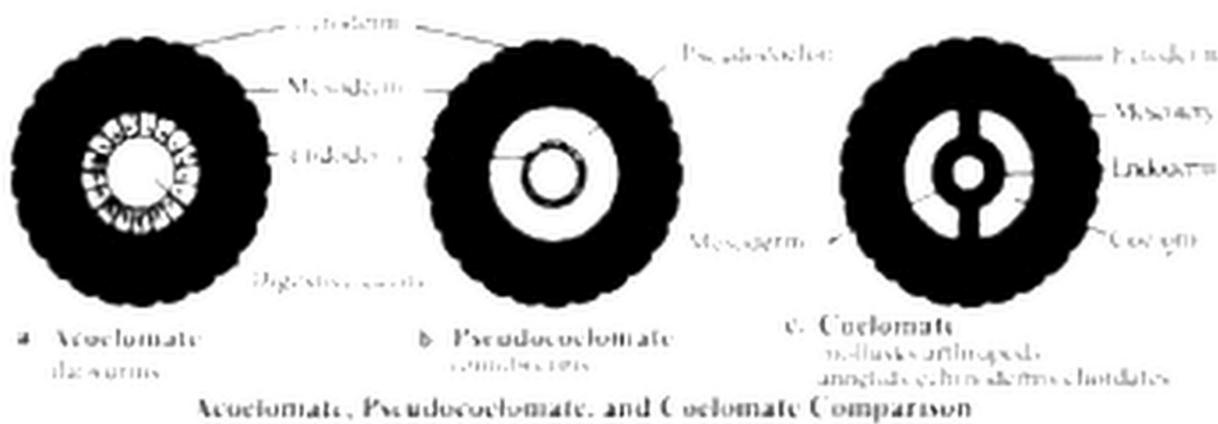


Grade Bilateria:

In Bilateria symmetry a plane through the midline of the body divides it into roughly equivalent right and halves that are mirror image. The front or anterior end of the animal generally has a head. The posterior or rear end of the animal may be equipped with a tail. There are well defined dorsal and ventral surface in Echinoderms the larval stages show bilateral symmetry and the adult secondarily develops radial symmetry. All the animals included in grade Bilateria are triploblastic. Bilateral symmetry is considered an adaptation to motility.

(d) Body cavity:

Animals can be grouped according to type of body or **coelom**, a fluid filled space between the outer body wall and digestive tube.



Acoelomate:

There is no body cavity between the digestive tract and outer body wall,

so these animals are called **acoelomate**. The mesoderm is packed solidly between the ectoderm and endoderm, e.g. Platyhelminthes (flatworm)

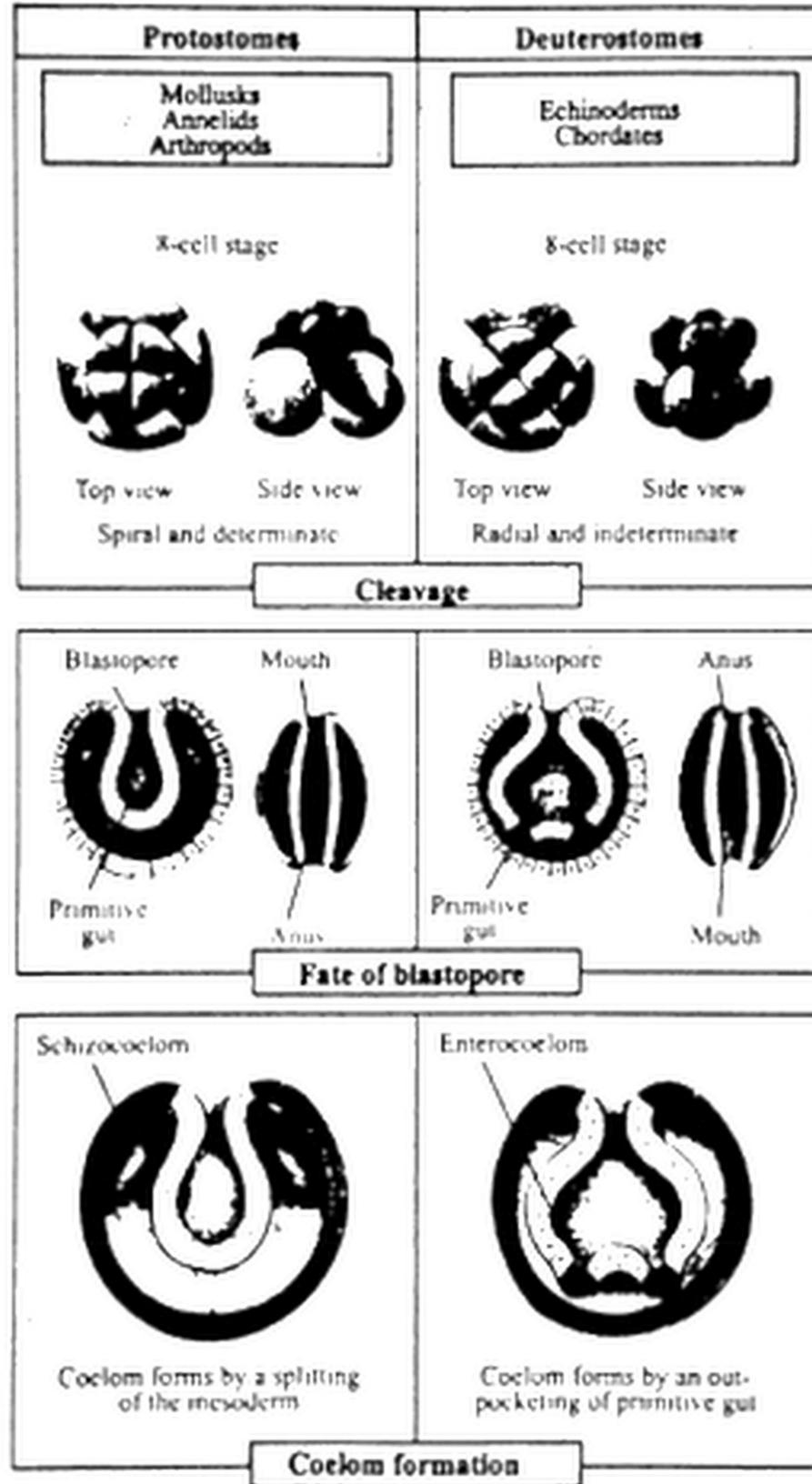
Pseudocoelomates:

If the body cavity develops between the mesoderm and endoderm it is called pseudocoelom (false cavity). Animals with this type of body cavity are called **Pseudocoelomates**, e.g. Aschelminthes (nematodes).

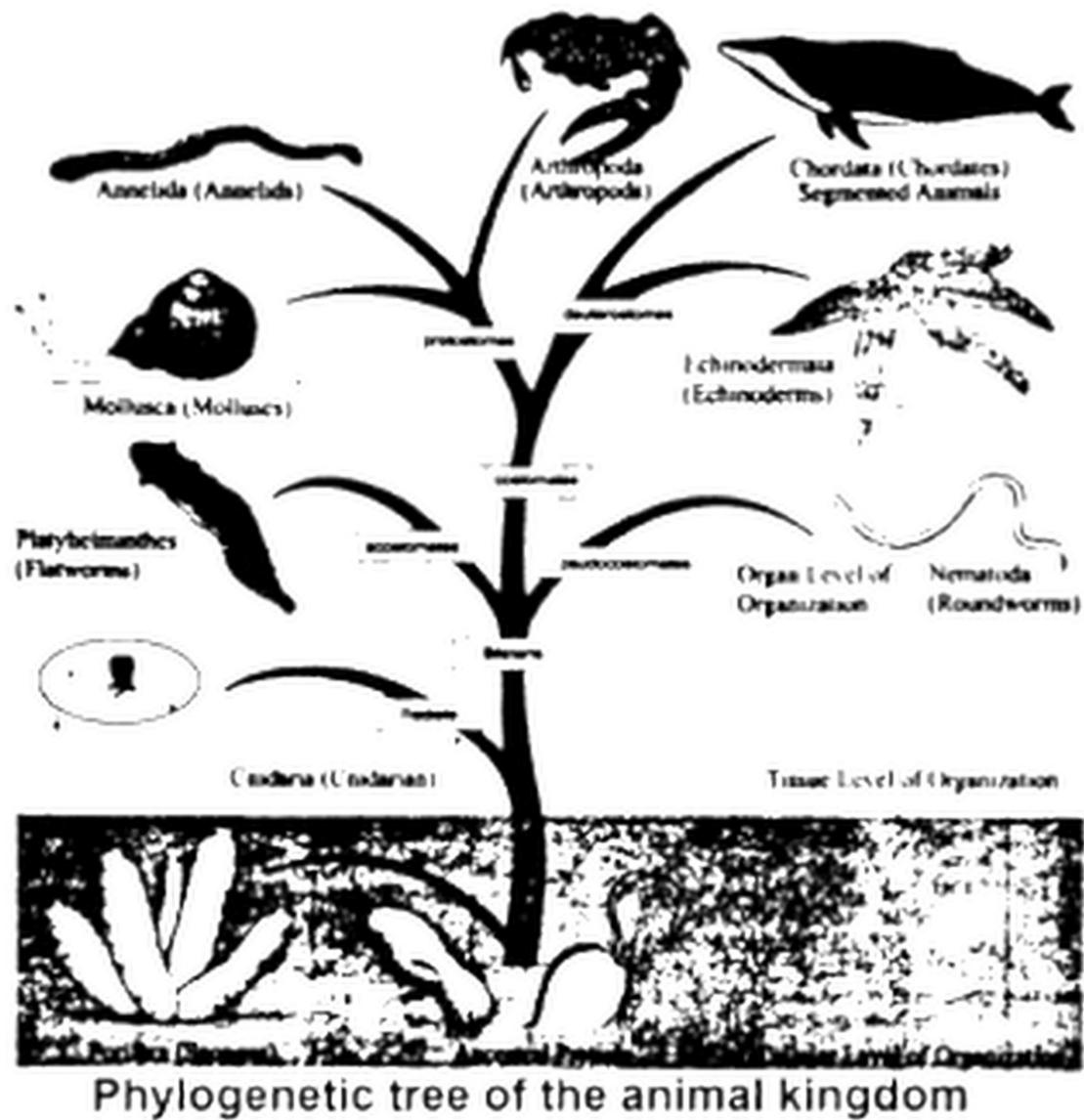
Coelomate:

If the body cavity forms within the mesoderm and is completely lined by mesoderm the body cavity is a **true coelom**. It is filled with coelomic fluid. Animals with a true coelom are called **coelomate**. Animals from annelids to chordates are coelomate. **Coelomate** can be divided into two groups; **protostomes and deuterostomes**. These groups reflect two main line of evolution based on their pattern of early development. Early during development, the embryo consists of a little ball of cells known as **blastula**. A group of cells move inward to form an opening called the **blastopore**. In most of the molluscs, annelids and arthropods, this opening develops into the mouth. These animals are **protostomes** (from Greek words meaning "first, the mouth").

In echinoderms (for example, sea stars and sea urchins) and chordates (the phylum that includes the vertebrates), the blastopore does not give rise to the mouth. Instead it generally develops into anus. The opening that develops into the mouth forms later in development. These animals are the **deuterostomes** ("second, the mouth").

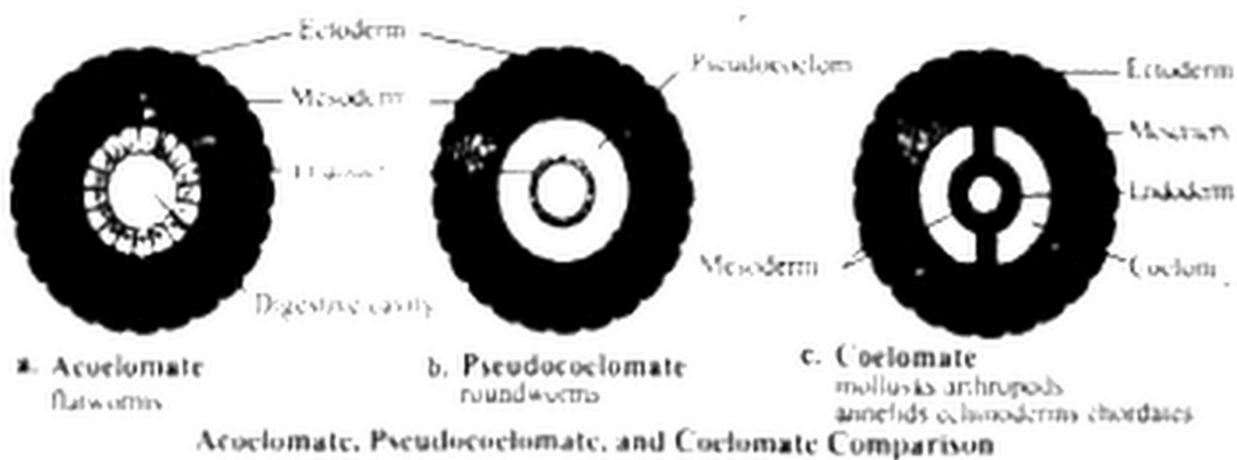


Protostomes versus deuterostomes



29. Differentiate between pseudocoelomates, acoelomates and coelomates. Classify coelomates into protostomes and deuterostomes.

Ans: Animals can be grouped according to type of body cavity or **coelom**, a fluid filled space between the outer body wall and the digestive tube.

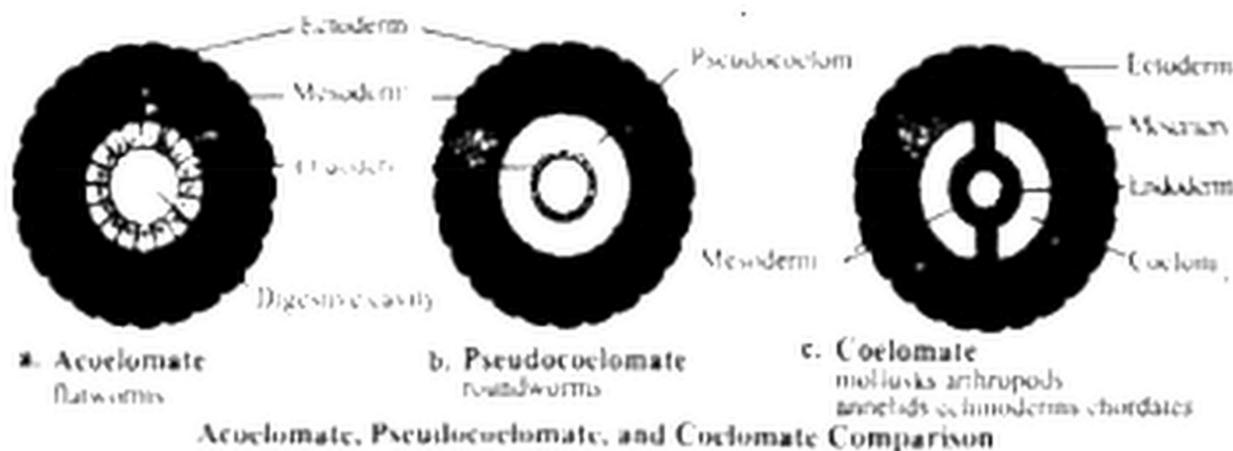


Acoelomate:

There is body cavity between the digestive tract and outer body wall, so these animals are called **acoelomate**. The mesoderm is packed solidly between the ectoderm and endoderm, e.g. Platyhelminthes (flatworm).

Pseudocoelomates:

If the body cavity develops between the mesoderm and endoderm it is called pseudocoelom (false cavity). Animals with this type of body cavity are called **pseudocoelomates**, e.g. Aschelminthes (nematodes).

Coelomate:

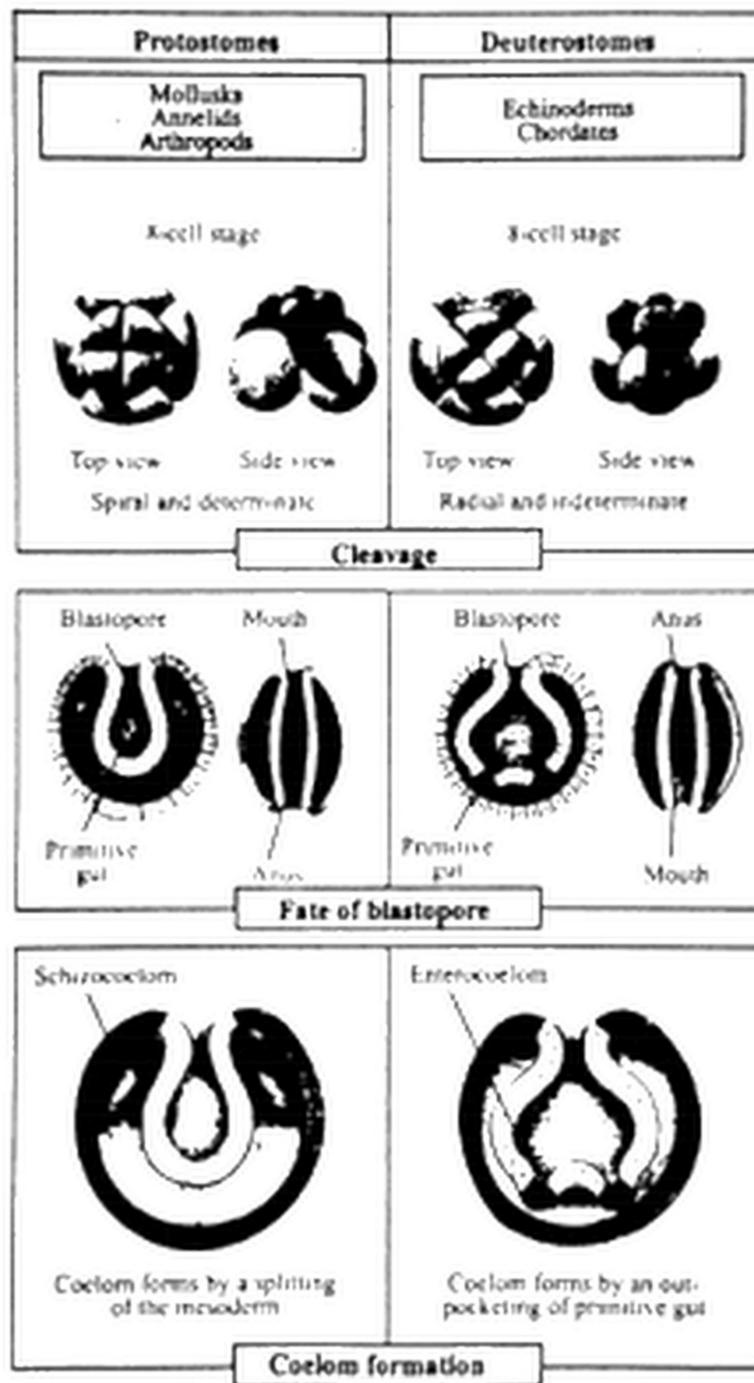
If the body cavity forms within the mesoderm and is completely lined by mesoderm the body cavity is a **true coelom**. It is filled with coelomic fluid. Animals with a true coelom are called **coelomate**. Animals from annelids to chordates are coelomate.

Classification of Coelomate:

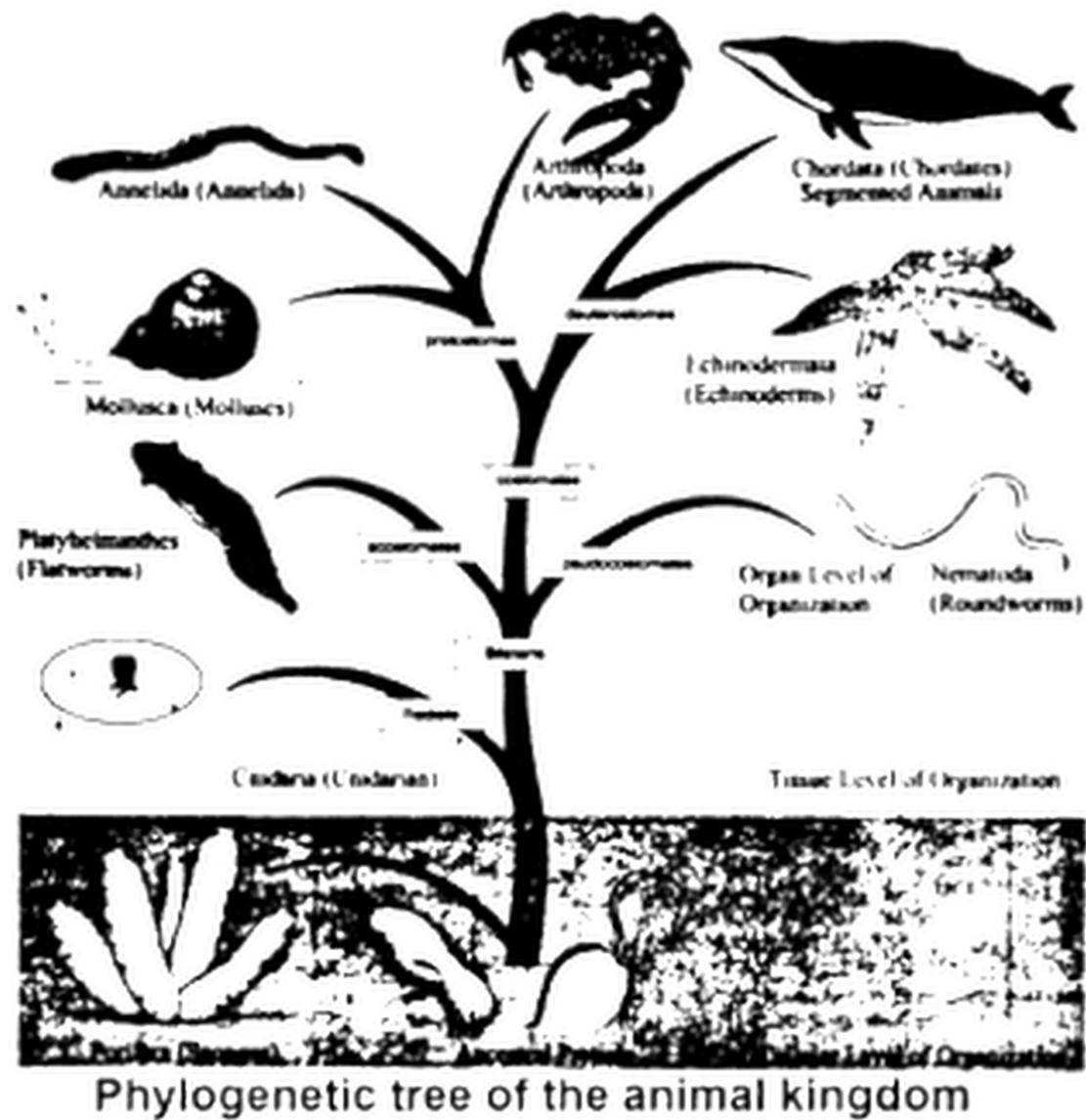
Coelomate can be divided into two groups **protostomes** and **deuterostomes**. These groups reflect two main line of evolution based on their pattern of early development. Early during development, the embryo consists of a little ball of cells known as **blastula**. A group of cells move inward to form an opening called the **blastopore**. In most of the mollusks, annelids and arthropods,

this opening develops into the mouth. These animals are **protostomes** (from Greek words meaning "first, the mouth").

In echinoderms (for example, sea stars and sea urchins) and chordates (the phylum that includes the vertebrates), the blastopore does not give rise to the mouth. Instead it generally develops into the anus. The opening that develops into the mouth forms later in development. These animals are the **deuterostomes** ("second, the mouth").



Protostomes versus deuterostomes



30. Describe the general characteristics, economic importance and examples of the following:

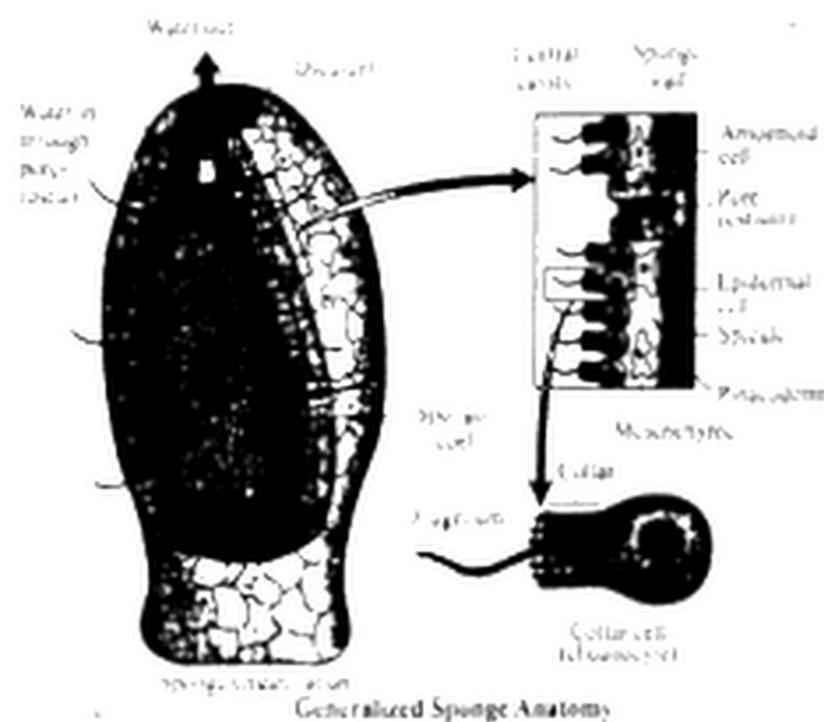
- | | |
|---------------------|-------------------------------|
| (a) Sponges | (b) Cnidarians |
| (c) Platyhelminthes | (d) Aschelminthes (Nematodes) |
| (e) Molluscs | (f) Annelids |
| (g) Arthropods | (h) Echinoderms |

Ans: 1. **PHYLUM PORIFERA** (Latin *porus*, pore, *ferra*, to bear):

General characteristics:

(i) Sponges are sessile attached to the rocks at the bottom of water. Larvae are motile

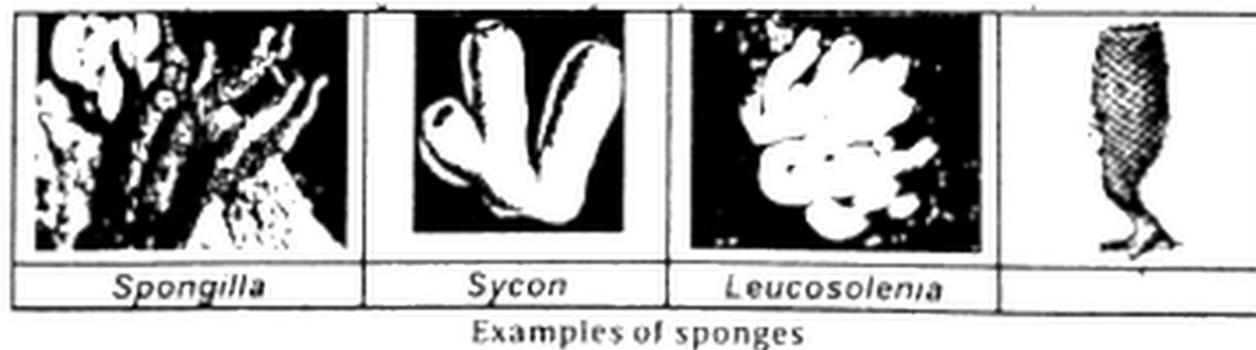
- (ii) Sponges are all aquatic, mostly marine, some found in freshwater.
- (iii) They range in size from a few millimeter wide to more than a meter long body is multicellular and not organized as tissue or organs.
- (iv) Body lacks symmetry.
- (v) The sponges consist of outer dermal layer called **pinacoderm**, and inner layer choanoderm made of flagellated cells called choanocytes. The middle region is called **mesenchyme**. Body is perforated by many pores called **Ostia**.
- (vi) There is a single cavity inside the body called **spongocoel**. Water enters through Ostia travels through the canal and goes out by a large main opening called osculum. Sponges depend on food coming along with water currents.
- (vii) Various shapes of Spicules form the skeleton. These are needle like and may be calcareous or siliceous. The bath sponge has sponging fiber.



- (viii) Asexual reproduction takes place by budding or **gemmules**. Buds develop into new sponges. Sexual reproduction takes place by egg and sperm. Sexes may be separate or hermaphrodite. The embryo development includes free swimming ciliated larval stages.

(ix) Sponges have remarkable ability of **regeneration** from a small fragment. Sponges have evolved from the protists called choanoflagellates.

Examples:



Importance of sponges:

Skeleton of sponges are used for washing and bathing. Sponges have great capacity to absorb water. They are used in surgical operations for absorbing fluid and blood. Sponges are used for sound absorption in buildings.

2. PHYLUM CNIDARIA (Greek, *Knide*. Nettle. +L. *aria*, connected with)

General characteristics of phylum cnidaria:

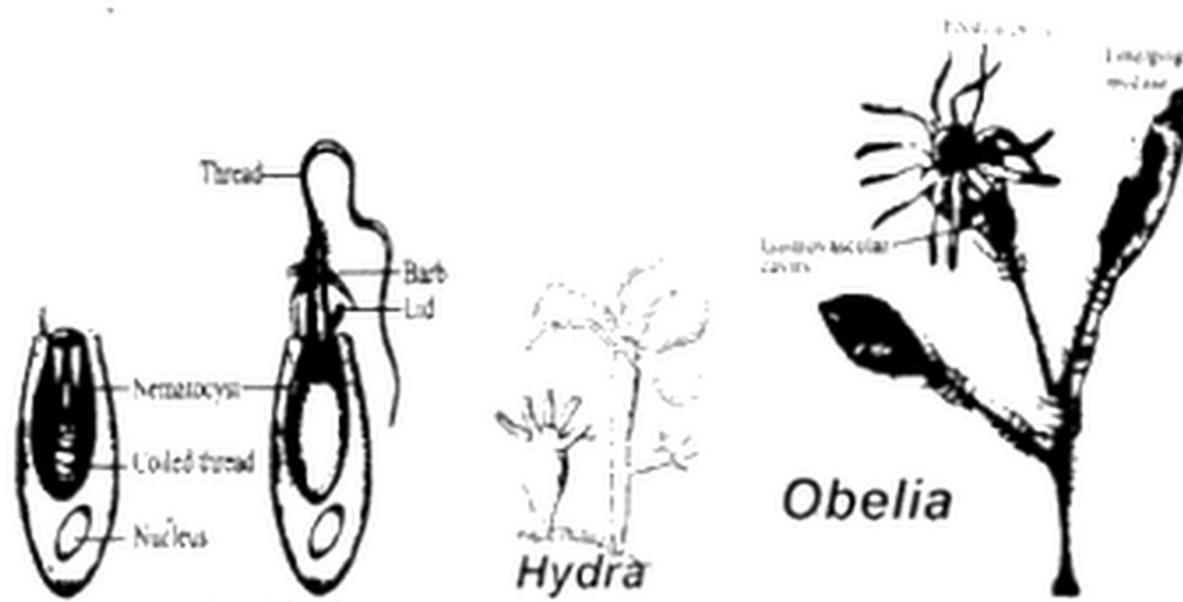
- (i) Cnidarians are entirely aquatic, mainly marine, few found in freshwater, e.g. *Hydra*.
- (ii) Most of the species are sessile, *Hydra*, while others are free living and motile e.g. Jelly fish. Some are colonial e.g. *Obelia*.
- (iii) They range in size from microscopic (*Hydra*) to two meters in length
(hydrozoan polyp)
- (iv) Body shows radial symmetry. Cnidarians are diploblastic animals having ectoderm, endoderm and **mesoglea** in between the two.

(v) They have a sac like internal **gastrovascular cavity**, which has only one opening the mouth.

(vi) The mouth is often surrounded by **tentacles**. Tentacles and body is provided with stinging cell organelles called **nematocysts**.

(vii) Asexual reproduction takes place by budding and sexual reproduction by gametes.

(viii) Cnidarians also occur in the form of colonies. The units of the colonies are called **zooids**. There are two main types of zooids. **Hydroids** or **polyps** which are feeding zooids **Medusae** are reproductive zooids, for sexual reproduction.



Importance of cnidarians:

Coral reefs protect shores from erosion by tidal waves. Corals are used in jewellery and others are used in aquaria, rock gardens etc. Some cnidarians have poisonous stings e.g. jelly fish and sea anemone.

Coral Reefs:

Corals are cnidarians. It is made of CaCO_3 . The ectodermal cells of the corals take lime from the sea water and form their exoskeleton. These exoskeleton form coral reefs and even island. Coral reefs are found in the

coastal water of Florida, West Indies, East coast of Africa, Australia and Island of Coral Sea.

3. Phylum Platyhelminthes (flatworms):

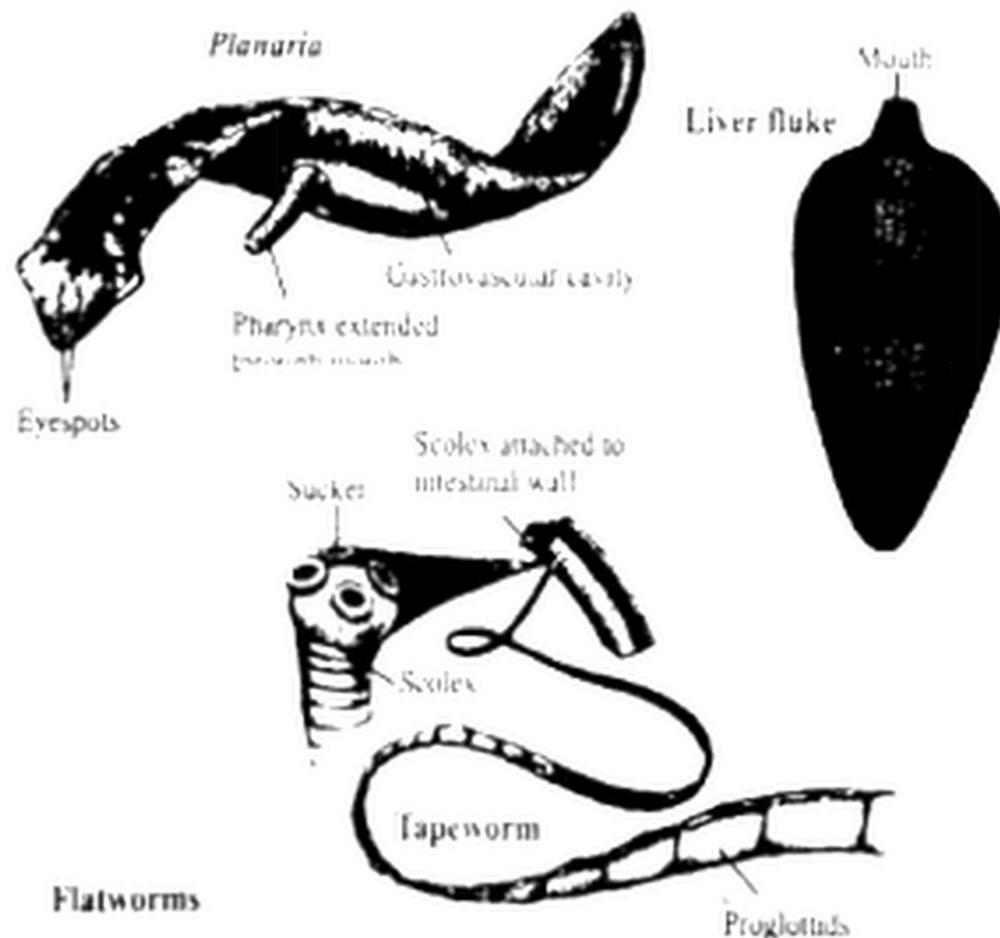
General characteristics of phylum Platyhelminthes:

- (i) The flatworms are free living, e.g. *Planaria*, or parasite, e.g. Tapeworm.
- (ii) They are found in freshwater, marine, animals' gut, liver.
- (iii) Body is soft and flattened dorsiventrally. Platyhelminthes are triploblastic and exhibits a bilateral symmetry.
- (iv) Coelom is absent and the spaces are filled with mesenchyme tissue.
- (v) Eyespots are present in some flatworms.
- (vi) Free living forms are motile.
- (vii) They move by cilia present on the underside of the animals, e.g. *Planaria*.
- (viii) In parasitic forms movement is restricted.
- (ix) Reproductive takes places both by asexual and sexual means. Asexual reproduction is by fission. Most forms are monoecious.
- (x) The reproductive system is complex, usually with well-developed gonads ducts and accessory organs. The fertilization is internal.

Examples: The examples of flatworms are *Dugesia* (planaria), *Fasciola* (liver fluke), *Taenia* (tapeworm).

Importance of Platyhelminthes:

The parasitic forms of flukes and tapeworms are very harmful **for man**, e.g. tapeworm, liver fluke, the blood fluke of cattle etc.



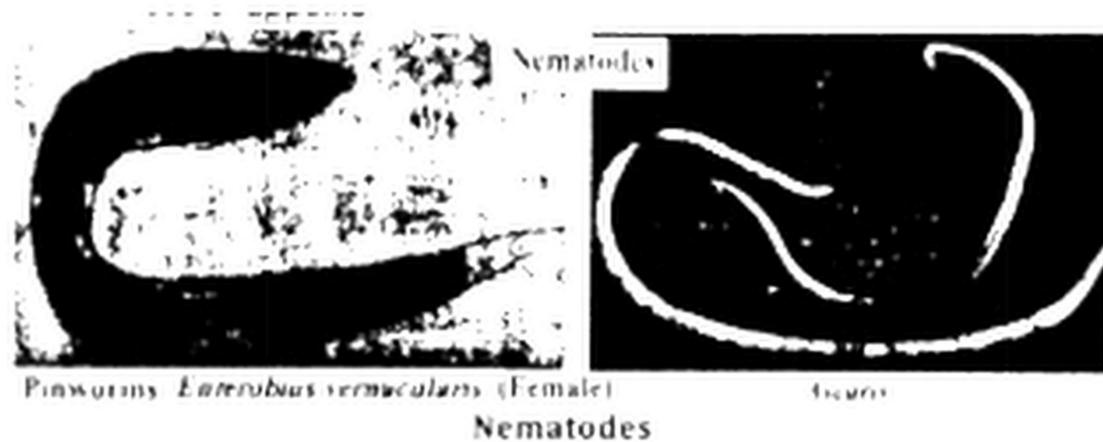
4. PHTYLUM ASCHELMINTHES (roundworms)/NEMATODA

General characteristics of phylum aschelminthes:

- (i) The roundworms are free living or parasites and live in soil, roots, human and animals intestine and muscles.
- (ii) Most roundworms are less than five cm long many are microscopic but some parasitic roundworms are more than one meter in length.
- (iii) The worms exhibit bilateral symmetry, having three germ layers. Body is cylindrical, tapering at both ends.
- (iv) Muscular layer is not continuous. It is divided into four longitudinal quadrants two – ventrolateral.
- (v) The body cavity is pseudocoelom.
- (vi) Most nematodes are dioecious. Fertilization is internal.

Importance of aschelminthes:

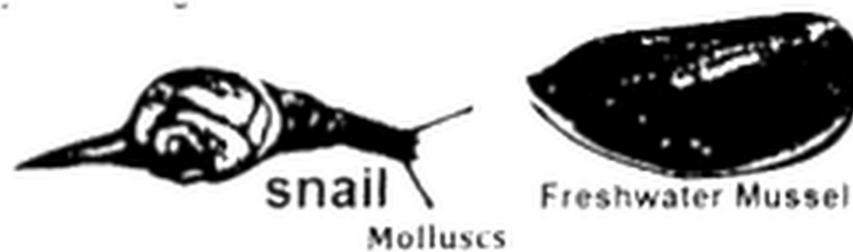
Ascaris lumbricoides is an intestinal parasite of man. Pinworms (*Enterobius vermicularis*) are parasites in the human caecum, colon and appendix causing insomnia and loss of appetite.



5. PHYLUM MOLLUSCA: (Latin, *Mollis*, soft)

General characteristics of phylum moliusca:

- (i) They are free living or sessile, and live in freshwater, marine and land (in moist places)
- (ii) The molluscs exhibit bilateral symmetry, are triploblastic, coelomate, soft and unsegmented animals. Body is divided into head ventral muscular foot dorsal visceral region.
- (iii) The whole animals covered in an envelope called mantle. It secretes the shell. The shell may be external (snail), internal (cattle fish) or even absent (octopus).
- (iv) Mouth cavity may have a tongue like structure called radula, e.g., cuttle fish, snail. Coelom is divided into haemocoelic channels or sinuses.
- (v) Sexes may be separate, e.g. *Unto* or *united*, e.g. *Helix*. The development takes place through trochophore larvae.



Economic importance of molluscs:

Shell of fresh water mussels are used in button industry. Shells are also used for making ornament. Some outers make valuable pearls e.g., pearl oyster Clams, oyster, mussels are source of food in Far East. Europe and America Slugs are injurious in garden and cultivation. Toredoshipworm damages wooden parts in ship.

6. PHYLUM ANNELIDA (Latin – *Annelus* = little ring)

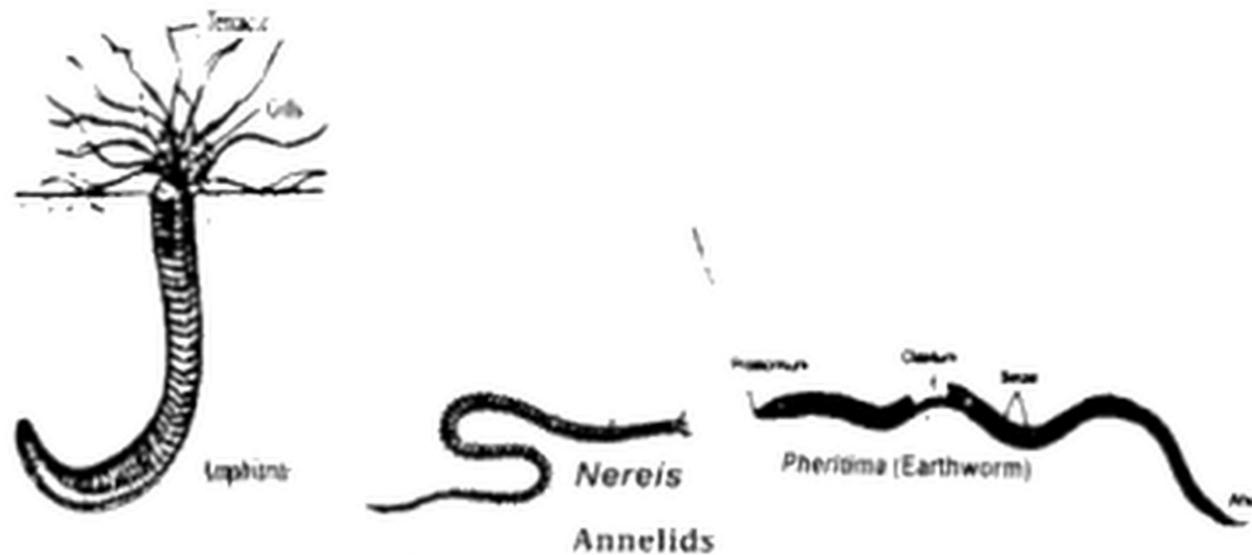
General characteristics of phylum annelid:

- (i) The annelids are called segmented worms. They are free living (Earthworm) or ectoparasite, e.g. (*Stylaria*, *Hirudo*).
- (ii) They are found in soil, freshwater and marine (*Nereis*). Body is metamerically segmented
- (iii) Coelom is a true coelom. It is separated into compartments. The coelomic fluid of the adjacent chamber is mixed. The coelomic fluid serves as a hydrostatic skeleton also.
- (iv) The body wall contains circular and longitudinal muscles which help in locomotion. The organs of locomotion are chitinous **chaetae or setae**. **Parapodia** is present in the body wall of *Nereis*.
- (v) The common mode of reproduction is sexual. Most of the annelids are hermaphrodite e.g. earthworm, leech. Sexes are separate in some annelids, e.g. *Nereis*. Fertilization is external. Development is direct or indirect through **trochophore larvae**.

(vi) Regeneration is common in annelids.

Examples:

The examples of annelids are *Nereis*, *Pheretima posthuma* (Earthworm),
Hirudo (Leech)



Economic importance of annelids:

Polychaetas form an important food item for many edible fish. Earthworms help in soil improvement. Leech is an ectoparasite to man and cattle.

7. PHYLUM ARTHROPODA: (Arthros, joined pods, feet).

General characteristics of phylum arthropoda:

- (i) The arthropods are called joint footed animals. They are free living or parasites and are found in all types of habitat.
- (ii) The body is segmented. Some are worm like and others are flying insects. Segments are modified, specialized and fused.

- (iii) Symmetry is bilateral; head, thorax and abdomen variously distinct or fused. Body is covered by **chitin**. It is flexible at many places to allow articulation. There are several pairs of appendages.
- (iv) Coelom is not present as the main body cavity. It is reduced and is called **haemocoel**, because it is connected with the blood vascular system. Alimentary canal has two openings, the mouth and anus.
- (v) Skeleton is exoskeleton, formed chiefly of chitin. Muscles are attached to exoskeleton for locomotion. **Sexes** are separate in arthropods. The male and female arthropods are often unlike.
- (vi) The reproductive organs and ducts are paired. The testes produce sperms and ovaries produce eggs. Fertilization is mostly internal. Development takes place through **metamorphosis**.



Economic importance of arthropods:

Lobsters, crayfish and prawns are eaten. Some crustaceans act as intermediate hosts for human parasites, e.g. Cyclops carry larvae of a nematode, the Guinea worm. Honey and bee's wax are produced by the honeybee, silk by silkworms and shellac from a wax is secreted by lac insects.

Insects aid in the production of fruits, seeds and vegetables by pollinating the flowers. Fruit fly (*Drosophila*), cockroach, grasshopper are abundantly used as laboratory animals for scientific learning and research.

Insects destroy field crops, fruit trees and timber plants. They spread diseases among human beings. Bees and wasp's sting, mosquitoes, lice and fleas bite and suck blood. Scorpions and a few spiders are poisonous and sting.

PHYLUM ECHINODERMATA (GK. *Echinos*, *spiny* and *derma* skin)

General characteristics of phylum echinodermata:

(i) The echinoderms are called spiny **skinned animals**. They are free living; some are attached to the substratum.

(ii) The echinoderms are exclusively marine. Most are found at the bottom along the shorelines in shallow seas.

(iii) Body is covered by delicate epidermis. The echinoderms are triploblastic coelomates and exhibit radial symmetry in adult.

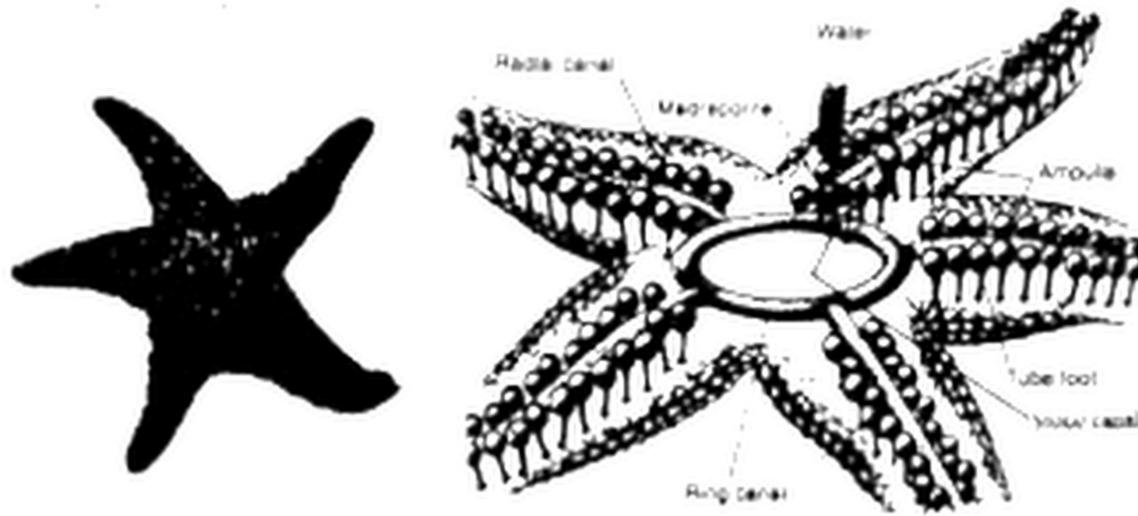
(iv) Echinoderms have an endoskeleton consisting of a spine bearing calcium rich plates. The spines, which stick out through the delicate skin, account for their name.

(v) The mouth is on the oral side and anus is on the body may be the aboral side. There is a central disc from which arms radiate.

(vi) The body may be flattened like biscuit, (cake urchin), star-shape with short arm (starfish) globular (sea cucumber).

(vii) Coelom consists of canals and spaces, and one of the which forms **water vascular system** (see glossary)

(viii) Organs of locomotion are the **tube feet**. These are present along the edges of grooves present in the arms.



(ix) The sexes are separate. The fertilization is external. The larvae such as **bipinnarial** and **brachiolaria** are complex and exhibit bilateral symmetry, autotomy and regeneration. (x) The regeneration is shown by the adult and larval stages. The examples are starfish, sea cucumber, **sea** lily, brittle star and **sea** urchin.

Economic importance of echinoderms

Many echinoderms are used as food. Dried skeleton of echinoderms is used as fertilizer because of their high percentage of calcium and nitrogen. Starfishes act as scavengers and thus clean seawater. They cause damage to oyster beds. The stinging sea urchins are poisonous.

31. Describes the evolutionary adaptations for digestion, gas exchange, transport, excretion and Co-ordination in the following phyla:

- | | | |
|-----------------|-----|--------------------------|
| | (a) | Porifera |
| | (b) | Cnidaria |
| Platyhelminthes | (c) | |
| | (d) | Aschelminthes (Nematoda) |
| (e) Mollusca | (f) | Annelida |
| | (g) | Arthropoda |
| | (h) | |
| Echinodermata | | |

Ans: (a) PORIFERA:

Evolutionary adaptations in sponges:

(1) Digestion:

It is completely intracellular and occurs in food vacuoles within choanocytes. All the cells of the dermal and gastral layers are in contact with water.

(2) Respiration:

There are no special organelles for respiration.

(3) Transportation:

It takes place through water current and diffusion. The water current system has greatly enlarged area for the feeding and gaseous exchange.

(4) Excretion:

It takes place through diffusion and outgoing water-current.

(5) Nervous system:

A sponge lacks nervous system. Sensory cell probably seems to coordinate the flow of water. Sponges seem to represent a dead end in evolution.

(b) Cnidaria:**Evolutionary adaptations in cnidarians:****(1) Digestion:**

Gastrovascular cavity is often branched or divided with septa with a single opening.

(2) Transportation and excretion:

Takes place through diffusion

(3) Respiration and excretion:

There is no respiratory and excretory system

(4) Nervous system:

Nervous system consists of nerve net and some sense organs. The name Cnidaria has been given to this group of animals due to presence of special cells called cnidocytes. These cells give rise to nematocyst the stinging cells characteristic of this group.

(c) Platyhelminthes:**Evolutionary adaptations in Platyhelminthes:****(1) Digestion:**

Digestive system is incomplete i.e. gastrovascular type, having only one opening to the exterior, the mouth.

(2) Respiration:

Respiratory system is absent.

(3) Transport:

Transport system is absent.

(4) Excretion:

Excretory system consists of two lateral canals with branches bearing flame cells (protonephridia)

(5) Nervous system:

Nervous system consists of a pair of anterior ganglia with longitudinal nerve cord.

(Nematoda):**adaptations in aschelminthes:****Digestion:**

Digestive system is complete. Digestive tract is a straight tube with mouth and anus at opposite ends of the body.

(2) Respiration: Respiratory organs are absent.

(3) Transport: Circulatory organs are absent.

(4) Excretion: Excretory system consists of canals and protonephridia.

(5) Nervous system: It consists of a ring of nerve tissue and ganglia around the pharynx with longitudinal nerve cords connected by transverse nerves.

(e)**Molluscs:****Evolutionary adaptations in molluscs:**

(1) Digestion:

Digestion system is complex having rasping organ radula and anus usually emptying into mantle cavity.

(2) Respiration:

Gaseous exchange takes place by **gills**, lungs mantle or body surface.

(3) Transport:

Open circulatory system consists of heart and blood vessels.

(4) Excretion:

There are one or two metanephridia, which open into the pericardial cavity.

(5) Nervous system:

The nervous system consists of paired cerebral, pleural, pedal and visceral ganglia with nerve cord.

(f) Annelida:**Evolutionary adaptations****in annelids:****(1) Digestion:**

Digestive system is in the form of an alimentary canal. It extends throughout the body. It has two openings the mouth and the anus. The mouth is surrounded by prostomium.

(2) Respiration:

Respiratory system is absent and respiration takes place through the moist skin.

(3) Transport:

Annelids are the first group in the animal kingdom having definite closed blood vascular system which runs throughout the body.

(4) Excretion:

Excretion takes place by nephridia. These are ciliated organs present in each segment.

(5) Nervous system:

Central nervous system is present, which extends throughout the body.

(g) Arthropoda:

Evolutionary adaptations in**arthropods:****(1) Digestion:**

Digestive system is complete, mouthparts modified from appendages and adapted for different methods of feeding.

(2) Respiration:

In insect's respiratory system consists of air tubes called trachea, (L *trachia*, windpipe). Spiracles are the openings of the main tubes to the exterior. Arthropods have a variety of respiratory organs. Aquatic forms have gills. Terrestrial forms have book lungs (e.g. spiders) or air tubes called trachea.

(3) Transport:

Circulatory system consists of dorsal contractile heart (blood sinuses).

(4)**Excretion:**

In insects the excretory organs are called Malpighian tubules, and the nitrogenous wastes are excreted in the form of solid uric acid.

(6) Nervous system:

Nervous system is highly developed. There is a brain and a ventral double nerve cord. There is a ganglion in each segment from which nerves arise.

(h) Echinodermata:**Evolutionary adaptations in echinoderms:****(1) Digestion:**

Digestive system is usually complete, axial or coiled anus is absent in ophiuroids.

Respiration:**(2) Respiration:**

Respiration is performed by dermal branchiae, tube feet, respiratory

tree e.g. sea cucumber and bursae e.g. spiny brittle star.

- (3) **Transport:** Blood vascular system is much reduced.
- (4) **Excretion:** Excretory organs are absent.
- (5) **Nervous system:** Nervous system includes a circumoral nerve ring and radial nerve-cords. There is no brain.

32. List the general characteristics, evolutionary adaptations and give examples of the phylum Hemichordata.

Ans: PHYLUM HEICHORDATA: (Gr. *Hemi*, half, *chorda*, string cord) They show characteristics of both echinoderms and chordates and both phyla belong to the group deuterostome branch of animal kingdom. Hemichordates are also called prochordates because of their close relationship to chordates.

Examples:

Saccoglossus.

Balanoglossus.

General

characteristics of phylum hemichordate:

- (i) The hemichordates are called acorn worms. All hemichordates are marine some are solitary, naked and slow moving, others are sedentary.
- (ii) Body is soft and unsegmented and has a worm like form. Body has three distinct regions proboscis collar and trunk.
- (iii)

Symmetry is bilateral and hemichordates are triploblastic. Body cavity is a true coelom. (iv) Excretory system comprises of a glomerulus situated in the proboscis and connected with blood vessels. There are no nephridia. (v)

Sexes may be separate or united. Fertilization is external. Development may include free swimming larval stage.

Evolutionary adaptations in hemichordates:**(1) Respiration:**

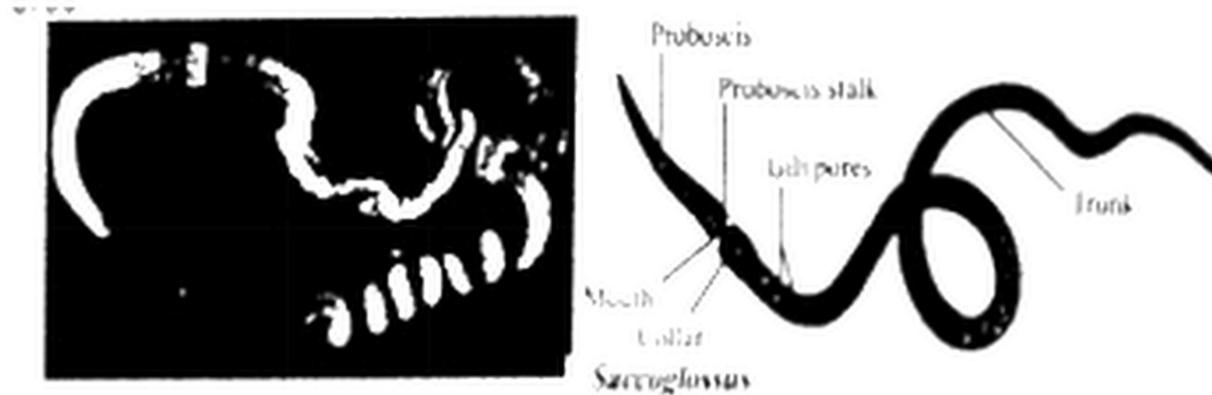
It occurs by gill slits connecting the pharynx with outside as in chordates.

(2) Circulatory system:

It includes a dorsal heart and two longitudinal vessels, a dorsal and a ventral, interconnected by small lateral vessels. Blood is colourless and without corpuscles.

(3) Nervous system:

It is diffused, consisting of an epidermal plexus of nerve cells and nerve fibres.



33. Describe the four basic characteristics of the phylum Chordata.

Ans: Phylum Chordata:

The representatives of the phylum chordate called that chordates are the most familiar, adaptable, successful and the most widely distributed animals, showing diversity of form, habitat and habits.

Characteristics of Chordates:

All the chordates possess four basic characteristics, which are:

- | | | | |
|------------------------------|-----------------------|-------------------|---------------|
| (a) | Notochord | (b) | Dorsal |
| hollow nervous system | (c) | Gill slits | |
| (d) | Postnatal tail | | |

(a) Notochord:

The Notochord is solid and jointed rod located in the mid-dorsal line between the gut and the central nervous system outside the coelom. The notochord service as an axial endoskeleton, giving support to the body and providing space for muscle attachment. In some lower chordates the notochord persists through out life, but in higher chordates it is partly or wholly replaced in the adult stage by a jointed back bone or vertebral column.

(b) Dorsal hollow central nervous system:

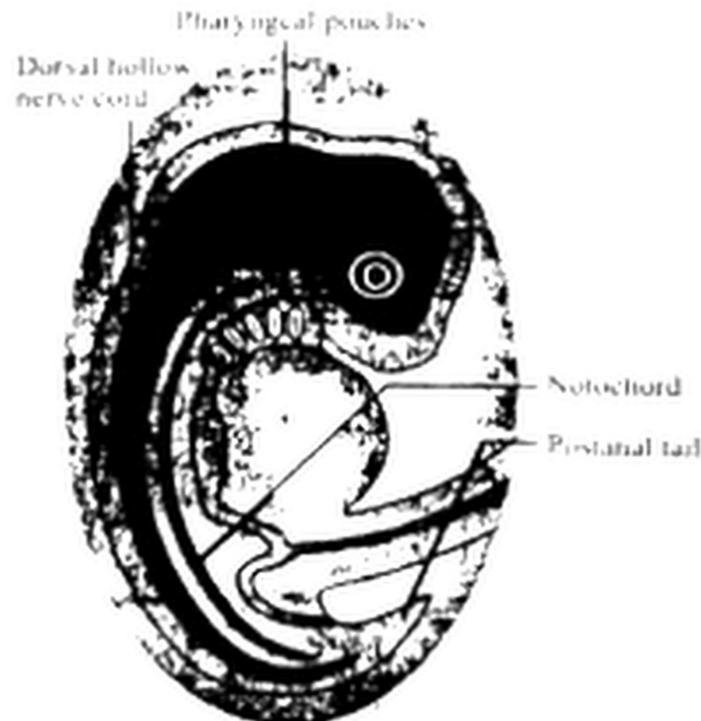
The central nervous system of all the chordates consists of a single, tubular fluid filled, nongangliated nerve cord, situated along the mid dorsal line above the notochord and outside the coelom.

(c) Gill slits:

The gill slits (pharyngeal pouches) are paired perforations on the lateral sides of the anterior part of the body, leading from the pharynx to exterior.

(d) Postanal tail:

It extends beyond anus present at least in embryo regresses (passage back, reversion) into tail bone in human.



Main Features of the Chordates, as Shown in a Generalized Embryo

34. Describe the general characteristics, evolutionary adaptation and give examples of super class agnatha.

Ans: SUPER CLASS AGNATHA (Jawless

fishes):

Classification:

It is divided into

two classes:

(a)

Myxini

Body slender, eel-like and rounded with naked skin.

There are no paired appendages and no dorsal fin in class Myxini.

(b) Cephalospidomorphi.

There are one or two median fins and no paired appendages in class Cephalospidomorphi.

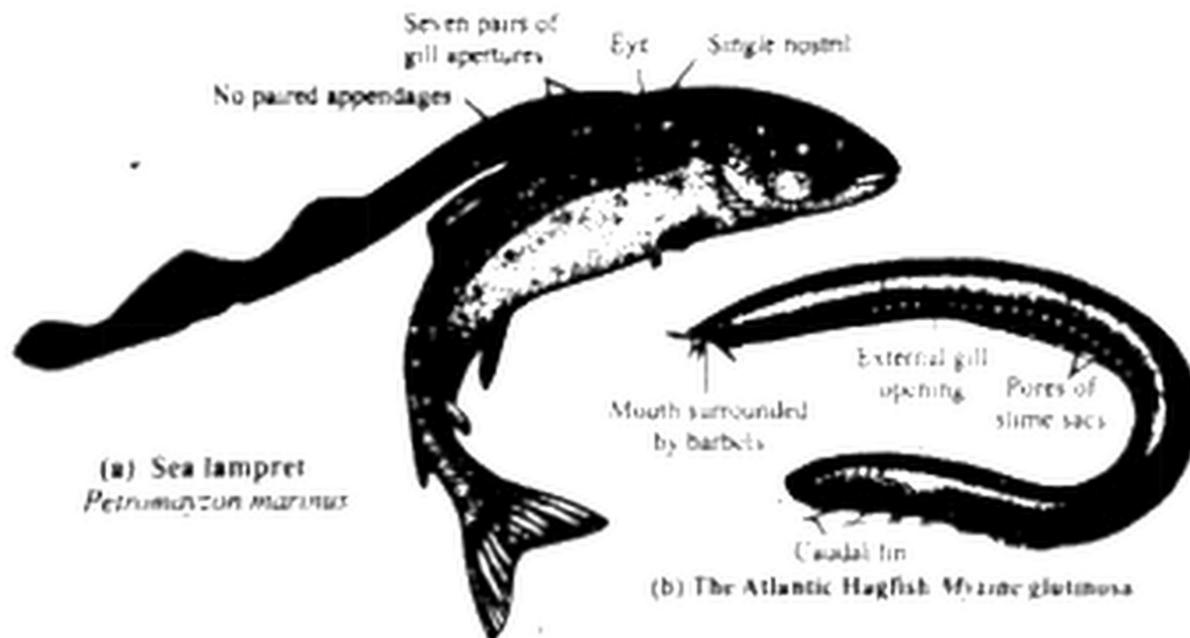
General characteristic of super class agnatha:

- (i) The caudal fin extends anteriorly along the dorsal surface.
- (ii) Skeleton is fibrous and cartilaginous and the notochord is persistent. Biting mouth with two rows of eversible (to turn outwards) teeth in class Myxini and the oral disk is sucker

like and tongue with well-developed teeth in class Cephalospidomorphi.

(iii) Sexes are separate fertilization is external and there is no larval stage.

Examples: The examples of agnatha are Hagfish and Lamprey.



Evolutionary adaptation in super class agnathan:

Buccal funnel and toothed tongue form a device for blood sucking in absence of Jaws. There are five to sixteen gills for respiration in class Myxini and seven pairs of gills with external gills opening in class Cephalospidomorphi. Dorsal nerve cord with differentiated brain.

Jaws Evolve

The gnathostomes have jaws. The tooth bearing bones of the head. Jaws are believed to have evolved from the first pair of gill arches of agnathans.

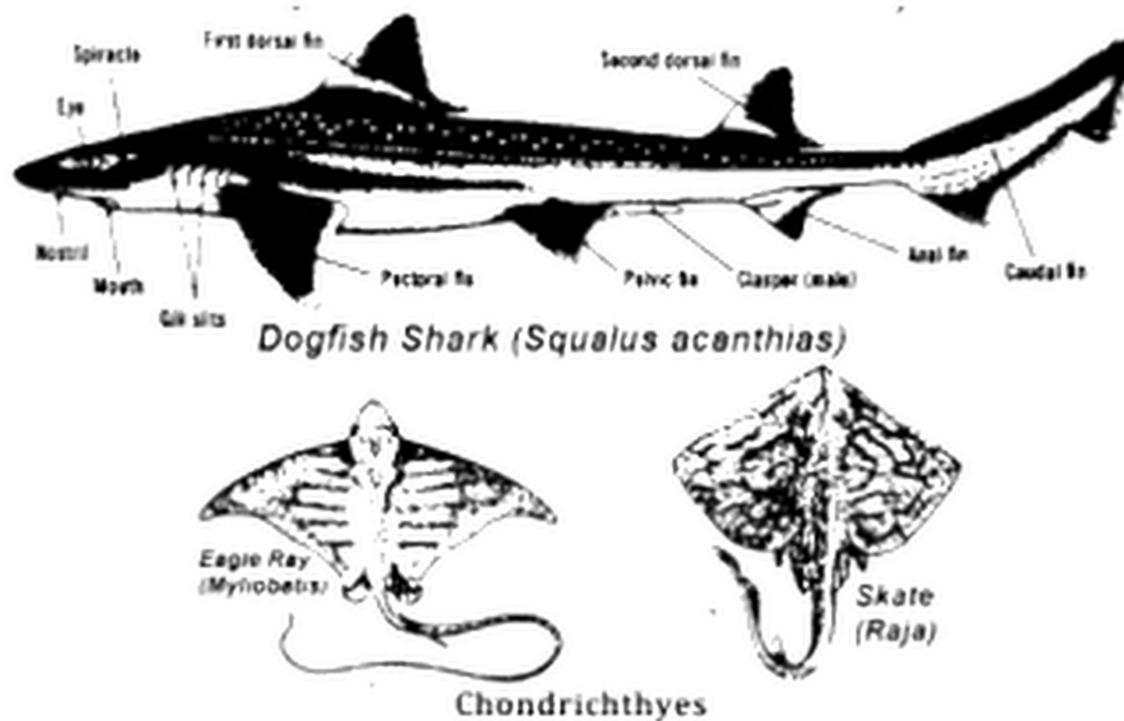
35. Describe the general characteristics, evolutionary adaptations and give examples of the following classes:

- | | | | |
|--------------|------|----------------|----------|
| | (a) | Chondrichthyes | (b) |
| Osteichthyes | | | (c) |
| Amphibia | (d) | Reptilia | |
| (e) | Aces | (f) | Mammalia |

Ans: (a) Chondrichthyes:

General characteristics:

(i) Body is laterally compressed and spindly (fusiform) shaped. Mouth is ventral. Olfactory sacs are not connected to mouth cavity.



- (i) Skin is tough and covered with minute placoid scale.
- (ii) The pectoral and pelvic fins are paired. There are two dorsal fins. The caudal fin is heterocercal.

(iv) Endoskeleton entirely cartilaginous.

(v) Digestive tract leads into the Cloaca. Stomach is J shaped.

(vi) The circulatory system consists of two-chambered heart. There is one atrium and one ventricle. There are 5-7 pairs of aortic arches.

(vii) Respiratory system includes 5-7 pairs of gills, without operculum. Swim bladder is absent. (viii)

Sexes are separate. Gonads are paired. Fertilization is internal. Most forms are oviparous or viviparous.

Examples:

It includes the sharks, dogfishes, rays, skates and chimaeras.

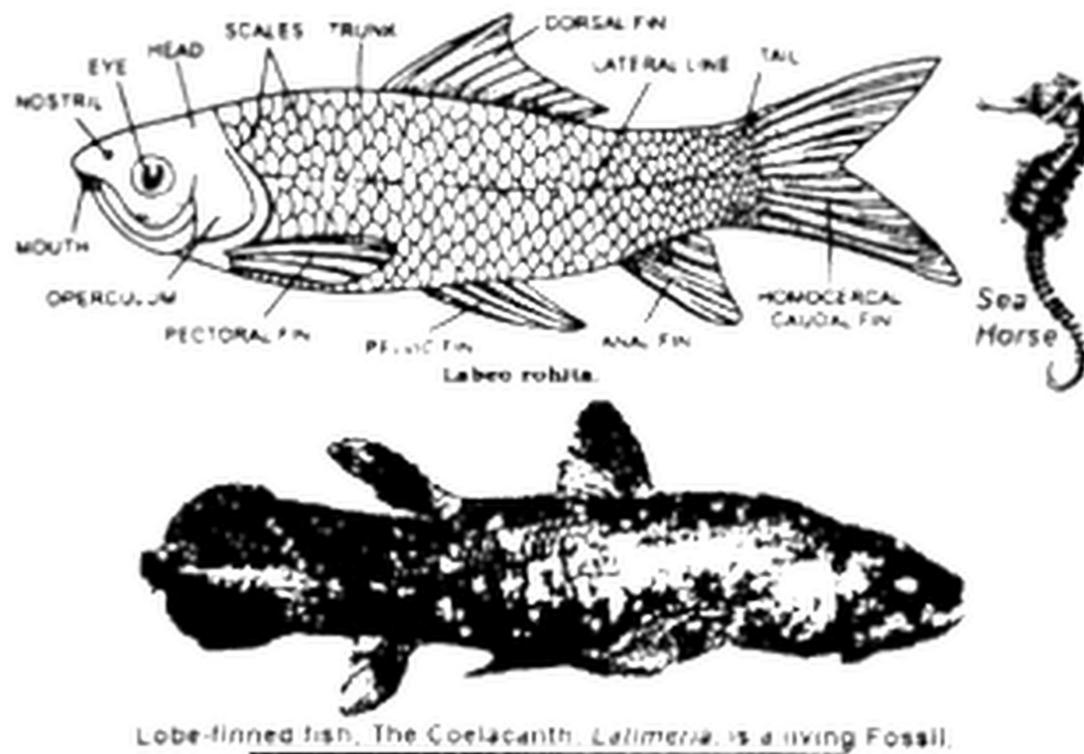
Evolutionary adaptations in class Chondrichthyes:

Spindle shaped body, slippery skin, presence scales on the body protect the animal. Ventral mouth is suited for capturing prey at the bottom of the sea. Internal fertilization, nourishment and protection of the embryo in the mother's body are evolutionary adaptive feature.

(b) Osteichthyes:

General characteristics of class Osteichthyes:

- (i) Body is usually spindle-shaped and streamlined for active movement through water.
- (ii) Endoskeleton is partly or wholly bony. Vertebrae are numerous. Pelvic girdle is often absent. Notochord persists in a greatly reduced form.
- (iii) Skin usually contains dermal scales embedded in the dermis.
- (iv) Both median and paired fins are present. Pelvic and pectoral fins are paired while dorsal fin is single. The caudal fin is homocercal.
- (v) Mouth is usually terminal, i.e. anterior end often bears numerous teeth. Jaws are well developed. Anus is present and Cloaca is absent. The four pairs of gills are supported by a bony arch.
- (vi) They are covered by operculum. Spiracles are mostly lacking.
- (vii) Swim bladder is usually present with or without connection with the pharynx. Swim bladder helps in buoyancy.
- (viii) Heart is two chambered, having only one atrium and one ventricle. There are four pairs of aortic arches. Red blood cells are oval and nucleated. Brain has ten pairs of cranial nerves.
- (ix) Sexes are separate. Gonads are paired. Fertilization is generally external. Most forms are oviparous (egg laying), some are ovoviviparous or even viviparous. (producing living young)



Limbs Evolve

All the animals which are called tetra pods have four limbs. The lobe-finned fishes of the Devonian period are ancestral to the amphibians, the first tetra pods. Animals that live on land use limbs to support the body, especially since air is less buoyant than water. Lobed-finned fishes and early amphibians also had lungs and internal nares as means to respire air.

Evolutionary adaptations in class Osteichthyes:

Body is laterally compressed spindle shaped and has slimy skin, strong segmental muscle for efficient swimming device. **Gills** help in respiration. **Air** or **swim bladder** enables the fish to easily shift from one depth to another. **Gill rakers** check the loss of food. Lack of teeth in the jaws is correlated to the herbivorous diet. (c)

Amphibia:

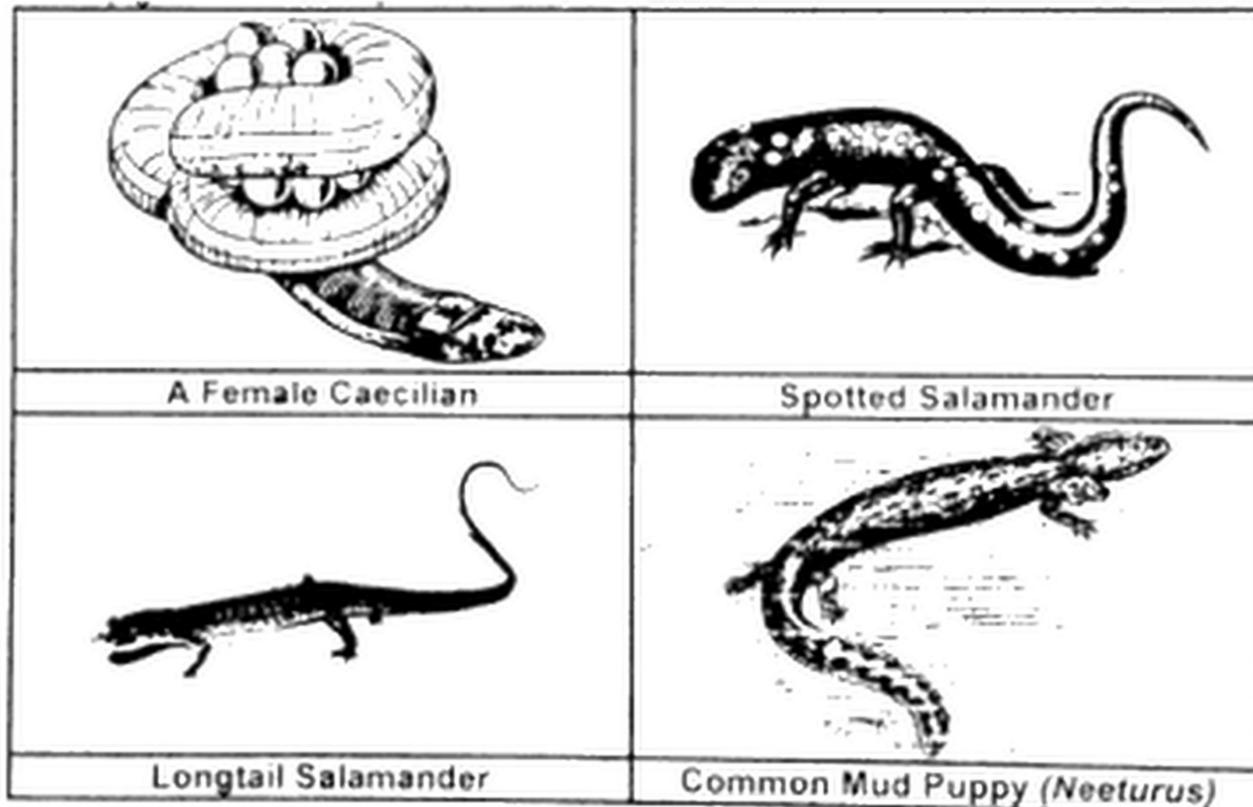
General characteristics of class amphibian:

(i) Body varies considerably in forms, is divisible only into head and trunk. Most have two pairs of pentadactyl limbs with 4-5 or fewer digits. Some are without legs, e.g. Caecilians. Webbed feet often present, e.g. frogs.

(ii) Skin is often smooth,
moist and rich in glands. It is highly vascular. (iii)

Scales are generally absent. In some glands are poisonous, chromatophore pigment cells are present in the skin.

In larval stage respiration takes place by **gills** and in the adults by lungs and skin.



- (iii) In larval stage respiration takes place by gills and in the adults by lungs and skin
 - (iv) Heart is three chambered with respect to atria and ventricle. Sinus venosus, tuncus arteriosus are present.
 - (v) Double circulation takes place through the heart.
 - (vi) Sexes are separate. Gonads are paired. Fertilization may be external or internal. Most forms are oviparous.
 - (vii) Development takes place through metamorphosis.
 - (viii) Amphibians are anamniotes. Body temperature is variable, i.e. poikilothermic (ectotherm) and most forms undergo hibernation in water.
- The examples of amphibians are

frogs, toads, salamanders, caecilian, mud puppy etc.

Evolutionary adaptations in class Amphibia:

Limbs for movement on solid substratum. Lungs for breathing air. Internal nares to make breathing possible by keeping mouth closed. Slimy skin for protection against desiccation. Changed in circulatory system to provide respiration by lungs and skin. There is reduction in bones to make the body lighter.

Transition from Aquatic to Land Habitat

Amphibians are on the borderline between aquatic and true terrestrial animals. The animals live in moist condition or in water. So the amphibians are not a successful group owing to their dependence on water as habitat, reproduction and development.

(d) Reptile:

General characteristics

of class reptilian:

(i) There are

two pairs of pentadactyl limb, each typically with five digits. Skin is rough, cornified and dry, which is adapted to land life.

(ii) Heart is incompletely four chambered, having two atria and partly

divided ventricle. **(iii)** Crocodiles have completely four chambered heart.

Reptiles are cold blooded animals, i.e. poikilothermic (ectotherm) and hibernate in winter.

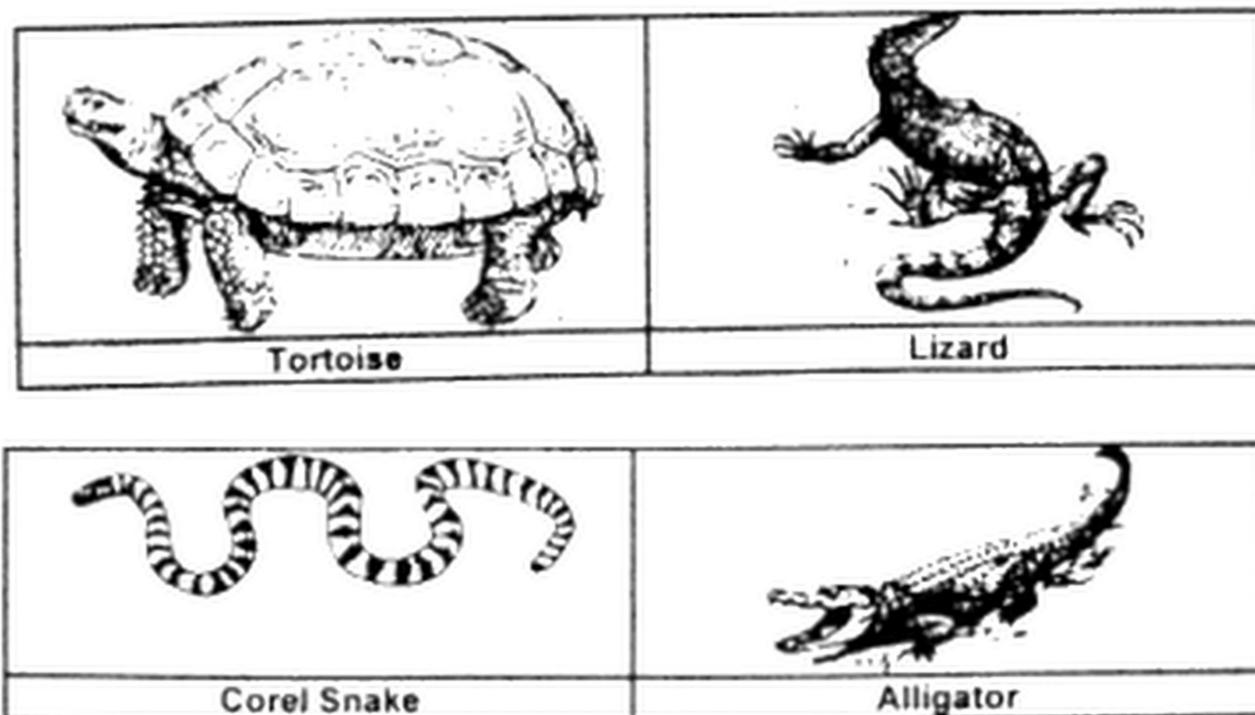
(iv) Sexes are separate. Gonads are

paired. Fertilization is internal. Most forms are oviparous. Eggs are large, amniotic and have large yolk eggs. Eggs are enclosed by leathery or limy shell for protection. Embryo is protected by three embryonic membranes known as amnion, allantois and chorion.

Examples: Examples of reptiles are tortoise, lizard, snake, crocodile and alligator etc. **Evolutionary adaptations in class reptilian:**

Reptiles show the advancement over the amphibians in having:

- (a) A dry skin which enables them to live away from water.
- (b) Separation of oxygenated and deoxygenated and deoxygenated blood in the heart. (c) A neck movable independent of the body.
- (d) Better mechanism of breathing.
- (e) Fertilization is internal.
- (f) Egg with shell for protection on land.



Reptiles

(e) Aves:

General characteristics of class aves:

- (i) Body of aves is streamlined and is boat shaped.
- (ii) It is divisible into a head neck a trunk and a tail. Neck is very long and tail very short. There are two pairs of pentadactyl limbs. The forelimbs are modified to form wings. The hind limbs are large, strong and adapted for perching, walking or swimming. Each foot usually bears four toes armed with horny claws.
- (iii) The skin is covered by and epidermal horny exoskeleton of feathers all over the body and scales on

the feet. Due to air spaces skeleton is light. Skull has large sockets. Jaws extend into horny beak. Teeth are absent.

(iv) Heart is four chambered having two atria and two ventricles. There is only right aorta. It curves to the right side and then bends backward. Birds are endothermic. (v)

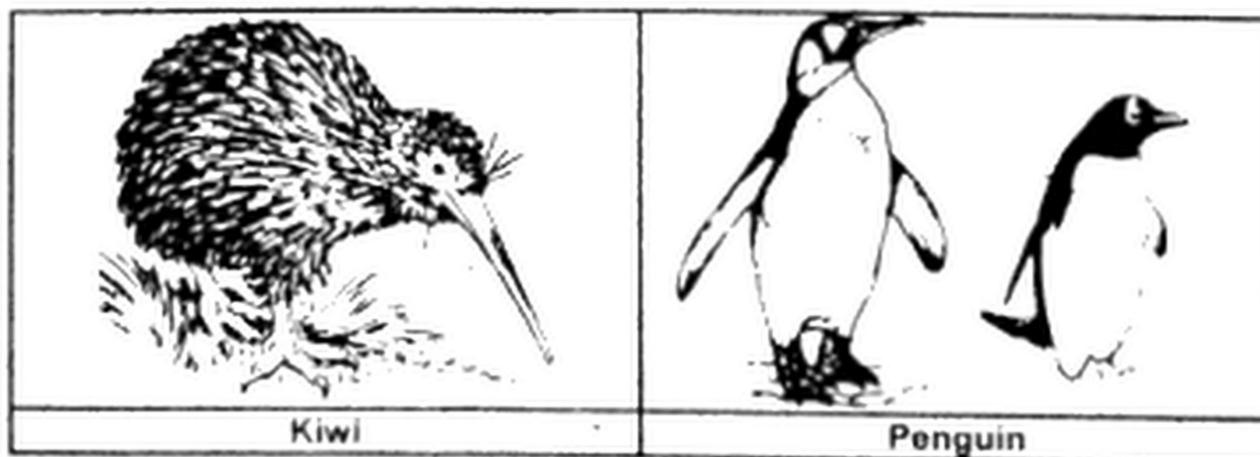
Respiration takes place only by lungs. A system of thin walled air sacs lying among the viscera maintains the supply of fresh air through the lungs. Voice box the syrinx lies at the junction of the trachea and bronchi.

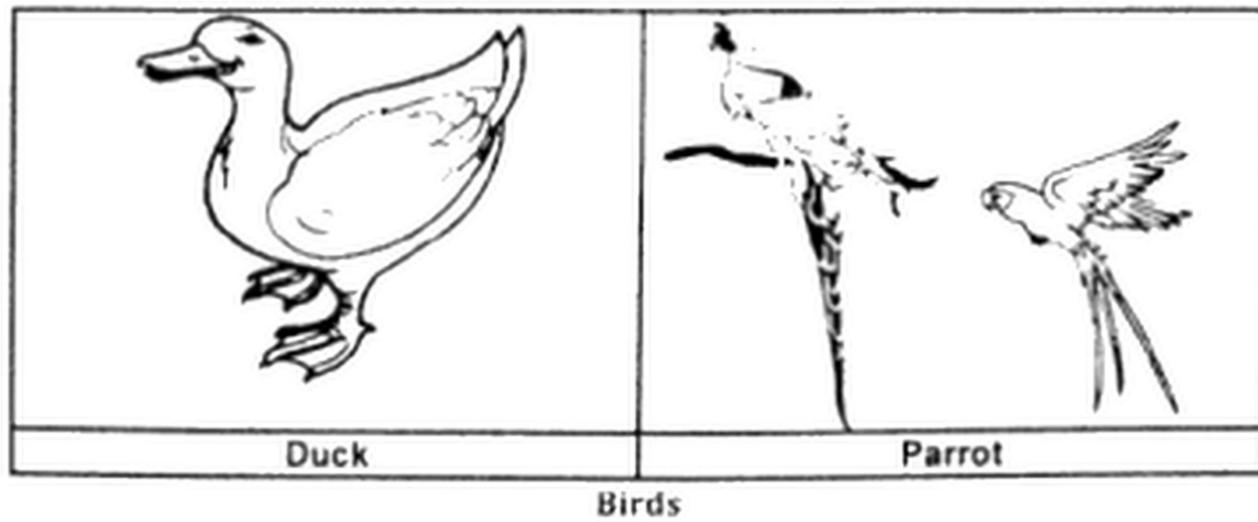
(vi) Alimentary canal has muscular structure called gizzard, which is used for crushing food.

(vii) Excretory system consists of a pair of kidneys. The ureter open into the Cloaca and the urinary bladder is absent. The urine is semisolid and uric acid is main nitrogenous waste. (viii) Sexes are separate.

Fertilization is internal. Eggs are large with much yolk. Only one ovary and oviduct is functional.

(ix) Some birds have secondarily lost the power of flight and are called running birds e.g. ostrich, kiwi, etc.





The Amniote Egg Evolves

It is adaptive for land animals to have a means of reproduction that is not dependent on external water. Reptiles practice internal fertilization and lay eggs that are protected by a shell. The Amniote egg contains extraembryonic membrane, which protect the embryo. One of the membranes, the amnion, is a sac that fills with fluid and provides a "private pond" within which the embryo develops.

Evolutionary adaptations in class aves:

An insulated covering over the body is present. Better aeration of blood in the lungs, taking place during both inspiration and expiration. Complete separation of venous and arterial blood in the heart.

A regulated body temperature keeps the aves equally active all the year round. Patterns of behavior, such as care for the young ones, nest building, courtship and affection for the mate and migration, which are practically unknown in reptiles.

(f) Mammalia:

General characteristics of class mammalian:

- (i) Body is variously shaped and divisible into ahead, a neck, a

trunk and a tail. There are two pairs of pentadactyl limbs. These are variously adapted for walking, running, burrowing and swimming or flying.

(ii) Skin is glandular, mostly covered by hair.

(iii) **Coelom** is completely divided into anterior smaller thoracic cavity and posterior larger cavity by a muscular partition the diaphragm, which is present only in the mammals.

(iv) Endoskeleton is fully ossified. Skull has two **occipital condyles**, large **cranium**. External ear or pinna is present. There is a chain of three bones in the ear incus, malleus and stapes (sta-pez). Mammals have deciduous and permanent teeth.

(v) Heart is four chambered. Only left aortic arch is present. Red blood cells are non-nucleated. Mammals are warm blooded (endothermic) animals.

(vi) Voice apparatus is well developed, and consists of **larynx** and **epiglottis**.

(vii) Mammals give birth to their young ones. Mammals feed them on milk produced by mammary glands of mother.

36. Describe the characteristics and give examples of subclass:

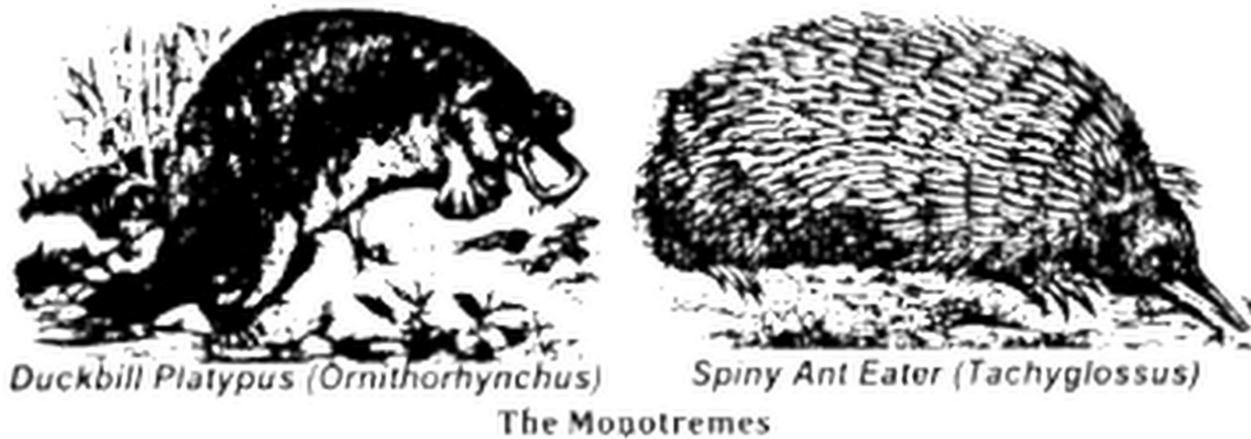
- (a) **Prototheria** (b) **Metatheria**
(c) **Eutheria**

Ans: (a) Prototheria:

The subclass Prototheria is a connecting link between reptiles and mammals and provides evidence of evolution and origin of mammals from reptiles. Certain members of this sub-class are adapted for aquatic life, e.g. Duck bill platypus, which has a bill similar to that of a duck and has webbed toes. The mammalian feature of the monotremes is that the female has mammary glands and they feed their Youngs. The reptilian features include the presence of Cloaca and cloacal opening (instead of separate opening for digestive and urinogenital system). Monotremes are found in Australia.

Examples:

The examples of monotremes are Duckbill platypus and Echidna-spiny ant eater.

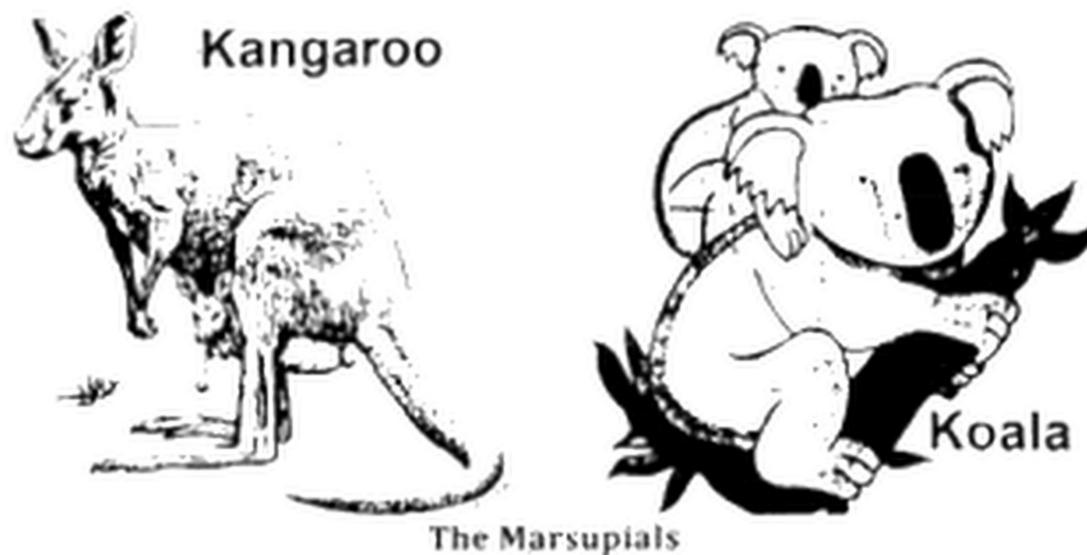


(b) Metatheria:

The females have an abdominal pouch the **Marsupium**, where they rear their young. The young one's when borne are immature. The nipples are in the pouch. The mother feeds the young ones and carries them in the pouch till they are matured enough. The Marsupials are found in Australia and America.

Examples:

The examples of marsupials are: opossum, kangaroo and Koala (also called, Koala bear, native bear)



(c) Eutheria:

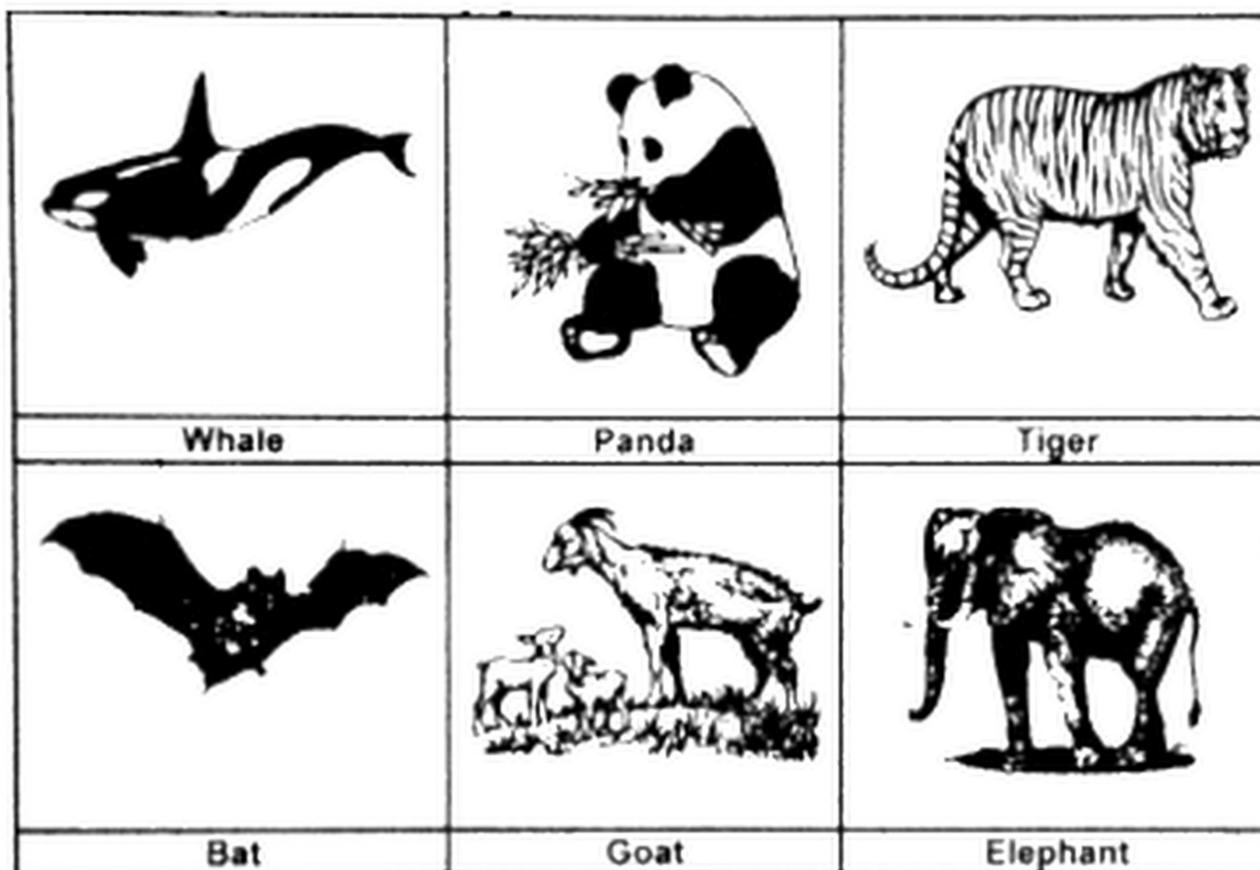
Development of young one takes place inside the body of the mother. The young's are borne an organ fully developed. Developing placental

mammals are dependent on placental an organ of exchange between maternal blood and fetal blood. Nutrients are supplied to the growing offspring, and wastes are passed to the mother for excretion. The young ones are born at a relatively advanced stage of development. So these mammals are called **placental mammals**.

All the placental mammals have maximum mammalian characteristics. In some hair have been modified into scales in pangolin, and spines in porcupine.

Examples:

Examples of the placental are man, whale, elephant, horse, rat, mice, bat, dolphin, cat, tiger, lion, monkey, gorilla, etc.



The Placentalis

37. Arthropods and vertebrates are highly successful group of animals on land. What characteristics shared by arthropods are adaptive to a land existence?

Ans: Arthropods and vertebrates are highly successful group of animals.

They share following land adaptive characteristics.

- i.** Both have strong outer coverings which protect them from ultraviolet light and desiccation. Arthropods have chitinous exoskeleton. Chordates have multilayered cornified skin.
- ii.** Both have limbs for swift movement. Limbs of both groups have joints for efficient movement.
- iii.** Both have well developed digestive system for consuming maximum energy.
- iv.** Both have efficient respiratory system. Arthropods have tracheal system. Chordates have lungs
- v.** Both have highly developed nervous system. It is composed of brain and nerve cords.
- vi.** Excretory system of both groups is based on conserving water.

