CHAPTER-9
DIVERSITY AMONG ANIMALS

Q1. Give the literal meaning of the word animalia.

Ans: The name animalia is derived from Latin word **"*anima*" meaning breath or soul.** All the animals of the world are included in the kingdom animalia.

Q2. Define invertebrates and mention the names of phyla included in it.

Ans: Definitation:

The animal species that lack a backbone are commonly known as **invertebrates.** Invertebrates account for 95% of known animal species.

Division of invertebrates:

The invertebrates have been divided into eight major phyla: porifera, cnidaria, platyhelminthes, aschelminthes, mollusca, annelida, arthropod a echinodermata.

Q3. Describe the group Protochordata (Acrania).

Ans: Group Protochordata (Acrania):

Protochordata has been divided into two sub-phyla:

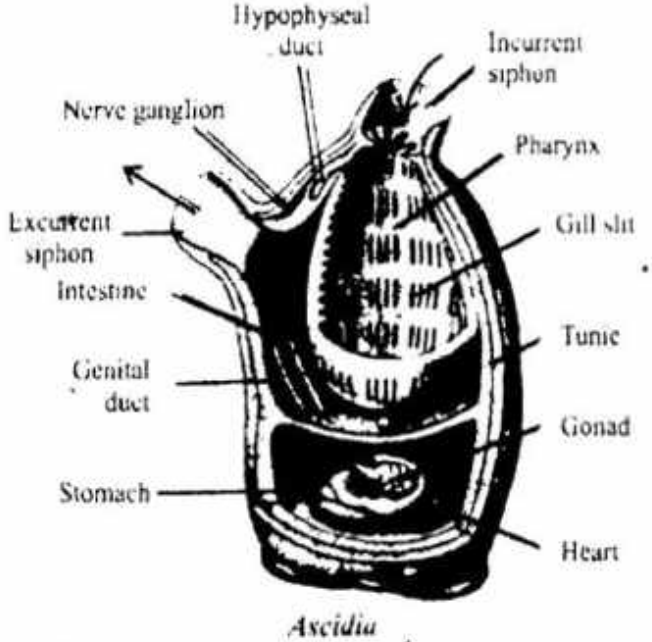
(i) Subphylum urochorda **(ii)** Subphylum cephalochordate

i. Subphylum Urochordata:

The body is covered by a covering called **tunic** so they are called **tunicates.** On the outside are two projections: the **incurrent siphon** which corresponds to the anterior end of the body and **excurrent siphon** that marks the dorsal side. Larva has a mid-dorsal supporting rod, the **notochord,** in the tail, so the group has been named urochordata. The notochord usually disappears during metamorphosis, so that adult has no skeleton. The examples of urochordates are *Ascidia, Halocynthia,* etc.



Halocynthia

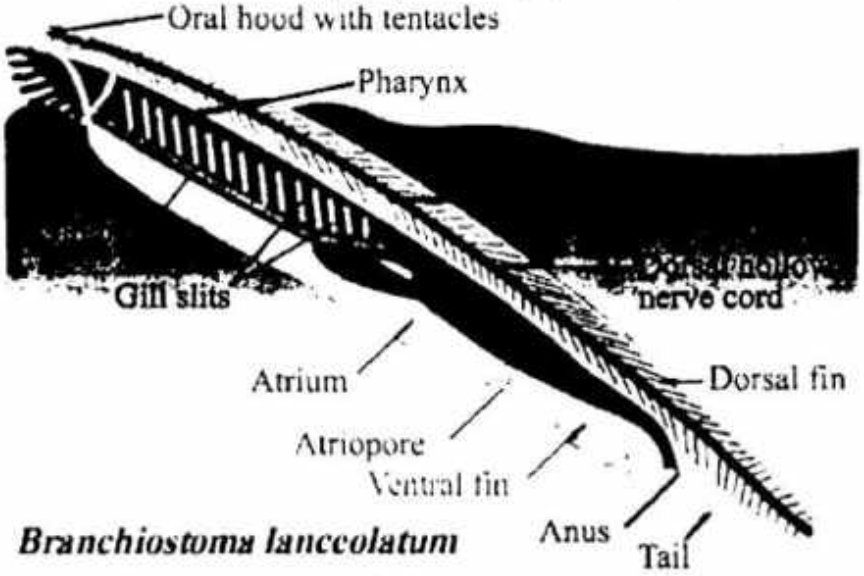


Ascidia

Urochordates

ii. Subphylum Cephalochordata:

Body is fish like. It has no head but tail is present. Notochord extends the entire length of the body. There is no organ for respiration. The Example of cephalochordate is: *Branchiostoma (Amphioxus)* (lancelet).



Branchiostoma lanceolatum

Q4. Briefly describe group Craniata.

Ans: Group Craniata:

Craniate has one subphylum i.e., vertebrata.

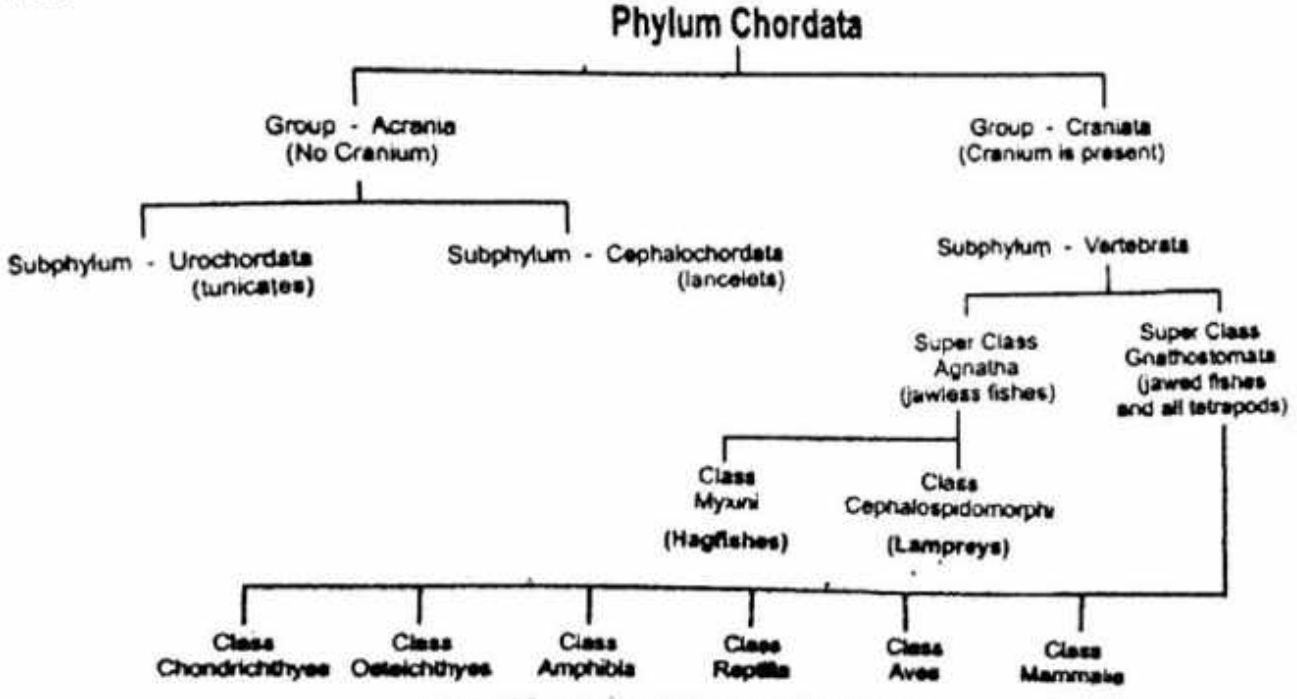
Subphylum Vertebrata:

The characteristics that give the member of this group the names "vertebrata" and "craniata" are spinal column of vertebrae, which forms the chief skeletal axis of the body, and a brain case or cranium. Subphylum vertebrata is divided into two super classes:

(a) Agnatha **(b)** Gnathostomata

Q5. Draw the flow chart of classification of phylum chordata.

Ans:



Classification of Phylum Chordata

Critical Thinking

What limits the ability of amphibians to occupy the full range of terrestrial habitats and allows other terrestrial vertebrates to live in them successfully?

Ans: In general amphibians are only partly successful in their colonization of land, since their limbs are short and they need to flex their body laterally in order to take reasonable strides

Amphibian skin is permeable and in a dry atmosphere would quickly dehydrate. they even do not have the mechanisms to drink water A moist skin is also required to supplement respiration, since the lungs are comparatively simple and not totally adequate for its needs.

These limitations restrict amphibians to moist environments. For reproduction amphibians are also almost entirely dependent on water since, like fish. their eggs have no water-proof covering and their larvae (tadpoles) are quite fish-like. These larvae initially have no legs swim using a long tail and breathes using external feathery gills

That is why they are not successful terrestrial vertebrates

Q7. Describe the evolutionary adaptations in class mammalian.

Ans: Evolutionary adaptations in class mammalia:

A regulated body temperature. This makes them independent of environmental change keeping active throughout the year. Complete separation of venous and arterial blood in the heart More efficient mechanism of respiration due to the presence of a diaphragm An active life and a high rate of metabolism.

A separate respiratory passage that avoids interference in breathing during feeding. Better developed senses of smell, sight and hearing. A more highly developed nervous system Large cerebrum and cerebellum provide for better coordination in all activities and for learning and retentive memory Patterns of behaviour. such as care and nursing of the young ones present.

Teacher's Point

Teacher would guide the students to.

- Trace the position in the phylogeny of major groups of animals.
- Draw the evolutionary tree of sponges, butterfly and monkey

Did You Know?

Bioinformatics is an interdisciplinary field that develops methods and software tools for understanding biological data As an interdisciplinary field of science. bioinformatics combines computer science. statistics. mathematics. and engineering to analyze and interpret biological data. Bioinformatics has been used for in silicon analyses of biological queries using mathematical and statistical techniques.

Did You Know?

Coelenterate animals may show a number of zooids They are of different forms They take up different functions? This is called **polymorphism.** Polymorphism denotes division of labour among the zooids of the individual A polymorphic colony contains many individuals called zooids They are mainly two types: (1) Medusae (2) Polyps. Polyp is sedentary. It shows mouth and tentacles at the free end. The medusa is free swarming. *Hydra* is a monomoiphic form It is represented by polyp form It performs all functions. *Obelia* like animals Show two forms, polyp nutritive zooid and medusa reproductive zooid This is called dimorphic organism In a colony of Obelia three types of zooids are present (1) Hydranth (a Polyp stage), (2) Blastostyle (asexually reproducing zooid) (3) Medusae are present.

Science Titbits

Origin of Arthropods: It is believed that the arthropods and annelids have a common origin, as both have appendages, a segmented body and cuticle

Science Titbits

What are the secrets of insect success? The body plan is modified and specialized in so many ways that insects have been able to adapt to a number of life styles They have ability to fly Protective mechanisms include body is covered by cutin mimicry protective colouration and aggressive behaviour The larvae and pupae do not have to compete with adults for food or habitats.

Science Titbits

Echinoderms show close resemblance with chordates. Both (1) have mesodermal skeleton. (2) are deuterostomous, (3) have similar early development. That is why echinoderms have been placed closest to phylum chordata

Teacher's Point

Teachers would guide the students to explain the role of invertebrates in the field of research and daily life

Science Titbits

Vertebrates are distinguished in particular by, having endoskeleton closed circulatory system, paired appendages, efficient respiration and excretion, high degree of cephalisation.

Teacher's Point

Teachers would guide the students to:

- Trace the position in the phylogeny of major groups of animals.
- Demonstrate an understanding of the connection of extinction of species with that of human activities.

Activity

Classifying the given invertebrates into phyla and given chordates into classes by using classification key.

EXERCISE

MCQs

1. Select the correct answer

(i) All animals are

(A) autotrophs (B) heterotrophs
(C) unicellular (D) motile

(ii) Which of the following is not included in grade bilateria

(A) cnidarians (B) nematodes
(C) annelids (D) molluscs

(iii) Which of the following class of animals includes the first verteberates to appear on Earth?

(A) agnatha, the jawless fishes
(B) chondrichthyes, the sharks
(C) osteichthyes, the bony fishes
(D) tunicates, the sea squirts

(iv) Which of these does not pertain to a protestome?

(A) spiral cleavage (B) blasto pore—anus
(C) schizocoelom (D) annelids

(v) Sponges belong to the phylum.

(A) aschelminthes (B) arthropoda
(C) porifera (D) mollusca

(vi) Which of the following is not a parasite?

(A) annelida (B) nematoda
(C) platyhelminthes (D) porifera

(vii) Which of the following most clearly demonstrates the evolutionary relationship between annelids and arthropods?

(A) a complete digestive tract (B) an exoskeleton
(C) radial symmetry (D) body segments

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(viii) Reptiles are much more extensively adapted to life on land than amphibians in that reptiles

(A) have shelled eggs
(B) have a complete digestive tract
(C) are endothermic
(D) go through the larva stage

(ix) Amphibians arose from

(A) cartilaginous fish (B) jawless fish
(C) ray finned (D) bony fishes with lungs

(x) Which of these does not pertain to a deuterostome?

(A) blastopore is associated with the anus
(B) spiral cleavage
(C) enterocoelom
(D) echinoderms and chordates

(xi) Which of the following has a gastrovascular cavity?

(A) sponges (B) earthworms
(C) roundworms (D) flatworms

(xii) Which of the following is not a subphylum of chordata

(A) hemichordata (B) urochordata
(C) cephalochordata (D) vertebrata

Answers

(i) B	(ii) A	(iii) A	(iv) B	(v) C	(vi) D
(vii) D	(viii) A	(ix) D	(x) B	(xi) D	(xii) A

SHORT QUESTIONS

2. Write four distinct features of animals.

Ans: The four distinct features of animals are listed below.

(i) Multicellular eukaryote
(ii) Ingestive heterotrophs
(iii) Reproduce sexually
(iv) Cell wall and plastids are absent
(v) Centrioles are present

3. Name the four criteria for animal classification.

Ans: Animals can be classified according following criteria.

(i) Presence or absence of tissue.
(ii) Number of tissue layers.
(iii) Body symmetry.
(iv) Types of body cavity.

4. Classify animals on the basis of presence and absence of tissue.

Ans: Animals can be classified according to the presence or absence of tissues into two subkingdoms: **Parazoa** and **Eumetazoa.**

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(i) B	(ii) A	(iii) A	(iv) B	(v) C	(vi) D
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Ans: Animals can be classified according to the presence or absence of tissues into two subkingdoms: **Parazoa** and **Eumetazoa.**

Parazoa:

Parazoa includes the simplest metazoans or 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

Eumetazoa:

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.**

5. Differentiate the diploblastic and Triploblastic levels of organization.

Ans:

Diploblastic	Triploblastic
Diploblastic animals produce two primary germ layers endoderm and ectoderm during gastrulation	Triploblastic animals produce three germ layers Endoderm, the mesoderm and the ectoderm during gastrulation.
Diploblastic animals are radially symmetrical.	Triploblastic animals are bilaterally symmetric.
Do not have a mesoderm	Develop a mesoderm.
Do not have body cavities	Develop a body cavity, the coelom
Do not have organs.	Have true organs
Examples include Jellyfish, Corals, Combfish	**Examples include** Molluscs, Worms, arthropods vertebrates, echinodermata

6. To what life style is radial symmetry an adaptation?

Ans: Radial symmetry is considered an adaptation for a **sessile life** It includes all the animals with **radial symmetry** having a top and bottom and similar body parts are arranged as spokes or radiate from a central body axis

Examples: (i) Jelly fish **(ii)** Sea anemone

7. To what life style is bilateral symmetry an adaptation?

Ans: Bilateral symmetry is considered an adaptation to motility

Examples: (i) Arthropods **(ii)** Vertebrae **(iii)** Echinoderms

8. Describe the body layers of sponges.

Ans: 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.**

9. What are nematocysts?

Ans: Nematocysts are specialized cells in the tentacle of Jellyfisn or other coelenterates containing a barbed or venomous coiled thread that can be projected in self defense or to capture prey.

10. Give three features of platyhelminthes for parasitic mode of life.

Ans: Following are the three features of platyhelminthes for parasitic mode of life

(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.

11. Give three distinguishing features of Aschelminthes.

Ans: Following are the distinguishing features of Aschelminthes:

(i) The roundworms are free living or parasites.

(ii) Most roundworms are less than five cm long and many are microscopic but some parasitic roundworms are more than one metre in length.

(iii) The worms exhibit bilateral symmetry having three germ layers.

(iv) Body is cylindrical, tapering at both ends. Muscular layer is not continuous.

(v) It is divided into four longitudinal quadrants, two - dorsolateral, two - ventrolateral.

(vi) The body cavity is pseudocoelom.

(vii) Most nematodes are dioecious. Fertilization is internal.

12. How locomotion takes place in Annelids?

Ans: The annelids are called segmented worms. The body wall contains circular and longitudinal muscles which help in locomotion. The organs of locomotion are chitinous **chaetae or setae.**

13. Write five salient features of phylum Arthropoda.

Ans: Following are the salient features of phylum Arthropoda.

(i) The arthropods are called joint footed animals.

(ii) They are free living or parasites and are found in all types of habitat.

(iii) The body is segmented.

(iv) Some are worm like and others are flying insects. Segments are modified, specialized and fused.

(v) Symmetry is bilateral; head, thorax and abdomen variously distinct or fused.

(vi) Body is covered by **chitin.** It is flexible at many places to allow articulation.

(vii) There are several pairs of appendages.

(viii) Coelom is not present as the main body cavity.

14. List any four harmful roles of insects.

Ans: Harmful roles of insects are listed below.

(i) **Insects** destroy field crops, fruit trees and timber plants.

(ii) They spread diseases among human beings.

(iii) Bees and wasp's sting, mosquitoes, lice and fleas bite and suck blood.

(iv) Scorpions and a few spiders are poisonous and sting.

15. List the similarities between echinoderms and chordates.

Ans: Echinoderms show close resemblance with chordates.

(1) Both have mesodermal skeleton.

(2) Both are deuterostomous.

(3) Both have similar early development.

That is why echinoderms have been placed closest to phylum chordata.

16. What does the term amphibian mean? Why amphibians are not considered a very successful group of vertebrates?

Ans: The word amphibian has been derived from Greek word "amphi" meaning both and "bios" meaning life.

It is defined as a group of cold blooded vertebrate which are distinguished by having an aquatic gill breathing larval stage followed by a terrestrial lung breathing adult stage

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

Examples: Toads, frogs, newts and salamanders

17. Describe the ways, which amphibians are adapted to life on land, and in what ways they are still restricted to a watery or moist environment.

Ans: Following are the ways, which amphibians are adapted to life.

(i) Limbs for movement on solid substratum.

(ii) Lungs for breathing air

(iii) Internal nares to make breathing possible by keeping mouth closed.

(iv) Slimy skin for protection against desiccation.

(v) Changed in circulatory system to provide respiration by lungs and skin

(vi) There is reduction in bones to make the body lighter.

18. List the adaptations that distinguish reptiles from amphibians and help them adapt to life in dry terrestrial environment.

Ans: Evolutionary adaptations in class reptilia:

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 deoxygehated 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.

19. Give an example of ectothermic and endothermic animals.

Ans: Examples of ectothermic animals:

(i) Snakes **(ii)** Turtles

(iii) Lizards **(iv)** Alligators

Example of endothermic animals:

(i) Birds **(ii)** Mammals

20. Name two phyla of animals that are radially symmetrical and two that are bilaterally, symmetrical.

Ans: Following are the phyla of animals that have radial and bilateral symmetry.

(i) Cnidaria and Echinodermata are the two phyla of animals that are radially symmetrical

(ii) Arthropoda and vernatoda are the two phyla of animals that are bilaterally symmetrical

21. List the vertebrate class (or classes) in which we find each of the following:

(a) A skeleton of cartilage **(b) A two-chambered heart**

(c) The amniotic egg **(d) A four chambered head**

(e) Lungs supplemented by air sacs

(f) Placenta

Ans: (a) A skeleton of cartilage is present in class Chondrichthyes.

(b) A two-chambered heart is present in class Osteichthyes.

(c) The amniotic egg is present in class Mammals.

(d) A four chambered head is present in class Mammals and Aves.

(e) Lungs supplemented by air sacs are present in class Aves.

22. Identify the phyla that have the following characteristics:

(a) radial symmetry

(b) acoelomate

(c) pseudoccelomate

(d) alternation of sexual and asexual stages

(e) cnidocytes

Ans: (a) Radial symmetry is present in phylum Cnidaria and Echinodermata.

(b) Acoelomate is present in phylum Platyhelminthes

(c) Pseudocoelomate is present in phylum Aschelminthes

(d) Alternation of sexual and asexual stages is present in phylum Chordates

(e) Cnidocytes is present in phylum Cnidaria.

23. Write three main differences between prototheria, metatheria and eutheria.

Ans: Differences between prototheria, metatheria and eutheria:

Characteristic	Prototheria	Metatheria	Eutheria
Literal names	Egg laying mammals	Pouched mammals	Placental mammals
Aquatic adaptation	Adapted to aquatic environment	Not adapted to aquatic environment	Few are adapted to aquatic environment
Placenta	Absent	Absent	Present
Marsupium	Absent	Present	Absent
Cloaca	Present	Absent	Absent

24. How do mammals differ from birds? And what adaptations do they share?

Ans: Difference between mammals and birds.

Mammals	Birds
Lack feathers	Have feathers
Posses teeth and lack beaks	Lack teeth and posses beaks
Don't lay eggs	Lay eggs
Members of mammals group	Members of group Aves

Adaptation shared by them:

(i) Both are warm blooded i e. endothermic.

(ii) Both are from phylum chordate.

(iii) Both are vertebrates.

(iv) Both have four chambered heart.

(v) Both take care of young ones.

(vi) Both have blood having erythrocytes and leukocytes

25. Define/Describe/Explain briefly:

animals, parazoa, eumetazoa, diploblastic animals, triploblastic animals, radial symmetry, bilateral symmetry, coelom, blastula, protostomes, deuterostomes, nematocyst, mesoglea, zooid, radula, trochophore larva, parapodia, haemocoel, metamorphosis, water vascular system, protochordata, notochord, swim bladder, amnion, placenta.

Ans: Animals:

"Animals are eukaryotic, multicellular **heterotrophs that lack cell walls**".

Animals are found almost in all types of habitat. They may be free living motile, sessile or a parasite. They range in **size** from worms only seen with a microscope to blue whales

Parazoa:

Parazoa includes the simplest metazoans or 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

Eumetazoa:

This is a major division of the animal kingdom comprising all multicellular forms except 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.

Diploblastic animals:

Animals in which the cells are arranged in two embryonic layers, an external ectoderm and an internal endoderm, are called diploblastic animals.

Example: Coelenterates

Triploblastic animals:

Triploblastic Describing an animal having a body composed of three embryonic cell layers: the ectoderm, mesoderm, and endoderm. Most multicellular animals are triploblastic

Radial symmetry:

Radial symmetry form of symmetry in which the body plan is divisible into identical [illegible]

Radial symmetry is a symmetry in which the sides exhibit correspondence or regularity of parts around a central axis. It is lacking left and right

Examples: Sea stars, sea anemones, jellyfish, and sea urchins

Bilateral symmetry:

A form of symmetry in which the opposite sides along a midline is a duplicate of the other in terms of body parts or appearance

Bilateral symmetry is a form of symmetry in which the opposite sides are similar. The external appearance is the same on the left and right sides in a sagittal plane

Examples: Such as the body plan of most animals, including humans.

Coelom:

Coelom is a fluid filled space between the outer body wall and the digestive tube.

OR

A coelom is a fluid-filled body cavity that is completely lined by tissue created from the mesoderm, the middle layer of the primary cells found in an embryo.

Blastula:

The blastula (from Greek blastos, meaning "sprout") is a hollow sphere of cells, referred to as blastomeres, surrounding an inner fluid-filled cavity called the blastocoele formed during an early stage of embryonic development in animals.

Protostomes:

In most of the molluscs, annelids and arthropods, the first opening in the embryo becomes the mouth.

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

Deuterostomes:

Deuterostomia is a subtaxon of the Bilateria branch of the subkingdom Eumetazoa, within Animalia, and are distinguished from protostomes by their deuterostomic embryonic development; in deuterostomes, the first opening (the blastopore) becomes the anus,while in protostomes, it becomes the mouth.

Nematocyst:

A capsule within specialized cells in the tentacles of cnidarians, such as jellyfish and corals, containing a barbed, threadlike tube that delivers a toxic sting to predators and prey.

Mesoglea:

Mesoglea, also known as mesohyl, is the translucent, non-living, jelly-like substance found between the two epithelial cell layers (i.e., between the ectoderm and endoderm) in the bodies of cnidarians and sponges.

Mesoglea refers more correctly to the tissue found in jellyfish and it functions as a hydro-static skeleton. Mesohyl generally refers to tissue found in sponges.

Zooid:

Zooid is an organic cell or organized body that has independent movement within a living organism, especially a motile gamete such as a spermatozoon. An independent animal like organism produced asexually, as by budding or fission.

Radula:

The radula (plural radulae or radulas) is an anatomical structure that is used by mollusks for feeding, sometimes compared to a tongue. It is a minutely toothed, chitinous ribbon, which is typically used for scraping or cutting food before the food enters the esophagus.

Trochophore larva:

Trochophore, also called **trochosphere**, small, translucent, free-swimming larva characteristic of marine annelids and most groups of mollusks. Trochophores are spherical or pear-shaped and are girdled by a ring of cilia (minute hairlike structures), the prototroch, that enables them to swim.

Parapodium:

The term parapodium refers to two different organs. In annelids, parapodia are paired, un-jointed lateral outgrowths that bear the chaetae. In several groups of sea snails and sea slugs, 'parapodium' refers to lateral fleshy protrusions.

Haemocoel:

Haemocoel the body cavity of arthropods and molluscs, which is filled with blood. The haemocoel is an enlarged blastocoel, which greatly reduces the coelom (this is restricted to the cavities of the gonads and excretory organs). The haemocoel can act as a hydrostatic skeleton.

Metamorphosis:

Metamorphosis is a biological process by which an animal physically develops after birth or hatching, involving a conspicuous and relatively abrupt change in the animal's body structure through cell growth and differentiation.

Water vascular system:

The water vascular system is a hydraulic system used by echinoderms, such as sea stars and sea urchins, for locomotion, food and waste transportation, and respiration. The system is composed of canals connecting numerous tube feet.

Protochordata:

A division of the phylum Chordata, including the Hemichordata, Urochorda and Cephalochorda. The group lacks a vertebral column, cranium and organs associated with the region of the head in other chordates, but has a dorsal nerve chord and gill slits.

Notochord:

A notochord is a primitive beginning to the backbone. It appears in embryos as a small flexible rod made from cells from the mesoderm, which is one of the three layers of cells of embryos. Notochords are only found in the phylum chordata, a group of animals that includes humans.

Swim bladder:

The swim bladder, gas bladder, fish maw or air bladder is an internal gas-filled organ that contributes to the ability of many bony fish to control their buoyancy, and thus to stay at their current water depth without having to waste energy in swimming.

Amnion:

Amnion a thin, membranous sac filled with a watery fluid (called the amniotic fluid) in which the embryo or fetus of a reptile, bird, or mammal is suspended during prenatal development.

Placenta:

The placenta is a flattened circular organ in the uterus of pregnant mammals that nourishes and maintains the fetus through the umbilical cord. This cord is the main link from the fetus to the placenta. Through it, the placenta provides oxygen and nutrients to the growing baby and removes waste products.

26. Write the difference between:

(a) parazoa and eumetazoa:

Parazoa	Eumetazoa
They are asymmetrical.	They are symmetrical.
They have no tissue.	They have tissues and organs.

They have cellular grade of organization	They have tissue level organization ranging to organ level organization
Example: Sponges	**Example:** Mamals

(b) diploblastic and triploblastic animals:

Diploblastic	Triploblastic
Diploblastic animals produce two primary germ layers endoderm and ectoderm during gastrulation.	Triploblastic animals produce three germ layers Endoderm, the mesoderm and the ectoderm during gastrulation
Diploblastic animals are radially symmetrical.	Triploblastic animals are bilaterally symmetric
Do not have a mesoderm	Develop a mesoderm
Do not have body cavities	Develop a body cavity, the coelom
Do not have organs	Have true organs
Examples include Jellyfish, Corals, Combfish	**Examples include** Molluscs, Worms, arthropods, vertebrates, echinodermata

(c) radial symmetry and bilateral symmetry:

Radial symmetry	Bilateral symmetry
It constitutes grade radiate	It constitutes grade bilateria.
It is considered an adaptation to sessile life	It is considered an adaptation to motile life.
Diploblastic animals exhibits radial symmetry	Triploblastic animals exhibit bilateral symmetry
Examples: Jelly fish and sea anemone	**Examples:** Vertebrates and Arthropoda

(d) acoelomate and pseudocoelomate:

Acoelomate	Pseudocoelomate
There is no body cavity between the digestive tract and outer body wall, so these animals are called **acoelomate.**	If the body cavity develops between the mesoderm and endoderm it is called pseudocoelom (false cavity).
Present inside the endoderm.	Present inside the mesoderm
Example: Platyhelminthes (flatworm)	**Example:** Aschelminthes (nematodes)

(e) pinacoderm and choanoderm:

Pinacoderm	Choanoderm
The sponges consist of outer dermal layer called pinacoderm.	The sponges consist of inner dermal layer layer choanoderm.
It is involved in protection, shape maintenance and structural support.	It is involved in gaseous exchange digestion.
Pinacoderm made up of pinacocytes.	Choanoderm made of flagellated cells called choanocytes.

(f) spongocoel and gastrovascular cavity:

Spongocoel	Gastrovascular cavity
The body cavity of sponges, is called spongocoel	A central digestive cavity with a single opening that functions as both mouth and anus is called Gastrovascular cavity.
The opening of spongocoel is called osculum	The opening of Gastrovascular cavity is called mouth.
It is present only in sponges.	It is present in both Cnidaria and flat worms

(g) hydroids and medusa:

Hydroids	Medusa
Hydroids are anchored, rigid barely moving specie found near the tidemark, they are attached to rocks.	Medusas are freebie floating, found in open water
Hydroids has a tubular body with a protracted stalk	Medusa has saucer shaped body with shortened trunk for example jelly fish
A fine parchment called vellum is absent in a Hydroids	Vellum is present in a medusa.
There is no gonad in a Hydroids	There are four gonads in medusa.
Hydroids reproduces abiogenetically.	Medusa replicates sexually.

(h) endotherm and ectotherm:

Endotherm	Ectotherm
Higher BMR i.e Basal metabolic rate	Lower BMR i.e Basal metabolic rate.
Higher C_{max} i.e. heat capacity	Lower C_{max} i.e. heat capacity
Greater food demands	Lower food demands.
Mainly aerobic metabolism.	Mainly anaerobic metabolism.
Greater stamina.	Lower stamina.
Examples: Birds, Mammals	**Example:** Reptiles

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.

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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, pseudcoelomatc and coelomate.

Mode of nutrition and digestive system:

All animals are **heterotroph** 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, molluscs (mollusks), and chordates or it may be endoskeleton in molluscs e.g., sepia, echinoderms, chordates and highly developed in vertebrates. Most animals are capable of locomotion at sometime 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, molluscs, echinoderms and amphibians.

Regeneration: **Regeneration** is exhibited by sponges, some cnidarians, annelids, crustaceans (arthropords) 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 metazoans or multicellular animals that show the cellular grade of organization in

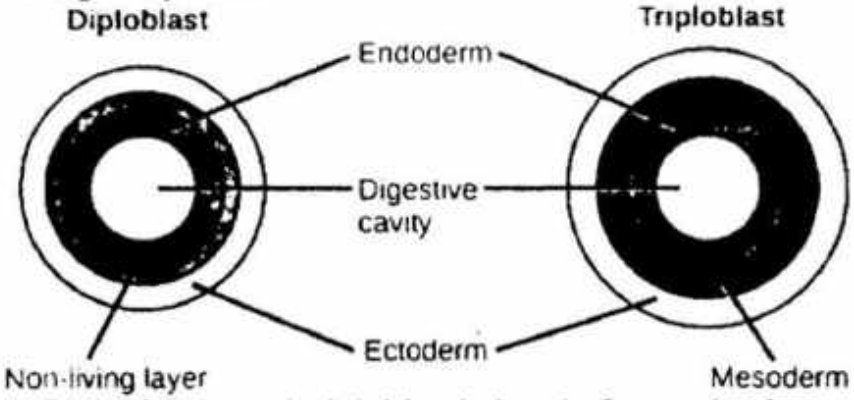
which cells demonstrate division of labour but are not strongly associated to perform a specific collective function. They are asymmetrical. It includes all the sponges.

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



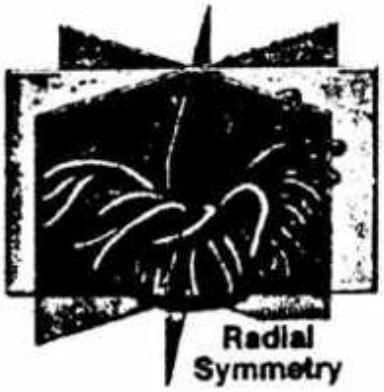
Diploblastic and triploblastic level of organization

(c) Body symmetry:

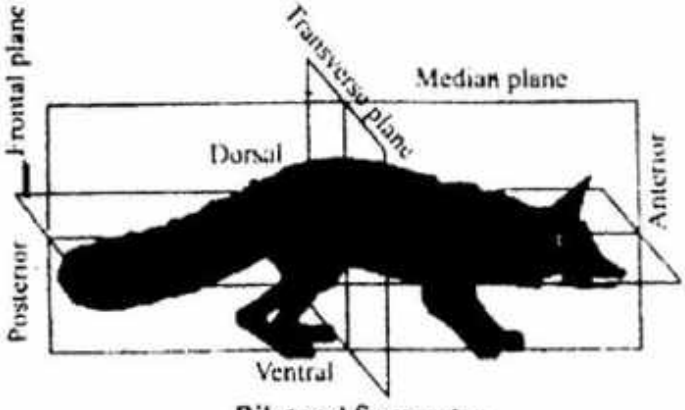
Animals can be classified according to **body symmetry.** The subkingdoms Eumetazoa are divided into grade Radiata and grade Bilateria.

Grade Radiata:

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



Radial Symmetry



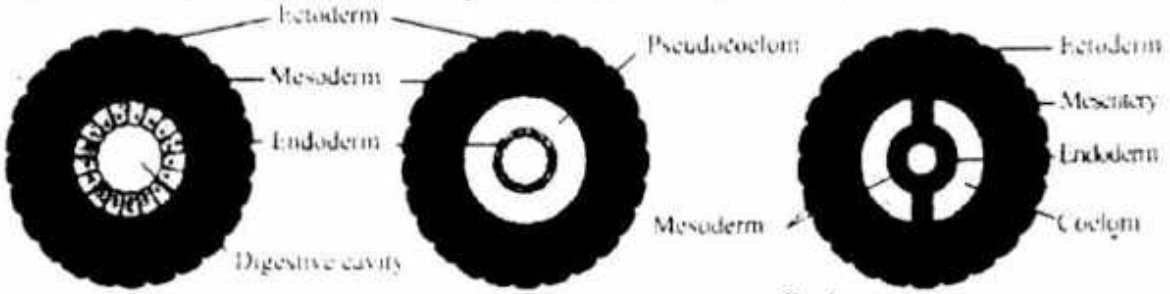
Bilateral Symmetry

Grade Bilateria:

In bilateral symmetry, a plane through the midline of the body divides it into roughly equivalent right and left 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 surfaces. 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 cavity or **coelom,** a fluid filled space between the outer body wall and the digestive tube.



Acoelomate, Pseudocoelomate, and Coelomate Comparison

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:

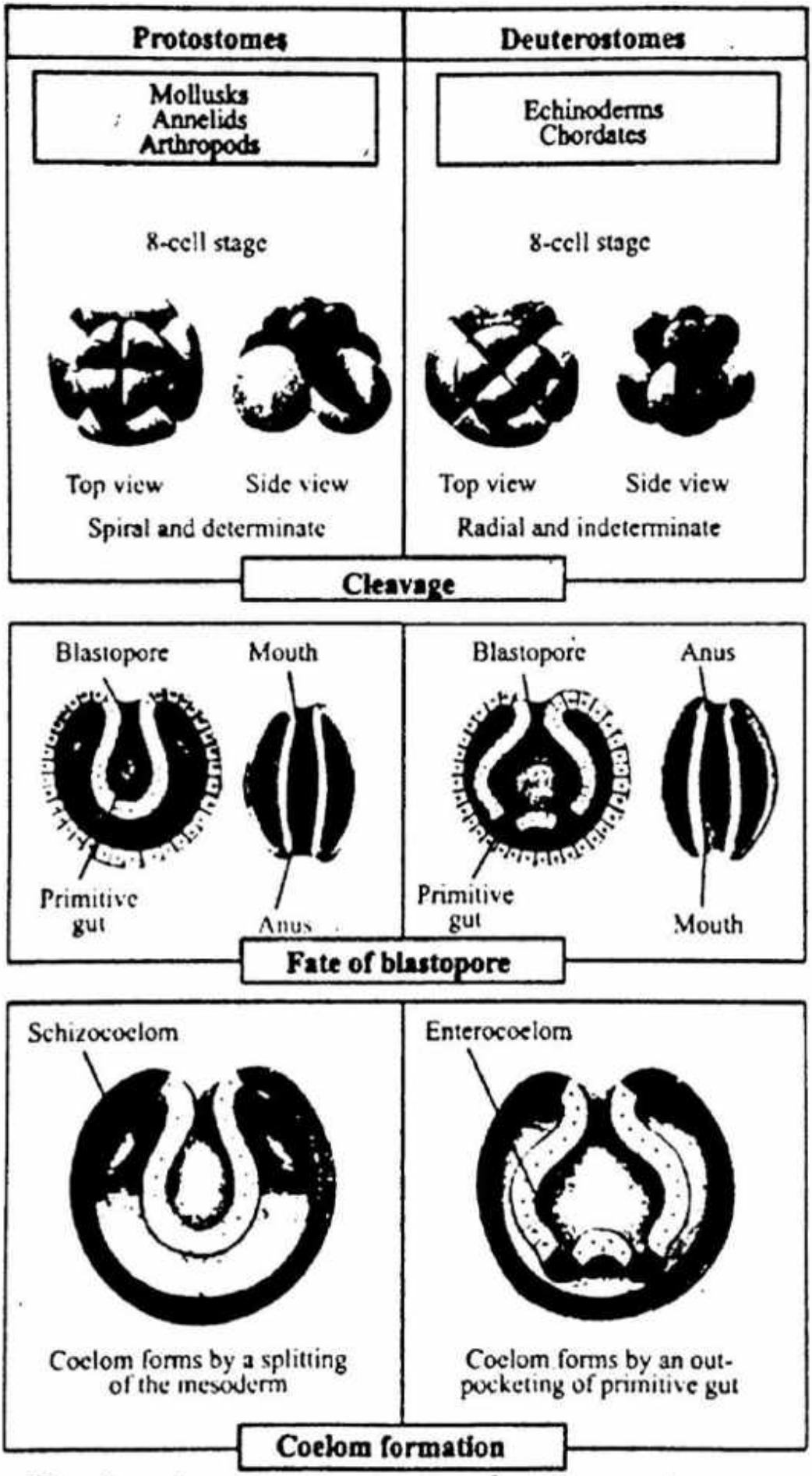
If the body cavity develops between the mesoderm and endoderm it is called pseudocoelom (false cavity). Animals with this type of body cavity are called **pseudocoelomates,** e.g., Aschelminthes (nematodes).

Coelomate:

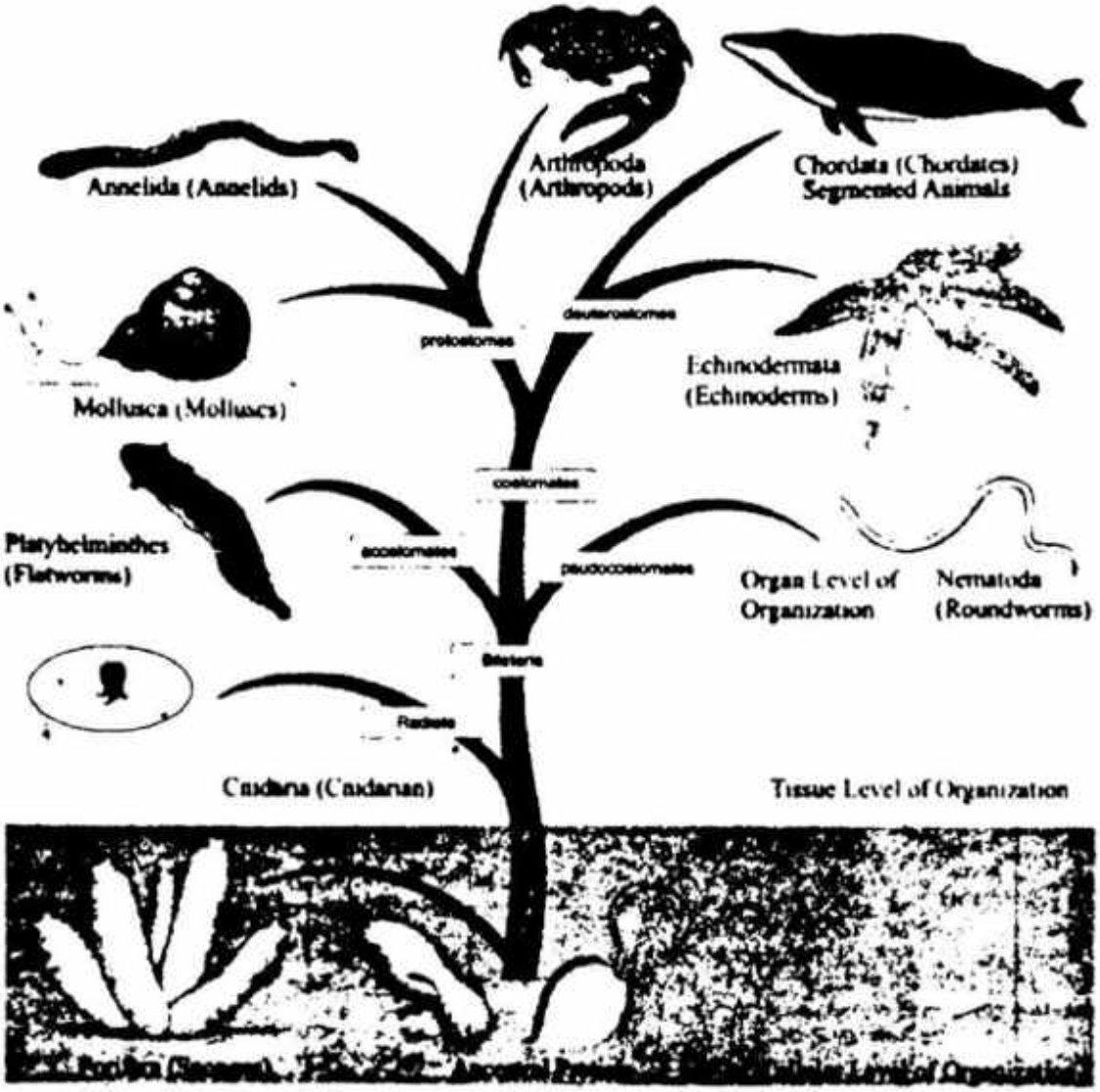
If the body cavity forms within the mesoderm and is completely lined by mesoderm the body cavity is a **true coelom.** It is filled with coelomic fluid. Animals with a true coelom are called **coelomate.** Animals from annelids to chordates are coelomate.

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 the anus. The opening that develops into the mouth forms later in development. These animals are the **deuterostomes** ("second, the mouth").



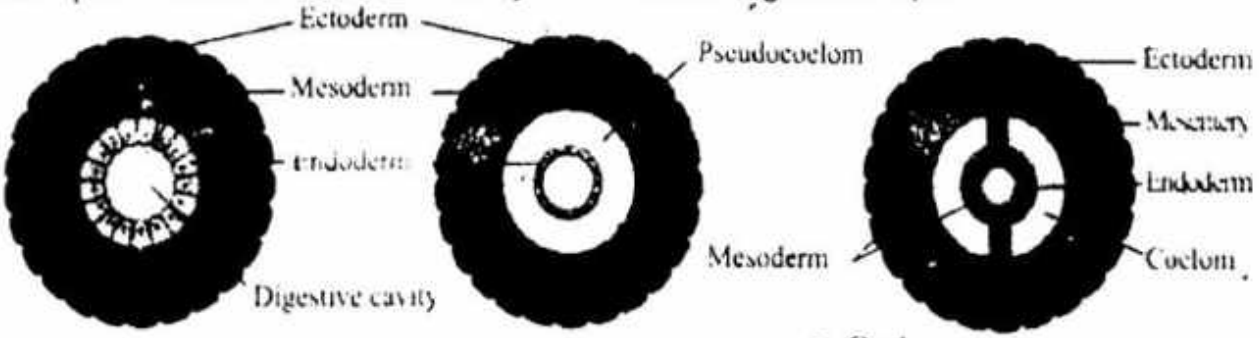
Protostomes versus deuterostomes



Phylogenetic tree of the animal kingdom

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.



a. **Acoelomate**
flatworms

b. **Pseudocoelomate**
roundworms

c. **Coelomate**
mollusks arthropods
annelids echinoderms chordates

Acoelomate, Pseudocoelomate, and Coelomate Comparison

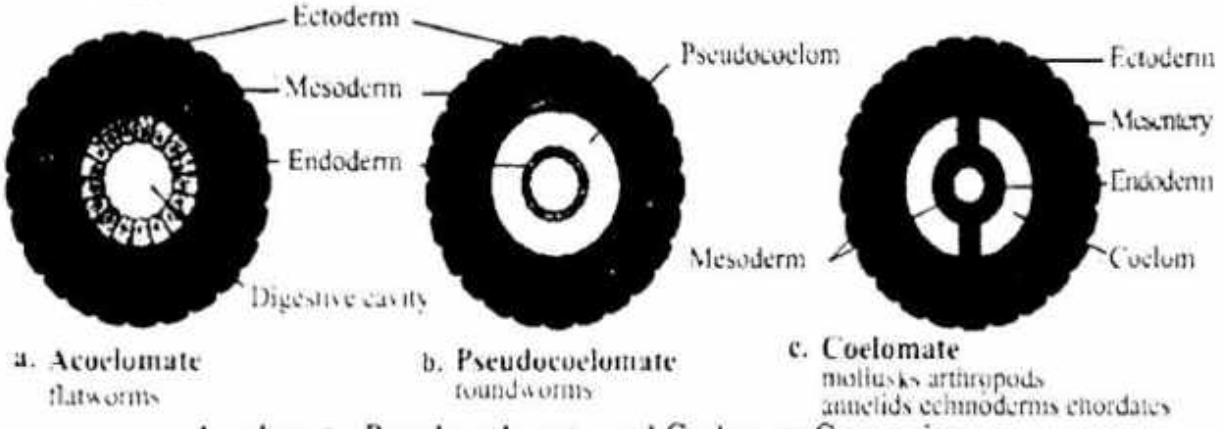
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Pseudocoelomates:

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:



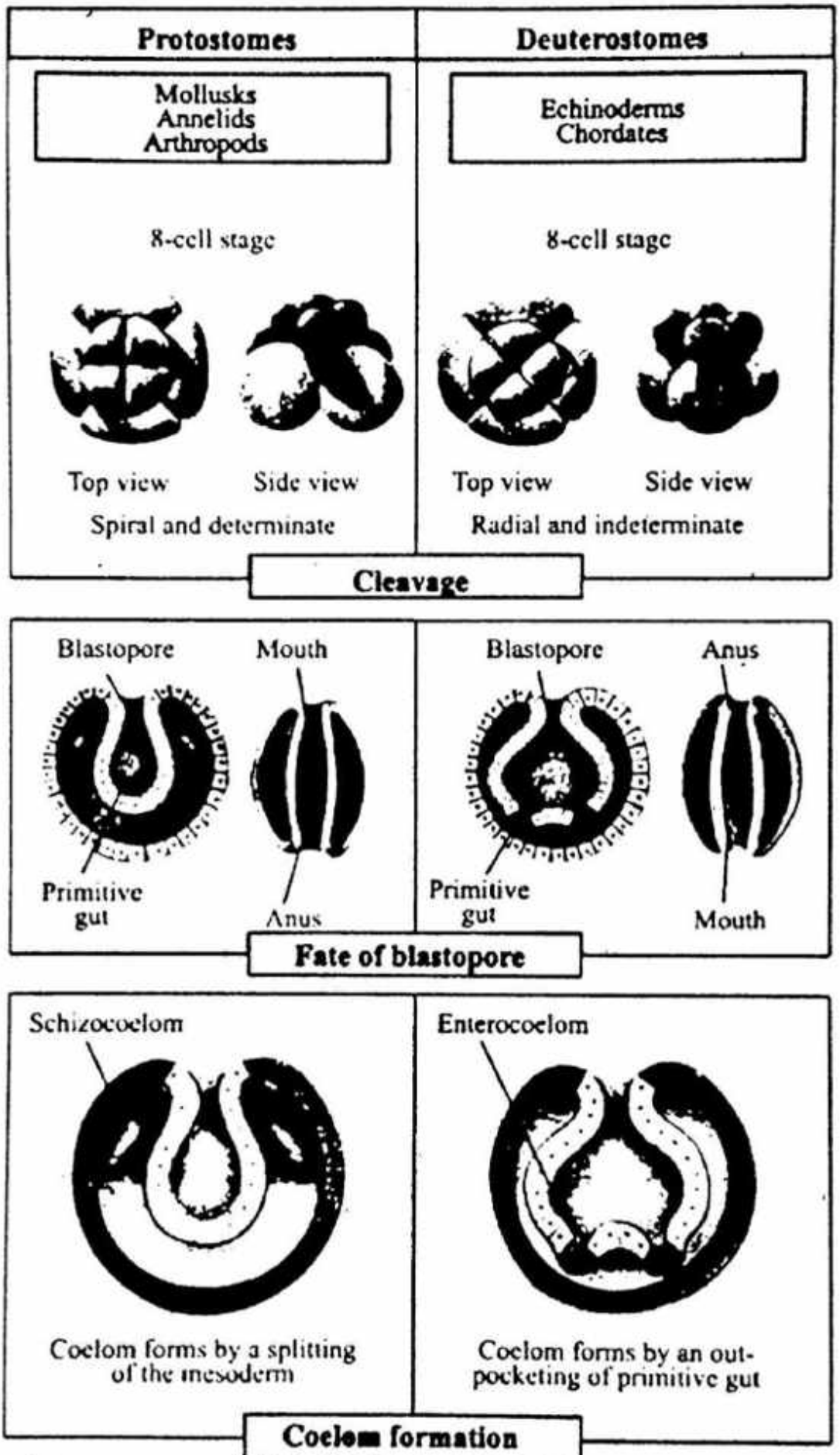
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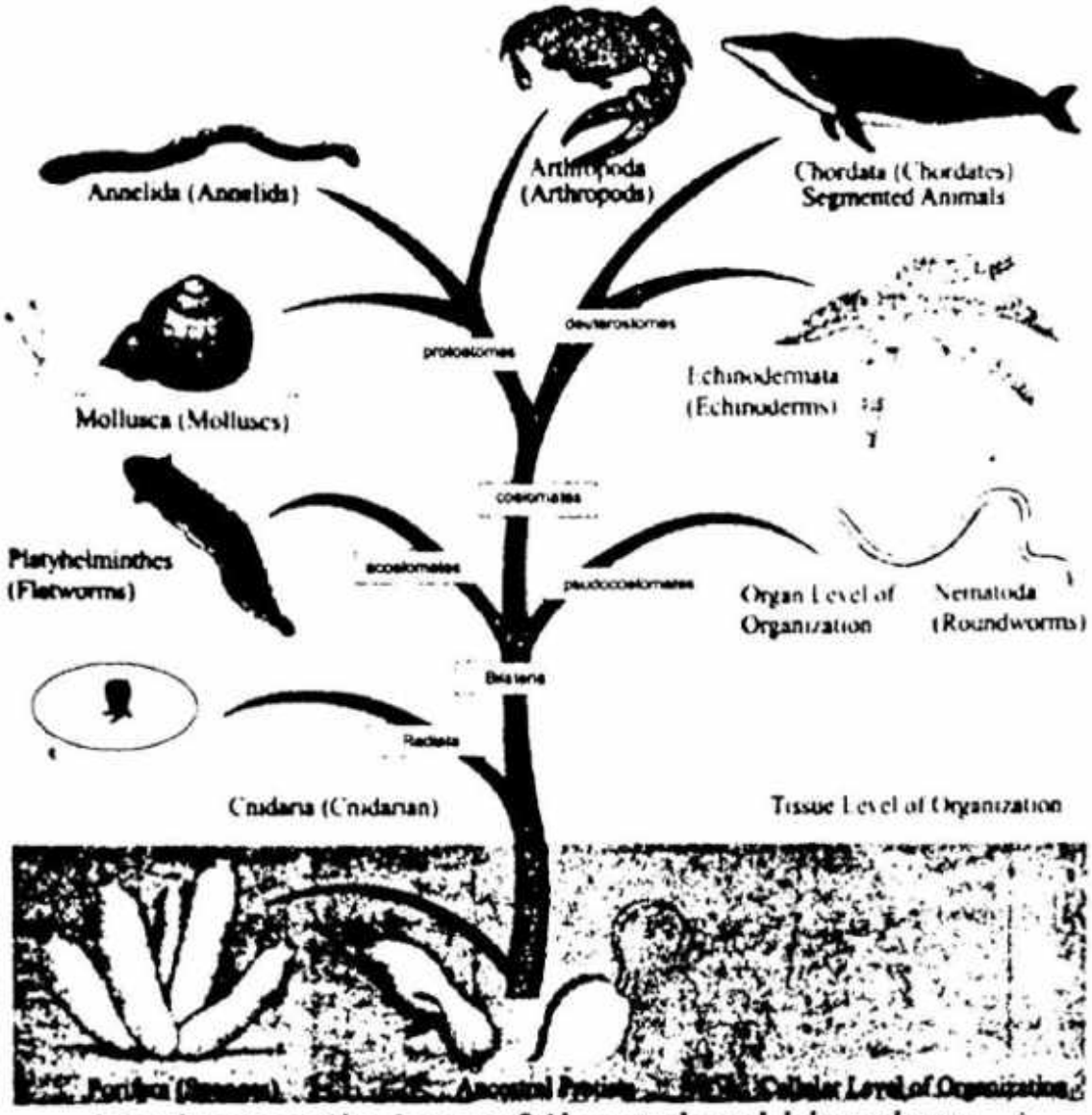
Classification of Coelomate:

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Protostomes versus deuterostomes



Phylogenetic tree of the animal kingdom

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

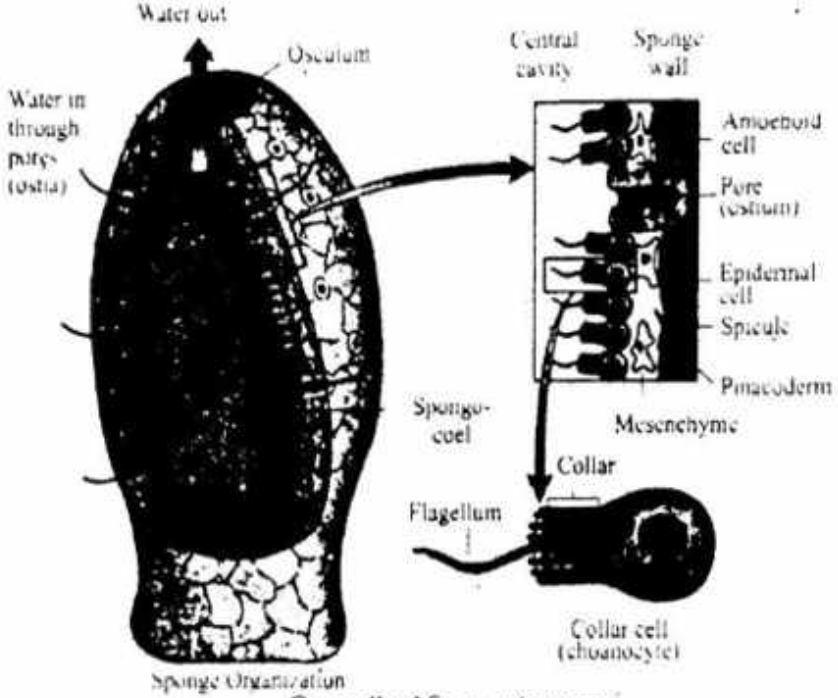
(iii) They range in size from a few millimetre wide to more than a metre long. Body is multicellular and not organized as tissue or organs.

(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 calcarious or siliceous. The bath sponge has spongin fibre.



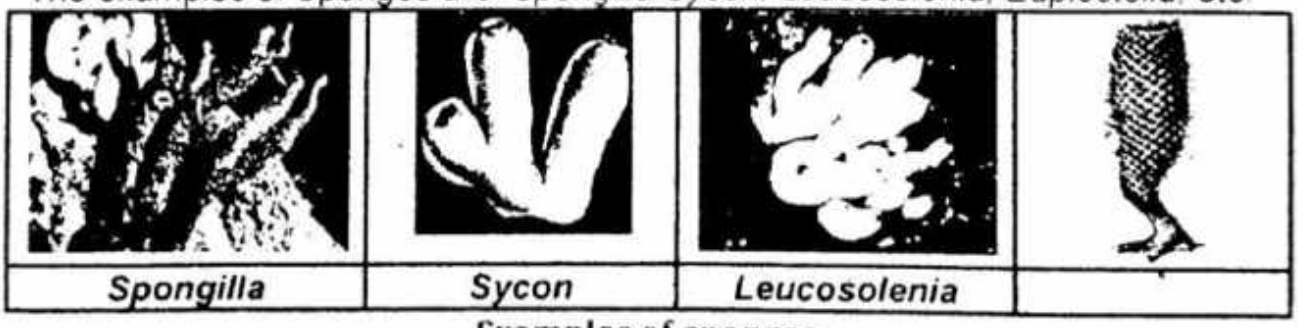
Generalized Sponge Anatomy

(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:

The examples of Sponges are *Spongilla Sycon, Leucosolenia, Euplectella*, etc.



Examples of sponges

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, e.g., *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 metres in length **(hydrozoan polyp).**

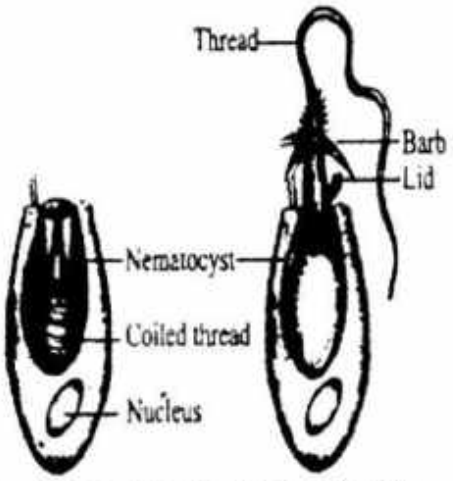
(iv) Body shows radial symmetry. Cnidarians are diploblastic animals having ectoderm, endoderm and **mesoglea** in between the two.

(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.

(vii) 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 and **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, animal 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.

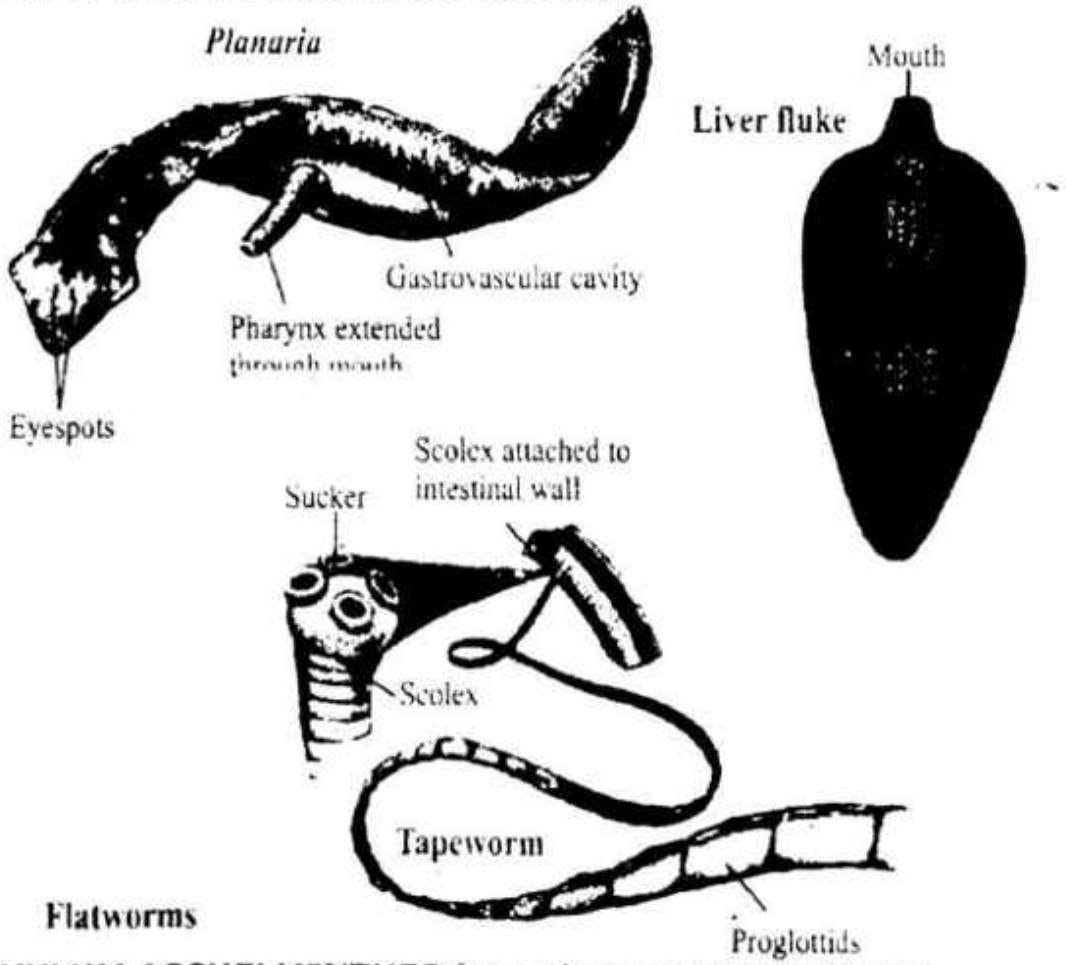
(ix) Reproduction takes places both by asexual and sexual means. Asexual reproduction is by fission. Most forms are monoecious.

(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.



Flatworms

4. PHYLUM ASCHELMINTHES (roundworms)/NEMATODA

General characteristics of phylum aschelminthes:

(i) The roundworms are free living or parasites, and live in soil, roots, human and animal intestine and muscles.

(ii) Most roundworms are less than five cm long and many are microscopic but some parasitic roundworms are more than one metre in length.

(iii) The worms exhibit bilateral symmetry, having three germ layers. Body is cylindrical, tapering at both ends.

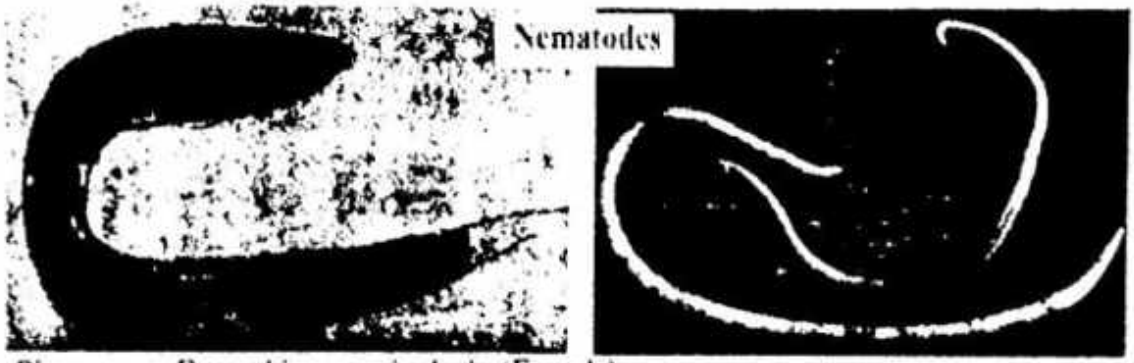
(iv) Muscular layer is not continuous. It is divided into four longitudinal quadrants: two - dorsolateral, two - ventrolateral

(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.



Pinworms *Enterobius vermicularis* (Female) *Ascaris*

Nematodes

5. PHYLUM MOLLUSCA: (Latin, *Moallis*, 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 animal is covered in an envelope called mantle. It secretes the shell. The shell may be external (snail), internal (cuttle 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



Molluscs

Economic importance of molluscs:

Shell of freshwater mussels are used in button industry. Shells **are** also used for making ornaments. Some oysters 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. Toredo a shipworm damages wooden parts in ships.

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

General characteristics of phylum annelida:

(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.

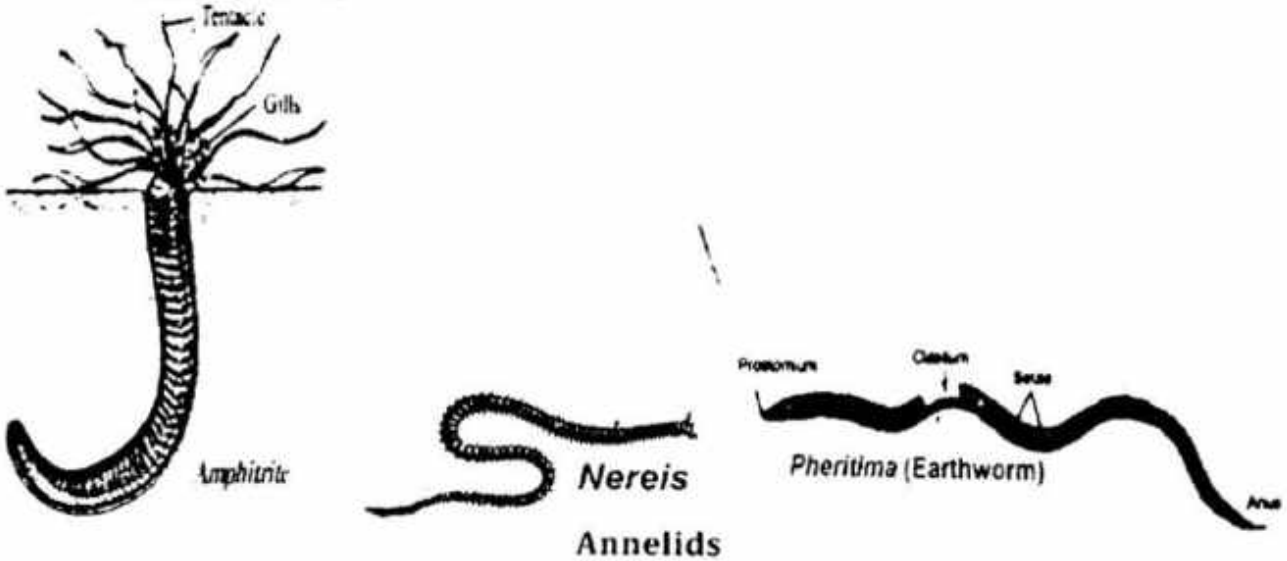
(iv) The body wall contains circular and longitudinal muscles which help in locomotion. The organs of locomotion are chitinous **chaetae or setae. Parapodia** is present in the body wall of *Nereis*.

(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, Pheritima posthuma* (Earthworm), *Hirudo* (Leech)



Annelids

Economic importance of annelids:

Polychaetes form an important food item for many edible fish. Earthworms help in soil improvement. Leech is an ectoparsite 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.

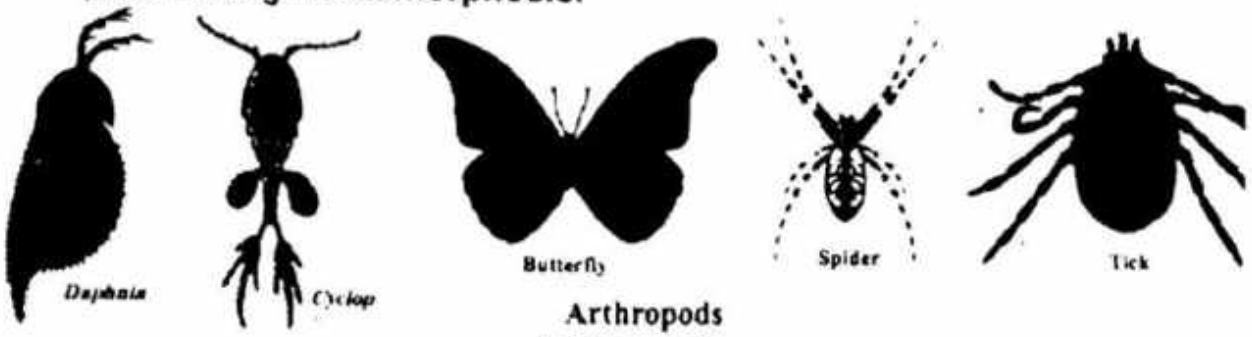
(ii) The body is segmented. Some are worm like and others are flying insects. Segments are modified, specialized and fused.

(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.**



Arthropods

Arthropods

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.

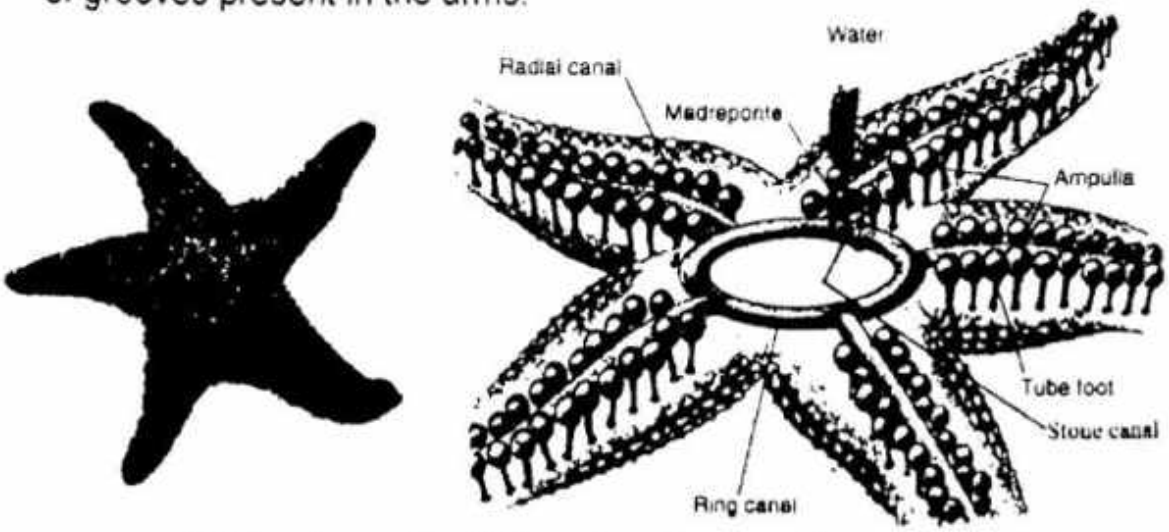
(iv) Echinoderms have an endoskeleton consisting of a spine bearing calcium rich plates. The spines, which stick out through the delicate skin, account for their name.

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

(vi) The body may be flattened like biscuit, (cake urchin), star-shaped with short arm (starfish) globular (sea urchin), star-shaped with long arms (brittle star) or elongated (sea cucumber).

(vii) **Coelom** consists of canals and spaces, and one of 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.



Echinoderm: Starfish and water vascular system

(ix) The sexes are separate. The fertilization is external. The larvae such as **bipinnaria** 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 are 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. Describe the evolutionary adaptations for digestion, gas exchange, transport, excretion and co-ordination in the following phyla:

(a) Porifera **(b) Cnidaria**
(c) Platyhelminthes **(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 cells probably seem 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 (prtonephridia)

(5) Nervous system:

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

(d) Aschelminthes (Nematoda):

Evolutionary adaptations in aschelminthes:

(1) 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) Mollusca:

Evolutionary adaptations in molluscs:

(1) Digestion:

Digestive 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 insects 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.

(5) 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.

(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 rig and radial nerve-cords. There is no brain.

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

Ans: PHYLUM HEMICHORDATA: (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:

Balanoglossus, Saccoglossus

General characteristics of phylum hemichordata:

(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.

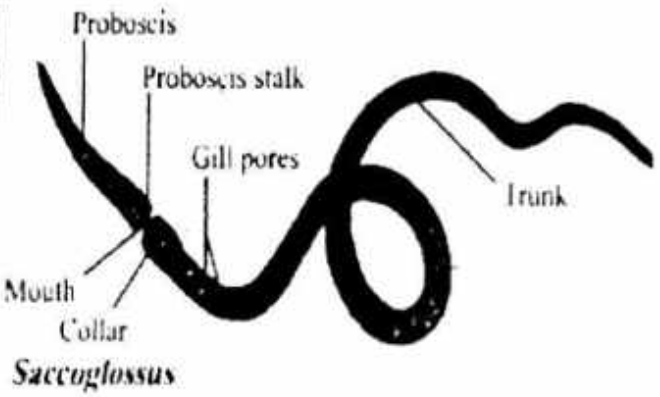
(2) Circulatory system:

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.





Saccoglossus

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

Ans: Phylum Chordata:

The representatives of the phylum chordata called the 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 a solid unjointed rod located in the mid-dorsal line between the gut and the central nervous system outside the coelom. The notochord serves as an axial endoskeleton, giving support to the body and providing space for muscle attachment.

In some lower chordates the notochord persists throughout life, but in higher chordates it is partly or wholly replaced in the adult stage by a jointed backbone or vertebral column.

(b) Dorsal Hollow Central Nervous System:

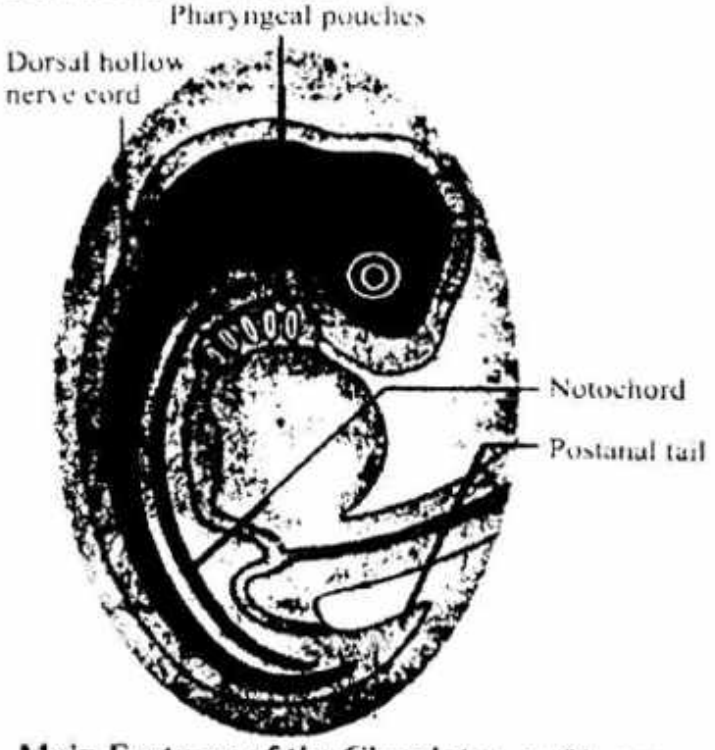
The central nervous system of all the chordates consists of a single, tubular fluid filled, nongangliated nerve cord, situated along the mid dorsal line above the notochord and outside the coelom.

(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 humans.



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

34. Describe the general characteristics, evolutionary adaptations 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.**

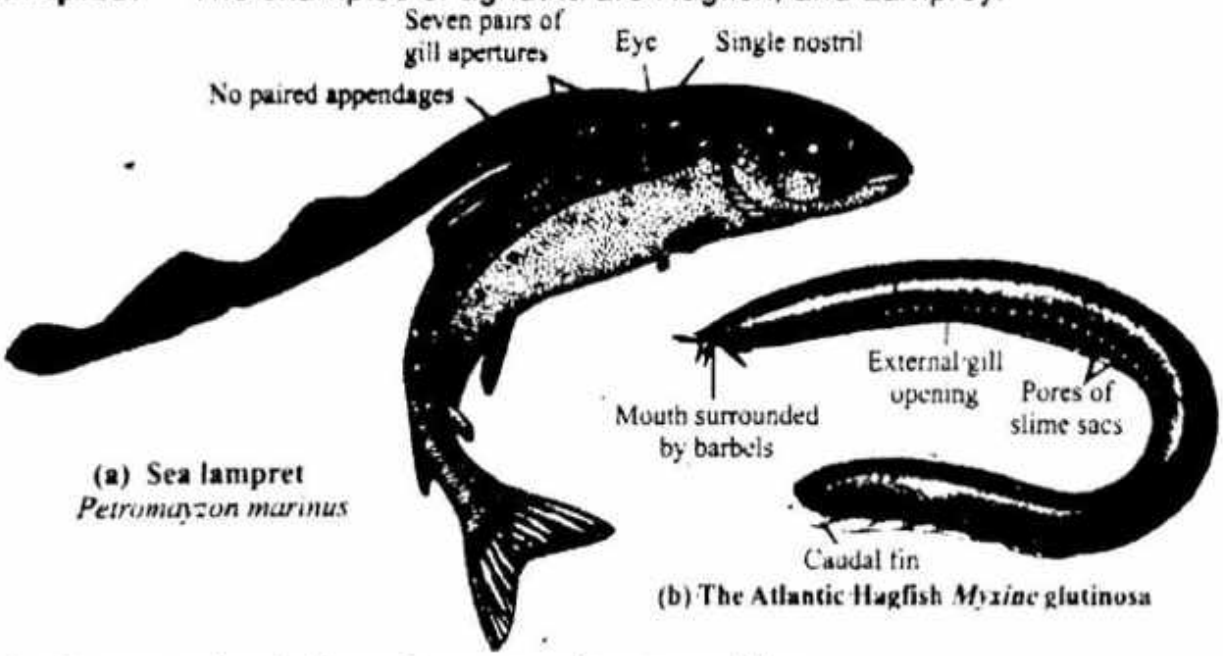
General characteristic of super class agnatha:

(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.



(a) Sea lampret *Petromayzon marinus*

(b) The Atlantic Hagfish *Myxine* glutinosa

Evolutionary adaptations in super class agnatha:

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 each with external gill opening in class Cephalospidomorphi. Dorsal nerve cord with differentiated brain.

Jaws Evolve

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

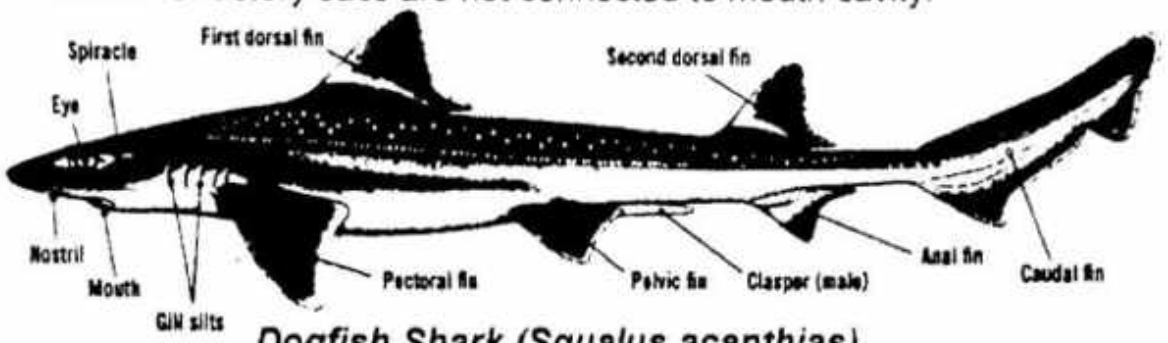
35. Describe the general characteristics, evolutionary adaptations and give examples of the following classes:

(a) Chondricthyes **(b) Osteichthyes**
(c) Amphibia **(d) Reptilia**
(e) Aves **(f) Mammalia**

Ans: (a) Chondricthyes:

General characteristics:

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



Dogfish Shark (Squalus acanthias)



Chondrichthyes

(ii) **Skin** is tough and covered with minute **placoid scale.**

(iii) The pectoral and pelvic fins are paired. There **are two** dorsal fins. The caudal fin is **heterocercal**.

(iv) Endoskeleton is 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 of 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**.

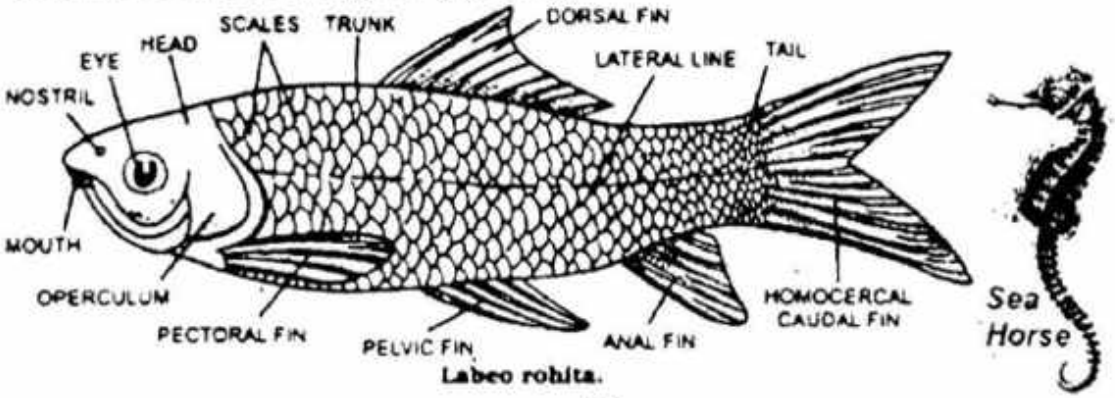
(v) Mouth is usually terminal, i.e., anterior end often bears numerous teeth. Jaws are well developed. Anus is present and cloaca is absent. The four pairs of gills are supported by a **bony arch.**

(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)



Labeo rohita.



Lobe-finned fish, The Coelacanth, *Latimeria*, is a living Fossil.

Limbs Evolve

All the animals which are called tetrapods have four limbs. The lobe-finned fishes of the Devonian period are ancestral to the amphibians, the first tetrapods. 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.

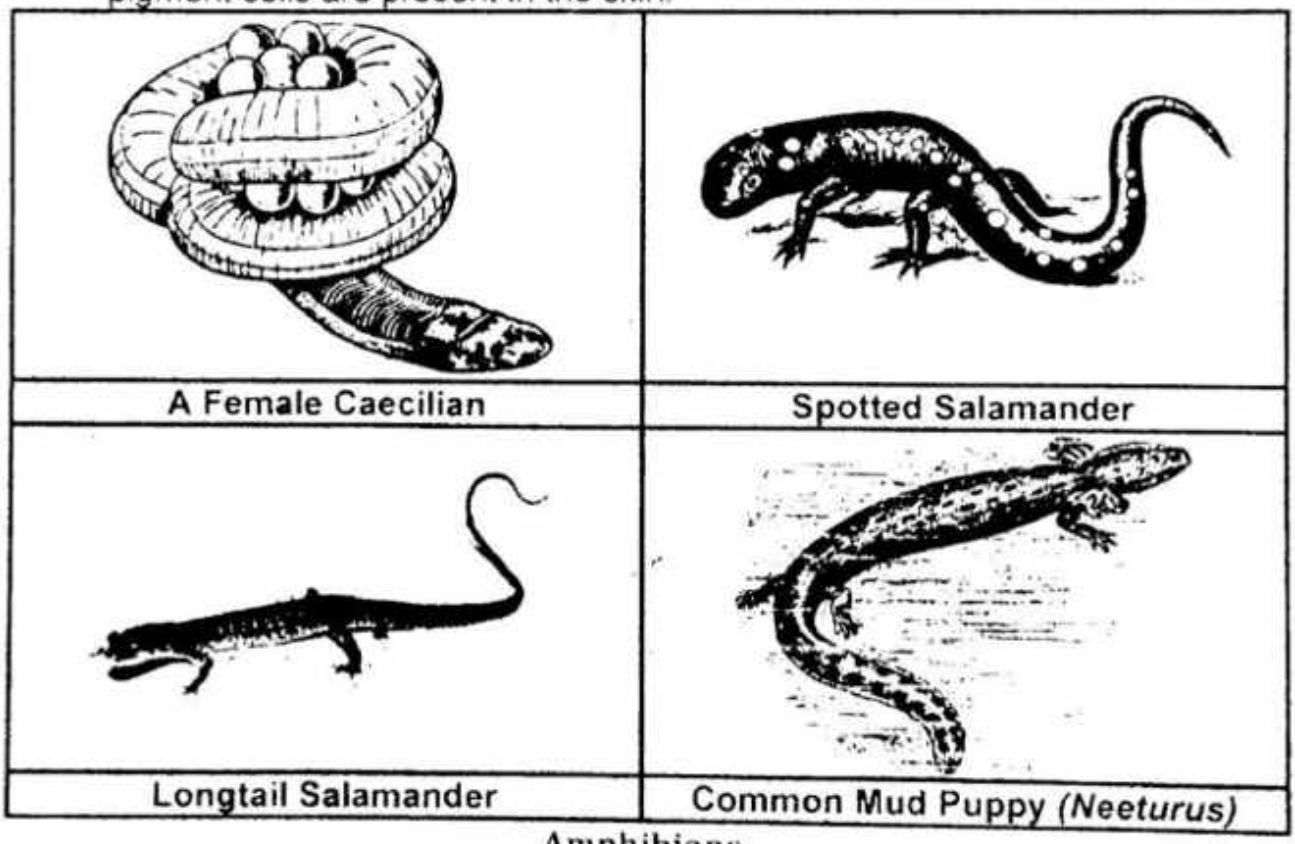
(c) Amphibia:

General characteristics of class amphibia:

(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.



Amphibians

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

(v) Heart is three chambered with respect to atria and ventricle. **Sinus venosus, truncus arteriosus** are present.

(vi) Double circulation takes place through the heart.

(vii) Sexes are separate. Gonads are paired. Fertilization may be external or internal. Most forms are oviparous.

(viii) Development takes place through **metamorphosis.**

(ix) Amphibians are **anamniotes.** Body temperature is variable, i.e., poikilothermic (ectotherms) and most forms undergo hibernation in winter.

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) Reptilia:

General characteristics of class reptilia:

(i) There are two pairs of pentadactyl limbs, 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., piokilothermic (ectotherms) 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. The

Examples: Examples of reptiles are tortoise, lizard, snake, crocodile and alligator etc

Evolutionary adaptations in class reptilia:

Reptiles show the advancement over the amphibians in having.

(a) A dry skin which enables them to live away from water.

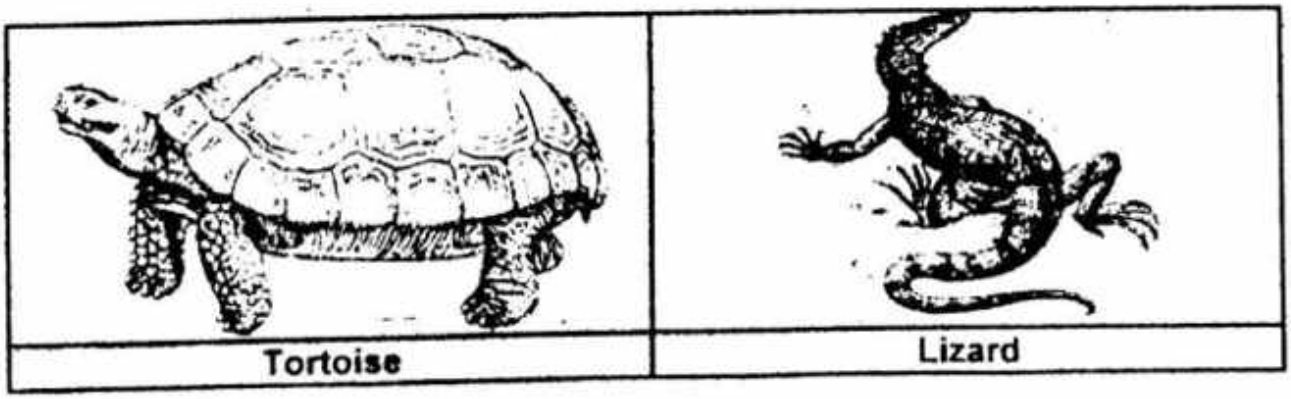
(b) Separation of oxygenated and deoxygehated blood in the heart.

(c) A neck movable independent of the body.

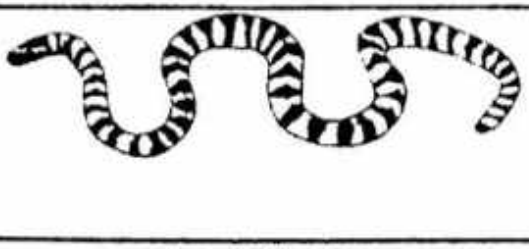
(d) Better mechanism of breathing.

(e) Fertilization is internal.

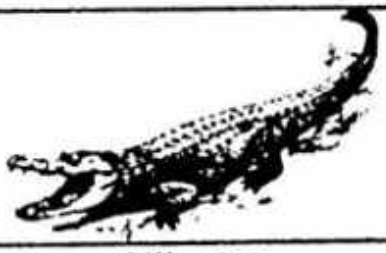
(f) Egg with shell for protection on land.



Tortoise | Lizard



Corel Snake



Alligator

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 an 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.

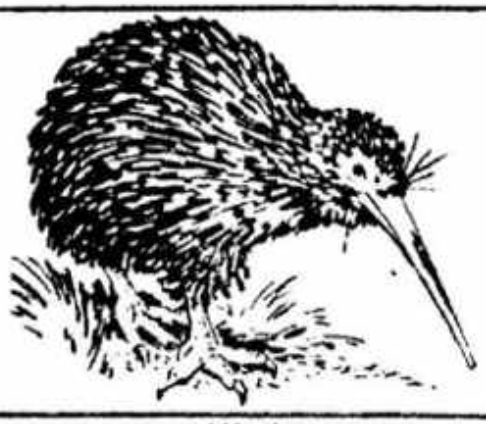
(v) Respiration takes place only by lungs. A system of thin walled air sacs lying among the viscera maintains the supply of fresh air through the lungs. Voice box the **syrinx** lies at the junction of the trachea and bronchi.

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

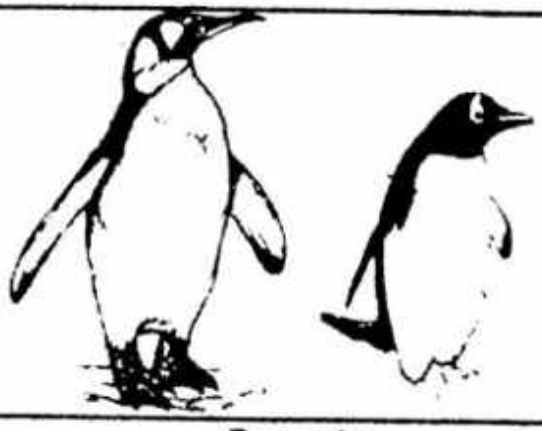
(vii) Excretory system consists of a pair of kidneys. The ureter open into the cloaca and the urinary bladder is absent. The urine is semisolid and uric acid is main nitrogenous waste.

(viii) Sexes are separate. Fertilization is internal. Eggs are large with much yolk. Only one ovary and oviduct is functional.

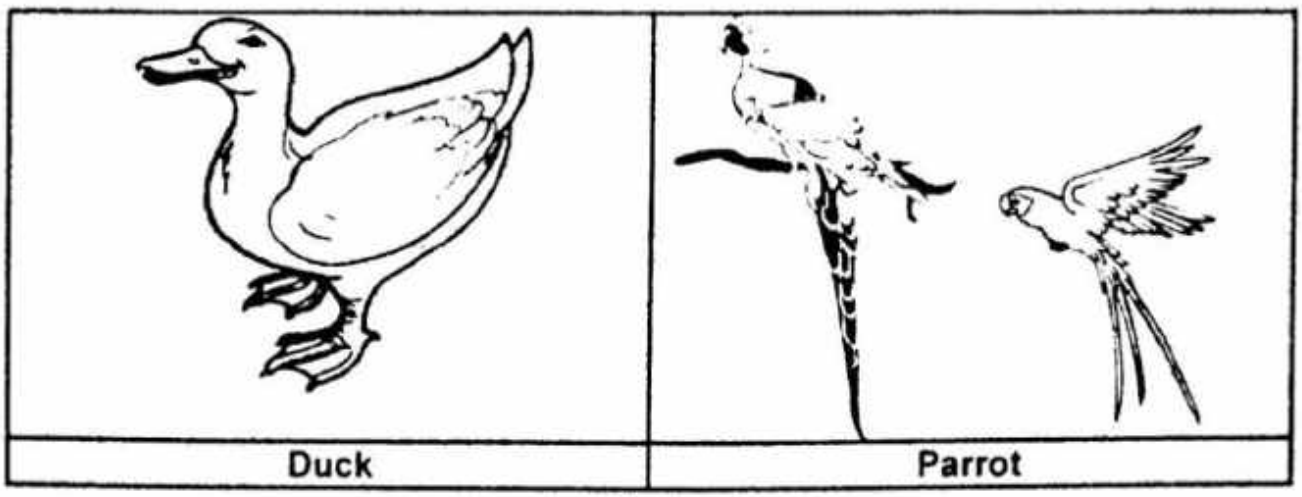
(ix) Some birds have secondarily lost the power of flight and are called running birds, e.g., ostrich, kiwi, etc.



Kiwi



Penguin



Birds

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 behaviour, 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 mammalia:

(i) Body is variously shaped and divisible into a head, 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.



Duckbill Platypus (Ornithorhynchus) *Spiny Ant Eater (Tachyglossus)*

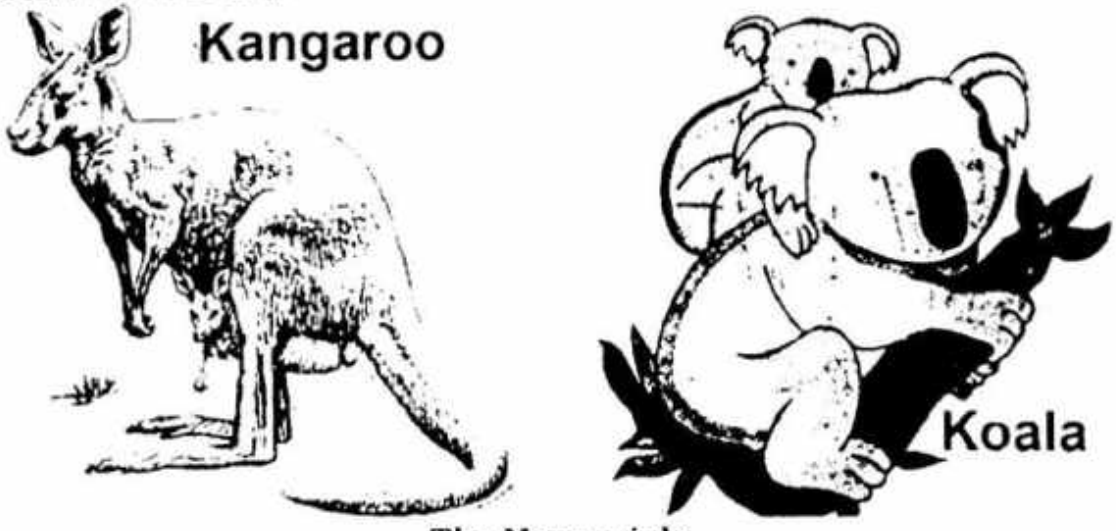
The Monotremes

(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).



The Marsupials

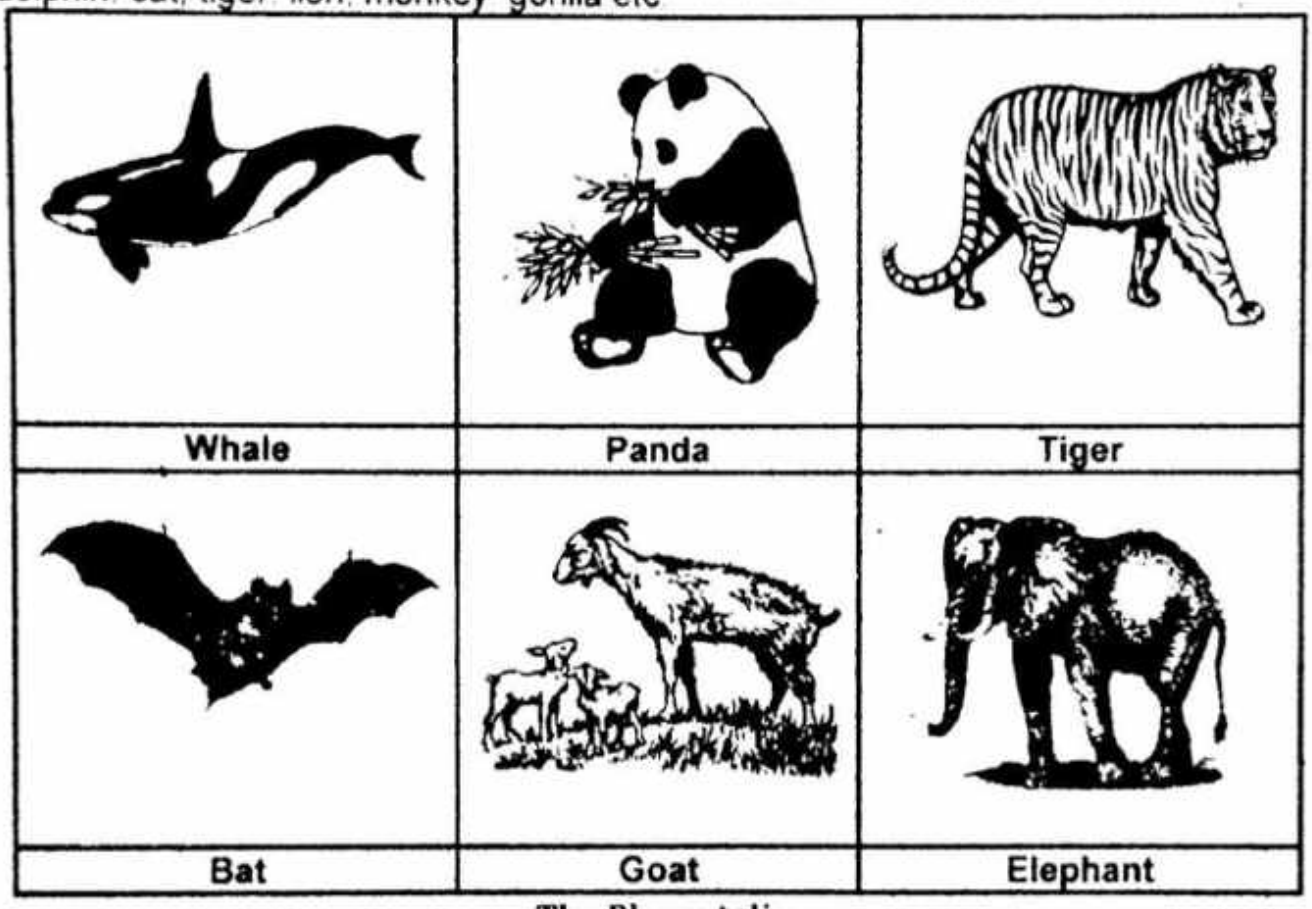
(c) Eutheria:

Development of young one takes place inside the body of the mother. The young's are borne fully developed. Developing placental mammals are dependent on placenta 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 placentalis are man, whale, elephant, horse, rat, mice, bat, dolphin, cat, tiger, lion, monkey, gorilla etc.



The Placentalis

37. Arthropods and vertebrates are highly successful groups of animals on land. What characteristics shared by arthropods and vertebrates 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 covings 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.