XI 4

ANIMAL KINGDOM

SYLLABUS

Salient features and classification of animals-nonchordate up to phyla level and chordate up to classes level (three to five salient features and at least two examples).

KEY CONCEPTS

INTRODUCTION

* Taxonomy- Study of **nomenclature, classification** and their **principles.** This word was given by **"Candolle"** (**Taxis** – arrangements. Nomos - Law)
* **Aristotle : -** "Father of Zoology". (Book : **Historia Animalium).** He is also known as the father of ancient taxonomy. He classified animals into two groups on the basis of their natural similarities and differences into –

(i) **Anaima :-** Those animals which don't have Red blood or in which RBC are absent e.g. Sponges, Cnidaria, Mollusca, Arthropoda. Echinodermata.

(ii) **Enaima :-** These animals have red blood. This group includes all vertebrated and it has been further divided into two sub groups.

(a) **Vivipara :-** It incldues animals which give birth to young-ones e.g., Mammals.

(b) **Ovipara :-** It includes animals which lay eggs. e.g. Amphibians, Aves, Reptiles etc.

* **G.L. Cuvier : -** Coined the term **Phylum.**
* **Invertebrate** and **Vertebrate** term was given by **Lamarck.**

ANIMAL CHARACTERS

* Animals are multicellular **eukaryotes**. In contrast to plants, algae, and fungi, their cells lack cell walls. Instead, structural support depends on collagen and other structural proteins. Collagen is an important *shared derived character* in animals.
* Animals are **heterotrophs.** As consumers, they depend on producers for their raw materials and energy. In contrast to the fungi, most animals ingest their food first and then digest it inside the body, usually within a digestive system.
* Animals can be **herbivores, carnivores** or **omnivores** on the basis of their nutritional requirements. Those animals which are herbivores, depend directly on plants as they eat only plant products like fruits, vegetables, cereals, pulses etc. Whereas the animals which are carnivores or omnivores eat other animals which obtained their nutrition from either plants or other animals. For e.g., lions eat deers and deers eat grass. Hence lions indirectly depend on grass. Here lions are carnivores and deers are herbivores.
* Cells that make up the animal body are specialized to perform specific functions. In all but the simplest animals, cells are organized to form tissues, and tissues are organized to form organs. In small animals with simple body plans, life processes such as gas exchange, circulation of materials, and waste disposal can take place by diffusion of gases and other substances

directly to and from the environment. Specialized organ systems perform these functions in large animals.

* Animals have diverse body plans. The term **body plan** refers to the basic structure and functional design of the body. An animal's body plan and lifestyle are adapted to its methods of obtaining food and reproducing.
* Most animals are capable of locomotion at some time during their life cycle. Some animals (such as sponges and corals) move about as larvae (immature forms) but are **sessile** (firmly attached to the ground or some other surface) as adults .
* Most animals have nervous systems and muscle systems that enable them to respond rapidly to stimuli in their environment.
* Most animals are diploid organisms that reproduce sexually, with large, nonmotile eggs and small, flagellate sperm. A haploid sperm unites with a haploid egg, forming a diploid **zygote** (fertilized egg). Animals go through a period of embryonic development. The zygote undergoes **cleavage,** a series of mitotic cell divisions.
* During cleavage the zygote develops into a hollow ball of cells called a **blastula.** Although some animals develop directly into adults, the majority first develop into a **larva,** a sexually immature form that may look very different from the adult The larva differs from the adult in many ways, including where it lives (its habitat), how it moves, and what it eats. Larvae typically go through **metamorphosis,** a developmental process that converts the immature animal into a juvenile form that can then grow into an adult.

ANIMAL HABITAT AND HABITS

* **Zooplankton.** They cannot swim actively and are drifted passively by water currents. Alongwith many protozoan protists, they include small crustaceans and various invertebrate larvae.
* **Nekton.** They are actively swimming animals in the sea or a lake, e.g., sharks, bony fish, etc. The animals which, live in the open water of a sea or lake are called pelagic animals. They include the zooplankton and the nekton.
* **Benthos.** They live on the bottom of a sea or lake, e.g., star fishes, sea cucumbers, sponges, corals, etc.
* **Cursorial Animals.** They run fast, e.g., kangaroo, dog, horse, etc.
* **Fussorial Animals.** They live in burrows/ underground, e.g., duck billed platypus, rabbit, etc.
* **Arboreal Animals.** They live on the trees, e.g., bats, monkeys apes, etc.
* **Scansorial Animals.** They climb walls, rock, etc. e.g., wall lizard, flying squirrel, etc.
* **Aerial or Flying Animals.** They can fly, e.g., winged insects, birds, bats, etc.
* **Solitary Animals.** They live alone e.g., Taenia, grasshopper.
* **Colonial Animals.** They live in groups and help one another and thus show social life. e.g., bees, termites, wasps and ants.
* **Gregarious Animals.** They live in groups but do not help one another, e.g., locust.
* **Free Living Animals.** They lead an independent life e.g., Frog, lizard, etc.
* **Motile Animals.** They move about e.g., earthworm, cockroach.
* **Sedentary or Sessile Animals.** They are fixed to the substratum like plants e.g., sponges.

IMPORTANT PHYLA

1. **Protozoa (included in Kingdom Protista) -** e.g. ***Amoeba, Paramoecium*** etc.
2. **Porifera (Kingdom Animalia) -** Sponges etc.
3. **Coelenterata/Cnidaria -Hydra,** Jellyfish etc.
4. **Ctenophora** (minor phylum)- ***Pleurobrachia*** etc.
5. **Platyhelminthes -** Flat worms **(**eg**:**Tape worm)
6. **Nemathelminthes /Aschelminthes -** Round worm **(eg: Ascaris)**
7. **Annelida -** Earthworm, Leech etc.
8. **Arthropoda -** Insects, Scorpion, Fly etc.
9. **Mollusca** - Snail, **Pila, Octopus** etc
10. **Echinodermata -** Star fish etc.
11. **Hemichordata -** ***Balanoglossus***
12. **Chordata -** Fish, Snake, Birds, Monkey etc.

* **Ernst Haeckel** (1866) : Introduced the terms '**Monera**' and '**Protista**'.
* **Leeuwenhoek** (1677): Observed protozoa for the first time.
* **G.L Cuvler** (1829) : Added the term "**phylum**" in taxonomy.
* **Goldfuss** (1817) : Coined the term "**Protozoa**".
* **Robert Grant** (1825) Proved that sponges are animals. He introduced the term "**Porifera**".
* **Leuckart** (1847): Used the word "**Coelenterata**".
* **Gegenbaur** (1859): Introduced the words "**Platyhelminthes**" and "**Nemathetmlnthes**".
* **Lamarck** (1801, 1816): Coined the Terms '**Annelida**' and "**Tunicata**".
* **Von Seibold** (1845): Proposed the term "**Arthropoda**".
* **Johnston** (1650): Coined the word "**Mollusca**".
* **Jacob Klein** (1738) : Coined the name "**Echinodermata**".
* **Bateson** (1885): Introduced the term "**Hemichordata**"

METAZOA

* Animal groups are characterized by mobility, and the presence of a sensory or a nervous system. These systems receive stimuli from the environment and respond by exhibiting some behaviour.
* The only exception are the porifers (pore-bearers) or the sponges. They have no cell that can be termed as nerve cell.
* Like plant life, early animal life also arose in sea.
* The animals which live on the sea floor are called **Benthonic** (e.g., echinoderms, corals and deep sea fishes), whereas, which swim about actively in sea are called **Nektons.**
* The multicellular eukaryotic organisms with holozoic mode of nutrition are called as **metazoans.**
* Based on complexity of organization, metazoans are further sub-divided into two sub-kingdoms, the Parazoa and Eumetazoa.
* **Parazoa :** Parazoa includes the sponges in which the cells are loosely aggregated and do not form tissues or organs.
* **Eumetazoa :** Eumetazoa includes the rest of the animals, the cells are organized into structural and functional units called as tissues, organs and organ systems.

BASIS OF CLASSIFICATION

Level of body organisation

Protoplasmic level → In protozoans, acellular body performs all biological activities.

↓

Cellular level → In sponges, cells are arranged as loose cell aggregates and division of labour occurs among cells. (Tissues absent)

↓

Tissue level → In coelenterates and ctenophores, cells performing the same function are arranged into tissues.

↓

Organ level → In platyhelminthes and other higher phyla tissues are grouped together to form organs.

↓

Organ system level → In higher animals, organs further organise to form organ systems.
e.g. Aschelminthes, Annelida, Arthropoda, Mollusca, Echinodermata and Chordata.

Body Symmetry

The arrangement of body parts around a central point or line determines the symmetry.

(a) **Asymmetrical -** some animals cannot be divided into two equal halves along any plane passing through the centre of the organism. Asymmetry is the complete absence of symmetry.
Example: Most of the sponges.

(b) **Radial Symmetry -** Animals are said to exhibit radial symmetry, when any plane passing through the central axis of the body divides the organism into two identical halves.
Example: Coelenterates, ctenophores and echinoderms(adult).

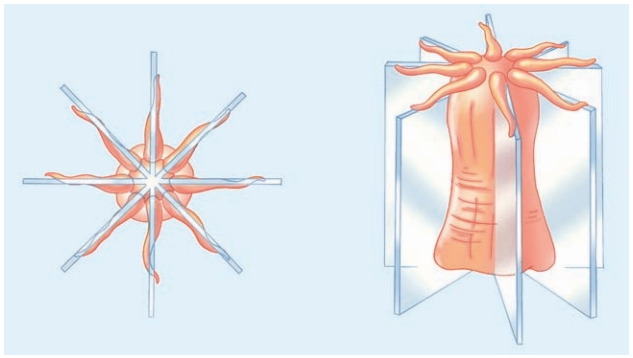


Figure : Radial symmetry

(c) Bilateral Symmetry - Animals where body can be divided into identical right and left halves in only one plane are said to be bilaterally symmetrical.

Example: Platyhelminthes to chordates.

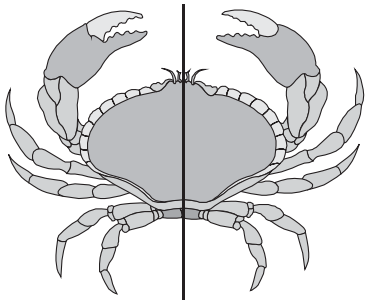
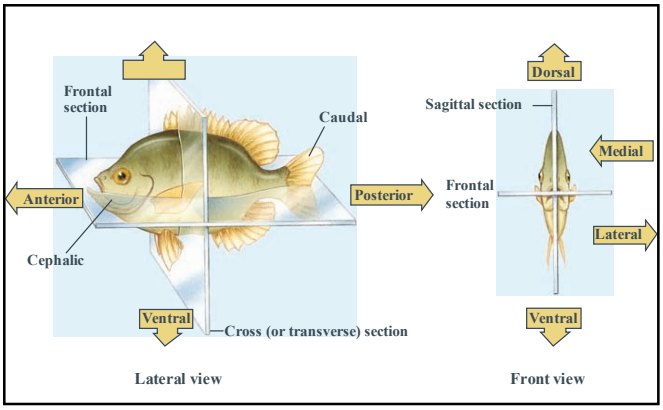


Figure : Bilateral symmetry

* Some definitions of basic terms and directions will help in locating body structures in bilaterally symmetrical animals. The back surface of an animal is its **dorsal** surface; the underside (belly) is its **ventral** surface. **Anterior** (or **cephalic**) means toward the head end of the animal; **posterior,** or **caudal,** means toward the tail end.
* A structure is said to be **medial** if it is located toward the midline of the body and **lateral** if it is toward one side of the body; for example, the human ear is lateral to the nose.
* In human anatomy, the term **superior** refers to a structure located above some point of reference, or toward the head end of the body.
* The term **inferior** is used in human anatomy to mean located below some point of reference, or toward the feet.



Germinal Layers

(a) Diploblastic:

* Animals in which the cells are arranged in two embryonic layers are known as diploblastic animals.
* Diploblastic animals have an external ectoderm and an internal endoderm.
* An undifferentiated layer **mesoglea** is present between **ectoderm** and **endoderm**.
* Example: Sponges, Coelenterates & Ctenophores.

(b) Triploblastic :

* Triploblastic animals are those, whose cells are arranged in three germinal layers, the outer ectoderm, inner endoderm and the third germinal layer **mesoderm** which is in between outer ectoderm and the endoderm.
* Example: Platyhelminthes to Chordates.

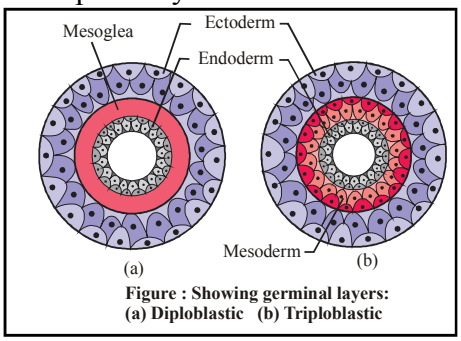


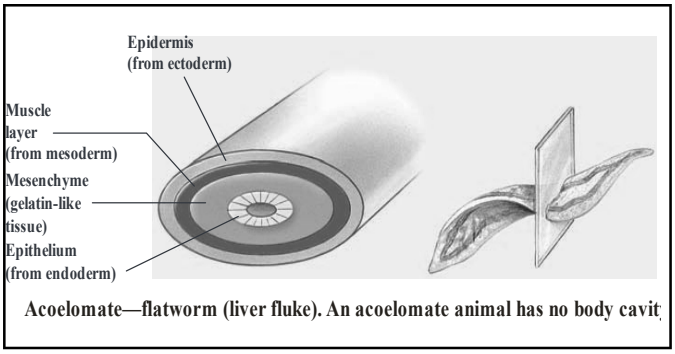
Figure : Showing germinal layers:
(a) Diploblastic (b) Triploblastic

Body cavity or Coelom

The presence or absence of a cavity between the body wall and the gut wall is important characteristic for classification.Coelom is the body cavity that is lined by the mesoderm.

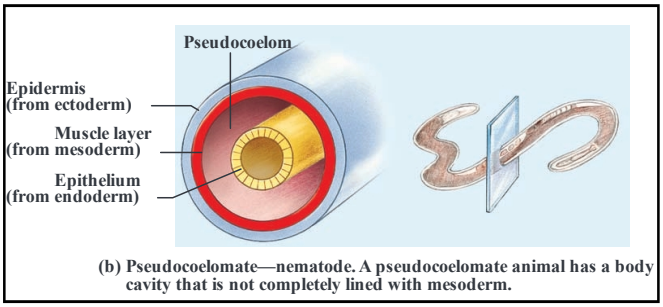
(a) Acoelomates : Animals in which the body cavity is absent are known as acoelomates.

Example: Platyhelminthes.



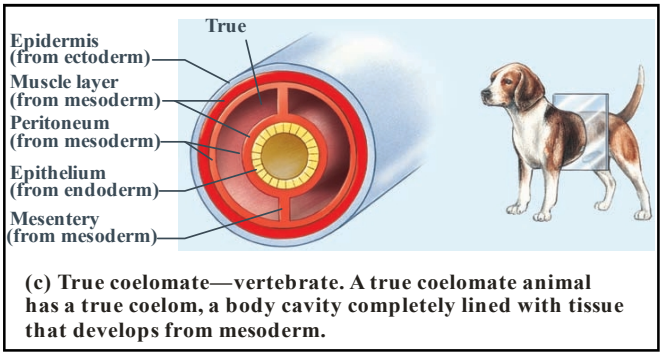
Acoelomate—flatworm (liver fluke). An acoelomate animal has no body cavit

(b) **Pseudocoelomates :** Animals in which the body cavity is not lined by the mesoderm, instead the mesoderm is present in scattered pouches in between the ectoderm and the endoderm are known as the pseudocoelomates.
Example: Aschelminthes.



(b) Pseudocoelomate—nematode. A pseudocoelomate animal has a body cavity that is not completely lined with mesoderm.

(c) **Coelomates :** Animals possessing the body cavity which is lined by the mesoderm are known as coelomates.
Example: Annelids, Mollusca,Arthropods, Echinoderms,hemichordates and chordates.



(c) True coelomate—vertebrate. A true coelomate animal has a true coelom, a body cavity completely lined with tissue that develops from mesoderm.

On the basis of embryonic development, the coelom is of two types:

(i) **Schizocoel :** Coelom formed by the splitting up of mesoderm. It is found in annelids, arthropods and molluscs. **Body cavity of arthropods is called heamocoel.**

(ii) **Enterocoel :** Coelom formed by fusion of gut pouches during embryonic stage. It occurs in Echinodermata, Hemichordata and Chordata.

Body Plan

(a) **Cell aggregate : Cell aggregate** type of body plan is present in sponges.

(b) **Blind sac :** Animals in which digestive system is incomplete.It has only one opening to the outside of the body that serves as both mouth and anus. Example **Coelenterates to Platyheiminthes**.

(c) **Tube within tube :** Found in those animals having complete digestive tract i.e with seperate openings, mouth and anus.
Example Nemathelminthes to Chordates.

Embryonic development

On the basis of fate of blastopore , animals can be divided into two categories

(a) **Protostomiates :** Animals in which mouth is formed first (blastopore → mouth)
Eg., Platyheiminthes to Mollusca

(b) **Deuterostomiates :** Animals in which anus is formed earlier than mouth (blastopore → anus)
Eg Echinoderms, Hemichordates and Chordates.

Segmentation

(a) **Pseudometameric** - eg Tapeworms

(b) **Metameric**- In Annelids, Arthropods and Chordates.
In these animals, the body externally and internally divides into segments or metameres with serial repetition of atleast some organs. For example, in earthworm, the body shows metameric segmentation and the phenomenon is known as **metamerism**.

Notochord

In some animals during embryonic development, a mesodermally derived rod-like structure is formed on the dorsal side, this is known as notochord. Animals with notochord are known as chordates and the animals which do not form notochord are known as non-chordates.
Example: Porifera to Echinoderms.

Blood vascular system

Blood vascular system is basically of two types : Open and Closed.

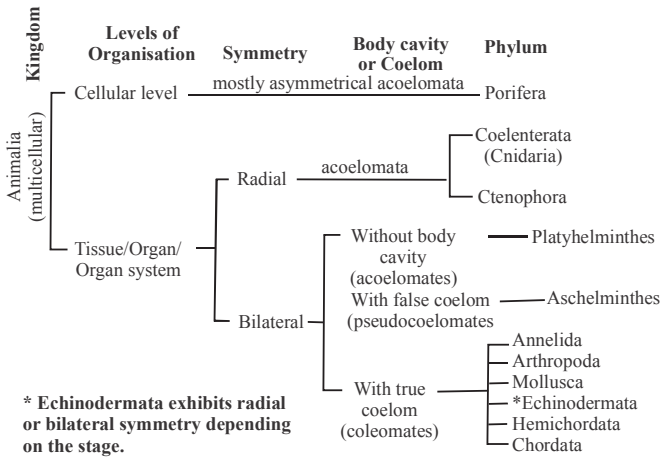
(a) **Open type :** In **open type,** the blood is pumped by the heart into the blood vessels that open into blood spaces (sinuses).
There is no capillary system (i.e., most arthropods, some molluscs **except** cephalopods and tunicates). These sinuses are actually the body cavitites, and are called **haemocoel.**
Example : Arthropods, Molluscs, Echinoderms, Hemichordates and some lower chordates like tunicates.

(b) **Closed type -** In this type of circulatory system the blood is circulated through a series of vessels of varying diameters - the arteries, veins and capillaries.
Example : Annelids, Cephalopod molluscus, Vertebrates, etc.

CLASSIFICATION OF ANIMALS

* Animals are classified into two principal groups *invertebrates* (with-out backbone) and *vertebrates* (with backbone). Backbone is the observable feature which defines whether the animal is vertebrate or invertebrate.
* Sponges, star fish, Obelia, worms, spiders, insects are the sub-groups of the invertebrate group, they do not have a backbone.
* Fishes, birds, frogs, snakes and mammals have a backbone and are the sub-group of the vertebrate group.

Outline of Animal Classification



* Kingdom Animalia has approximately 36 sub-divisions known as 'phyla'. Each phyla share particular properties structurally and functionally which together separate it from other phyla.

Golden Tips

* Mesoderm layer is absent in the embryos of diploblastic animals.
* In the course of evolution, true coelom appeared for the first time in Annelida.
* On Dorsal side, the notochord is formed during embryonic development.
* Echinoderms has tube within tube type of body plan evolved along deuterostomic evolutionary line.

PHYLUM-PROTOZOA (KINGDOM PROTISTA)

* It is 3rd largest phylum. It includes unicellular eukaryotes where one celled body perform all the biological activities like multicellular animals. So they are tarmed as "**Acellular**" organism, proposed by Dobell.
* They are world wide, cosmopolitan Microscopic, mostly aquatic, **free living (Amoeba)** or parasitic (*Plasmodium*). Solitary or colonial (*Proterospongia*). These causes serious diseases.
* Body level of organisation is **Protoplasmic level**. Their protoplasm is uninucleated or multinucleated. Few show **nuclear dimorphism**.Eg Paramoecium.
Some are naked , have body bounded by delicate membrane or a firm pellicle/Test/shell. In few groups of protozoa $CaCO_3$ & Silica shell's exoskeleton is found. e.g. Radiolarian group (silica) & Foraminiferan group ($CaCO_3$) (eg Globigerina).
* Locomotory structures are:
(1) Finger-like Pseudopodia
e.g. ***Amoeba, Entamoeba***
(2) Whip like Flagella e.g. ***Euglena***
(3) Hairy cillia e.g. ***Paramoecium***

(4) Absent in sporozoan parasites eg ***Plasmodium.***

* Nutrition of Protozoans are mainly **holozoic** (Amoeba), **Mixotrophic** (Euglena) , **Parasitic** (Plasmodium).
* Digestion is **intracellular** take place in food vacuole.
* Respiration and Excretion take place by exchange of gases through body surface. Some excretion may occur through **contractile vacuole**. Nitrogenous waste is **Ammonia**. Some fresh water protozoans get rid of excess water through contractile vacuole known as **Osmoregulation**.
* Reproduction takes place by

Asexual

(1) Binary fission
  (a) Simple fission ***(Amoeba)***
  (b) Transverse fission ***(Paramoecium)***
  (c) Longitudinal fission ***(Trypanosoma, Euglena)***

(2) Multiple fission ***(Plasmodium)***

(3) Budding(***Ephelota*** /***Sessile protozoan***)

Sexual :

(1) Syngamy *(Plasmodium),*

(2) Conjugation *(Paramoecium)*

* They do not have natural death because in unicellular animals there is no division of somatoplasm & germplasm so these are considered as **immortal**.

4 Classes of Protozoa (on the basis of locomotory organs)

(1) Mastigophora or Flagellata

* Free living (aquatic) or parasitic
* Locomotion by 1 or 2 or many thread like flagella.
* Body covered by pellicie.
* Reproduction- Asexual by binary fission but sexual absent.

e.g.

1. **Proteroponga-** Between protozoa and porifera.
2. **Leishrnania donovani** - Dimorphic and digenetic parasite, causes **Kala azar/Dum-dum fever/ Leishmaniasis** In humans, carrier-sandlly **(Phlebotomus)**
3. **Trypanosoma gambiense** - Polymorphic and Digenetic parasite, causes **sleeping sickness**, or **African trypanosomiasis** Carrier - Tse tse fly (Giossina)
4. **Giardia Intestinalis** - (Grand old man of Intestine) monogenetic that causes Diarrhoea / Giardiasis and infection through contaminated food and water.
5. **Trichomonas vaainalis -** Vaginal parasite of woman that causes "Leucorrhoea disease'
6. **Trichonympha** - Symbiont in intestine of termite and Cockroach.

(2) Sarcodina /Rhizopoda

* Free living (aquatic) or parasitic Locomotion by different types of pseudopodia.
* Body-naked or with shell
* Reproduction-Asexual by binary fission but sexual absent

e.g.

1. **Amoeba**-finger-like pseudopodia called **lobopodia** Cytoplasm differentiated into ectoplasm and endoplasm.
2. **Pelomyxa** (Chaos-chaos) Largest and muflinucleated amoeba.
3. **Entamoeba histolytica** - Dimorphic and monogenetic parasite, causes "**amoebic dysentry"** infection through contaminated food and water.
4. **Entamoeba gingivalis** - Increases infection of **pyorrhoea** (Causative agent Trichomonas tinax)
5. **Entamoeba coli** - Found in colon as commensal.
6. **Actinaphrys** (Sun-animalcule) Pseudopodia supported with axial filaments called **axopodia**.

(3) Ciliata

* Free living (aquatic) or parasitic
* Locomotion by numerous cilia
* Body covered by pellicle
* Binucieated **meganucleus** for somatic functions and **micronucelus** for reproductive function.
* Reproduction Asexual by binary fission Sexual by conjugation

e.g.

1. **Paramoecium** (slipper animalcule)
   - Cytostome (cell-mouth) and cytopyge (cell-anus) are present.
   - Trichocyst for offence and defence.
2. **Vorticella** (Bell animacule)
3. **Balantidium coil** - Found in colon of man.

(4) Sporozoa

* All are endoparasite and pathogenic.
* Locomotory organelles absent
* Thick pellicle for protection
* Reproduction
- Asexual by multiple fission
- Sexual by syngamy

eg

1. **Plasmodium**
   - Digenetic blood parasite (malaria)
   - Carrier is female anopheles
2. **Babesia** - Digenetic and causes "Texas cattle fever or Red water fever" in cattles/Tick fever
   - Spread by ticks
3. **Monocystis**- Monogenetic, found in seminal vesicle of earthworm.
4. **Nosema** - Causes pebrine disease in silk worm.

Few common protozoans

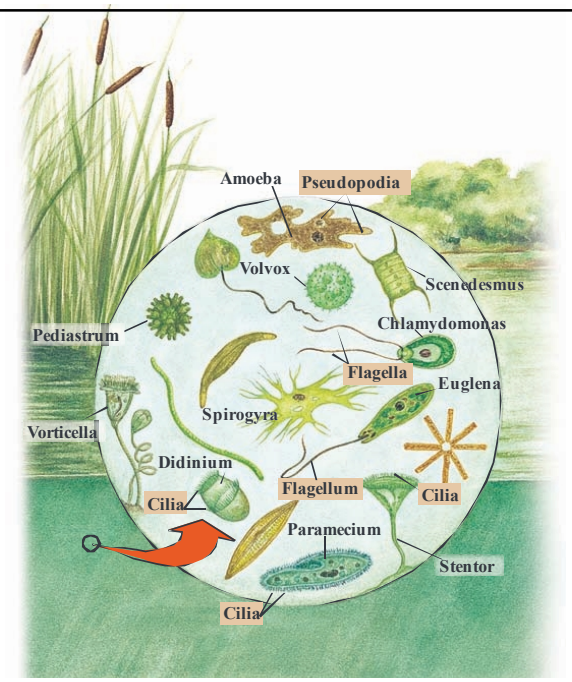


Figure : Protists in a drop of pond water. Several modes of locomotion are shown.

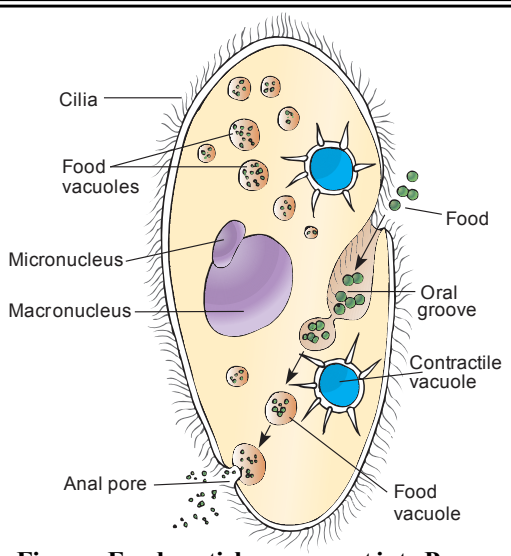


Figure : Food particles are swept into Paramecium's ciliated oral groove and incorporated into food vacuoles. Lysosomes fuse with the food vacuoles, and the food is digested and absorbed; undigested wastes are eliminated through through the anal pore.

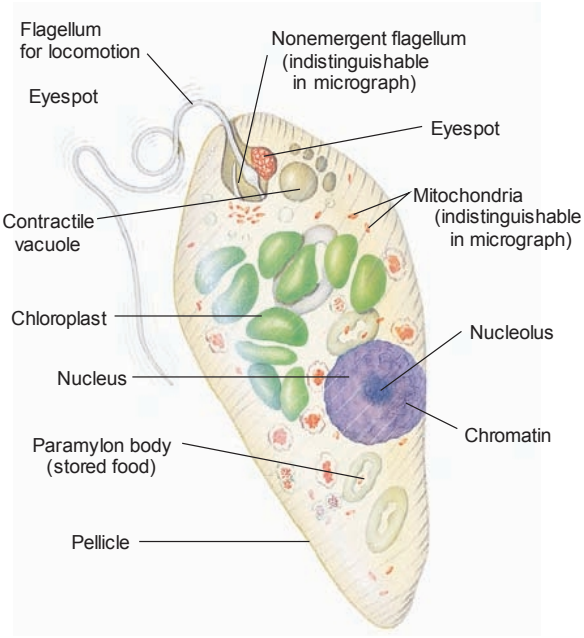
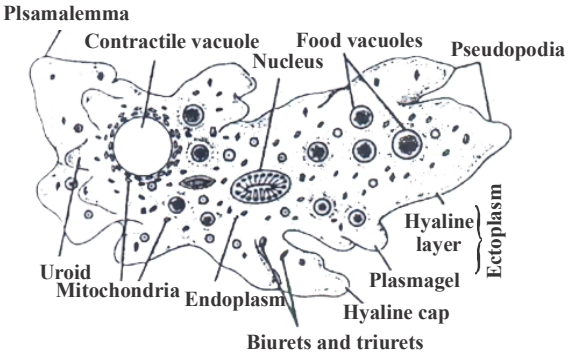
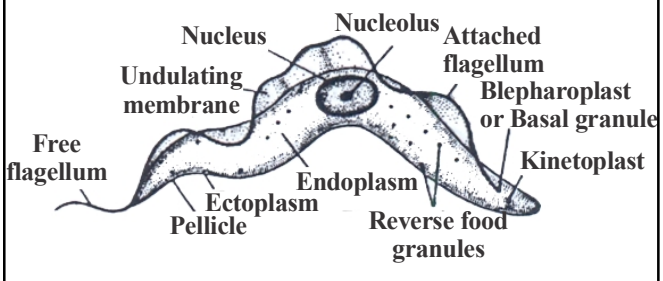


Figure : Euglena's pellicle is flexible and changes shape easily. The eyespot may shield a light detector at the base of the long flagellum, thereby helping Euglena move to light of an appropriate intensity.



Structure of Amoeba proteus



Trypanosoma gambiense

KINGDOM ANIMALIA

PHYLUM - PORIFERA (Sponges)

* The word "porifera" was used for the first time by Robert Grant in 1736.
* The word "Porifera" is derived from Greek words - *Poros* = pore, *ferre* = to bear.
* John Ellis (1765) established the animal nature of sponges.
* Members of this phylum are commonly known as sponges.
* Study of sponges is known as **Parazoology**.
* All are aquatic and sessile, mostly marine but few are found in fresh water also.
* They are solitary or colonial.
* Entire body with pores i.e. numerous small **Ostia** for entry and one large opening **Osculum** for exit of water.
* Sponges have various body form and shapes with irregular shape mostly **asymmetrical**, (Radial symmetry in *Leucosolenia)*
* Sponges are primitive multicellular animals and have cellular level of organisation with two germ layer i.e. **Diploblastic**.
* Body wall consists of –

(1) Outer Dermal layer or Pinacoderm
(a) Pinacocytes (Flat cell) (b) Porocytes (oval)

(2) Inner Choanocytic layer or Choanoderm
Collar cell or Choanocytes (Flagelated)
Unique Charactristic of Porifera.

(3) Between these two layers gelatinous material ***Mesenchyme*** is present which contains certain amoebocytes cells like:
Scleroblast - For formation of skeleton elements.
Archaeocytes- Totipotent cells (formation of ova and spermatazoa)

* Body wall enclosed a large cavity the **spongocoel or paragastric cavity** with small hollow canals
* **Canal system or** water transport system.
It is unique feature of sponges ,water enters through minute pores (**ostia**) in the body wall into a central cavity, **spongocoel**, from where it goes out through the **osculum**.

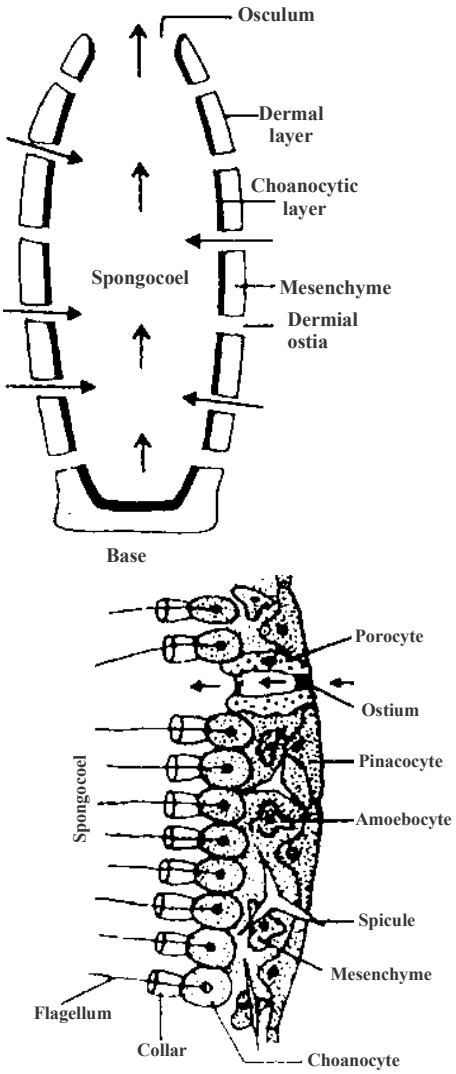
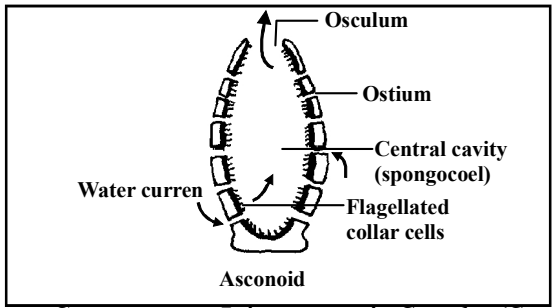


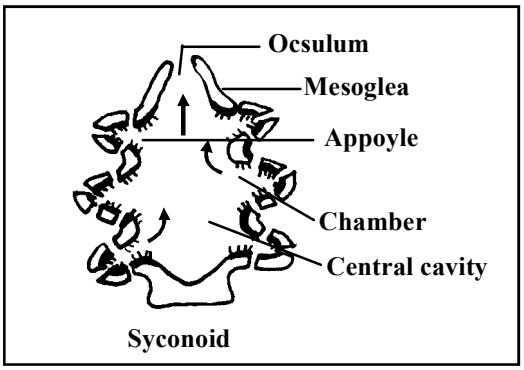
Figure : Body wall of a sponge (*Leucosolenia*)

* **Types of Canal system :**

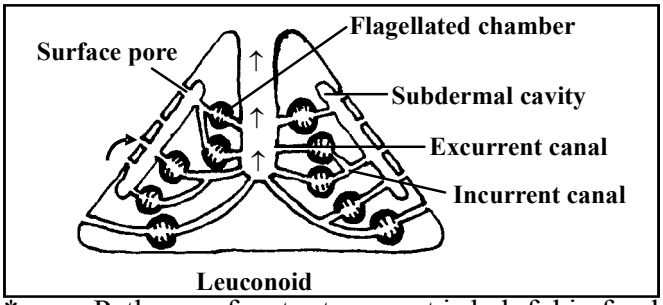
(i) Ascon type: It is found in Leucosolenia.
. . . . . → ostia → spongocoel → osculum → outside.



(ii) Sycon type : It is present in Scypha (Sycon).
Path of water: water → ostia → incurrent canals → Prosopyles → radial canals → apopyles → spongocoel → osculum → outside.



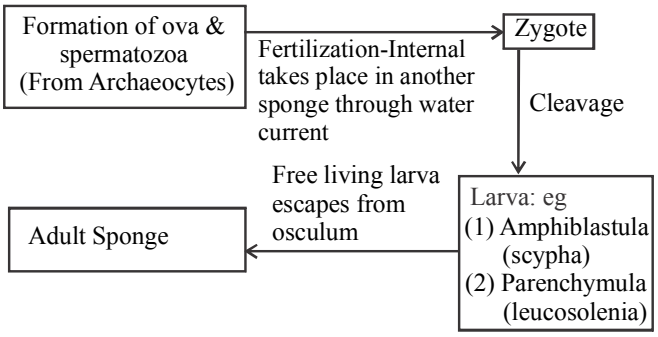
(iii) **Leucon type :** It is found in Spongilla.
Path of water : water → ostia → Incurrent canals → prosopyles → flagellated chambers → apopyles→ excurrent canals→ osculum→ outside.



* Pathway of water transport is helpful in food gathering(nutrition), respiratory exchange and removal of waste.
* **Choanocytes** forms lining of Spongocoel and radial canals. Ceaseless beating of flagellate helps in maintaining flow of water current.
* Nutrition is holozoic .Digestion is **intracellular** and occurs in food vacuoles of choanocytes.
* Skeleton is internal, consist of tiny **calcarious Spicules (calcoblast)** or siliceous spicules **(silicoblast)** or fine spongin fibre **(spongioblast)**, located in mesenchyme.
* Respiration and Excretion takes place by diffusion of gases through body surface. Excretory matter is Ammonia.
* Reproduction takes place by means of

(A) **Asexual-** By Budding/Fragmentation/Special cell mass Gemmules containing **Archaeocytes**. Endogenous budding of asexual reproduction in sponge is known as Gemmulation.

(B) **Sexual-** Sponges are Hermaphrodite (same individual can produce both eggs and sperm), fertilization : internal and cross fertilization (Protogynous condition).Development is indirect having a larval stage which is morphologically distinct from adult.

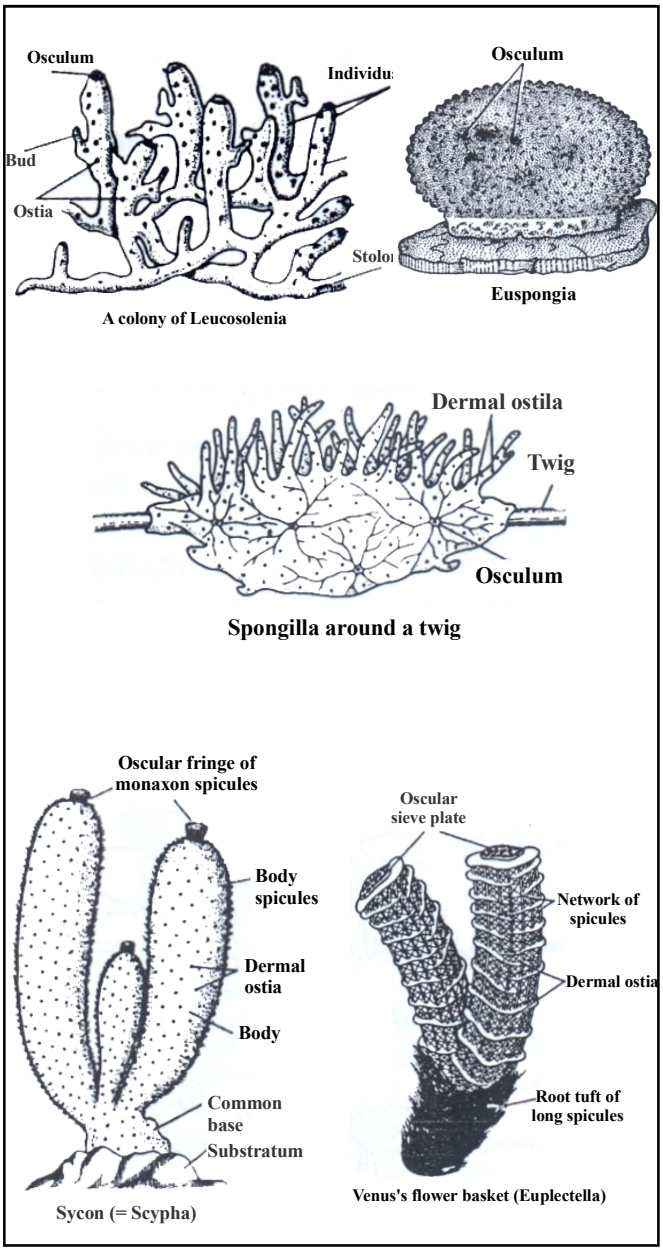


PORIFERA
(3 classes on the basis of Skeleton)

	Calcarea	Hexactinellida	Demospongia
Skeleton	Calcareous spicules	6 rayed siliceous spiculas (Glass sponge)	1 or 4 rayed silicious spicules or spongin fibre
Habitat	All marine in shallow water	All marine and found in deep water	Marine or fresh water sponges.
e.g.	*Leucosolenia (smallest)*	*Euplectella* - (Venus flower basket, Bridal gift in Japan)	*Euspongia* - (Bath sponge)
	Scypha (Sycon)	*Hyalonema* - (Glass rope sponge)	*Spongilla* - (Fresh water sponge) *Clionia* - (Boring sponge) harmful to Oyster.

SOME COMMON PORIFERANS

1.	Venus flower basket	*Euplectella*
2.	Glass rope sponge	*Hyalonema*
3.	Common bath sponge	*Euspongia*
4.	Bowl sponge	*Pheronema*
5.	Boring sponge	*Clicna*
6.	Mermaid's gloves	*Chalina*
7.	Horse sponge	*Hippospongia*
8.	Bread crumb sponge	*Halichondria*
9.	Neptune's goblet	*Poterion*
10.	Leaf spong	*Phyllospongia*



LEUCOSOLENIA

* Marine sponge.
* Colonial and sessile sponge.
* Found in shallow water.
* The whole body surface of *Leucosolenia* bears many small incurrent pores (ostia).
* At the apical end of each individual sponge a single excurrent pore (osculum) is present.
* The osculum bears a fringe of mono-axon spicules.
* Body wall of *Leucosolenia* is diploblastic, formed from two germinal layers, outer ectoderm and inner endoderm.

SYCON

* Sycon is a calcareous sponge, found attached to rocks, stones etc.
* Sycon is commonly known as "urn sponge" or "crown sponge".

EUSPONGIA

* Commonly called "bath sponge".
* Skeleton is of spongin fibres forming fine meshes.
* Dry skeleton has great power of soaking water or other fluids.

EUPLECTELLA

* Common in off-shore waters of Japan and Philippines.
* Commonly known as "Venus flower basket."
* Skeleton is of siliceous spicules.

HYALONEMA

* One of the commonest glass sponge (class Hexactinillida).
* Commonly known as "Glass rope sponge".
* Main body is rounded or oval showing radial symmetry.

SPONGILLA

* Fresh water sponge.
* Grows into an irregular mass.

* Skeleton is of spongin fibre.
* Complicated leucon type of canal system.

CLIONA

* Cliona is a marine sponge, commonly known as "boring sponge".
* Skeleton is of spongin fibres.
* Leucon type canal system.
* *Cliona* bores through shells of oyster and mussels and destroys them.

Golden Tips

* Body having meshwork of cells, internal cavities lined with food filtering flagellated cells and indirect development are the characteristics of Phylum Porifera.
* In the kingdom animalia Porifera is without any nerve cell.
* The skeleton of sponges is secreted by scleroblasts.
* Ostia are present in poriferans.
* *Leucosolenia* and *Spongilla* have porous body and are diploblastic.
* Spicules are found in *Sycon*.
* Choanocyte is found in Porifera.
* Tissues are absent in the body of sponge.
* Ascon type of canal system is found in *Leucosolenia*.
* The digestion of food in sponges is intracellular.
* In poriferans, the rudimentary division of labour is present between cells.
* The fertilisation is internal and development is indirect in sponges.
* Sponges are acoelomate.
* Sponges are not considered true metazoans because tissues are not formed by cells.
* Sponges have enormous powers of regeneration.
* *Spongia officinalis* is costliest bath sponge.
* *Hyalonema* and *Euplectella* are used for ornamental purposes.
* In Japan *Euplectella* is given as wedding gift as a token of "together unto death" because male and female shrimps live inside its spongocoel.

PHYLUM - COELENTERATA (Cnidaria)

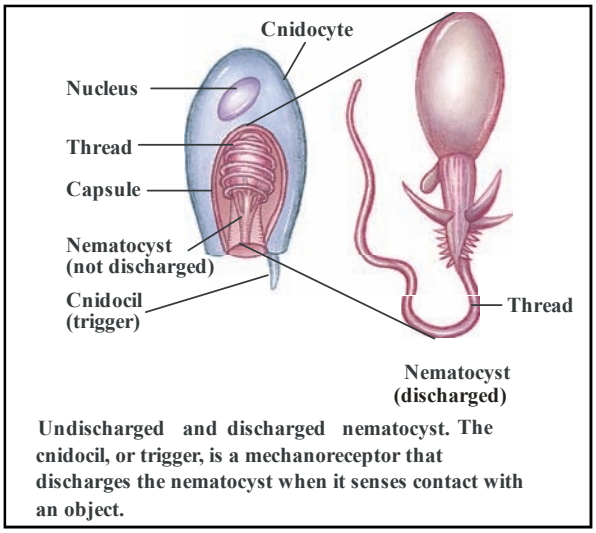
* Phylum Coelenterata was created by Leuckart in 1888.
* The name Coelenterata is derived from Gr. **Coela** = cavity and **Enteron** = gut, referring to the body cavity i.e., **coelenteron.**
* The name **Cnidaria** is also derived from Gr. **Kinde** = needle, referring to Cnidoblast cells.
* They are aquatic, mostly marine, sessile or free-swimming, radially symmetrical animals.
* Cnidarians get their name from specialized cells, called **cnidocytes** (from a Greek word meaning "nettle cells"), that contain stinging organelles. Cnidocytes are located mainly in the epidermis, especially on the tentacles.
  The cnidocytes contain stinging "thread capsules," called **nematocysts**. Each cnidocyte has a small, projecting trigger (cnidocil) on its outer surface and a coiled, hollow thread inside.
* Examples: Physalia (Portuguese man-of-war), Adamsia (Sea anemone), Pennatula (Sea-pen), Gorgonia (Sea-fan) and Meandrina (Brain coral).
* **Cnidoblasts** are used for anchorage, defense and for the capture of prey.

Figure : Diagrammatic view of Cnidoblast

Anatomy and Physiology of Cnidoblasts

* Cnidoblasts or nematocysts are derived from interstitial cells of epidermis.
* Nematocysts are found only in epidermis mainly on tentacles.
* Nematocysts are also known as **'independent effectors'.**
* *Hydra* has four types of nematocysts: **penetrants** or **stenoteles** (largest), **volvents** (smallest), **stereoline glutinants** (small, atrichous) and **streptoline glutinants** (large holotrichous).

* Penetrant is the most complex type of nematocyst. When discharged it releases thread tube by which a poisonous fluid, **hypnotoxin** is injected paralyzing the prey.
* Hypnotoxin is chemically protein and phenols. Volvents when discharged tightly coils its thread around small projections such as hair or bristles of prey.
* Glutinants secrete a sticky substance used in locomotion by fastening the tentacles to solid objects. Nematocysts are mainly present on tentacles.
* A group of nematocysts is known as **cnidom.**
* Nematocyst or stinging capsule is a part of the cell called cnidoblast or cnidocyte.
* The trigger needle of cnidoblast is called **cnidocil.** Both chemical and mechanical stimuli are involved in discharge of cnidoblast. On stimulation the nematocyst shoot out within 0.3-0.5 seconds. *Hydra* paralyses its prey by nematocyst. If all nematocysts of a *Hydra* are removed it would affect its capacity to capture prey.



Undischarged and discharged nematocyst. The cnidocil, or trigger, is a mechanoreceptor that discharges the nematocyst when it senses contact with an object.

* Cnidarians exhibit tissue level of organisation and are diploblastic.
* Cavity of the **Coelenteron** is having single aperture. Mouth serve both purpose i.e. **incomplete digestion tract (Blind sac).**
* **Digestion** is **Extra-cellular** as well as **Intracellular** i.e. takes place in Coelenteron as well as food vacuole. Coelenteron is also responsible for distribution of food besides partly digesting it. This dual role named coelenteron as **Gastrovascular** cavity.
* **Respiration** and **Excretion** takes place by diffusion of gases through **body surface.**
* Excretory matter is Ammonia.
* **Nervous system** present both in polyp & medusa and form a loose net work of nerve fibres on either side of mesogloea (Diffused type). Neurons are non-polar. Sensory cell are also present. Medusa have sense organ **Rhopalia** or **statocyst**/Tentaculocyst.
* Gonads have no duct. Fertilization may be **External** or **internal**.
* Cleavage is **Holoblastic.**
* Development includes larva.
* ***Obelia*** – **Planula** (free living) and **scyphistoma** larva fixed polyp like.
* Larva of *Aurelia* – **Ephyra** , Scyphistoma
* Some of the cnidarians, e.g., corals have a skeleton composed of calcium carbonate. Cnidarians exhibit two basic body forms called **polyp** and **medusa** .

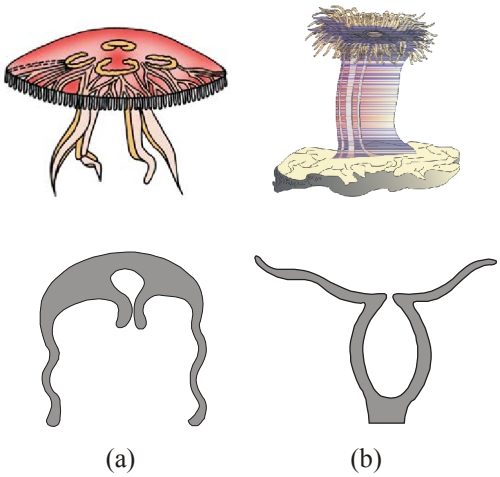


Figure Examples of Coelenterata indicating outline of their body form : (a) Aurelia (Medusa) (b) Adamsia (Polyp)

* The former is a sessile and cylindrical form like Hydra, Adamsia, etc. whereas, the latter is umbrella-shaped and free-swimming like Aurelia or jelly fish.
Those cnidarians which exist in both forms exhibit alternation of generation (Metagenesis), i.e., polyps produce medusae asexually and medusae form the polyps sexually (e.g., Obelia).
* The **polyp** form, represented by *Hydra*, typically has a dorsal mouth surrounded by tentacles.

* In the **medusa**, or jellyfish form, the mouth is located in the lower concave, or oral, surface; the convex upper surface is the aboral surface.
* Some cnidarians have the polyp shape during one stage of their life cycle and the medusa form during another stage.
* Sexes may be separate or united. Coelenterates can reproduce **Asexually** by Budding (Polyp) and by **Sexually**-(Medusa).
* The **Portuguese man-of-war** and some other cnidarians consist of colonies of many individuals, some of which are polyps and others medusae.
* In colonies of coelenterates following common types of zooids are present :

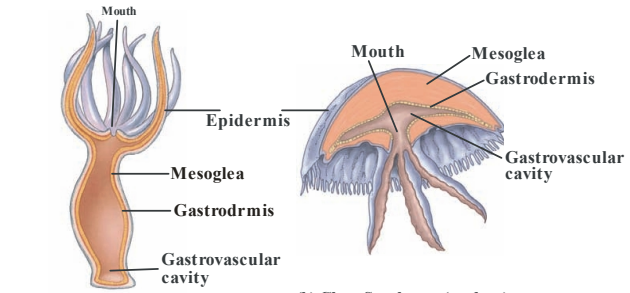
i. **Gastrozooid :** For feeding,
ii. **Dactylozooid :** For defence and food capture, are full of nematocysts.
iii. **Gonozooids :** For reproduction.

* The occurrence of more than one type of individuals in a species is known as **polymorphism**.
* Order Siphonophora shows excessive examples of polymorphism.
* **Major classes of Phylum Cnidaria**

Class and Representative Animals	Characteristics
Hydrozoa *Hydra, Obelia,* Portuguese man-of-war	Mainly marine, but some freshwater species; alternation of polyp and medusa stages in most species (polyp form only in *Hydra*); some form colonies
Scyphozoa Jellyfish	Mainly marine; typically inhabit coastal water, free-swimming medusa most prominent form; polyp stage often reduced
Anthozoa Sea anemones, corals, sea fans	Marine; solitary or colonial polyps; no medusa stage in most; gastrovascular cavity divided by partitions into chambers, increasing area for digestion,sessile.

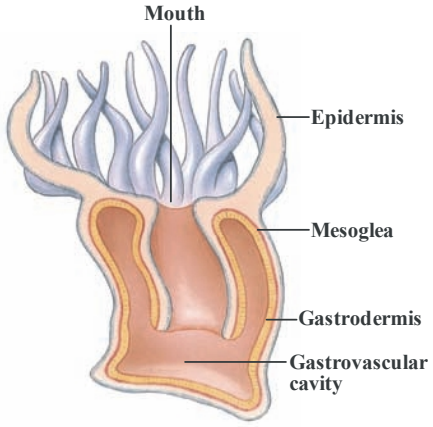
* **Few Cnidarians**

1.	Jelly fish	*Aurelia*
2.	Portugese man of war	*Physalia*
3.	Sea anemone	*Adnmsia or Metridium*
4.	Sun jelly	*Cyanea*
5.	Dead man's finger	*Alcyonium*
6.	Organ pipe coral	*Tubipora*
7.	Red preceious coral (Moonga)	*Corallium*
8.	Brain coral	*Meandrina*
9.	Mushroom coral	*Fungia*
10.	Sea pen	*Pennatula*
11.	Sea fan	*Gorgonia*
12.	Sea fur	*Obelia*
13.	Sea feather	*Pteroides*



(a) Class Hydrozoa (polyp). This hydrozoan (Gonothyraea loveni) forms a colony of polyps. The drawing illustrates a single polyp.

(b) Class Scyphozoa (medusa). The sea nettle (Chrysaora fuscescens) uses its tentacles equipped with cnidocytes to capture small animals (zooplankton) suspended in the water.



(c) Class Anthozoa (polyp). Coral polyps (Montastrea cavernosa) extended for feeding.

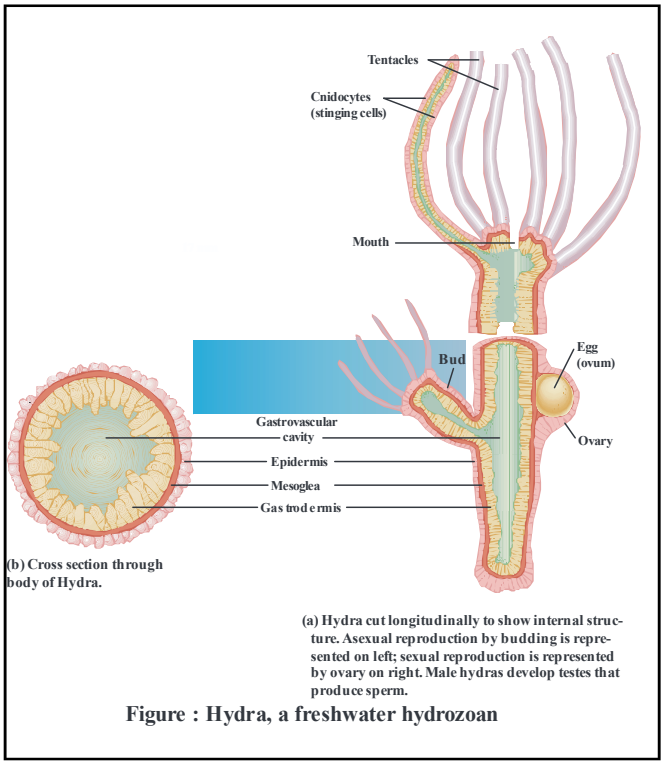
METAGENESIS

* Occurrence of more than one type of individuals in their colonies performing different functions is called polymorphism, for e.g. Physalia.
* Cnidarians exhibit dimorphism with polypoid and medusoid stages (Metagenesis or alternation of generations).

HYDROZOANS

* It include hydras and hydroids, such as Obelia and the Portuguese man-of-war.
* Although not really typical, the solitary *Hydra* is the cnidarian that beginning biology students most often study.

* To the naked eye, *Hydra* looks like a bit of frayed string. Because it has a remarkable ability to regenerate, biologists named *Hydra* after the multiheaded monster of Greek mythology that could grow two new heads for each head cut off.
* When *Hydra* is cut into several pieces, each piece can regenerate all the missing parts and become a whole animal.
* *Hydra* lives in fresh water and typically attaches to a rock, aquatic plant, or detritus by a disc of cells at its base.
* *Hydra* has a cylindrical body with 6-10 hollow tentacles.
* The tentacles of *Hydra* help in locomotion and food capture, so these are analogous to pseudopodia of Amoeba.
* The basal part of *Hydra* has a pedal or basal disc. Mouth is situated on a manubrium or hypostome. It is the most sensitive region in the body.
* *Hydra* has no anus.
* In summer, male and female gonads are seen as slight projections at the sides.
* The testes appear as conical elevations on the body wall usually located nearer the oral end of the body.
* The ovaries develop later and are located near the basal end of the body.
* *Hydra* is carnivorous feeding on small crustaceans. The most favourite food of *Hydra* is waterfleas (Daphnia and Cyclops).
* It recognizes its food because of chemical stimulus by the presence of glutathione in the tissue fluid of the prey.
* Digestion in *Hydra* is first extracellular (in gastrovascular cavity) and then intracellular (in endoderm cells).
* It can digest proteins, fats and some carbohydrates. It has no enzymes to digest starch. Undigested residues are egested from coelenteron through mouth.
* *Hydra* has no specialized cells for respiration. It respires by means of general body surface. Oxygen is carried to tissues by diffusion.
* *Hydra* has a nervous system, but no brain.
* *Hydras* reproduce asexually by budding during periods when environmental conditions are optimal. However, they differentiate as males and females and reproduce sexually in the fall or when pond water becomes stagnant. The zygote may become covered with a shell that protects it through the winter or until conditions become more favorable.
* Some species of *Hydra* are called green hydra for e.g. *Chlorohydra viridissima*. It is green because of symbiotic association with a unicellular green alga *Chlorella vulgaris*. Algae live in the musculonutritive cells of *Hydra*.



(a) Hydra cut longitudinally to show internal structure. Asexual reproduction by budding is represented on left; sexual reproduction is represented by ovary on right. Male hydras develop testes that produce sperm.

Figure : Hydra, a freshwater hydrozoan

OBELIA

* Colonial coelenterate, forming dimorphic colonies.
* Commonly called "Sea fur".
* In the colony of Obelia two types of individuals are present, **feeding zooids** - polyp and **reproductive zooids -** blastostyle.

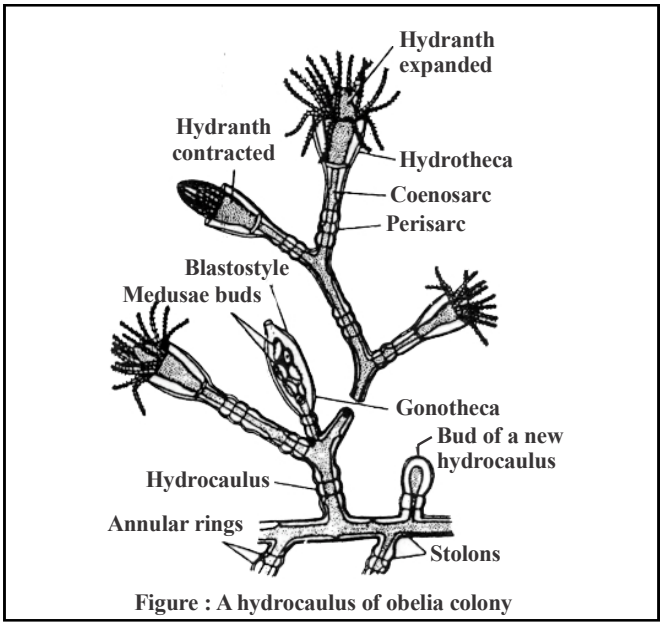
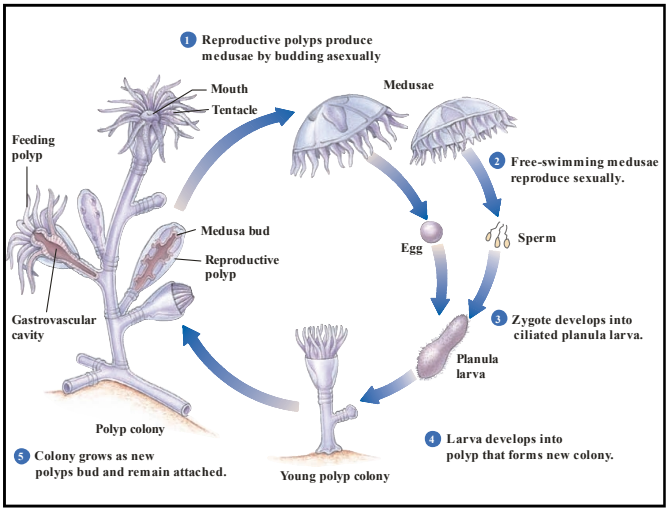


Figure : A hydrocaulus of obelia colony

* Polyp phase of *Obelia* is colonial.
* Medusa phase of *Obelia* is solitary.
* Medusa reproduce by sexual reproduction.
* Medusa are unisexual.
* In *Obelia* fertilization takes place in sea water.
* **Life cycle of *Obelia***



PHYSALIA

* Marine, colonial coelenterate.
* Commonly known as "Portugese man of war".
* Colony is highly polymorphic.
* Gastrozooids, gonozooids and dactylozooids are modified polyp forms.
* A large pneumatophore and gonophores are modified medusa form.

AURELIA

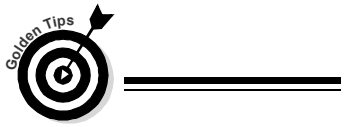
* Common jelly fish found in coastal waters of Chennai.
* Solitary, marine, medusa form.
* In *Aurelia* mesogloea is thick and appears jelly like, hence the common name jelly fish.
* At the margin of bell short tentacles are present.
* Four oral arms surround the mouth.
* Reproduces by sexual reproduction.
* **Planula larva** is found in life cycle of Aurelia.
* Planula larva grows into a polyp form - hydrotuba, which gives rise to several **ephyrae larvae** by strobilization.
* Each ephyra larva grows into adult jelly fish.

METRIDIUM

* Marine, solitary, polyp form.
* Commonly known as sea anemone.
* Body of *Metridium* is elongated and remains attached to a substratum with the help of pedal disc.
* Free end of body bears mouth, surrounded by several small hollow tentacles.
* Mouth opens into pharynx, which is divided into several chambers by presence of mesenteries.
* Asexual reproduction takes place by budding.
* Sexual reproduction takes place by gamete formation.

CORAL REEFS

* External skeleton of coelenterates of class Anthozoa.
* The colonies of corals grow in size and form extensive masses known as coral reefs.
* Coral reefs are of three types - fringing reefs, barrier reefs and atoll.
* **Fringing reefs :** Lying close to shores.
* **Barrier reefs:** Located some distance from shores.
* **Atoll or lagoon** island : Ring like reef encircling a lagoon.



* Coelenterates are first true metazoans.
* Metagenesis refers to alternation of generation between asexual and sexual phases of an organism.
* *Obelia* exhibits metagenesis.
* Sea fan (*Gorgonia*) lacks a cell wall.
* Stinging capsules (nematocysts) are found in sea pen and sea fan.
* Jellyfish lack alimentary canals (complete digestive systems).
* *Hydra* is diploblastic.
* Digestion in *Hydra* takes place within gastrovascular cavity.
* High degree of polymorphism is found in Cnidaria.
* Larva of jelly fish (*Aurelia*) is planula.
* Polyp phase is absent in *Aurelia*.
* Scyphozoan medusa is more commonly known as Jelly fish.
* The central body cavity of coelenterates is called Gastro-vascular cavity.
* Coelenteron of *Hydra* is not true coelom because
  (i) It is not lined by mesoderm.
  (ii) Coelomic fluid is not filled in Coelenteron.
* In *Hydra* nutrition is holozoic.
* *Hydra* is carnivorous.
* Hydra is *ammonotelic*.
* Greatest coral reef is Great Barrier Reef of Australia.
* *Physalia* is a colonial coelenterate which shows excessive polymorphism.

PHYLUM - CTENOPHORA

* Ctenophora name was given by Eschescboltz.
* Ctenophores, commonly known as **sea walnuts** or **comb jellies** are exclusively marine, radially symmetrical, diploblastic organisms with tissue level of organisation. The body bears eight external rows of ciliated **comb plates**, which help in locomotion.
* Nematoblasts are absent, so they are also called "acnidaria"
* Digestion is both extracellular and intracellular.
* **Bioluminescence** (the property of a living organism to emit light) is well-marked in ctenophores.
* Sexes are not separate. Reproduction takes place only by sexual means. Fertilisation is external with indirect development.
* They are carnivorous and feed on plankton, swim by cilia and reproduce only sexually. Power of regeneration is well marked.
* The body wall consists of outer epidermis, inner gastrodermis and middle mesogloea. Special adhesive cells called **colloblasts** (= lasso cells), are present in the epidermis of tentacles which help in food capture.
  Colloblasts are a characteristic feature of ctenophores.
* They are acoelomates.
* Digestive tract (Gastrovascular system) consists of **mouth, pharynx** or **stomodaeum, stomach** or **infundibulum,** anal canals and two **anal pores.** Since there are mouth and anal pores, the digestive tract is **complete.** Digestion is both **extracellular** and **intracellular.** The digestive tract distributes the food in addition to digesting it, hence it is also called the gastrovascular tract.
* Skeletal, circulatory, respiratory and excretory systems are absent.
* The aboral end bears a sense organ, called **statocyst** for equilibrium. Presence of aboral sense organ is the characteristic feature of the phylum ctenophora.
* They are monoecious. Gonads develop from endoderm. Fertilization is generally external. Asexual reproduction is rare. Paedogenesis is common.
* Egg contains yolk, hence it can be said to be a lecithal egg**.** Yolk is initially accumulated at the centre (centrolecithal condition) but later on when cleavage starts yolk shifts to one side (telolecithal condition). Cleavage is complete, holoblastic, unequal, biradial and determinate. Cydippid larva is observed during the developmental stages.

* **Classification.** The phylum ctenophora is divided into two classes:

Class 1 : Tentaculata. They have tentacles and small stomodaeum. Examples: *Hormiphora* (Sea walnut), *Pleurobrachia* (Sea gooseberry). *Ctenoplana, Cestum* (The Venus' Girdle).

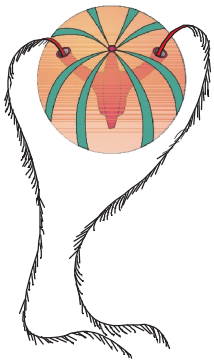


Figure : Example of Ctenophora (*Pleurobrachia*)

Class 2 : Nuda. Their body is without tentacles. They have spaceous mouth and stomodaeum. Example: *Beroe*

Golden Tips

* Ctenophora reproduces by sexual means.
* In *Beroe* symmetry is biradial.
* Ctenophores are commonly called comb-jellies.
* Tentacles of ctenophores contain Colloblasts.
* Cnidoblasts are absent in the ctenophores.
* Ctenoplana is creeping animal. It lives on the surface of water of sea.

PHYLUM - PLATYHELMINTHES

* The word "Platyhelminthes is derived from two Greek words - *Platy* = flat and *Helminths* = worm, as the body of these animals is flat, leaf like or ribbon like.
* The word "Platyhelminthes" was given by - Gegenbaur (1859).
* Platyhelminthes or 'flatworms' are primitive, dorsoventrally flat, bilaterally symmetrical, acoelomate and triploblastic animals which have blind sac body plan.
* The flatworms are both free-living as well as parasitic. The free living forms are included in the class **Turbellaria,** whereas the other two classes, Trematoda and Cestoda are exclusively parasitic.
* The body is soft, dorso-ventrally flattened, leaf like or ribbon like.
* They are triploblastic with three germ layers (ectoderm, mesoderm and endoderm).
* Cephalization (formation of head) develops.
* Appendages are absent and symmetry is bilateral.
* Skeletal, respiratory and circulatory systems are absent.
* Digestive tract is complete i.e. with one opening like mouth or sucker. Digestive system is reduced or absent in parasitic forms
* Nervous system is ladder-like. It consists of brain ganglion in the head region. From brain arises two longitudinal nerve cords joined at intervals by transverse commissures.
* Pseudometamerism or false segmentation occurs in some flatworms through repeated budding.
* They can reproduce asexually and regenerate from a part of the body.
* They are hermaphrodite. Cross fertilization is predominant and fertilization is internal. Gonads with reproductive ducts and copulatory organ is present.

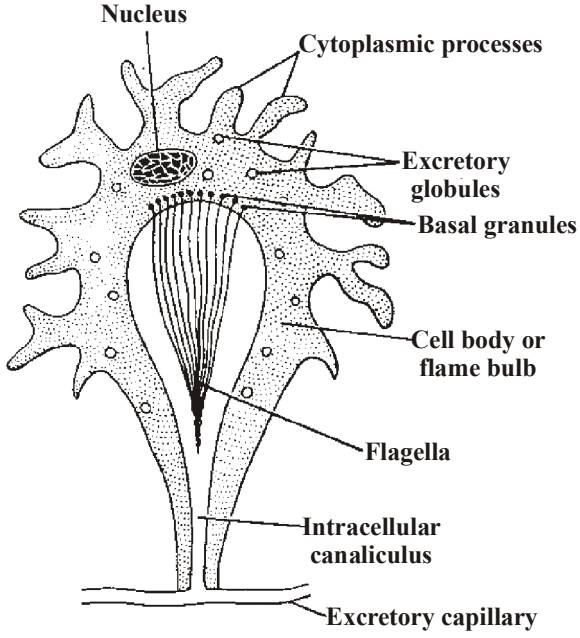


Figure : A flame cell

* Development is direct or indirect with larval forms.
* There are specialized cells called **flame cells** meant for excretion and osmoregulation.
* Parasitic form often posses intermediate hosts.
* Hooks and suckers are present in the parasitic forms. Some of them absorb nutrients from the host directly through their body surface.
* Sexes are not separate. Fertilisation is internal and development is through many larval stages. Some members like Planaria possess high regeneration capacity.
* Examples: *Taenia* (Tapeworm), *Fasciola* (Liver fluke).
* **Classes of Phylum Platyhelminthes**

Class and Representative Animals	Characteristics
Turbellaria Planarians	Mainly free-living; mainly marine; body covered by ciliated epidermis; typically carnivorous; prey on tiny invertebrates
Trematoda and Monogenea Flukes	Parasites with a wide range of vertebrate and invertebrate hosts; may require intermediate hosts; adults have suckers for attachment to host
Cestoda Tapeworms	Parasites of vertebrates; complex life cycle usually with one or two intermediate hosts; larval host may be invertebrate; typically have suckers and sometimes hooks for attachment to host; eggs produced within proglottids, which are shed; no digestive or nervous systems

Few common flatworms

1.	Lung fluke	*Paragonimus ringeri*
2.	Chinese liver fluke	*Opisthorchis sinensis*
3.	Blood fluke	*Schistosoma haematobium*
4.	Dog tape worm or Hydatid worm	*Echinococcus granulosus*
5.	Beef tapeworm	*Taenia saginata*

DUGESIA (PLANARIA)

* Found in fresh water, Nocturnal, Cannabalism, slow creeping omnivorous.
* Reproduce sexually as well as asexually (Transverse Binary fission), good power of regeneration. Pharynx can be everted.

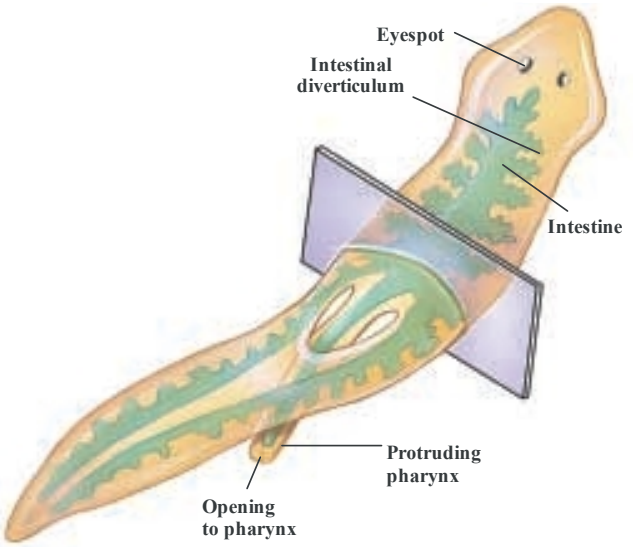


FIGURE
Architecture of a solid worm. This organism is Dugesia, the familiar freshwater "planaria" of many biology laboratories.

FASCIOLA HEPATICA (LIVER FLUKE)

* Commonly known as sheep liver fluke.
* Digenetic parasite.
* Found in the bile ducts and liver of Sheep and causes Liver-rot or cirrhosis disease.
* Life history involve two hosts (Digenetic parasite)

(1) Primary host - Sheep & Goat

(2) Secondary host - Garden-snail (Planorbis, Lymnea)

* Shows many larval stage namely Miracidium → Sporocyst → Redia → Cercaria → Metacercaria → eaten by sheep and develops into adult fluke.
* Infective stage for Primary host (Sheep) - Metacercaria
* Infective stage for Secondary host (Snail) - Miracidium. (Free swiming)

SCHISTOSOMA HAEMATOBIUM

* Commonly known as blood fluke.
* Digenetic parasite.
* Found in veins of human bladder and intestine.
* Respire aerobically and feeds on blood.

* Unisexual, Large male carries female in a groove gynaecophoric canal on ventral side.
* Life history shows sexual dimorphism.
* Life history involve two hosts (Digenetic parasite)

(1) Primary host - **Man**

(2) Secondary host - **Garden-snail *(Planorbis, Lymnea)***

* Larva enters human body by boring in skin while bathing in ponds.
* It damages the liver& causes intestinal disorder: **Schistosomiasis or Bilharzia disease.**

TAENIA SOLIUM

* Commonly known as pork tape worm of man.
* Digenetic parasite and endoparasite.
* Flat, white ribbon - like body.
* *T. solium* is human gut parasite.
* Attached to intestinal wall by hooks & suckers.
* Anaerobic respiration.
* Hermaphrodite - Self fertislization.

* The body is distinguishable into three parts, namely **scolex, neck** and **strobila. Scolex** has a rostellum bearing two circlets of chitinous hooks and four suckers or acetabula for holding onto the host.
* **Neck** is the unsegmented part and new segments are formed in this region.
* **Strobila** is the main body made of proglottids.
* A **proglottid** is a unit of body enclosing a complete set of genitalia. There are three types of proglottids. These are:

(i) **Immature proglottids:** These proglottids are behind the neck and without reproductive organs. These are the 200 anteriormost segments of the strobila, which are smaller and somewhat broader than longer.

(ii) **Mature proglottids:** These proglottids are in the middle having both male and female reproductive organs. These are medium sized, squarish and mature with functional hermaphrodite genitalia.

(iii) **Gravid proglottids:** These are rectangular in shape with branched uterus containing fertilized eggs. These include about 150 to 350 posteriormost proglottids. These are **gravid** with a large and branched uterus.

At about the middle of its right or left lateral margin, each proglottid bears small conical prominence, called **genital papilla**. The papillae of successive segments are usually alternate on right and left sides. These are very clear in mature and gravid segments in which each **papilla** has a **common genital pore** at its tip. Gravid proglottids regularly detach, one-by-one or in small groups, from the rear end of strobila and pass out with host faeces. This phenomenon is called **apolysis.**

* Life history involve two hosts (Digenetic) .

(1) Primary host - **Man**

(2) Secondary host - **Pig/Cow**

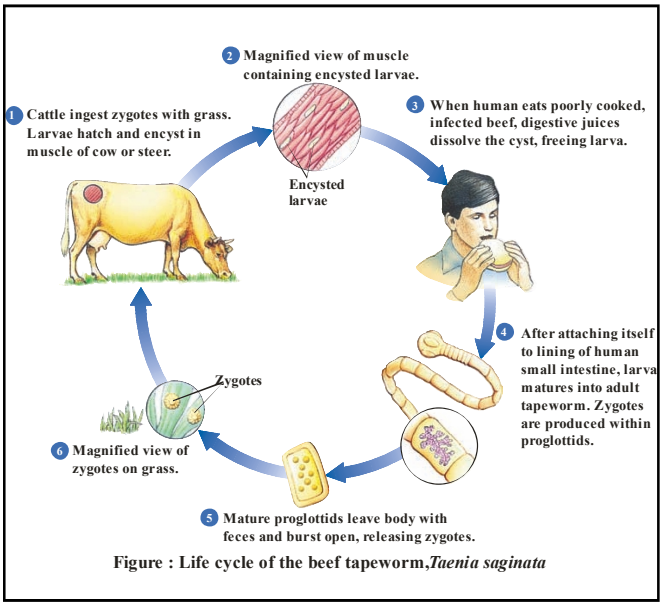


Figure : Life cycle of the beef tapeworm,*Taenia saginata*

* Development through many larval stages namely **Onchosphere, Hexacanth, Bladder worm and Cysticercus**
* Man gets infection from undercooked pork containing encysted larvae cysticerci.

Infective stage for primary host (Man) - **Cysticercus**.

Infective stage for secondary host (Pig)- **Onchosphere**

* It causes the disease **Taeniasis** and **Cysticercosis**

ECHINOCOCCUS GRANULOSUS

* Common dog tapeworm or hydatid worm.
* Digenetic parasite.

* Dog, cat, fox etc. are final hosts and man is intermediate host of *Echinococcus granulosus*.
* Adult *Echinococcus granulosus* is with three segments.
* Larva forms hydatid vesicles or watery bladder in man.

* The cercarial stage of a liver fluke is produced by asexual multiplication.
* Flame cells of flatworms help in osmoregulation and excretion.
* *Planaria* possesses high capacity of regeneration.
* Laurer's canal is found in *Fasciola*.
* In *Taenia solium* alimentary canal is absent.
* Turbellarians are free living flatworms.
* Three germ layers are present in the embryonic stage of platyhelminthes
* Fasciola is supposed to show the phenomenon of polyembryony (larval stages give birth to next larval stages).
* *Taenia solium* is commonly known as pork tape worm of man.
* *Taenia solium* is a digenetic parasite and endoparasite.
* *T. Saginata* is called - unarmed tapeworm
* Nervous system appears for the first time in flat worms.
* Platyhelminthes are first bilaterally symmetrical triploblastic animals.
* Body of platyhelminthes is at tissue-organ level of organization.

PHYLUM - ASCHELMINTHES (NEMATHELMINTHES OR NEMATODA)

* Gagenbaur suggested the name "Nemathelminthes" in 1859.
* Word "Nematoda" is derived from Greek words - *Nema* = thread and edios = form.
* Phylum includes round worms.
* Aquatic, tarrestrial, free-living or parasites.
* Animal of this phylum are **Cylindrical,** tapering at both end **without** segmentation.
* **Bilaterally Symmetrical -** Triploblastic, Organ-system level and having tube within tube plan.
* Anterior end does not show distinct head.
* No appendage.
* **Body wall** consist of

(i) **Cuticle** - Non living, thick, resistant to digestive enzymes of host.

(ii) **Epidermis** - Syncytial i.e., a continuous layer of cytoplasm having scattered nuclei.

(iii) **Muscle layer** - Only longitudinal fibres present.

* **Body cavity** is **Pseudocoel** (developed from blastocoel) and contain **Pseudocoelomic fluid.**
* High fluid pressure in the pseudocoelom maintains body shape. It is called **Hydroskeleton.**
* **Digestive tract** is **complete** and differentiated into mouth, pharynx, intestine & Anus.
Mouth is surrounded by 3 - lips having sensory papillae and amphids. Pharynx is **muscular.** It is used to suck food. Intestine is non muscular.
* **Respiration** is through body surface by diffusion.
* **Circulatory system** is undeveloped
* **Nervous system** comprises of circum pharyngeal ring (Brain).
*– Sense organs like **Papillae** (Tangoreceptors), **Amphids** (chemoreceptor) are present on lip.
* Paired unicellular **Phasmids** (chemoreceptor) are found near hind end of body.
* **Excretory system** is H-shaped formed by single cell called **Renette cell.**
* Excretory substance is **ammonia**.
* **Reproductive system** is developed and sexes are generally separate.
* **Sexual dimorphism** is present.
* **Male** is smaller than female and curved from its caudal end.
* Male has penial spicule for copulation. Genital tract joins digestive tract to form cloaca.
* Female is larger than male and straight. Genital tract open independently. Female lays numerous eggs with Chitinous shell.
* Fertilization is **internal** and development is mostly **direct**.

* Cleavage is **Holoblsatic spiral** and **determinate** type.
* Number of cells are **fixed** from larva to adult such development is known as **Eutely.**
* **Classes of Phylum Aschelminthes**

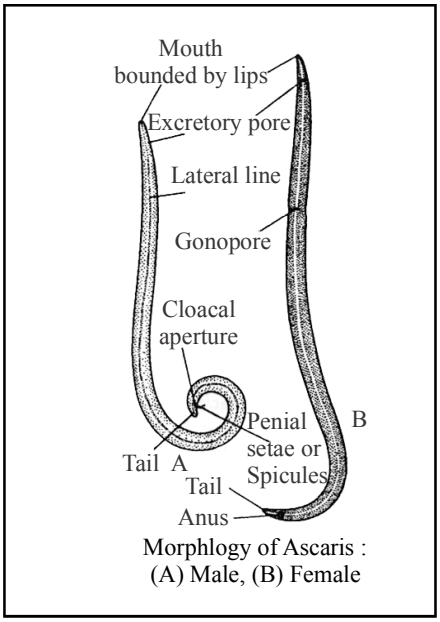
Class	Characteristics
Aphasmidia	• Phasmids are absent. • Amphids are of various types. • E.g.: *Trichinella, Trichuris*.
Phasmidia	• Phasmids are present near hind end of body. • Amphids are present near anterior end. • E.g.: *Ascaris, Enterobius*, *Wuchereria*.

Some common Aschelminthes

1.	Pin or thread worm	*Enterobius vermicularis*
2.	Whip worm	*Trichiuris trichiuris*
3.	Filaria worm	*Wuchemia bancrofti*
4.	Eye worm	*Loa-loa*
5.	Hook worm	*Ancylostoma duodenale*
6.	Guinea worm or Fiery serpent	*Dracunculus medinensis*

ASCARIS

* Pseudocoelomate, unsegmented, monogenetic parasite.
* Sexes are separate.
* Shows sexual dimorphism.
* Shows tube within tube body plan.
* Most common endoparasite found in small intestine of man.
* Primary Migration : Course of primary migration in Ascaris is - hepatic portal vein → liver → hepatic and postcaval vein → heart → pulmonary artery → lungs.
* Secondary Migration : Alveoli → trachea → pharynx → oesophagus → stomach → intestine.



Morphlogy of Ascaris : (A) Male, (B) Female

* **The roundworm Ascaris :**

(a) The complete digestive tract that extends from mouth to anus.

(b) This cross section through Ascaris shows the tube-within-a-tube body plan. The protective cuticle that covers the body helps the animal resist drying.

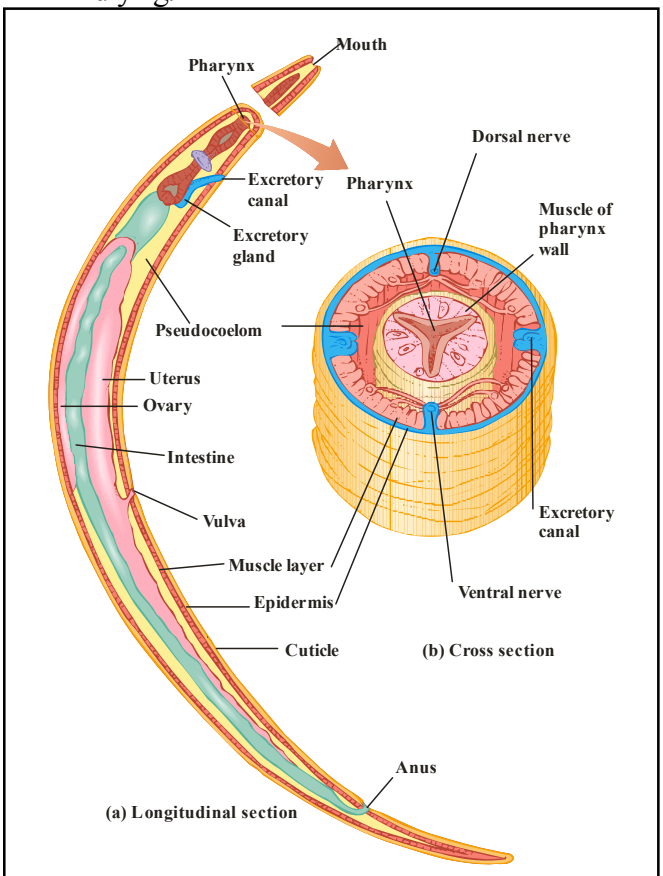


Fig. Path of migration of *Ascaris* larva

WUCHERIA BANCROFTI (FILARIA)

* Digenetic parasite.
* The final host of *Wucheria bancrofti* is man.
* The secondary host of *Wucheria bancrofti* and vector of *Wucheria bancrofti* is female *Culex* or *Aedes* mosquito.
* Microfilariae enter in the blood circulation at night.

ANCYLOSTOMA DUODENALE

* Commonly known as 'Hook worm'.
* Monogenetic parasite, found in intestine of man.
* Male and female are separate.
* Posterior end of male hook worm bears umbrella like **copulatory bursa.**

ENTEROBIUS VERMICULARIS (OXYURIS VERMICULARIS)

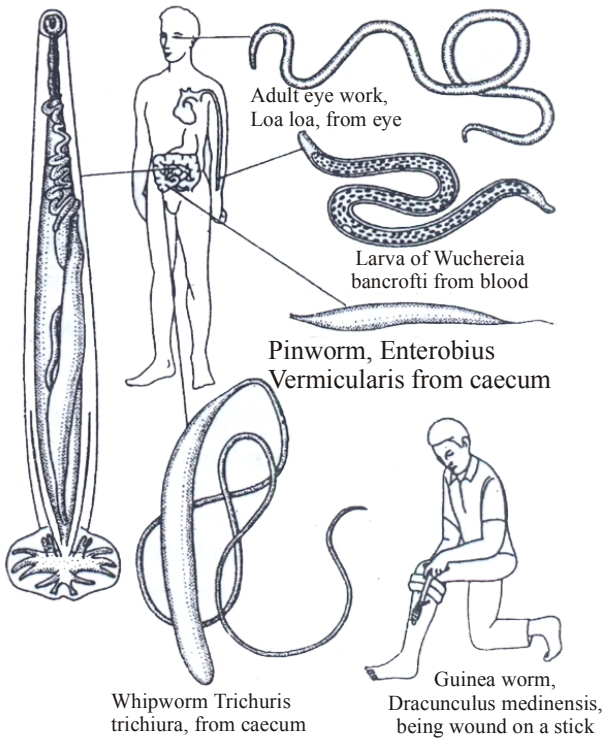
* Commonly known as "pin worm" or "seat worm".
* Monogenetic parasite.
* Found in caecum, colon and appendix of man.
* Male and female pin worms are separate.
* Posterior end of male *Enterobius vermicularis* is curved.

TRICHURIS TRICHIURA

* Commonly known as "Whip worm".
* Monogenetic parasite.
* Found in caecum and large intestine of man.
* Sexes are separate.

DRACUNCULUS MEDINENSIS

* One of the oldest known parasites, commonly known as "Fiery serpent" or "Guinea worm."
* Digenetic parasite.
* Final host of *Dracunculus medinensis* is man.



Some roundworms that parasitize man

Golden Tips

* Roundworm is a pseudocoelomate.
* *Enterobius vermicularis* is the scientific name of pinworm of man.
* Filariasis is caused by *Wuchereria.*
* Aschelminthes (round worms) are bilaterally symmetrical and triploblastic.
* Syncytial epidermis is found in *Ascaris*.
* *Wuchereria* is found in lymph nodes.
* *Ascaris* remains attached in the intestine of host by its muscular lips.
* Pseudocoel of *Ascaris* is intracellular space.
* Muscle layer is absent in the gut of *Ascaris.*
* Pharynx of *Ascaris* acts as a suction pump
* Respiration in *Ascaris* is anaerobic.
* Eggs of *Ascaris* are mammilated eggs having an outer warty albuminous coat called ripplings.

PHYLUM - ANNELIDA

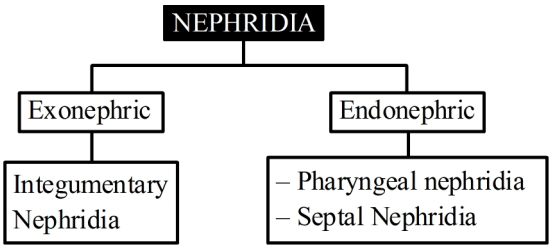
* The word "Annelida" was first used by Lamarck.
* The word "Annelida" is derived from two Greek words - *Annelus* = ring and *edios* = form.
* Free living found in moist soil, fresh water, sea or few are parasite.
* Body is Soft, elongated, cylindrical or flattened divided into segments or metameres by ring like, grooves called Annuli.
* **Symmetry** – Bilateral, Triploblstic, Organ-system level having tube within tube plan, metamerically segmented.
* Anterior end forms a distinct head with sense organ in few annelids.
* Appendages are simple unjointed, and locomotory having **Chitinous Setae** and **Parapodia with setae.**
* **Body wall** consist of –

(i) **Cuticle** – Thin moist albuminoid cutical allow free exchange of gas.

(ii) **Epidermis** – Single layered epidermis made up of supporting cell, sensory and glandular cell.

(iii) **Muscle layer** – (1) Circular layer**,** (2) Longitudinal layer. Muscle are smooth/ unstriated.

* Body wall may have minute chitinous setae.
* Locomotion by means of setae or parapodia or both. Absent in leeches
* **First Protostomi animals.**
* Body cavity is true coelom lined by mesodermal coelomic epithelium **(Schizocoel.)**
* It is divided by transverse septa into compartment. It is filled with coelomic fluid that contains cells.
* As such there is no **Skeleton.** Fluid filled coelom serves as a **hydrostatic skeleton.**
* **Digestive tract** is **complete,** straight and extends through entire body. The gut has both circular and longitudinal muscles. Few annelids are **sanguivorous.** Digestive gland are developed for the first time in Annelida.
* **Respiration** is through moist **skin** i.e. **Cutaneous respiration**. Some have **gills** (branchial respiration).
* **Circulatory system is closed.** Some blood vessels enlarge to act as pumping heart. (Heart appear first time in annelids)
* The blood is red with haemoglobin dissolved in plasma **(Erythrocruarin).** It has amoeboid corpuscles only.
* Few Annelids like ***Sabella*** have **Chlorocruarin** as a respiratory pigment.
* **Hirudinaria** has circulatory system with **haemocoelomic system.**
* **Excretory organ is Nephridia.** Coiled tubules also helps in osmoregulation.



* Excretory matter (1) **Ammonia** in aquatic form (2) **Urea** in land form
* **Nervous system** consist of a **circumentric nerve ring,** double, midventral, nerve cord with ganglia.
* Sense organ chemoreceptor, photoreceptor & tentacle, palp, eyes may be present.
* Sexes may be separate or united. **Asexual** reproduction by **budding** or fission. In some cases. **Atoke** (asexual), **Epitoke** (sexual) phenomenon also found ***(Nereis).***
* Cleavage is **spiral** and **determinate unequal & holoblastic.** Regeneration is usually found. Life history includes a **trochophore** larva in few annelids.
* **Nereis :** Inhabits in sea - shore between tide mark, burrower, nocturnal, carnivorous, gregarious, fertilization - in sea.
* Parapodia in each segment except first & last. During breading body divides in two parts.
* Anterior asexual part - **Atoke** and posterior sexual portion **Epitoke**. This change is known as **epitoky.**

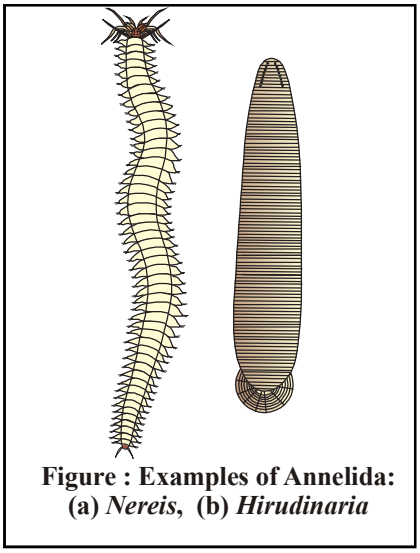
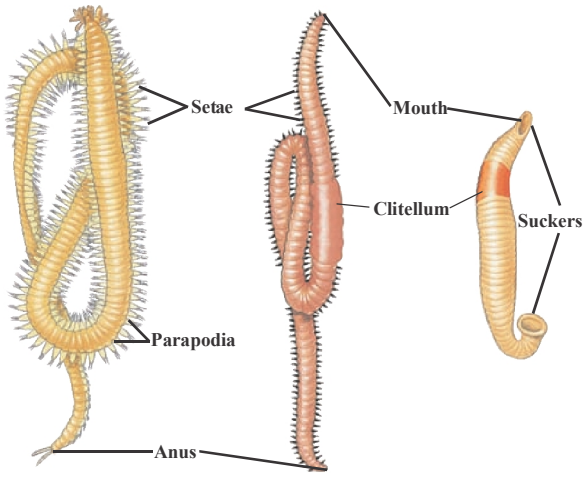


Figure : Examples of Annelida: (a) *Nereis*, (b) *Hirudinaria*

* During course of evolution metameric segmentation, True coelom, closed circulatory system and pumping heart appeared first in annelids.

* **Major Classes of Phylum Annelida**

Class and Representative Animals	Characteristics
Polychaeta Sandworms, tubeworms	Mainly marine; each segment bears a pair of parapodia with many setae; well-developed head; separate sexes; trochophore larva
Oligochaeta Earthworms	Terrestrial and freshwater worms; few setae per segment; lack well-developed head; hermaphroditic
Hirudinida Leeches	Most are blood-sucking parasites that inhabit fresh water; appendages and setae absent; prominent muscular suckers



(a) Class Polychaeta. Polychaetes are marine worms with paddle-shaped parapodia.

(b) Class Oligochaeta. Oligochaetes, which include the earthworms, inhabit freshwater and moist terrestrial areas.

(c) Class Hirudinida. Many leeches are parasites that feed on blood.

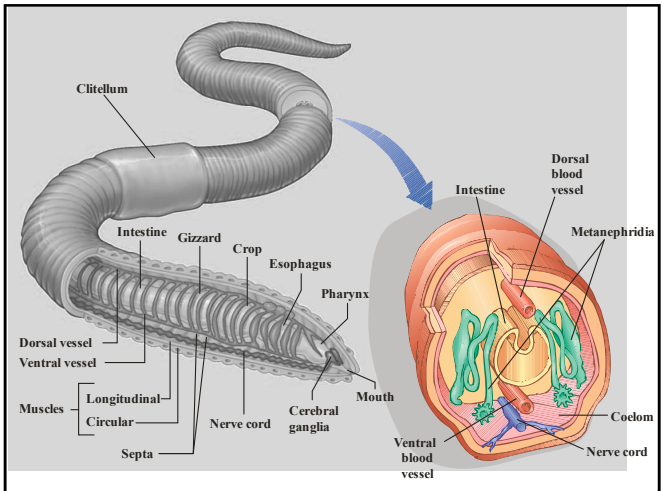
Figure : Three major groups of annelids

SOME COMMON ANNELIDS

1.	Clam worm or Sand worm or Rag worm	*Nereis*
2.	Fire worm	*Odontosyllis*
3.	Peacock worm	*Sabella*
4.	Fan worm	*Serpula*
5.	Blood worm	*Tubifex*
6.	Medicinal leech	*Hirudo medicinalis*
7.	Cattle leech	*Hirudinaria granulosa*
8.	Fish leech	*Piscicola*
9.	Paddle worm	*Chaetopterus*
10.	Peanut worm	*Sipunculus*

Pheretima posthuma

* The common Indian earthworm, *Pheretima posthuma* belongs to the class **oligochaeta** of the phylum Annelida.
* The generic name *Pheretima* was first used by **Kinberg** in 1867.
* Our knowledge of *Pheretima* is mainly due to the work of **Karm Narayan Bahl** (1926).
* Earthworm is a burrowing (fossorial) animal living in burrows made in moist soil.
* Earthworm is **nocturnal,** i.e. active during night.
* Earthworm is brown or clay-coloured. This is because of the pigment **porphyrin.**
* Body wall is dermomuscular and consists of cuticle, epidermis, muscular layers and coelomic epithelium.
* The body cavity is a true coelom **(schizocoel),** containing milky white **alkaline coelomic fluid.**



(a) The internal structure has been exposed at the anterior end of an earthworm.

(b) Cross section of an earthworm.

Figure : Body plan of an earthworm

* Excretory organs in earthworms are slender and coiled tubules called **nephridia.**
* According to their locations and structure, the nephridia of *Pheretima* are of three types, viz., **septal, integumentary** and **pharyngeal.**
* Earthworms possess a well-developed and metamerically segmented nervous system divisible into three usual sections, viz., **central, peripheral** and **autonomic** systems.
* Sense organs in earthworm are quite simple. Three types are: Epidermal receptors (tangoreceptors), Buccal receptors (gustatory and olfactory) and Photoreceptors (with L-shaped lens or optic organelles) on the surface of skin on dorsal side. Earthworm has **no eyes,** photoreceptors are used to judge intensity and duration of light, do not have the capacity of vision.
* Earthworms are **friends of farmers** because they enrich the soil by nephridial excretion, it increases the fertility of soil. Earthworms help in ploughing of fields, make the soil porous.

* Sea mouse belongs to Phylum Annelida.
* Brown colour of earthworm is due to the pigment porphyrin present in body wall and coelomic fluid.
* In the coelomic fluid different types of cells are present. These are - chloragogen cells, amoebocytes, circular cells and leucocytes.
* Number of body segments in *Pheretima posthuma* is 100 to 120.
* Clitellum helps in cocoon formation
* Gizzard is the only part of the alimentary canal of earthworm which is lined by cuticle.
* Dorsal vessel of earthworm can be compared with the heart of chordates.
* Direction of blood flow in dorsal vessel is form backward to forward.
* Earthworms excrete their nitrogenous wastes along with faeces, thus increase fertility of soil.
* Leeches are ectoparsite and sanguivorous (blood sucking) in habit. Two suckers are present.
* In leech (*Hirudinaria*) botryoidal tissue (excretory in nature) is filled in body cavity.
* Body cavity of leech is haemocoel.
* A leech can store so much of blood in its crop (10 chambered) that is can live upto one year without next meal.
* Locomotory organs of *Nereis* are parapodia and setae.
* Annelids are first animals with true coelom (schizocoel).
* Other common species of earthworm are:
Lumbricus : European and American species.
Eutyphaeus : North Indian earthworm.
Megascolex : South Indian earthworm.
Drawida : South India species.
* Largest earth worm is megascolex.

PHYLUM - ARTHROPODA

* Phylum Arthropoda was created by Von Seibald (1845).
* The word "Arthropoda" is derived from two Greek words (*Arthros* = jointed; *podos* = foot), meaning joint legged.
* It is the largest phylum in the animal kingdom, including 900,000 species. **The largest class is insecta with 750,000 species.** General characters are–
* They are triploblastic coelomate and bilaterally symmetrical animals.
* The body cavity is full of haemolymph (blood) and it's known as haemocoel. The true coelom is restricted to gonals.
* The body is covered by chitinous cuticle, which forms the exoskeleton, strengthen by deposition of minerals (Cal. Phosphate & Carbonate).
* They have a segmented body, each segement bearing a pair of jointed appendages covered by a jointed exoskeleton.
* Exoskeleton is made of chitinous cuticle that is shed at intervals.
* The process of casting off of skin or integument is known as ***ecdysis*** or moulting. ***Chitnnous exoskeleton*** **is secreted by the underlying epidermis**.
* The body is divided into head, thorax and abdomen. In some cases the head and thorax is fused to form cephalothorax.

In insects the thoracic segments have legs and wings, the abdomen has no legs in insects.

* Muscles are striated.
* Respiration by gills (Prawn), Book-gills (King crabs), trachea system (insects), book-lungs (scorpion). Trachea carry oxygen directly to the body cells.
* Excretion takes place through green glands or malpighan tubules coxal gland.
* Excretory matter = Ammonia (Aquatic) ; Uric Acid (Terrestrial) Nephridia (Perpatus)
* Sensory structures in arthropods are **antennae** for perceiving odour, eyes, statocysts or balance organs and sound receptors (in chirping crickets and cicadas). Eyes are compound. In honey bees, butterflies and months and insects, the gustatory receptors are present on their feet.
* The heart is dorsal pulsatile, many chambered and the circulatory system is open (Haemocoel). Blood haemolymph colourless.
* The central nervous system consists of a circumentric ring formed by paired pre-oral ganglia connected by commissures to a solid, dorsal ganglionated, ventral nerve chord.
* In land arthropods, the fertilization is always internal. Few aquatic has external fertilization.
* Arthropods are oviparous. In some like the scorpion, the eggs hatch within the female body. They bring forth the young ones alive. They are viviparous.

Advancement Over Annelida

* Distinct-head in all species.
* Jointed appendages serving a variety of functions.
* Jointed exoskeleton for protection and muscle attachment.
* Striped muscles arranged in bundles for moving particular parts.
* Special respiratory organs such as gills, trachea, book lungs in majority of cases.
* Well developed sense organs such as compound eyes, statocysts auditory organs, taste receptors etc.
* Endocrine glands and pheromone secretion for communication
* Examples: Economically important insects - Apis (Honey bee), Bombyx (Silkworm), Laccifer (Lac insect)
  Vectors-Anopheles,Culex and Aedes (Mosquitoes)
  Gregarious pest - Locusta (Locust)
  Living fossil - Limulus (King crab).
* **Classes of Phylum Arthropoda**

Class	Characteristics
Crustacea	• Body divisible into cephalothorax and abdomen. • 2 pairs of antennae and a pair of stalked compound eyes. • *Palaemon* (Prawn)
Chilopoda	• Body divisible into head and trunk. • Single pair of antennae. Each trunk segment bears a pair of legs. First pair of legs are modified into poison claws. • *Scolopendra* (Centipede)
Diplopoda	• Body is divided into head, thorax and abdomen. • Single pair of antennae Each thoracic segment bears a pair of legs (except first segment). Each abdominal segment has two pairs of legs. • *Julus* (Millipede)
Insecta	• Body is divided into head, thorax and abdomen. • A pair of antennae and a pair of compound eyes. Thorax has 3 segments with 3 pairs of legs and 2 pairs of wings. • Silver fish, cockroach, bed bug, wasp etc.
Arachnida	• Body divisible into cephalothorax and abdomen. • Cephalothorax bears simple eyes and 6 pairs of appendages (one pair of chelicerae, one pair of pedipalpi and four pair of legs). Antennae are absent. • Scorpion, spider, tick, mite
Merostomata	• Body divided into cephalothorax and abdomen. • 5-6 pairs of abdominal appendages with book gills. • *Limulus* (King crab) living fossil
Onychophora	• Single pair of antennae, eyes and jaws. • *Peripatus* (Connecting link between Annelida and Arthropoda)

INSECTS

* The insects may be divided into four groups on the basis of their mode of development.
* **Insects without Metamorphosis *(Ametabolous Development)***. Certain insects, such as silver fish, does not undergo metamorphosis. These insects are most **primitive** and **wingless.**
* There are present three stages in the life history; ***egg, young*** and ***imago*** (adult)
* **Insects with gradual Metamorphosis *(Paurometabolous Development).*** In this type of metamaophosis, the life history includes ***egg, nymph (***young) and ***imago*** (adult). The nymph resembles the adult in its mode of life but differs in structure, the young being without wings. Gradual metamorphosis. Occurs in cockroaches, grasshoppers, locusts, termites, stick insects, praying mantis, bed bug and lice.
* **Insects with incomplete Metamorphosis *(Hemimetabolous Development).*** In this type of metamorphosis the life history includes ***egg, naiad*** (young) and ***imago*** (adult). The naiad differs from the adult in both mode of life and structure. Incomplete metamorphosis occurs in **dragon flies** and **may flies.**
* **Insects Complete Metamorphosis *(Holometabolous Development).*** In this type of metamorphosis the life history includes ***egg, larva, pupa*** and ***imago*** (adult).
* Complete metamorphosis occurs in ***butterflies***, ***moth, beetles, house flies, mosquitoes, fleas, honey bees***, ants , wasps.
* The larvae of butterflies and moths is called ***caterpillar***.
* The larva of houseflies is known as **maggot.**
* The larva of beetles is termed **grub** and the larva of mosquito is called ***wriggler***.
* The young one formed after every moulting is called as ***instar.***
* The period between two molting is ***stadium.***
* ***Hypermetabolous***. Each larval stage differs from the others in habits, food and mode of living e.g. Blisterbeetle
* **Mouth parts in insects**

(i) **Bitting and chewing :** Grasshopper, Cockroach, Termites, Caterpillars.
(ii) **Piercing sucking :** Mosquitoes, Buts, Tse-tse fly.
(iii) **Chewing-lapping type :** Honey Bee
(iv) **Sponging type :** Housefly
(v) **Siphonging type :** Butterflies, moths

* Muscles are stripped/striated/voluntary (first time developed in Arthropods)
* Due to presence of joints, muscles are separate or arranged in bundles in them.

SOME COMMON ARTHROPODS

1. Water flea	*Daphnia*
2. Mosquito	*Anopheles*
3. Gnat	*Culex*
4. Parasitic barnacle	*Sacculina*
5. Goose barnacle	*Lepas*
6. Rock or ship barnacle	*Balanus*
7. Hermit crab	*Eupagurus*
8. Prawn	*Palaemon, Penaeus*
9. True crab	*Cancer*
10. Tadpole shrimp	*Apus*
11. Lac insect	*Laccifer* or *Kerialaeca*
12. Cricket	*Gryllus*
13. Fire fly	*Lamprophorous*
14. American lobster	*Homarus*
15. Rock lobster	*Palinurus*
16. Human louse	*Pediculus humanus*
17. Mole crab	*Hippa*
18. Glass crab	*Phyllosoma (larva)*
19. Fresh water crab	*Paratel*
20. Stone fly	*Perla*
21. May fly	*Ephemera*
22. Dragon or Damsel fly	*Sympetrum*
23. Giant water bug	*Belostoma*
24. Grass hopper	*Romalea*
25. Locust	*Schistccera*
26. Praying mantis	*Mantis*
27. Cray fish	*Astacus*
28. Silver fish	*Lepisma*
29. Leaf insect	*Phyllium*
30. Stick insect	*Carausius*
31. Mussel shrimp	*Cypris*
32. Bed bug	*Cimex*
33. Butter fly	*Kalima*
34. Honey bee	*Apis*
35. Fruit fly	*Drosophila*
36. Termite	*Eutermes*
37. Ant	*Formica*
39. Silk moth	*Bombyx*

PERIPLANETA AMERICANA

* Four species of cockroach are found in our country.
* Different genera of cockroach are :
- *Periplaneta americana* (American cockroach).
- *Periplaneta australasiae* (Australian cockroach).
- *Blatta orientalis* (Oriental cockroach).
- *Blatella germanica* (German cockroach).
* Name "*Periplaneta*" was given by Burmeister in 1838.
* Linnaeus in 1758 named it *Blatta americana*.
* The meaning of word *Periplaneta* is "availability throughout the planet".
* Largest Cockroach is "*Megaloblatta longipenis*" found in Columbia. A female cockroach, preserved in Akira Yokokuya Thamagate of Japan is 97 mm. long and 45 mm. broad.

MOSQUITO

* Mosquitoes are nocturnal insects of family Culicidae.
* Three common genera are *Culex, Anopheles* and *Aedes*.
* Body of mosquito is divisible into head, thorax and abdomen.
* *Anopheles* sits at an angle to surface. Its wings have spots.
* *Culex* sits parallel to the surface. Its wings are plain.
* *Aedes* (*Stegomyia*) sits parallel to surface. Body is with black and white stripes.
* Head of mosquito bears 2 compound eyes, 2 ocelli, 2 long antennae.
* In mosquito piercing and sucking type of mouth parts are found.
* Antennae of males are with dense hair (plumose antenna) and mandibles are absent.
* Antennae of females have. few small bristles (pilose antenna).
* Johnstons's organ is present at the base of antenna.
* Johnstons's organ is auditory receptor.
* Food channel is formed by labrum, epipharynx and hypopharynx.
* In mosquito copulation occurs in air.
* Fertilization is internal.
* Mosquito is oviparous.
* Eggs are laid in stagnant water.
* Hatching occurs after 24 to 72 hours.
* Larva or wriggler shows wriggling movements.

HOUSE FLY

* House fly is a **diurnal** insect.
* Common species of house fly are
  Musca nebulo (Indian species)
  Musca domestica (European species)
  Musca vicinia (African species).
* Body is divisible into head, thorax and abdomen.
* Head of house fly bears 2 compound eyes (each with about 4000 ommatidia), 3 ocelli, 2 brushy antennae .
* In house fly sponging type of mouth parts are present.
* In house fly copulation occurs while sitting.
* Fertilization is internal.
* Housefly is oviparous.

SCORPION

* Scorpion is terrestrial and nocturnal arthropod.
* Scorpion shows cannibalism.
* Body of scorpion is divisible into (cephalothorax) and opisthosoma.
* In cephalothorax 5 pairs of lateral eyes and one pair of median eye is present.
* Last five abdominal segments are long which form tail like posterior end known as metasoma.

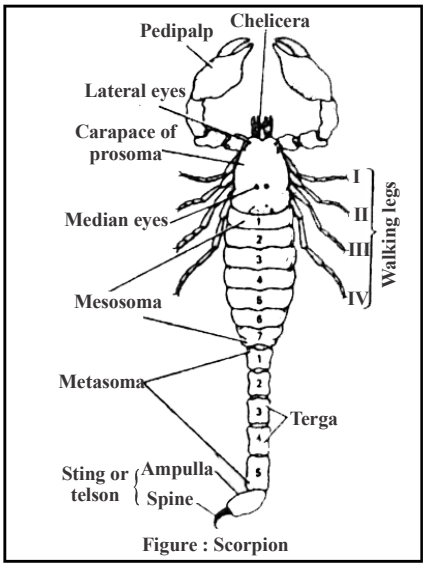
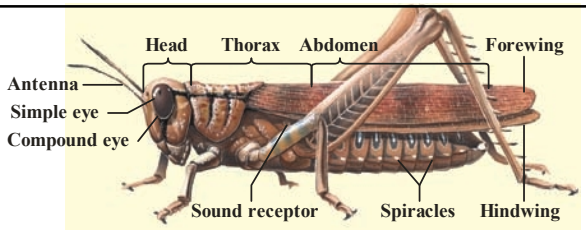


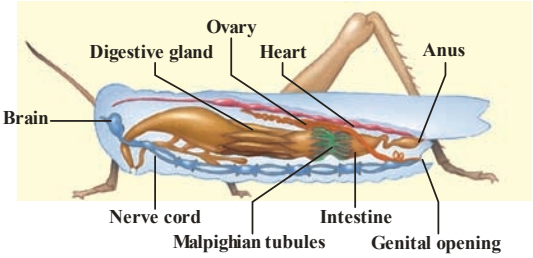
Figure : Scorpion

GRASSHOPPER

* Grasshoppers are member of class Insecta.
* Common genera of grasshopper are *Schisiocerca* and *Remalea*.
* Grasshopper is solitary and term locust is used for gregarious and migratory forms.
* Mouth parts of grasshopper are cutting and chewing type.
* In India locusts breed in deserts of Rajasthan.
* In grasshopper metamorphosis is incomplete.



(a) External structure. Note the three pairs of segmented legs.

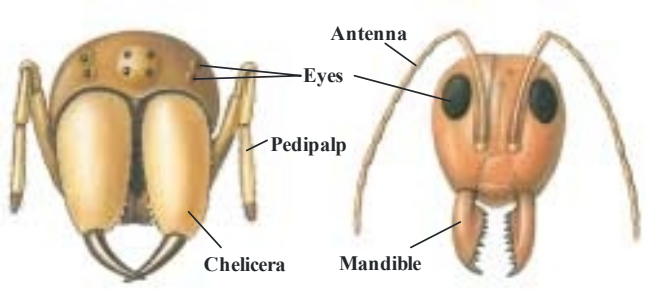


(b) Internal anatomy

Figure : Anatomy of the grasshopper

SPIDER

* Spiders are member of class. Arachnida.
* The body of spider is divisible into prosoma and opisthosoma.
* In spiders four pairs of walking legs are present.



(a) Chelicerate (b) Mandibulate

Figure :
Chelicerates and mandibulates. In the chelicerates, such as a spider (a), the chelicerae are the foremost appendages of the body. In contrast, the foremost appendages in the mandibulates, such as an ant (b), are the antennae, followed by the mandibles.

TICKS AND MITES

* Ticks and mites are members of class Arachnida.
* In ticks and mites four pairs of legs are present.
* No external segmentation is visible in ticks and mites.
* Mites are free-living as well as parasites of animals and plants.

TERMITES

* Termites are social and colonial insects.
* Termites are polymorphic insects with well established caste system.
* Two main castes are - fertile males and females, and infertile or sterile males and females.
* Fertile males and females are reproductive wingless King and Queen and winged fertile males and females.

INSECTS OF ECONOMIC IMPORTANCE

(a) Honeybee: Honeybees are colonial, social, polymorphic insects with a division of labour. A colony of honeybee consists of three castes, viz., **queen, drone** and **worker.** Different species of honeybee are:

Apis mellifera – European bee
Apis dorsata – Rock bee (largest)
Apis indica – Indian bee
Apis florae – Little bee (smallest)

* Bee rearing or bee keeping is called **'apiculture'.**
* Mouthparts of honeybee are **'chewing** and **lapping type'.** Diploid (2n = 32) fertilized eggs give rise to queen and workers and unfertilized haploid (n= 16) produce males or drones.
* Natural **parthenogenesis** occurs in honeybee. Haploid parthenogenesis in honeybee is called as **arrhenotoky.**
* **'Royal jelly'** is secreted by worker. It is digested honey, pollen and secretion of maxillary gland.
* Bee wax is a secretory product of **hypodermal glands** of the abdomen of worker bee.
* Honeybee keeps the nectar for sometime in its crop.
* Honey is a product of regurgitation of nectar from crop.

* Sucrose is hydrolysed into monosaccharides like glucose, levulose and fructose.
* If a worker bee from another nest of the same species be introduced in a hive, it will be killed and kicked away. The sting of honeybee worker is a modified **ovipositor.**
* **Bee Dance:** Honeybees communicate to other members of the colony by dance and sound.
* **Karl von Frisch** decoded the language of dance by bees. **Karl von Frisch** (the zoologist from Austria) got **Nobel Prize** in 1973 on the work of bee dance.
* According to **Wenner** in addition to dance, honeybee communicates by sound. Bee messages include: (1) Source of food supply (2) Food source direction in relation to sun and distance from the colony (3) Richness of source.

(b) Silk Moth: *Bombyx mori* is the **mulberry silkworm.** Caterpillar feeds on mulberry leaves. Salivary gland secretes liquid silk.

* The salivary gland (labial gland) is modified forming silk gland of the larva.
* Silk is obtained from cocoon (pupa, chrysalis). Ripe cocoons are treated with boiling water to kill the moth before hatching.
* Silk thread is formed of two proteins namely **fibroin** and **sericin.**

(c) Lac Insect

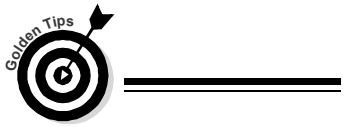
Lac is produced commercially by an insect *Tachardia lacca* (*Laccifer lacca).* Lac is actually secreted for its protection and not for the food of the insect. Lac or shellac is an exuviate (secretion) of mainly the female insect. Lac is a resinous substance.

(d) Cochineal Bug

Dactylopis coccus lives upon cactus. Dead and dried bodies are used for making a dye called cochineal dye.

(e) Blister Beetle

Lytta is a genus of blister beetle. The drug **cantheridine** is prepared from its blood. Cantheridine is widely used for healthy growth of hair.



* Malpighian tubules serve as excretory organs in Arthropoda.
* Hexapoda is the largest Class of Phylum Arthropoda.
* Juvenile hormone in insects is released from corpora allata.
* Earthworm and *Periplaneta* both have segmented body.
* The stage between larval moults in an insect is called instar.
* *Anopheles* breed in clean water and their larvae lie parallel to the surface of water.
* A female *Anopheles* mosquito can be recognised by proboscis and palpi are long and more or less of equal length.
* Males of both *Anopheles* and *Culex* suck juices of flowers and fruits.
* Moth has feathery antennae but butterfly has club shaped antennae.
* Cyclops belongs to Class Crustacea.
* Blood worms are the larvae of *Chironomus*.
* Green glands present in some arthropods help in excretion.
* Crayfish is an arthropoda.
* Lady bird beetle is an insect.
* Haemocoel is found in arthropoda.
* Excretory product of spider is guanine.
* *Daphnia* is commonly known as water fleas.
* 3-segmented club shaped maxillary palp is present in male *Anopheles.*
* Arthropoda is characterised by exoskeleton, metameric segmentation and jointed appendages.
* In insects, respiratory gas exchange occurs through Tracheae.
* Blood of most arthropods is colourless.
* Blood is called haemolymph which is filled in body cavity, such body cavity is called haemocoel.
* Blood of arthropods is blue due on the respiratory pigment haemocyanin which contains copper.
* Tentorium of cockroach is considered analogous to vertebrate cranium.

* Hypopharynx of cockroach is analogous to tongue of mammals.
* In cuticle protein arthropodin is present which is soluble in water.
* Mouth parts of cockroach are cutting and chewing type or mandibulate type.
* In arthropods true coelom arises by spliting of mesoderm which is later on replaced by haemocoel.
* About 95% arthropods are insects.
* Rearing of silk moth - sericulture.
* Rearing of honey bees - apiculture
* Honey bees are social and polymorphic insects.
* In a colony of honey bees a queen (fertile female), 1 to few 100 drones (fertile males) and up to 60,000 workers (sterile females) are found.

PHYLUM - MOLLUSCA

* The name "Mollusca" was given by Jonston in 1650.
* The word mollusca is derived from Greek word "*Molluscus*" = soft.
* Study of molluscs is known as - **malacology.**
* Study of shells of molluscs is known as - **Conchology**.
* It is **second largest** animal Phylum.
* Mollusca (Soft bodied) are **marine** or **fresh water** or terrestrial.
* Body is unsegmented with variety of shapes. **Neopilina** is exceptionally segmented. (connecting link).
* Molluscs are usually **bilateral.** Few are secondarily **asymmetrical** (snail) due to twisting (Torsion) during growth.
* Triploblastic with Organ system level.
* **Body wall** includes one layered epidermis (usually cilited) with unstripped muscles found in bundles.
* Body parts consist of

(i) **Head** with sense organ. Head is absent in Pelecypoda & Scaphopoda.
(ii) Dorsal **visceral mass** containing organ system.
(iii) **Ventral foot** for locomotion.
(iv) Thin fleshy fold or outgrowth of dorsal body wall covers the body. This fold is called **mantle or pallium.** It encloses a space mantle or pallial cavity between itself and the body. The mantle usually secretes an external limy **shell**. Shell is made up of **Calcium carbonate and Concheolin protein**.

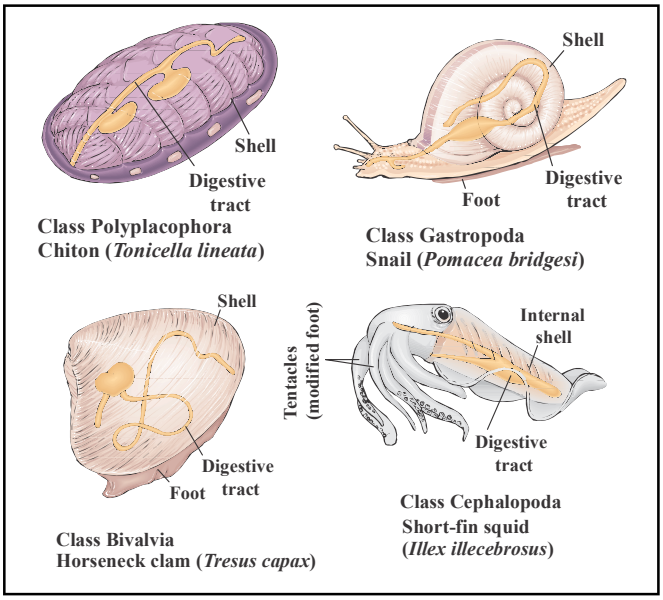
* Shell may also be internal (Cuttle fish), reduced and even absent (Octopus)
* **Coelom** is greatly **reduced.** It is represented by cavities in the **pericardium, kidneys** and **gonads**. Space among the viscera contain blood and form **haemocoel**.
* **Digestive tract** is complete. Buccal cavity contain a rasping organ the **Radula**, with transverse row of teeth.
* Anus opens into the mantle cavity.
* Digestive glands are known as **hepatopancreas.**
* **Respiration** is usually by **gills** i.e., **Ctenidia.** But respiration may take place by **body surface** also. **Dentalium** respire by **Mantle.**
* **Pila** respire by **pulmonary sac on land** and by **gills** in water.
* **Circulatory system is open.** It includes dorsal **pulsatile heart** and a few arteries that open into sinuses.
* Blood flow in a mollusc follows the patttern : Heart → aorta → smaller blood vessels → blood sinuses (hemocoel) → blood vessels to gills → heart
* **Cephalopoda** has **closed** type of circulatory system.
* Blood has a copper containing, blue respiratory pigment **Haemocyanin.** Blood is colourless with amoebocytes.
* **Excretory system** includes 1 or 2 pairs of sac like **kidneys,** which open into the mantle cavity. Kidney of molluscans are **Metanephridia** known as **Kaber's organs** or **Organ of Bojanus.** Excretory matter is **ammonia** or uric **acid.**
* **Nervous system** comprises three paired **ganglia**

(1) **Cerebral** (above the mouth)
(2) **Pedal** (In the foot)
(3) **Visceral** (in visceral mass)

* These are inter connected by

(1) **Commissure** (Joins similar ganglia)
(2) **Connectives** (Joins dissimilar ganglia)

* Sense organs includes
  (1) **Eye** - Present over a stalk called **ommatophore** (Gastropoda).
  (2) **Statocyst/Lithocyst -** For equilibrium in foot
  (3) **Osphradia -** Chemoreceptor/Olfactory as well as for testing chemical & physical nature of water.
* **Sexes** usually **separate** (snail has **ovotestis**). Gonads have ducts.
* Fertilization may be **external** or **internal.**
* Cleavage is **spiral, determinate, unequal** and **holoblastic.**
* Development is - **Direct** or **indirect.**
* **Trochophore** is very common larva of Mollusca phylum.
* Larva - **Glochidium** (Fresh water mussel) and **Veliger (Pila)**
* Precious pearl of the size of tennis - ball is made by a mollusk - **Tridekna**
* **"Nacre layer"** is called **"Mother of Pearl".** This layer is made up of $CaCO_3$ and choncheolin protein.
* Father of pearl industry - **Kokichi Mikimoto**
* Examples: Pila (Apple snail), Pinctada (Pearl oyster), Sepia (Cuttlefish), Loligo (Squid), Octopus (Devil fish), Aplysia (Seahare), Dentalium (Tusk shell) and Chaetopleura (Chiton).



Classes of Phylum Mollusca

Class	Characteristics
Monoplacophora	*(monas-* one, *plax-plate, pherein-bearing)* The shell is cup or spoon-shaped. *E.g., Neopilina.*
Scaphopoda	Tubular shell, open at both ends. *E.g., Dentalium.*
Cephalopoda	Head and foot regions are combined and modified into structure cephalopod or head foot having eyes and eight tentacles. Shell may be external *(Nautilus),* internal *(Sepia)* or absent *(Octopus).*
Amphineura	Non-ganglionated nerve ring present around mouth with two pairs of interconnected nerve cord. *E.g., Chaetopleura* (Chiton).
Gastropoda	Shell made up of one piece. The early embryo is symmetrical but during development, the body twists showing torsion, so that the body becomes asymmetrical. This class includes largest number of molluscs. *E.g., Pila, Doris, Limax, Limnaea, Patella, Helix.*
Pelecypoda or Bivalvia	Shell is made up of two halves. *E.g., Unio, Mytilus* (Sea mussel), *Teredo* (Shipworm), *Pinctada* (Pearl oyster).

SOME COMMON MOLLUSCS

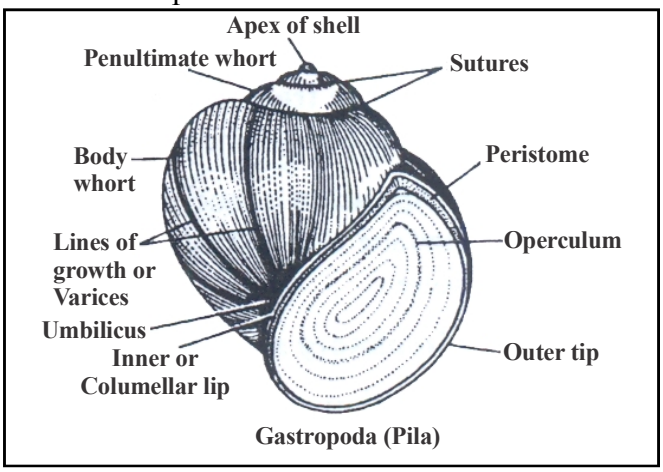
1. Cowrie	*Cypraea*
2. Devil fish	*Octopus*
3. Cuttle fish	*Sepia*
4. Squid or sea arrow	*Loligo*
5. Pearl oyster	*Pinctada vulgaris*
6. Apple snail	*Pila*
7. Snail	*Helix*
8. Garden slug	*Limax*
9. Rock borer	*Pholas*
10. Edible oyster	*Ostrea*
11. Fresh water mussel	*Unio*
12. Razor clam	*Solen or Ensis*
13. Sea hare	*Aplysia*
14. Sea lemon	*Doris*
15. Sea mouse	*Chiton*
16. Sea butterfly	*Creseis*
17. Sea mussel	*Mytilus*
18. Ship worm	*Teredo*
19. Tusk shell	*Dentalium*
20. Ancestral mollusk	*Neopilina*

NEOPILINA

* Connecting link between Annelida and Mollusca.
* Discovered in 1952 and described by Lemche and Wingstrand in 1959.
* Also called living fossil.

PILA

* Commonly called apple snail.
* Amphibious.
* Opening of globe shaped shell of *Pila* is closed by operculum.
* Body of *Pila* is asymmetrical due to torsion.
* Osphradium is the chemoreceptor present at the entry of mantle cavity.
* In *Pila* respiration on land occurs by pulmonary sac and in water by a single gill or ctenidium.
* In *Pila* no larval stage is present during development.

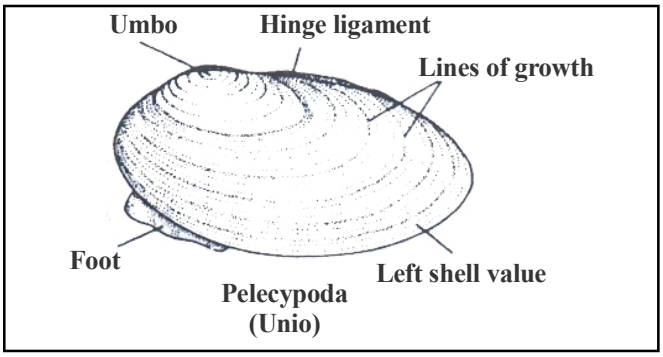


CHITON (The Coat of Mail Shell).

* Marine and occurs between tide marks.
* Found attached to rocks by its foot.
* Nocturnal and herbivorous. When it is detached, it coils like a millipede.
* The shell consists of a row of eight plates.

UNIO

* Found at the bottom of fresh water lakes, rivers, ponds etc.
* Body is enclosed in a bivalved shell formed of $CaCO_3$.
* Head is not well defined.
* Excretory organs are a pair of kidneys, called - **organ of Bojanus**.
* **Keber's organs** also help in excretion.
* Heart is surrounded by pericardium and has one ventricle and two auricles.
* Larva is **Glochidium**.



PINCTADA VULGARIS

* Common Indian pearl oyster.
* Shell is bivalved with unequal halves.
* When some foreign particles enter the body of pearl oyster, a nacreous secretion is secreted by mantle around it.
* Gradually many nacreous layers are secreted and ultimately the foreign particle becomes pearl.
* Technique of pearl culture was first developed in Japan.
* Tokichi Nishikawa was the first man to obtain a round cultured pearl.
* **Kokichi Mikimoto** is called "Father of Pearl Industry".
* In India pearl oysters are cultured in Chennai.
* Most valuable pearls are formed by genus *P. vulgaris*.

OCTOPUS

* Commonly known as devil fish because of the presence of eight oral arms (modified foot).
* Shell is internal.
* Moves by jet propulsion and help of arms.
* Has ink glands.
* Ink of *Octopus* has no effect on human skin but it paralyzes sense of smell of the predator.
* *Octopus* can change colour very quickly.

SEPIA

* Commonly called cuttle fish.

* Eight arms and two tentacles with suckers are present on head of *Sepia*.
* A muscular funnel ejects water current in the form of jet which helps in fast swimming.
* An ink gland is present in the body of *Sepia* which ejects black ink at the time of danger and helps in escape of the animal.
* In *Sepia* very thick non-medullated nerve fibres are present in which nerve impulse travels at very fast speed.

LOLIGO

* Commonly called squid or sea-arrow.
* Squids are largest invertebrates with highest rate of nerve conduction among invertebrates.
* Body of *Loligo* is torpedo shaped.
* Head of *Loligo* bears 8 oral arms and two tentacles.
* In *Loligo* ink glands are also present.

* Torsion is the characteristic of Gastropoda.
* Devil fish belongs to the Phylum Mollusca.
* "Archythius longpinus" is largest snail, found in 1887 in Cook Straight city of New Zealand. It was 17·4 meters long and its two tentacles were 15.01 meter long.
* Shell is secreted by mantle.
* *Neopilina* is a connecting link between Annelida and Mollusca. Also called living fossil.
* In cephalopoda foot is present on head.
* In gastropoda foot is located above stomach.
* *Sepia* (cuttle fish) and *Loligo* (squid) form smoke screen in seawater for their defence.
* Smoke screen is produced by ejecting ink from ink glands.
* Among invertebrates *Octopus, Loligo* and *Sepia* have largest and human (vertebrate) like eye.
* The animal which has foot on head - *Octopus*.
* The animal which actively bores into the wood of the ship is ship worm - *Teredo*.

PHYLUM - ECHINODERMATA

* Name "Echinodermata" was given by Jacob Klein in 1738.
* The name echinodermata is derived from Greek words *Echinos* = hedge hog, *derma* = skin, *ata* = characterized.
* All are Marine except **Synapta similis.**
* Generally live at **bottom** and slow moving.
* Body shape is **star like, cylindrical like, melon-like, disc-like, flower like.**
* Body unsegmented with **bilateral symmetry** in larva and **radial pentamerous** (arranged in five or multiple) in adult.
* Echinoderms are **triploblastic** with **organ - system level** of organization
* Echinoderms do not have **head.**
* **Tube feet** (podia) which comes out through radial area i.e. **Ambulacral** used for locomotion. They are extended and retracted by variation in **hydraulic pressure** of fluid in them and by contraction of their muscle.
* **Body wall** of echinoderms consists of

(i) **Epidermis** - Single layered & ciliated.

(ii) **Dermis** - Below the epidermis thick dermis having **mesodermal endoskeleton** of calcareous plate (Ossicles). It has spines.

(iii) **Muscles** - Smooth and lie below dermis.

* Minute pincerlike structure **pedicellariae** comes out through skin. They keep body surface clear of debris by opening & closing. These are made up of three calcareous plates.
* Echinoderms have true **Coelom** lined by **ciliated mesothelium. Enterocoelous** contain fluids with free amoeboid cells called **coelomocytes.**
* Coelom is divided into many tubes and sinuses, which together form **3** systems.

(i) A unique water filled **ambulacral** or **water vascular system** with tube feet to help in locomotion. A perforated plate **madreporite** permits entry of water into ambulacral system which also help in food and gas transport system. Structures like Pollian vesicle, tiedmann body or recemose, stone canal are also found in water vascular system.

(ii) **Haemal system.**

(iii) **Perihaemal system.**

* **Respiration** takes place by **gills** called **dermal branchiae** or papulae in most of Echinoderms like Starfish, **genital bursae** in Brittle star, **cloacal respiratory trees** Sea- Cucumber, **Peristomial gills** - Sea urchin. tube - feets also helps in respiration in all Echinoderms
* **Digestive tract** is **complete,** (incomplete -brittle star).
* **Circulation system** is reduced and **open type** called **haemal system** /Perihaemal system. No heart or pumping vessel.
* There is no **specialised excretory organ system**. Nitrogenous waste (ammonia) diffuses out via **gills, bursae, respiratory tree and tube feet**. Amoeboid cells in coelomic fluid also perform excretory function by absorbing excretory matter.
* **Nervous system** is simple and primitive type includes a Nerve ring and radial nerve cord with simple sense organ. (No brain)
* Echinoderms resemble **chordates** in early embryonic development.
* Echinoderms have separate sexes.
* **Fertilization** is **external** (no copulation). Life history includes ciliated, bilaterally symmetrical larva that undergoes metamorphosis and change into a adult (Deuterostome).
* **Larva**

Star fish	→	Bipinnaria
Brittle star	→	Ophiopluteus
Sea urchin	→	Echinopluteus
Sea cucumber	→	Auricularia
Feather star	→	Doliolaria

* Few echinoderms (star fish) have great power of **regeneration**. They break off their arms for defence purpose. This phenomenon is known as **Autotomy**
* Echinoderms in angry or frightened state vomits out viscera (internal organ). This phenomenon is known as **Evisceration.**
* Heart urchin has **lophophore** (Ciliary structure)
* Examples: Asterias (Star fish), Echinus (Sea urchin), Antedon (Sea lily), Cucumaria (Sea cucumber) and Ophiura (Brittle star).

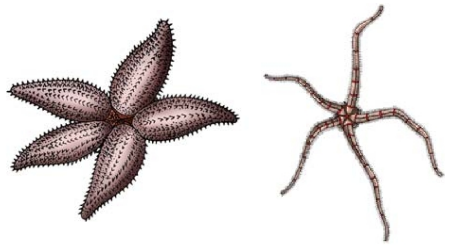


Figure : Examples of Echinodermata : (a) *Asterias*, (b) *Ophiura*

* **Classes of Echinoderms**

Class and Representative Animals		Characteristics
Crinoidea Feather stars, sea lilies		Feather stars motile; sea lilies, sessile, attach to ocean floor by stalk; oral surface on upper side of disc; tube feet along feathery arms trap microscopic organisms
Asteroidea Sea stars		Arms (rays) extend from central disc; tube feet on undersurface of each arm; mouth in center of underside of disc; carnivorous predators and scavengers
Ophiuroidea Basket stars, brittle stars		Resemble sea stars, but arms long, slender, and more set off from central disc; tube feet used to collect and handle food
Echinoidea Sea urchins, sand dollars		Skeletal plates flattened and fused to form a test; sand dollars burrow in sand and feed on organic particles; sea urchins graze on algae
Holothuroidea Sea cucumbers		Body is elongated, muscular sac; mouth surrounded by tentacles that are modified tube feet; sluggish animals that live on sea bottom; many species eject organs when conditions poor; for defense, can eject tubules out of anus

SOME COMMON ECHINODERMS

1. Starfish	*Astropecten*
2. Feather star	*Antedon*
3. Brittle star	*Ophiothrix*
4. Sea cucumber	*Cucumaria*
5. Sea urchin	*Echinus*
6. Cake urchin	*Clypeaster*
7. Sea pentagon	*Pentaceros*
8. Sea star or starfish	*Asterias*

ASTERIAS

* Commonly known as starfish.
* Starfish is found at sea bottom and moves with the help of **tube feet**.
* Body of starfish is divisible into oral and aboral surface.
* On aboral side of starfish **pedicellariae** are present.
* Water vascular system or ambulacral system consists of radial canals, ring canals and stone canal.

ECHINUS (Sea urchin).

* Found in rocky sea bottom.
* Teeth are used for feeding.
* Omnivorous.
* Moves with the help of spines.
* The body is globular with long, pointed movable spines.
* Pedicellariae are present among the spines.
* The mouth is present in the centre of oral surface.
* The sea urchin has a masticatory apparatus, called **Aristotle's lantern.** It is named after its discoverer and because of its resemblance to ancient Greek ship lantern.
* Formed by five strong and sharp teeth.
* Projects slightly through the mouth.
* The anus is a much smaller aperture.

ANTEDON (Feather star)

* Found attached to the rocks and stones at bottom of shallow seas (sessile).
* Feeds on microscopic debris and planktons.
* Has great power of autotomy and regeneration.
* The body comprises a cup shaped central *disc* and five slender arms.
* Each arm is bifurcated, bearing a row of **pinnules** on each side.
* Oral surface has a mouth and anus. From the mouth five ambulacral grooves radiate and after bifurcating they go to the two branches of each arm. A branch goes to each pinnule.

* In Echinodermata adult shows radial symmetry, while the larva shows bilateral symmetry.
* The pentaradial symmetry is seen in echinodermata.
* Water-vascular system is found in sea-cucumber.
* Tube feet are locomotary organs of star fish.
* Echinoderms are spine skinned animals.
* Echinoderms are exclusively marine animals.
* Star fish can open shells of oysters and then eat them.
* Echinoderms have power of regeneration
* Tube feet are found only in echninoderms.
* Tube feet are organs of locomotion and also help in respiration.
* Echinoderms have some chordate like characters like **enterocoelic coelom, mesodermal skeleton** and deuterostomic embryonic development.
* Few echinoderms (star fish) have great power of **regeneration**. They break off their arms for defence purpose. This phenomenon is known as **Autotomy**.
* Sea cucumbers in angry or frightened state vomits out viscera (internal organ). This phenomenon is known as **Evisceration**.

PHYLUM - HEMICHORDATA

* The term Hemichordata was given by **Bateson.**
* Animals of this phylum are all **fossorial,** and their tunnels are 'U' - shaped.
* Body **worm like,** and soft.
* Body is divided into **three parts.**
  a - **proboscis** b - **Collar** c - **Trunk**

* Body wall has **single layered epidermis.** No dermis
* Body cavity is **enterocoelus,** that is divided into **Protocoel, Mesocoel** and **Metacoel**.
* Mostly **ciliary feeders.** Complete alimentary canal is present in digestive system. This is **straight or 'U' - shaped.**
* Circulatory system is **open type.** Blood is colourless with ameoboid corpuscles.
* Heart is dorsal.

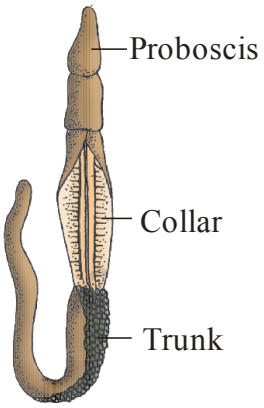


Figure : *Balanoglossus*

* Skeletal tissue is absent.
* **True notochord** is **absent**.
* Hemichordata have a rudimentary structure in the collar region called **stomochord**, a structure similar to notochord.
* Post anal tail is Absent.
* Dorsal heart, ventral nerve cord, no respiratory pigment.
* Respiration by gills.
* **Excretion** is done by a **single glomerulus.** This single glomerulus is situated in the proboscis known as **Proboscis gland.**
* **Central nervous system** is just **like non chordates. Brain** is present in the form of **nerve - ring.**
* Mostly animals are **unisexual** and reproduction is sexual.
* Fertilization is **external.** Cleavage holoblastic.
* **Development** is **direct** or **indirect** because some animals have **tornaria larva** just like **bipinnaria larva** or echinodermata in their developmental stages.
* Proboscis gland in Balanoglossus is associated with excretion.
* **Hemichordata** is divided into **two Classes**
  (1) Enteropneusta (2) Pterobranchia
* **Balanoglossus.** (Tongue worm or Acorn worm)
* **Rhabdopleura**
* **Saccoglossus**
* Earlies included Hemichordata in **Chordata phylum. Hyman** (1959) kept in **separate phylum** Hemichordata in **invertebrates.**
* **Hemichordata is connecting link between Non-Chordata & Chordata.**
* Examples: *Balanoglossus* and *Saccoglossus*.

PHYLUM - CHORDATA

* Phylum Chordata was created by Balfour in 1880.
* The word Chordata is derived from Greek words *Chorde* = a string or cord and *ata* = to bear.
* Although not the largest phylum, chordata contains the most familiar species, including humans.
* Chordates were evolved during **ordovician** period of **palaeozoic era.**
* Notochord supports the body of these animals.
* So, chordates are the animals in which notochord is present in any stage of their life – span.
* Animals, which do not have notochord, are called **non - chordates.**
* In chordates, species of maximum life animals is pisces group and minimum life animals is Amphibian group.
* Animals belonging to phylum Chordata are fundamentally characterised by the presence of a **notochord**, a **dorsal hollow nerve cord** and **paired pharyngeal** gill slits . These are bilaterally symmetrical, triploblastic, coelomate with organ-system level of organisation. They possess a post anal tail and a closed circulatory system.

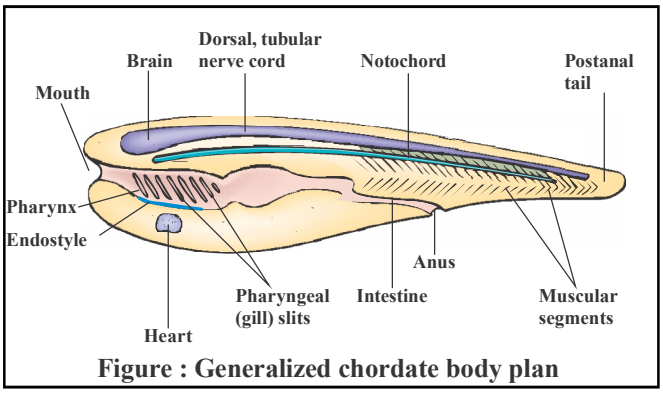


Figure : Generalized chordate body plan

Fundamental characters of Chordates

1. All chordates have a **notochord** during some time in their life cycle. The notochord is a dorsal, longitudinal rod composed of cartilage. The notochord is firm but flexible, and it supports the body.
2. At some time in their life cycle, chordates have a **dorsal, tubular nerve cord**. The chordate nerve cord differs from the nerve cord of most other animals in that it is located dorsally rather than ventrally, is hollow rather than solid, and is single rather than double.
3. Chordates have a larva or embryo with a muscular **postanal** tail, an appendage that extends posterior to the anus.

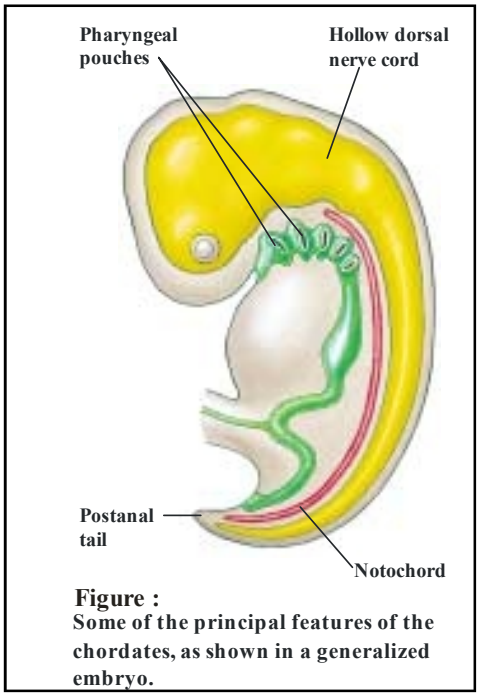


Figure :
Some of the principal features of the chordates, as shown in a generalized embryo.

4. The endostyle is a groove in the floor of the pharynx that secretes mucus and traps food particles in the sea water passing through the **pharynx**. The endostyle is present in the urochordates, cephalochordates, and lamprey larvae. The thyroid gland evolved from the endostyle and is present in all other chordates. Chordates have **pharyngeal slits** (also called pharyngeal gill slits) or pharyngeal pouches during some time in their life cycle
5. In the embryo, a series of alternating branchial (gill) arches and grooves develop in the body wall in the pharyngeal (throat) region. Pharyngeal pouches extend laterally from the anterior portion of the digestive tract toward the grooves. In aquatic chordates, the tissue breaks through where the pouches meet the grooves, forming slits.

General characters of chordata

* These animals are **aquatic, terrestrial** or **aerial**, free living.
* Body is **bilaterally symmetrical.**
* Bodywall **triploblastic,** in which all the three germinal layers **ectoderm, mesoderm** and **endoderm** are present.
* **Metamerism** is found in (arrangement of **muscles in embryonic stages)** and in **adults** (arrangement of **vertebrae** and **ribs.**)
* True **coelom** (**enterocoelous** type) & Deuterostomous animals.
* Alimentary canal and digestive system is **complete**. Digestive glands are present and digestion is **extracellular.**
* In these animals, **heart** is **Ventral.**
* Blood vascular system is **closed** type. Respiratory pigment is haemoglobin present in RBC.
* **Hepatic portal system** is found in **all chordates** but **Renal portal system** is present in all except **birds** and **mammals.**
* **Exoskeleton** is present.
* **Mesodermal endoskeleton** is present which is made up of **cartilage** and **bones**
* In **embryonic stages** of chordates a muscular tail is found that is known as **post anal tail.**

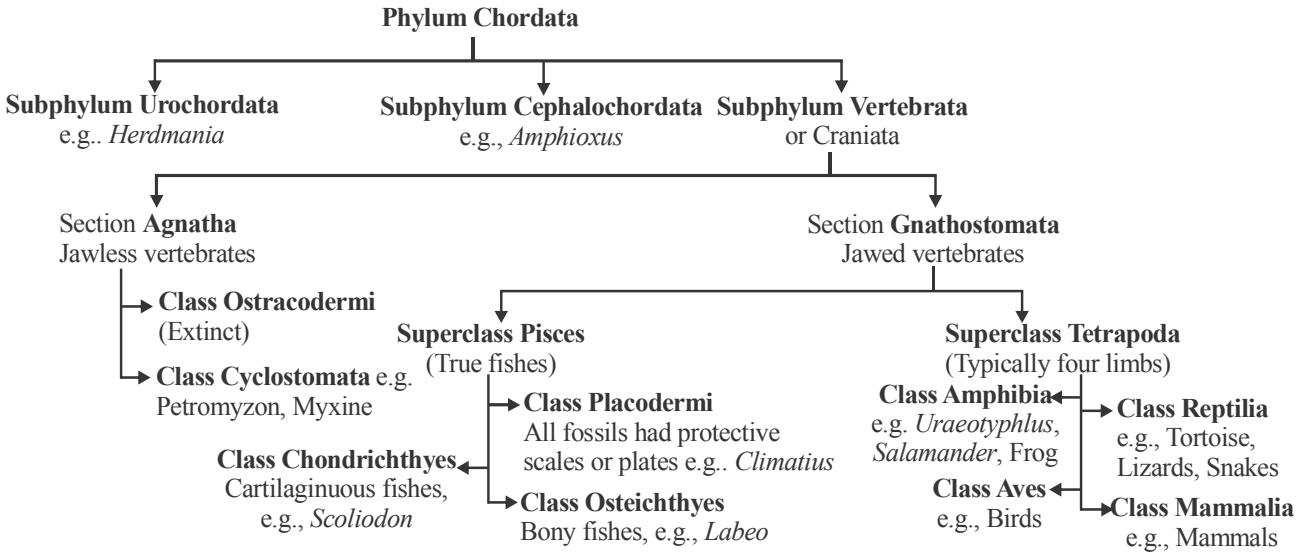
In some Chordates this tail is reduced/Absent e.g. man, apes.

* **Proto, meso** and **metanephric kidneys** are found in the form of **excretory organs.**
* **Sexual** reproduction is **dominant.**
* **Males** and **females** are separate.
* Metamorphosis or development of embryo is **direct**. In some it is indirect.
* May be **cold blooded** (Poikilothermous) e.g. – **Fishes, Amphibians, Reptiles** or **warm blooded** (Homeothermous) e.g. **Birds** and **Mammals**.

* **Comparison of Chordata with Non-chordata.**

S.N.	Chordata	Non-chordata
1.	All chordates are bilaterally symmetrical.	1. These are asymmetrical, radially symmetrical or bilaterally symmetrical.
2.	True metamerically segmented animals.	2. Non-segmented, false segmented or true metamerically segmented.
3.	Triploblastic animals having organ-system grade of body organisation.	3. Cellular, diploblastic or triploblastic animals having protoplasmic to organ-system grade.
4.	Post-anal tail usually present.	4. It is usually not found.
5.	True coelomate animals.	5. Acoelomate, pseudocoelomate or true coelomate animals.
6.	Notochord present at some stage or replaced by a backbone or ring-like vertebrae forming the vertebral column.	6. Notochord or vertebral column not found.
7.	Gill-clefts present at some stage of life.	7. These are never found.
8.	Alimentary canal placed always ventral to nerve cord.	8. It is always placed dorsal to the nerve cord.
9.	Anus well differentiated and opens before the last segment.	9. It is either not differentiated and whenever differentiated then opens on the last segment.
10.	Heart is placed ventrally, blood flows towards posterior direction in dorsal blood vessel.	10. When present placed dorsally, blood flows towards anterior direction in dorsal blood vessel.
11.	Haemoglobin, a respiratory pigment contained in red blood corpuscles.	11. Haemoglobin either absent or found dissolved in plasma; red blood corpuscles not found.
12.	Hepatic portal system present.	12. It is absent.
13.	Respiration either by gills or lungs.	13. It is either by general body surface, gills or trachea.
14.	Nervous system hollow; brain dorsal to pharynx in the head.	14. It is solid; brain either absent or above to pharynx.
15.	Nerve cord single, dorsal, and hollow without ganglia.	15. It is double, ventral, solid and usually with ganglia.
16.	Dorsal and ventral nerve roots are separate.	16. These are not separate.
17.	Mostly sexual reproduction occurs.	17. In some forms asexual reproduction is also common in addition to sexual reproduction.
18.	These are cold-blooded as well as warm-blooded.	18. All are cold-blooded.

* Phylum Chordata is divided into three subphyla: **Urochordata or Tunicata, Cephalochordata and Vertebrata.**



SUB-PHYLUM - UROCHORDATA OR TUNICATA

* In Urochordata, notochord is present only in larval tail, while in Cephalochordata, it extends from head to tail region and is persistent throughout their life.
* All the members of this subphylum are marine, free swimming or attached with rocks.
* Examples: Urochordata – Ascidia, Herdmania, Salpa, Doliolum; Cephalochordata – Branchiostoma (Amphioxus or Lancelet).
* Adults are normally fixed and larva is free swimming.
* All the adult members have test all over their body, made up of tunicin just like cellulose [tunicine = $C_6H_{10}O_5$] so these animals are also called tunicata. The test is secreted by specific cells of mesoderm.
* Notochord is found only in tail of tadpole larva. Tail is lost during metamorphosis. Chordate characters are found only in the tail region of tadpole larva, so the name Urochordata was given to this subphylum.
* Excretion is by super neural gland, pyloric gland and nephrocytes.
* Dorsal tubular nerve cord is found in nervous system, which is present only in larval stage. In adult stage, nerve cord is modified into a neural ganglion.
* Most of the animals are bisexual. Asexual reproduction is normaly by budding. Each gonad contains testis and ovary portion in it.
* Fertilisation is external and mostly cross-fertilisation.


Ascidia

* A free swimming larval stage is found in this group, just like tadpole of frog, it is also called tadpole larva.
* All the members of this subphylum show **Retrogressive metamorphosis**. During this metamorphosis, a well developed free swimming larva is changed into ill developed, fixed adult. In these animals larval stage is more developed. **Endostyle** absorbs iodine from water and is homologous to **thyroid gland** of mammals.
* **Larval tunicates** have typical chordate characteristics and superficially resemble tadpoles. The expanded body has a pharynx with slits, and the long muscular tail contains a notochord and a dorsal, tubular nerve cord. Some ..... *appendicularians*) retain their chordate features and ability to swim. These animals are common members of the zooplankton.

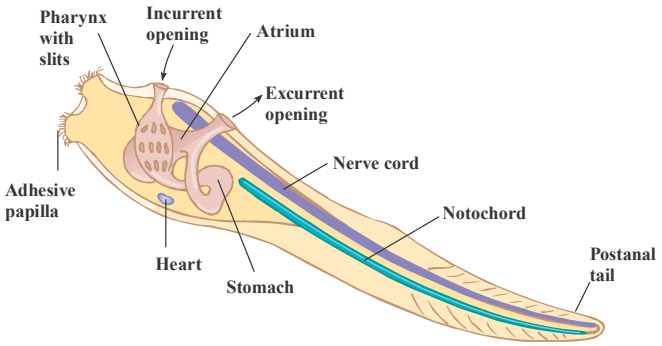


Figure : Internal structure of a larval tunicate (lateral view).

Example :
Herdmania - Sea - potato or sea - squirts.
Ascidia, Pyrosoma - Biolumniscene is found. (Strongest light among marine organism)
Doliolum **(Barrel shaped)**, ***Salpa***

* Blood vascular system is **open type** heart is **ventral**, tubular and **neurogenic shows alternate forward & backward.**
* Respiratory pigment is **Vanadium** in blood which is stored in purple blood corpuscles known as **Vanadocytes.** Absent in Herdmania.
* Excretion is by **supra neural gland, pyloric gland** and **nephrocytes.**
* Retrogressive metamorphosis occur in Urochordata.
* In adult tunicate notochord is not present.

Sub-phylum - CEPHALOCHORDATA

* Members of this subphylum are found in shallow **sea water.**
* Body is laterally compressed like fish, and is segmented.
* Head is absent, body is divided into trunk and tail.
* Paired appendages absent but middle layer fins are present.
* Alimentary canal **complete**. Buccal opening is covered by oral hood from all the four sides. Just beneath it, "**Wheel organ**" or "Ciliated organ of Mullar" present. This organ helps in the ingestion of food by producing circular currents in water.
* Blood vascular system is **closed type** and respiratory pigment absent.
* Fundamental chordate characters remain through out life. Larva and adult both show chordate characters.
* These are unisexual animals.
* Fertilisation is external.
* Development is indirect i.e. larval stage is found.
* Most cephalochordates belong to the genus *Branchiostoma*, which consists of animals commonly known as **lancelets**, or **amphioxus**. Lancelets are translucent, fish-shaped animals, 3 to 8 cm (1.3 to 3.2 in) long and pointed at both ends. They are widely distributed in shallow seas. Larvae can swim freely, but adults typically burrow in the sand in shallow water near the shore. In some parts of the world, lancelets are an important source of food.
* Notochord is present throughout the life in *Amphioxus*.

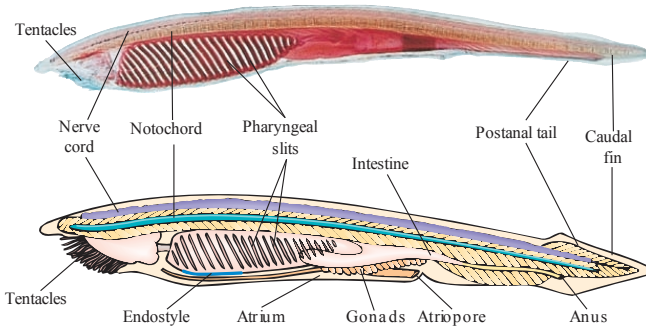
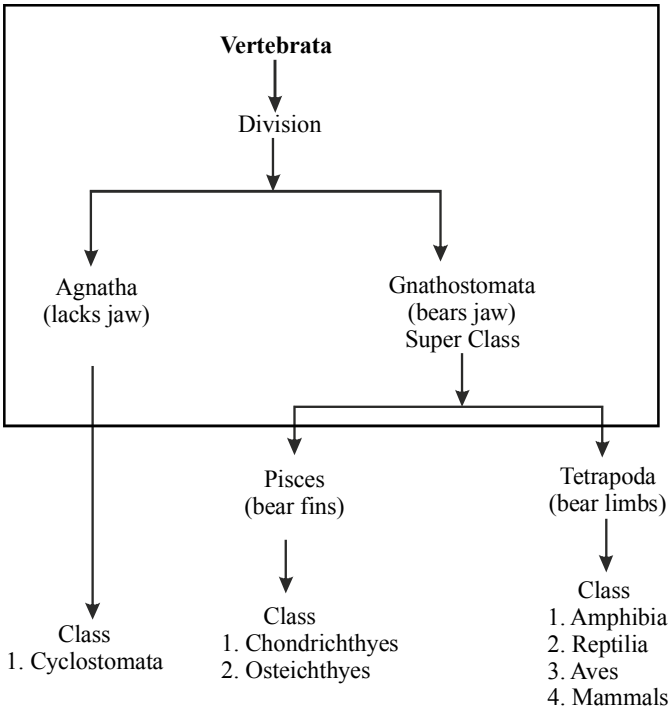


Figure : Cephalochordate body plan lancelet, Branchiostoma (amphioxus)

SUB-PHYLUM - VERTEBRATA

* The members of subphylum Vertebrata possess notochord during the embryonic period. The notochord is replaced by a cartilaginous or bony **vertebral column** in the adult. Thus all vertebrates are chordates but all chordates are not vertebrates. Besides the basic chordate characters, vertebrates have a ventral muscular heart with two, three or four chambers, kidneys for excretion and osmoregulation and paired appendages which may be fins or limbs.

The subphylum Vertebrata is further divided as follows:



* Some of the earliest known vertebrates, collectively referred to as **ostracoderms**, consisted of several groups of small, armored, jawless fishes that lived on the bottom and strained their food from the water. Thick bony plates protected their heads from predators, and thick scales covered their trunks and tails. Most ostracoderms lacked fins. They became extinct by the end of the Devonian period.

Golden Tips

* Venous heart is found in fishes.
* The vertebrate does not have cnidoblast.
* The dolphin found in Chilka lake is Irrawaddy dolphin.
* Egg of reptile and birds are polylecithal.
* Hag fish is not a true fish.
* In *Labeo* the notochord is replaced by bony vertebral column in the adult.

CLASS - CYCLOSTOMATA

* Mostly marine, except some fresh water species.
* These are **parasite** as well as **scavanger.**
* Also called as **Jawless fishes (false - fishes).**
* Body long, thin, tubular, tail is flat.
* Skin soft, smooth and scaleless.
* **Mouth** is rounded, sucker like and biting - eating type.
* **Three eyes** are found on the head, one medain **pineal eye** and two lateral eyes.
* Only one Nostril **(Monorhynous).**
* Internal ear contains **one** or **two semicircular canals.** Internal ear works as **statoreceptor** only. ie. Organ of balance.
* Gill clefts are **6** to **15 pairs.**
* Digestive system is without stomach. Intestine has **spiral typhlosole.**
* Notochord and vertebral column both are present. Cranium and Vertebral column is made up of **cartilage.**
* Bones are absent.
* Heart is two - chambered. It is called **Venous - heart.**
* Kidneys are **protonephric** or **mesonephric** type.
* Paired fins absent. Dorsal median and tail fin is present.
* Tail is **protocercal type**. In this type of tail, notochord is extended at the last end of tail and tail fin is divided into two equal dorsal and ventral lobes.
* Animals **unisexual**, fertilization **external**, larval stage absent,
* In Petromyzon - **Ammocoete** larva is present.

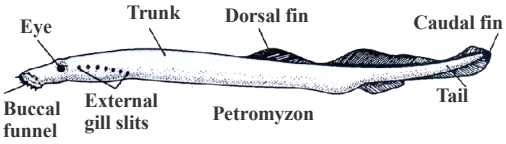
Petromyzon or *Lamprey*

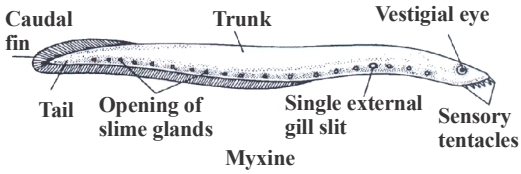
* It is a living fossil.
* Ectoparasite (Sanguivorous) on true fishes. Many teeth are found in mouth.
* Shows **Anadromous** migration.
* Larva **Ammocoete** is considered as connecting link between Cephalochordata and Cyclostomata.

Myxine or Hag fish :

* It has wrinkled lips just like an old woman.

* It usually remain attached with the gills of host.
* It has **Archaenephric kidney** in young ones i.e. which can filter blood and coelomic fluid.
* Petromyzon (Lamprey) and Myxine (Hagfish).





Gnathostomata :

* Mouth is surrounded by true jaws.
* Vertebral column well developed.
* Movement by paired fins or legs.
* Gonads are paired, genital ducts are present.
* 3 Semi circular canals are found in internal ear.
* Pineal eye is absent.
* Animals are unisexual.
* Gills or lungs are meant for respiration.
* Gnathostomata is classified into two super classes on the basis of locomotory organs, respiratory organs, heart and blood vascular system.

  Super Class : -[1] Pisces [2] Tetrapoda

Golden Tips

* Petromyzon is a jawless fish, which lays eggs in fresh water and whose ammocoetes larvae after metamorphosis return to the ocean.
* Lampreys and hag fishes comprises 'jawless fishes'.
* Petromyzon belongs to cyclostomata.
* Pancreas is absent in Cyclostomata.
* Ammocoete larva is of *Petromyzon.*

SUPER CLASS - PISCES

* This super class includes **true fishes.**
* "Devonian period" is called "Golden period of fishes"
* Study of fishes is lethyology.
* They are cold blooded **(Poikilothermous)** animals i.e., they lack the capacity to regulate their body temperature.
* Animals are **aquatic**, may be fresh water or marine.
* Body is long, boat shaped and stream lined, which is divided into head, trunk and tail. Neck is absent.
* Body is covered by **dermal scales**. But Cat fish, Torpedo & Wallagonia fish are **scale less.**
* Paired fins are present for swimming. e.g. Pectoral and pelvic fins are paired. Along with these unpaired fins are also found on the body e.g. mid dorsal fin and caudal fin.
* External **nares** are one pair. This condition is known as Dirtiynous condition.
* External and middle ears are absent only internal ear is present in which three semi-circular canals are present, which work as statoreceptor.
* Respiration by **gills**, gills are 4 to 7 pairs and naked or covered by operculum.
* Teeth are acrodont.
* Heart two chambered, known as "**Venous heart**", because it contains only impure blood, which goes to gills for purification from heart, pure blood is then distributed to all parts of body directly from gills. i.e. circulation of blood is unicircuit.
* RBC (Present in blood) are **nucleated**. Sinus venosus, renal and hepatic portal systems are found in circulatory system.
* Endoskeleton is made up of cartilage or bones.
* Vertebrae in fishes are **amphicoelus**, in which centrum is concave at both the surfaces.
* In the skull of fishes only one occipital condyle is present, so their skull is called monocondylar type.
* Cranial nerves are 10 - pairs.

* Lateral line sensory system is present in the body of fishes, which includes many receptor organs which can detect vibrations (Rheoreceptor) and Electric field.
* Kidneys in fishes are **mesonephric** type.
* Cartilagenous fishes excrete urea, Marine bony fishes excrete trimethylamine oxide and fresh watered fish exceret ammonia. Urinary bladder is absent.
* Fishes are **unisexual.**
* Fertilization is **internal or external.**
* Metamorphosis is direct i.e. larval stage is lacking during development.
* Small fishes (Baby fishes) are called **Fry or Hatchling.**
* Super class pisces classified into three classes :
  (a) Placodermi (b) Chondrichthyes
  (c) Osteichthyes

* In Catadromous migration fish move from fresh water to sea. Example - *Anguilla* (eel).
* In Anadromous migration fish move from sea to fresh water. Example - *Salmon, Hilsa*.
* In Remora or Sucker fish dorsal fin is modified into a sucker.
* Sucker fish remains attached to body of sharks, whales etc showing commensalism.
* Stone fish is most poisnous fish.
* **Some common fishes**

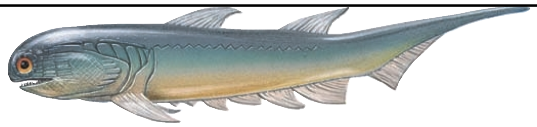
1. Rohu	*Labeo rohita*
2. Sardine	*Sardinops*
3. Singhi	*Aeropneustus*
4. Snake head	*Channa*
5. Magur, cat fish	*Clarias*
6. Salmon	*Salmo*
7. Herring	*Clupea*
8. King of Herrings, rat fish	*Chimaera*
9. Dog fish	*Scoliodon*
10. Sucker fish	*Echeneis, Remora*
11.Flying fish	*Exocoetus*
12. Sea horse	*Hippocampus*
13. Gold fish	*Carassius*
14. Eel	*Amphipnous*
15. Flat fish	*Pleuronectes*
16. Bow fin	*Amia*
17. Carp	*Cyprinus*
18.Electric ray	*Torpedo*
19.Globe fish	*Tetrodon*
20.Porcupine fish	*Diodon*
21. Lachi	*Wallago*
22.Tengra, Singhada	*Mystus*
23.African lung fish	*Protopterus*
24.American lung fish	*Lepidosiren*
25.Australian lung fish	*Neoceratodus*
26.Bombay duck	*Harpodon*

* **Major Classes of Fishes**

Class	Typical Examples		Key Characteristics	Approximate Number of Living Species
Placodermi	Armored fishes		Jawed fishes with heavily armored heads; often quite large	Extinct
Acanthodii	Spiny fishes		Fishes with jaws; all now extinct; paired fins supported by sharp spines	Extinct
Osteichthyes	Ray-finned fishes		Most diverse group of vertebrates; swim bladders and bony skeletons; paired fins supported by bony rays	20,000
	Lobe-finned fishes		Largely extinct group of bony fishes; ancestral to amphibians; paired lobed fins	7
Chondrichthyes	Sharks, skates, rays		Streamlined hunters; cartilaginous skeletons; no swim bladders; internal fertilization	850
Myxini	Hagfishes		Jawless fishes with no paired appendages; scavengers; mostly blind, but a well-developed sense of smell	43
Cephalaspidomorphi	Lampreys		Largely extinct group of jawless fishes with no paired appendages; parasitic and nonparasitic types; all breed in fresh water	17

CLASS - PLACODERMI

* In this class, **extinct** fishes (Fossil fish) are included, which use to live from devonian period to permian period. So these were the **first fresh water true fishes.**
* Their body was covered by **bony plates**, so these are called "**Armoured fishes**".
e.g. : ***Climatius*** - First jawed fish.



(a) An acanthodian. Climatius was a spiny-skinned acanthodian with large fin spines and five pairs of accessory fins between the pectoral and pelvic pairs. Climatius was a small fish that reached a length of 8 cm (3 in).

(b) A placoderm. Dinichthys was a giant placoderm that grew to a length of 8 m (26 ft). (Most placoderms were only about 20 cm, or 8 in, long.) Its head and thorax were covered by bony armor, but the rest of the body and tail were naked.

Figure : Early jawed fishes
Acanthodians and placoderms flourished in the Devonian period.

CLASS-CHONDRICHTHYES OR ELASMOBRANCHI

* This includes **cartilagenous fishes** i.e. endoskeleton is made up of **cartilage**.
* Fishes are generally **marine**.
* Exoskeleton over the skin is made up of **placoid** scales. These scales are like denticle and are originated from dermis of skin.
* In these fishes, **5 - 7 pairs** of gills are present, which open directly outside the body by gill slits, operculum is normally absent in these fishes, except is **chimaera** where operculum is present.
* Mouth is present at the **ventral surface** of head.
* **Suspensorium** of jaws is **Hylostylic type**.
* Air - bladder or lungs are absent.
* **Spiracles** present.
* A **spiral valve** or **scroll valve** is found in intestine.
* Cloacal aperture is present.
* There is special structure at the dorsal surface of head in these fishes, which is called **"Ampulla of Lorenzini"**, this works as **thermoreceptor.**

* Tail is **heterocercal** type.
* Genital ducts open into cloacal aperture.
* Fertilization is **internal** – male fishes have **"Claspers"** as copulatory organs, which are developed by the inner edges of pelvic fins.
* Fishes are oviparous or viviparous (few have yolk sac placenta).
* **Scoliodon : -** Dog fish - Dog like sense of smell. It is also known as **Indian shark - viviparous**
* ***Pristis* : -** Saw - fish

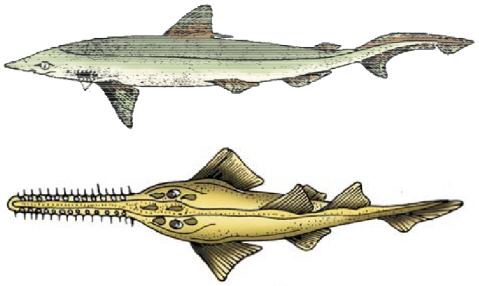


Figure : Example of Cartilaginous fishes: (a) *Scoliodon* (b) *Pristis*

* **Sphyrna/Zygaena -** Hammer headed shark
* **Stegostoma** - Tiger Fish / Zebra shark
* **Carcharodon -** great white shark
* **Rhinobatus -** Guitar Fish
* ***Trygon* : -** Sting ray - Its dorsal fin has poisonous spines.
* **Torpedo : - Electric ray -** In this fish an electric organ is found which is a modified muscle, it can give shock of about 100 volts. Scales are absent.
* **Rhinodon : -** Whale shark - It is the largest fish. Its length is 13 – 14 meters.
* **Chimaera : -** "Rat fish" or "King of herrings" or Ghost fish. Connecting link between bony & cartilagenous fish. Operculum present. Cartilage fish with operculum is placed under **holocephali** group.

Golden Tips

* *Torpedo* is a marine cartilaginous fish that can produce electric current.
* Jaw of shark contains acrodont teeth.
* Chondrichthyes is characterised by placoid scale and ventral mouth.

CLASS - OSTEICHTHYES OR TELEOSTOMI

* Includes **Bony fish**. **Endoskeleton** of these fishes is made up of **bones**.
* Found in fresh water as well as marine water.
* **Exoskeleton** is made up of scales, such as cycloid or ctenoid or ganoid type. Placoid scales are absent.
* Respiration by **4 - pairs** of gills. These are covered by **operculum**.
* Mouth is normally terminal or subterminal.
* Suspensorium of Jaw is **autosytylic**.
* Accessory respiratory organ **"air bladders"** is present. This helps in swimming as well as in respiration both.
* Spiracle is absent.
* Scroll valve in intestine is absent.
* Cloaca absent, in place of cloacal aperture **anus** is present.
* No Ampulla of Lorenzini.
* Tail is normally homocercal type but sometimes it may be **diphycercal** type.
* Genital ducts open outside the body through separate apertures.
* Fertilization is **external, claspers** are absent in male fishes.
* Fishes are **oviparous** but may be **ovoviviparous** or **viviparous**.
* ***Labeo*** "Rohu" or "Indian carp" - It is a fresh water fish.
* ***Clarias*** "Cat fish" or **magur**
* **Wallagon** Lachi (scale less)
* **Heteropneustis -** Singhi
* **Channa** – Lata Fish
* **Laphius** – Angler Fish
* ***Hippocampus*** -"Sea – horse" or "Pregnant male" It swims in water in its vertical position. A pouch like structure is present at the abdomen of male fishes known as "Brood - pouch" in this pouch male collects the eggs. Secondary vivipary and parental care is found in Hippocampus.

* ***Catla*** - Catla (Fresh water)

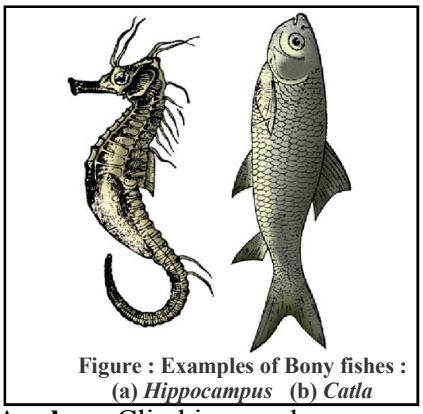


Figure : Examples of Bony fishes :
(a) *Hippocampus* (b) *Catla*

* **Anabas** - Climbing perch.
* **Sardinella** - Salmon
* **Acipensor** - Sturgeon - Endoskeleton is **cartilaginous.**
* ***Betta*** - Fighting Fish
* **Pterophyllum** - Angel Fish
* ***Exocoetus*** - Flying fish - Its dorsal fin is long, it can fly (glide) over 400 metre with the help of this fin.
* **Anguila** - Eel : - Snake like. migrate to sea for spawning. Young eel (Elver) migrate back to fresh water
* **Solea** - Flat fish
* **Fistularia** - Flute fish
* **Harpodon** - Bombay Duck
* **Amia** - Bow fish
* **Echeneis** (Remora) - Sucker fish. Shows commensalism with shark and whales. Dorsal fin modified into sucker.
* **Mystus** - Singhara
* **Cirrhinia** - Mrigal
* **Latimaria or coelacanth - Living fossil** – It is the **oldest living vertebrate** known till date. Belongs to group **Crossopterygii**.
* **Chenocephalus** - Ice fish only vetebrate without haemoglobin.
* **Opsanus** - Toad fish
* **Synanceja horrida** - Stone fish it is the most poisonous fish.
* **Gambusia** (Top minnow) - Larvivorous fish.

Dipnoi Group

* Fishes of dipnoi group are called **Lung-fishes** or **"Uncle of amphibia"** because lungs helps in respiration.
* Three chambered heart.
* External and internal both the nares are present.
* Their tail is **heterocercal** type, Scale is **cycloid** type.
* These are freshwater fishes.
* **Lepidosiren** : - South American lung fish. Respire though lungs only.
* **Protopterus : -** African lung fish : - It is living fossil fish. Paired lungs are present.
* **Neoceratodus : -** Australian lung fish. Respire by gills only. single lung is present which is used in stressful condition.
* **Shagreen** is dried skin of Cartilaginous fish.
* **Cod liver** oil is rich in Vitamin D, Shark liver oil is rich in Vitamin A
* **Maltese cross** is found in vertebra .of cartilaginous fishes such as shark.
* **Mermaid's purse** refers to Egg capsule of shark.
* **Isinglass** is a gelatinous product from air bladder of certain fish for making cement, Jelly & for cleaning of wine & beer.
* Smallest fish **Mystichthyes** - Goby fish - Pandaka (8 - 10 mm)

Golden Tips

* The body of rohu fish is covered by cycloid scale but the tail is homocercal.
* All bony fishes have four pairs of gills and an operculum on each side.
* Scientific name of rohu is *Labeo rohita.*
* Swim bladder is present in *Labeo.*
* Buoyancy in a bony fish is maintained with the help of swim bladder.
* In sea horse (*Hippocampus*) - brood pouch is present on belly of male for incubation of eggs (parental care).

SUPERCLASS – TETRAPODA

* Members of this superclass are found in water and on land.
* Locomotion by 2 pairs of **pentadactylous** limbs.
* Gills are present only in embryonic stages.

Main respiratory organ in adults is **lung**.

* Exoskeleton is made up of scales, feathers or hair.
* Endoskeleton is made up of **bones**.
* Heart is three or four chambered and **double circulation** is found in them.
* Kidneys are **mesonephric** or **metanephric** type.
* Middle ear is present. **Birds** and **mammals** have external ears also.
* Superclass - Tetrapoda is divided into four classes.

Class - **Amphibia**
Class - **Reptilia**
Class - **Aves**
Class - **Mammalia**

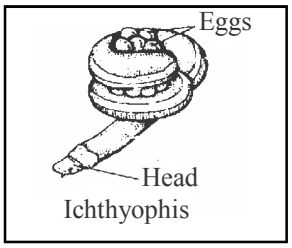
CLASS - AMPHIBIA

* As the name indicates (Gr., Amphi : dual, bios, life), amphibians can live in aquatic as well as terrestrial habitats.
* **Carboniferous** period is the golden age of Amphibians
* Class amphibia include animals which can live on both the places at ease i.e. — under water and on the land. (Never found in marine iater).
* These are the first chordate animals which came out of water but these are not able to live on land permanently. They depend on water for their reproduction. Their eggs do not have protecting covering to check the evoporation.
* These are cold blooded or **poikilothermal** animals.
* These animals undergo **hibernation** or **aestivation** to prevent themselve from extreme cold and heat and to overcome unfavourable conditions.
* Body is divided into **head** & **trunk.** Tail may be present in some. Neck is totally absent.
* Skin is **moist, smooth** and **scale less.**
* Numerous **mucus** glands are found in skin which help in moistening the skin, So these animals respire mainly through moist skin **(Cutaneous respiration).**
* Most of them have two pairs limbs. Forelimbs have four fingers and hindlimbs have five fingers.
* Mouth is bigger in size. Upper or both the jaws have teeth. These are **pleurodont, homodont** and **polyphyodont.** (Frog - Acrordont)
* A well developed, and **complete** alimentary canal along with digestive glands are present in digestive system (Salivary glands are absent in frog).
* Alimentary canal, urinary bladder and genital ducts open into a common chamber called **cloaca,** which opens to the exterior.
* Respiration by **gills, skin, lungs** or **buccopharyngeal** cavity.
* Heart is three chambered, 2 auricles and 1 ventricle (arteriovenous). Sinus venosus and Truncus arteriosus are well developed.
* R.B.Cs are **biconvex,** oval and **nucleated.**
* Renal portal system and hepatic portal **system** are present.
* 1 pair of kidneys are mesonephric or **opisthonephric** type. They are mostly **Ureotelic.** But tailed amphibians and larvas are**Ammonotellic.**
* Skull has two occipital condyles **(dicondylic skull).**
* Vertebrae, in these animals are **procoelus** type, in which centrum is **concave** from anterior side and **convex** from posterior **side.**
* A Tympanum represent the ear. Only one ear ossicle columella **(stapes)** is present in middle ear. External ear absent.
* Eyes have eyelids.
* Cranial nerves are **10 - pairs.**
* *Sexes* are separate.
* Fertilization is **external** and takes place in the **water,** but some animals show **internal** fertilization.
* These are **oviparous,** which lay their eggs in water.
* Development is **indirect through larva** i.e. **Tadpole larva** - In Frog,
Axolotal larva - In Salamander

This class is divided into three orders
(A) Gymnophiona or **Apoda**
(B) Caudata or **Urodela**
(C) Anura or salientia

(a) Order : Gymnophiona or Apoda

* These are **primitive limbless amphibians and** their **body** is worm like burrowing in nature.



* Scales present but embeded into skin. ***e.g.*** :- ***Ichthyophis*** **(caecilian)** Eyes covered by skin and tympanum absent. (blind or deaf worm)

(b) Order : Caudata or Urodela

* Body is distinctly divided into **head, trunk and tail (tailed amphibians).**
* Two pairs of equal **sized** limbs present. Usually exhibit neoteny i.e. retention of larval traits even during adult stage
* Example :

Salamandra : It is **viviparous**, its larva is called Axolotl larva. It sometimes show neoteny. (Longest gestation period 36 months)

Ambystoma - Tiger salamander (Axolotl larva)

Necturus - Water dog or mud puppy It shows **permanent neoteny.**

Amphiuma - Congo-eel-Largest RBC is present.

(c) Order : Anura or salientia

* Tail is absent in adult stage like frogs and toads **(Tailless amphibians).**
* Eyes with **lids, tear** glands present. (Lower lid movable & upper immovable).
* **Middle ear** and **Tympanic membrane present.**
* These have well developed **vocal sacs** i.e. power of voice.
* Fertilization **external** and development through tadpole larva.
* Examples: Bufo (Toad), Rana (Frog), Hyla (Tree frog), Salamandra (Salamander), Ichthyophis (Limbless amphibia)

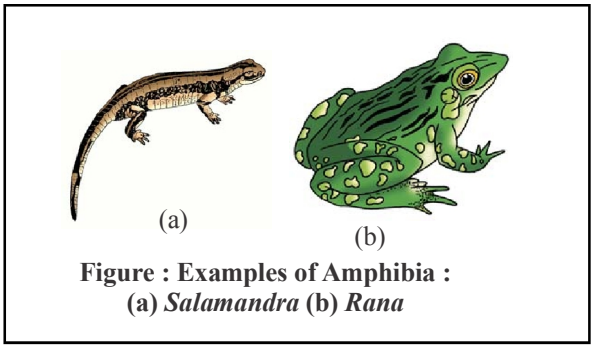


Figure : Examples of Amphibia : (a) *Salamandra* (b) *Rana*

* Frog has no parotid glands and toad has a pair of parotid glands.
* Disappearance of the tadpole tail during metamorphosis is brought about by lysosomes.
* Ichthyophis is a limbless amphibian.
* Limbless amphibians belong to the order gymnophiona.
* Axolotl larva shows neoteny, paedogenesis and absence of thyroxine affect metamorphosis.
* In *Scoliodon* (fish) the skin is tough containing minute placoid scales.
* A teleost fish can be differentiated externally from an elasmobranch by Operculum.
* Ampulla of Lorenzini in *Scoliodon* acts as Thermoreceptors.
* Surinam toad is *Pipa*.
* **Some common Amphibians**

1. Indian bull frog	*Rana tigrina*
2. Toad	*Bufo*
3. Tree toad, Tree frog	*Hyla*
4. Flying frog	*Rhacophorus*
S. Marsupial frog	*Gastrotheca*
6. Mid wife toad	*Alytes*
7. Mud eel	*Siren*
8. Mud puppy	*Necturus*
9. Newt	*Triton, Tritus*
10. Blind salamander	*Proteus*
11. Surinam toad	*Pipa*
12. Limbless amphibian	*Ichthyophis*

* Order **Urodela** ("visible tail") includes salamanders, mud puppies, and newts, all animals with long tails; order **Anura** ("no tail") is made

up of frogs and toads, with legs adapted for hopping; and order **Apoda** ("no feet") contains the wormlike caecilians.

* Although some adult amphibians are quite successful as land animals and live in dry environments, most return to the water to reproduce.
* Eggs and sperm are typically released in the water.

CLASS - REPTILIA

* Class name refer to creeping or crawling mode of Locomotion. (Latin reptum - To creep or Crawl)
* **Mesozoic era** was the Golden age of Reptiles.
* Study of reptiles is known as "**Herpetology**".
* These are **Cold blooded/Poikilothermal animals.**
* Reptiles were the **first successful terrestrial vertebrates** but some are also found in aquatic habitat.
* Body is divided into head, neck, trunk and tail.
* Exoskeleton is made up of horny **epidermal scales** or **scutes**.
* Skin is **dry**, **cornified, rough and nonglandular,** Snakes & Lizard shed their scales as skin cast.
* Limbs, when present are two pairs and each limb has five digits. Each digit has incurved nails. (Snakes are limbless).
* A complete alimentary canal is found in these animals, which opens into cloaca.
* Teeth are **acrodont, pleurodent** and **thecodont** type. Tounge is **protrusible.**
* Respiration occurs through **lungs** through out the life.
* Heart is usually **3 chambered but 4 chambered** in crocodiles, **right and left both systemic arches** are present.
* Sinus venosus is ill developed and trunkus arterious is absent. RBCs arc oval and **nucleated.**
* Only **one occipital** condyle is present in skull **(monocondyler** skull).
* Ribs are present in neck and thorax region.
* Centrum of vertebrae are **procoelous** type.
* One pair of **Metanephric** kidneys are present for excretion arid osmoregulation.

These animals are **uricotelic** for water conservation.

* Brain is well developed and **12** - pairs of cranial nerves present. They do not have external ear opening. Tympanum represent ear.
* Lateral line system is absent. At the roof of buccal cavity Jacobson's **organ** (olfactory) is present.
* Ureters, genital ducts and alimentary canal open into **a single cloacal aperture.**
* These are unisexual animals. Fertilization is **internal.**

One or two penis (Hemipenis) is found in male animals as copulatory organ.

* They are mostly **oviparous.**
* Eggs are leathery and cleidoic, i.e. eggs are covered by a shell made up of $CaCO_3$.
* Development direct i.e. larva stage is absent. Parental care is often marked.
* Class Reptilia is classified on the basis of presence or absence of **temporal fossae** in the temporal of skull and on their number.

Subclass - Anapsida :

* Temporal fossae are absent in the temporal region of the skull i.e. roof of skull is complete.

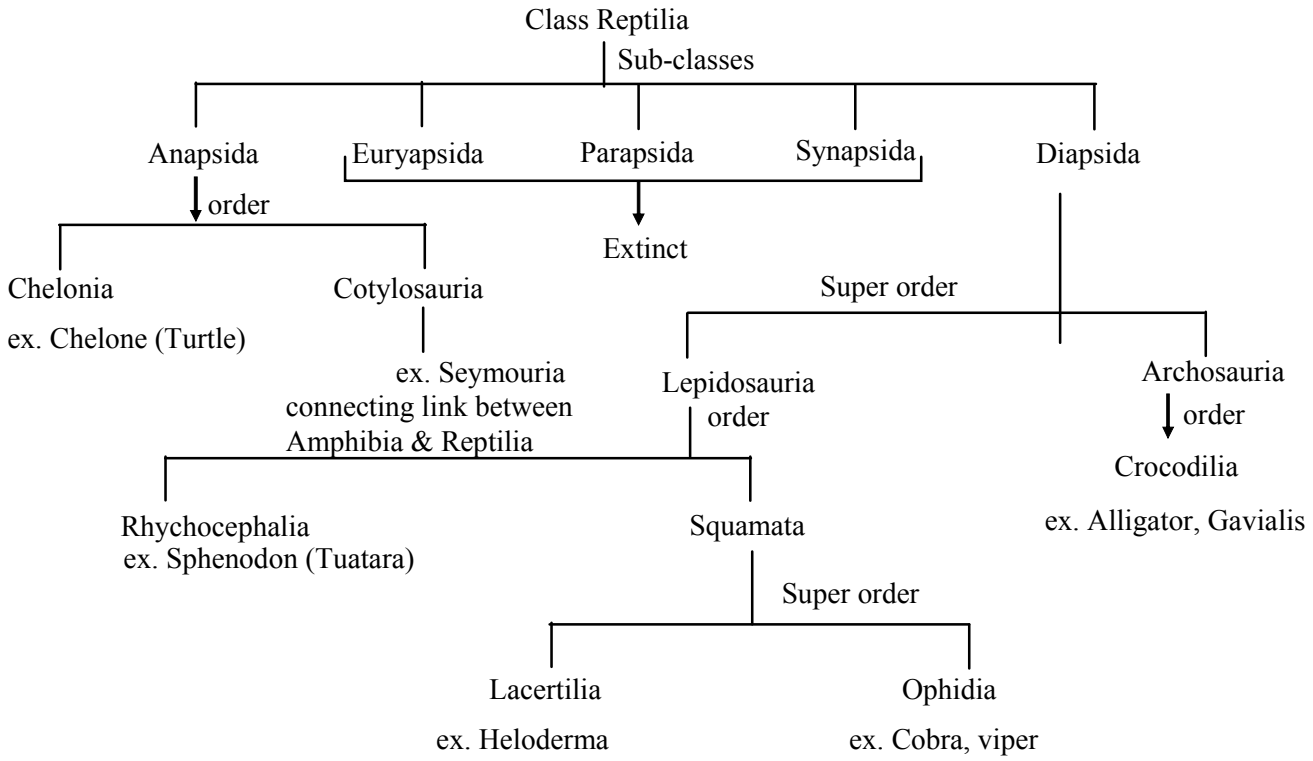
Order : **Chelonia**

* They are terrestrial, marine and fresh water animals.
* Whole body is covered by firm bony shell, dorsal plate is called **carapace** and ventral plate called **plastron.**
* Jaws are horny **beak like and teeth less.**
* Scales are found on **neck, limbs and tail.**

All these three organs can be pushed into the **carapace.**

* Thoracic vertebrae and **ribs** are attached with **carapace.**
* **Cloacal** aperture is vertical and it helps in respiration (cloacal respiration).
* Single copulatory organ is found in male animal.

e.g. ***Testudo*** : Land tortoise
Trionyx : Fresh water Terrapins (Edible)
Chelone : Marine Turtles
Kachhuga tactum : Roofed tectum.

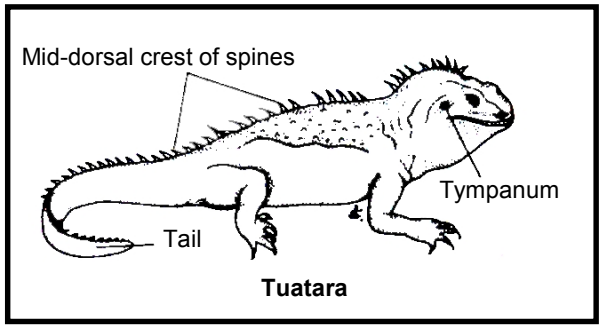


Sub-class - Diapsida

* One pair superior and one pair inferior temporal fossae are found in the temporal region of skull.

(a) Order : Rhynchocephalia

* Most of the species of this order are found in the form of fossils. (Extincted)
* Only **Sphenodon punctatum** species is live. It is found in New Zealand only.



Tuatara

* A functional third eye or pineal eye is found in the head.
* Teeth are acrodont type.

(b) Order - Squamata :

* All the lizards & snakes are included in this order (Largest order).
* Body is covered by epidermal scales.
* Vertebrae are procoelus type.
* Teeth are pleurodont, i.e. teeth are situated at lateral side of jaw bone.
* Copulatory organs are paired (hemipenis).

Lizards

* Study of lizards is called 'Saurology'.
* Eyelids are **movable** Lizards have limbs, urinary bladder, tymparum, girdles and nictitating membrane in the eye.
* **Foramen of panizzae** is present in the heart of lizard.

Example

1. ***Hemidactylus :*** Common lizard/**wall lizard**. It can shed its own tail at the time of emergency. It is called **autotomy**. Power of regeneration is well marked.
2. ***Calotes :*** Blood sucker/Garden lizard/Girgit. It can change its colour according to environment.
3. ***Draco :*** **Flying lizard**. It can glide from one tree to another tree with the help of lateral skin extensions called patagia.
4. ***Chameleon :*** **Tree lizard** (Viviparous)

5. ***Varanus :*** Goh or Monitor lizard. ***Varanus komodoensis*** -Komodo Dragon is the **Largest living lizard.**
6. ***Ophiosaurus :*** It is **limbless lizard**. It is also called **glass - snake.**
7. ***Heloderma :*** Gila - monster. It is the only poisonous lizard. Its poison glands are modified sublingual salivary glands.
8. ***Phrynosoma :*** Horned toad (viviparous)

Snakes

* The study of snakes is called **ophiology** or **serpentology**.
* Girdles and limbs absent (**Limbless**).
* Eyelids are immovable and nictitating membrane in eyes are absent.
* Urinary bladder **absent.**
* **Tympanum**, middle ear absent.
* Tongue thin, long and sensitive to odour and vibration.
* Left lung is ill developed.

1. ***Python molurus*** - **Ajgar**, the **largest non-poisonous snake** (25 feet). Rudiments of hind limbs are found on the body.
2. ***Ptyas mucosus / Zamenis*** or Rat snake. It is commonly called **Dhaman**. It feeds on rats, so it is also called "Friend of farmers. It is a **non-poisonous** snake.
3. ***Eryx Johni*** - **Sand** boa, **Dumuhi**, a non-poisonous snake.
4. ***Hydrophis*** - **Marine deadly poisonous**, tail is laterally compressed and viviparous snake.
5. ***Naja naja*** - **Indian cobra.** Poisonous snake (**Neurotoxic**).
6. ***Naja bungarus*** or ***N.Hannah*** - **King cobra**, poisonous snake. It is the largest snake among poisonous snakes (Head with one or two circular mark).
7. ***Bangarus*** - Krait : Poisonous snake (neurotoxic).
8. ***Vipera*** - Viper snake: Head is differentiated from body. Poisonous and viviparous snake. Its venom is **haemotoxic/Cardiotoxic. Loreal pit** is found which is a **thermoreceptor.**
9. ***Crotalus*** - It produces a characteristic rattling sound of "Rate - rate- rate", so it is called **rattle snake**. It is poisonous and ovoviviparous snake.

* Examples: Chelone (Turtle), Testudo (Tortoise), Chameleon (Tree lizard), Calotes (Garden lizard), Crocodilus (Crocodile), Alligator (Alligator). Hemidactylus (Wall lizard), Poisonous snakes - Naja (Cobra), Bangarus (Krait), Vipera (Viper).

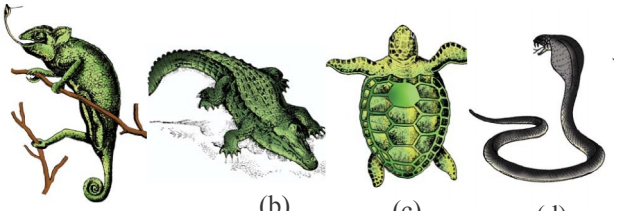


Figure : Reptiles : (a) *Chameleon*, (b) *Crocodilus*, (c) *Chelone*, (d) *Naja*

Golden Tips

* Reptilia have body covered with dry and cornified skin, scales over the body are epidermal, they do not have external ears.
* *Heloderma* is poisonous lizard.
* Venom of cobra attacks on nervous system.
* Calotes versicolor belongs to Class Reptilia.
* Syndactyly, prehensile tail and long protrusible tongue are the unique features of *Chameleon*.
* Venom of viper is haemotoxic.
* Venom of cobra is neurotoxic.
* Venom of sea snake is neurotoxic.
* In Reptiles, tympanum represents ear.
* **Some common Reptiles**

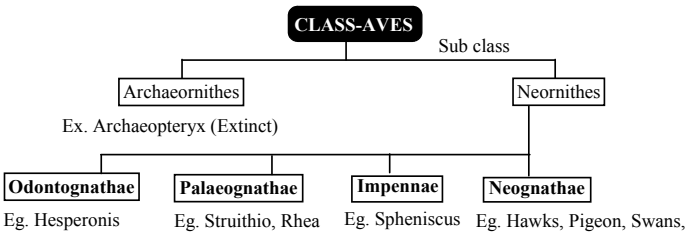
1. Wall lizard	*Hemidactylus*
2. Primitive lizard, Tuatara	*Sphenodon*
3. Poisonous lizard	*Heloderma*
4. Flying lizard	*Draco volans*
S. Garden lizard, girgit	*Calotes*
6. Indian cobra	*Naja naja*
7. King cobra	*Ophiophagus hannah*
8. Krait	*Bungarus*
9. Rattle snake	*Carotalus*
10. Rat snake, Dhaman	*Zamenis*
11. Blind snake	*Typhlops*
12. Class snake, Limbless lizard	*Ophisaurus*
13. Ajgar	*Python molurus*
14. Himalayan pit viper	*Ancistrodon*

* In reptiles, birds and mammals, All the three embryonic membranes **amnion, chorion** and **allantois** present in the embryo. Yolksac is also attached with embryo. these classes are grouped under **Amniota** group, so reptiles are first amniotes, while fishes and amphibians are grouped under Anamniota group because these extra embryonic membranes are absent in them.

CLASS - AVES

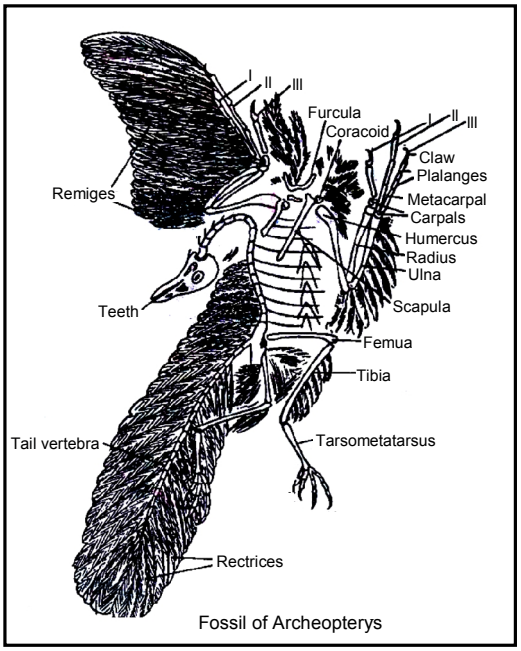
* Members of Class Aves are called "Masters of air".
* All types of **birds** are included in this class.
* Study of birds is known as '**Ornithology**'.
* **Dr. Salim Ali** was the great ornithologist of India and regarded as **"Birdman of India" .**
* Birds are also known as **"Feathered bipeds or glorified reptiles"**
* Birds are warm blooded or Homeothermic or endothermic **animals** i.e. Body temperature remains almost constant. (Approx 102°F)
* Body is boat shaped. It is divided into **head, neck, trunk** and **tail.** Neck is **long** and **flexible**.
* The characterstic features of birds are **presence of feathers all over the body** and most of them can fly except flightless bird. Feathers keep them warm and also makes body weight light. Feathers are modification of epidermal scales.
* Skin is **dry and without glands.** But oil glands or **Preen** glands are found on tail or **Uropygium**. These glands secrete oil, which lubricates feathers.
* Forelimbs are modified into wings, which help in flying.
* Hind limbs are best adapted for clasping the branches of trees or for perching or for walking swimming. Scales are found only on hind limbs.
* Digestive tract has additional chambers - the **crop and gizzard.**
* **Oesophagus** is modified into **Crop** for quick food ingestion and storage and **Gizzard** for crushing the food which is swallowed unmasticated. **Pigeon** or **crop milk** is secreted by **both sexes** (Crop product).
* A three chambered **cloaca** is present in the birds.
* Jaws are modified **into** horny beak **which is toothless**.
* **Spongy lungs** are present for respiration **Air sacs are also found.** Air sac connected to lungs suppliment respiration.
  Sound producing organ at the junction of trachea and bronchi of birds is called **syrinx.**
* Heart is four **chambered.** Double circulation is found.
* Hepatic portal system is well developed in birds, but renal portal system is ill developed. Sinus venosus is absent. Only **Right** aortic **arch is** present. R.B.Cs are **nucleated.**
* Endoskeleton is fully **ossified (bony).** Long bones are hollow, with air filled cavities and these bones are called **pneumatic bones**. These make the body light in weight and help in flying.
* Skull is **monocondylic.**
* **Centrum** of the vertebra is **heterocoelous**.
* **Last four caudal vertebra fuse** to form **pygostyle**. Which helps in wagging of tail.
* Sternum is large. Swollen basal part of sternum is called **"Keel"** This keel offers sites for attachment of **flight muscles.**
* Ribs of birds are **bifid and uncinate processes are present in ribs.**
* Two bones, **clavicle** and **interclavicle** fuse to form **V-shaped bone called furcula** or **Wish bone** or **Merry thought bone,** which act as a spring between two pectoral girdles.
* Pygostyle, Keel and Furcula are **absent** in flight less birds.
* Kidneys **metanephric**. Ureters open into **cloaca**. They are mostly **Uricotelic**.
* Most of the birds do not have **urinary bladder** and **copulatory organ**.
* Brain is large, smooth, highly developed. **Cerebellum is well developed for aerial mode of life.**
* Cranial nerves are **12 - Pairs.**
* Eyes are large and **nictitating membrane** is present in eye. Vision is **monocular**.
* A specific comb like structure **Pecten** is found in the eyes of all birds except kiwis. Pecten helps in accomodation of eye and provides nutrition to eye balls. **Acute vision** and **telescopic vision** of birds is due to pecten.

* External ears are present but ear pinnae are absent. Only one ossicle **columella** (Stapes) is found in middle ear.
* Olfactory organs are less - developed.
* Birds are **monodelphic** i.e. only left ovary and left oviduct is functional in females.
* Birds are **unisexual**. **Sexual dimorphism** is well marked. Copulatory organ absent in males.
* Fertilization is **internal**. They are oviparous and development is direct.
* All the birds form nests. **Parental care** is well marked.



(a) Subclass : Archaeornithes

* It includes extinct birds or toothed birds of Jurassic period.
* Wings are ill developed. ic. capacity of flying was very less.
* **Bones** were non-pneumatic.
* **Pygostyle** and keel were **absent**.
* There were present 3 - 3 clawed digits of forelimb at the free edges of wings.



Fossil of Archeopterys

* **Teeth** were present in the jaws of skull.
* They are considered as the **connecting links** between **reptiles** and **birds**.

e.g. ***Archaeopteryx*-Lizard bird**. (Extinct in Cretaceous period) Its fossil was discovered by Andreas Wagner in 1861 from Bavaria (Germany).

(b) Subclass : Neornithes

* This subclass includes mostly live animals and **extinct** animals of post jurassic period.
* Wings are well developed which are used in flying (except some birds)
* Bones are pneumatic.
* **Pygostyle** and **Keel** present.
* Digits of forelimbs are fused and claws absent.
* They have **toothless beak.**

This subclass is classified under three superorders

(i) Super order - Impennae

* It indudes **aquatic and marine birds.**
* Forelimbs are modified into **flippers** for swimming.
* **Sternum** without **keel**.

e.g.

- **Aptenodyts** - Penguin, also called "sea bird of Antarctica"

(ii) Super order - Palaeognathae or Ratitae

* It includes large and massive birds, which are flightless in nature.
* These are able to run fast. Wings are reduced or absent.
* Caudal vertebrae are free and **pygostyle** is absent.
* Sternum is **raft like** which lacks **Keel**.
* **Oil glands** or **preen glands** absent.
* Sound producing organ syrinx is absent.
* Usually urinary bladder and copulatory organ in males present. e.g.
* ***Struthio*** - African ostrich or Camel-bird - It is the **largest living bird** of modern period. It is almost 8 feet in height. Polygamous, male incubate the eggs (Largest eggs).
* ***Rhea***- American ostrich.
* ***Apteryx*** - Kiwi - It is National bird of New zealand. It has hair like feathers all over its body. It is smallest flightless bird.

* ***Dromaeus***- Emu - It is a monogamous bird in which only males look after their young ones and eggs.
* ***Casuarius*** - Cassowary - found in New Guinea/ Australia.

(iii) Super order - Neognathae or Carinatae

* It includes small sized **flight birds** of modern era. Wings are well developed.
* **Pygostyle** is present.
* **Keel** in sternum is highly developed.
* Oil glands or preen glands are found.
* Sound producing **syrinx** is present.
* Urinary bladder and copulatory organ absent. e.g.
  - ***Pavo-cristatus***- Peacock - It is the national bird of India.
  - ***Psittacula***- Indian parrot. (Upper jaw movable)
  - ***Columba livia***- Blue rock pigeon - Its crop glands secrete pigeon milk
  - ***Neophron***- Vulture (Scavenger bird)
  - ***Passer domesticus***- Sporrow - It shows commensalism with man.
  - ***Corvus splendens***- Crow
  - ***Diomedea***-**Albatross** - Marine bird with **largest wings** in Flying birds.
  - ***Helena***- Humming bird or sunbird. It is the smallest flying bird. It is found in cuba. It can fly in forward and backward both the drections.It can fly like helicoptor. Its size is about 3 to 4 cm.
  - ***Micropodus***-Pitohui/pathua - It is the only one poisonous bird, which is found in New guinea.
  - ***Swift spine tailed***- Fastest flying bird, it is found in Japan.
* Examples: Corvus (Crow), Columba (Pigeon), Psittacula (Parrot), Struthio (Ostrich), Pavo (Peacock), Aptenodytes (Penguin), Neophron (Vulture).

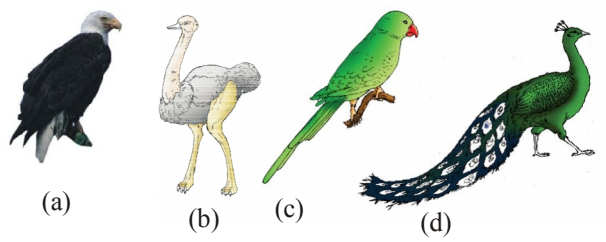


Figure : Some birds : (a) *Neophron*, (b) *Struthio*, (c) *Psittacula*, (d) *Pavo*

* **Migratory birds :**

Pluvianlis dominica - It is an American bird which migrates from south to north & from north to south.

Scolopax eusticola - It migrates from hill area to planes.

Himidyan partiges - It can fly over 6000 miles

Sterna parasisaea - Champion bird - Arctic to Antarctic and back.

* **Bird Sanctuary**

Keoladeo Ghana bird Sanctuary (largest) - Bharatpur (Rajasthan)

Sultanpur (Lake) bird Sanctuary - Gurgaon (Haryana)

Govind Sagar bird Sancturary - Bilaspur (Haryana)

Chilka lake bird Sancturary - Balagaon (Orrisa)

* **Feathers :**

There are different types of feather namely (1) Quill (filght feather) consists of (a) Remiges - feather of wings (b) Retrices - feather of tail (2) Coverts - small just like quill for filling gap on wings & tail. (3) Contours - small feather to cover the body (4) Filoplums - Beneath the contours (5) Down feather - Cover the body of newly hatched bird.

* Syrinx is the sound producing organ of bird.
* Pigeon is an oviparous organism.
* The dark colour of the breast muscles of birds of flight is due to presence in high concentration of myoglobin.
* Renal portal system is absent in birds.
* The scientific name of peacock is *Pavo cristatus.*
* Aves are homoiothermous.
* Study of birds – Ornithology.
* Study of nests of birds - Nidology.
* Famous ornithologist of India - Dr. Salim Ali. (Bird man of India).
* Largest bird - Ostrich (2m. tall, weight 136 kg.)
* Largest wing spread - Albatross, wing span is more than 3 metres.

* **Some common birds**

1. Weaver bird, baya	*Ploceus philippinus*
2. Swan	*Cygnus*
3. Swallow, bulbul	*Molpestes*
4. Wild duck	*Anas*
5. Starling	*Sturnus*
6. Albatross	*Diomedea*
7. House crow	*Corous splendens*
8. House sparrow	*Passer domesticus*
9. Parrot	*Psittacula*
10. Eagle	*Aquila*
11. Myna	*Acridotheres tristis*
12. Chuckor	*Aclectoris*
13. Koel	*Eudynamis*
14. Owl	*Bubo*
IS. Ostrich	*Struthio camelus*
16. Penguin	*Aptenodytes*
17. Dodo	*Raphus*

* Smallest bird- Humming bird of Cuba (less than 6 centimetres, weight - 4 gms.)
* Flightless birds - Emu, Kiwi, Ostrich, Cassowary, Penguin.
* Kiwi is smallest flightless bird.
* Birds have keen sense of sight but poor sense of smell.
* National bird of India - *Pavo cristatus* (Peacock).
* Cuckoo is the bird which lays its eggs in nests of other birds.
* Fastest flying bird - *Micropodus* (swift), Speed 200 miles/hour can cover a distance of 500 miles at a stretch.
* Arctic tern and Wagtail are some migratory birds of India.
* Longest annual migration is taken by Arctic tern.
* Great India Bustard (*Choriotis nigriceps*) is a large protected bird of India, found in desert of Rajasthan and Gujarat.

CLASS - MAMMALIA

* **Coenozoic era** (Recent) is **golden era of mammals**.
* Study of mammals is known as **Mammology**.
* The members of this class are **cosmopolitan** and found in a variety of habitats - polar ice, deserts, mountains, forest, grasslands and dark caves. Some of them adapted to fly or live in water.
* Mammals are **warm blooded** or **homeothermic** or endothermic animals.
* Body is divided into **head, neck, trunk** and **tail**.
* The most unique mammalian characterstic is the presence of milk producing glands (**mammary glands**) by which the young ones are nourished.
* A horizontal, **diaphragm** is present in between thorax and abdomen of all the members without any exception. Diaphragm helps in **respiration, defaecation, micturition** and **parturition**.
* The skin of mammals is unique in possessing **hair**.
* Skin of mammals is thick arid glandular. So many types of glands are present in the skin as **sweat glands**, **sebaceous glands** and **mammary glands**. (Mostly modified sweat gland)
* Two pairs of limbs are present in trunk. Limbs are **pentadactyl** which help in swimming, walking, running etc. **Hind limbs** are absent in some aquatic mammals.
* Alimentary canal is **complete**. Anus and urinogenital apertures are separate. Cloaca is absent.
* Teeth are **Thecodont** (embeded in boy sockets), **Heterodont** (different types) and mostly **Diphyodont** (comes twice).
* Respiration is by one pair of lungs (Enclosed in pleural cavity).
* **Larynx** or sound organ is found in the neck region for the production of sound.
* Heart **four chambered**. Double circulatory system is present. No sinus venosus. Only **left aortic** (systemic) arch present.
* RBCs small, circular and **enucleated**.
* Skull is **dicondylic**. Vertebrae are **acoelous** or **amphiplatyan type** i.e. centrum is flat and with cartilaginous pads at both the sides.
* Neck is having **7 cervical vertebrae except Bradypus/Sloth has 9 or 10** cervical vertebrae and **Sea -cow/Manatee** has 6 cervical vertebrae.
* Ribs are **bifid**. (Bicephalic)
* One pair of **Metanephric** kidneys are situated in abdominal cavity, They are **ureotelic**.
* Brain is comparatively large. **Cerebrum** and **cerebellum** are highly developed.

* A special structure is present for the connection of both the cerebral hemispheres of brain, that is called **corpus - callosum**. (Present only in higher mammals)
* Mid brain consists of 4 solid optic lobes collectively known as **corpora quadrigemina**.
* Cranial nerves are 12 - **pairs.**
* External ear is present in the form of **ear pinna**.
* **Malleus, Incus** and **stapes** are the three ear ossicles in middle ear.
* Mammals are **unisexual** animals. Testes of males are situated outside the abdominal cavity in the **scrotal sacs**. A distinct penis is present in males for copulation.
* Fertilization is **internal** and it takes place in **fallopian tubes**.
* Embryo is attached with the uterus of mother by placenta in higher mammals, so these animals are also called **placental** animals.
* Mostly mammals are **viviparous**, which give birth to their young ones. Some mammals are **oviparous** [Prototherians].
* Parental care is well marked in mammals. Mother feeds the child by milk secreted by her mammary glands and looks after her child.
* Examples: Oviparous-Ornithorhynchus (Platypus); Viviparous - Macropus (Kangaroo), Pteropus (Flying fox), Camelus (Camel), Macaca (Monkey), Rattus (Rat).

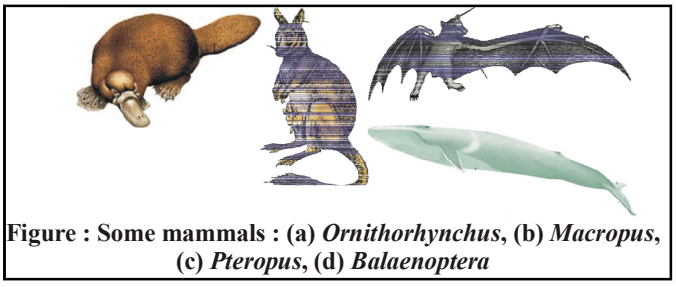


Figure : Some mammals : (a) *Ornithorhynchus*, (b) *Macropus*, (c) *Pteropus*, (d) *Balaenoptera*

* **Livings mammals are classified into following 3 groups.**

(i) Prototherians or Monotremes :

* It includes primitive reptile like **egg laying mammals.**
* Mammary glands are without nipples.
* **Gynaeomastism** is found in these animals. Mammary glands are functional in males and females both.
* **Cloaca** is present.
* **Testes** in males are situated inside the body as their body temperature is low.
* These are partially homeothermic animals.
* **Pinnae** are absent.
* **Corpus - callosum** is **absent** in brain.
* A toothless horny beak is found in adult animals, but teeth are present in child hood only (**Monophyodont**).
* They are found in Australia, New Guinea and Tasmania.
* These are considered : As Connecting links between **reptiles** and **mammals.**
  e.g. : ***Ornithorhynchus*** **(Duck billed platypus) Poison glands** are present in the claws of male platypus. It is oviparous mammal.
* Echidna / Tachyglossus (spiny **ant-eater**).

(ii) Metatherians or Marsupials

* An abdominal pouch called **marsupium** is found in these animals, in which immature young ones are kept after delivery.
* Mammary glands with **nipples** are situated in **marsupium.**
* **Two vagina, two clitoris** and **two uteri** are present in a **female** animal and bifid penis present in male.
* **Yolk sac** or false placenta are found.
* **Corpus callosum** is **absent**.

e.g.

* ***Macropus*** : Kangaroo - Found in Australia only. Saltatorial locomotion.
* ***Didelphys*** : **Opossum** - It has Shortest gestation period (12-13 days).

(iii) Eutherians :

* These are **true placental mammals**, that give birth to a mature baby. A true placenta is found, which provides both attachment and nutrition to baby.
* Nipples are well marked in mammary glands
* Uterus and vagina are single in in female.
* Corpus callosum is found in brain.


(a)


(b)


(c)

Three types of mammals.(a) This echidna, *Tachyglossus aculeatus*, is a monotreme. (b) Marsupials include kangaroos, like this adult with young in its pouch. (c) This female African lion, *Panthera leo* (order Carnivora), is a placental mammal.

Ex. of Euthrians

(1) **Pteropus (Flying fox) :** It is Frugivorous bat. These are true flying mammals. Ecolocation sensory system (Radar system) present. Their order is chiroptera.

(2) Camelus (Camel)

(3) Macaca (Monkey)

(4) Rattus (Rat)

(5) Canis (Dog)

(6) Felis (Domestic cat)

(7) Panthera leo = Lion

(8) Panthent tigris = Tiger (National Animal of India)

(9) Zalopus = Sea lion
Order of carnivorous mammal is **Carnivora**. They have digitigrade locomotion and Carnassial Teeth Their upper last premolar and lower first molar are modified for tearing the flesh, these are called carnassial Teeth.

(10) **Delphinus** = Common dolphin

(11) ***Balaenoptera musculus*** - Blue whale - Found in **Antarctic ocean**. A Horny sheet called **Baleen** plate (for filtration) is found in upper jaw instead of teeth. Milk is squirted down to the throat of baby by the muscle contraction of mother. **Retea mirabile** is found in thoracic region which helps in **respiration** in under water.

(12) ***Orcinus*** - Killer whale.

(13) ***Physeter*** - Sperm whale- From its stomach **Ambergris** is secreted which is used in making perfumes.
Order of fish like marine mammals is called **Cetacea** in which whale, dolphin are included. They have no hind limb, Hair, Ear Pinna.

(14) ***Elephas*** - Indian elephant

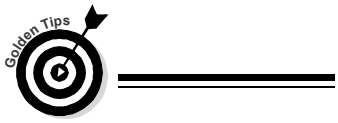
(15) ***Loxodonta*** - African elephant, it is the largest living land animal.

(16) **Horse = Equus [Odd toed animals]**

(17) **Rhinoceros = Single horn Genda**. It is found in Kaziranga National Park, Assam.

(18) **Hippopotamus = River horse.**

* **The Orders of Mammals :**
There are 19 orders of mammals. Seventeen of them (containing 94% of the species) are placental. The other two are the primitive monotremes and the marsupials.



* *Balaenoptera* and *Delphinus* are aquatic mammals.

* *Ornithorhynchus* is an oviparous mammal.

* Besides bats, echolocation sonar mechanism also occurs in Whales and dolphins.

* Pinnae are present in mammals.

* *Pteropus* (flying fox) belongs to the order Chiroptera.

* The character which differentiates mammals from birds is seven cervical vertebrae in neck.

* In *Balaenoptera* (Blue whale) milk is squirted down to the throat of body by muscular contraction of thorax of mother.

* Duck billed platypus is a connecting link between reptiles and mammals.

* Hair of mammals are derivatives of epidermis, made of keratin.

* Tusks of elephant are modified incisors.

* Platypus has teeth in young stage which are replaced by a fleshy membrane in adult.

* The only mammal which has poison glands in its skin is Ornythorhyncus (duck billed platypus).

* Cow, camel etc. are called rominants or cud-chewing mammals. Their stomach is four chambered and digestion of cellulose takes place here with the help of microorganisms.

* **Some common mamals**

1. Man	*Homo sapiens*
2. Chimpanzee	*Pan troglodytes*
3. Indian elephant	*Elephas maximus*
4. African elephant	*Loxodonta africana*
5. Dog	*Canis familiaris*
6. Cat	*Felis domesticus*
7. Horse	*Equus cabalus*
8. Ass	*Equus asinus*
9. Zebra	*Equus zebra*
10. Ox	*Bos indicus*
11. Buffalo	*Bubalus bubalus*
12. Lion	*Panthrea leo*
13. Tiger	*Panthera tigris*
14. Rhino	*Rhinoceros*
15. Pig	*Sus*
16. Sheep	*Ovis*
17. Indian monkey	*Macaca mulatta*
18. Gorilla	*Gorilla gorilla*

* Blue whales are the largest animals - upto 30 m long.
* The hairless mammal, in which milk is squirted down the throat of the body by the muscular contraction of the mother is whale.
* All mammals have movable lips except for whale.
* Gorillas do not drink water. Water in vegetation is sufficient for their needs.
* Presence of diaphragm is the character found in all mammals.
* The mammal in which no hind limbs are present is whale.
* **Plantigrade** foot is basic type of foot with five digits. Entire sole rests on ground while walking e.g., man.
* **Digitigrade** foot is with four toes and heel raised. Walk on digits, e.g., dog, cat.
* **Unguligrade** foot is with only one digit, walk on toes i.e, hooves which are homologous to toe nails.
* **Unguligrade** foot is most specialized foot e.g,. Horse, donkey, giraffe.
* A bat's heart beats 1000 times a minute during flight, but during hibernation it drops to only 20 beats per minute.
* Among living mammals, only monotremes lay shelled eggs.
* In marsupials, a fertilized egg is surrounded by chorion and amniotic membranes, but no shell forms around the egg as it does in monotremes.
* Marsupials evolved shortly before placental mammals, about 100 million years ago.
* Of the 19 orders of living mammals, 17 are placental mammals.

CONCEPT REVIEW

* Members of **kingdom Animalia** are eukaryotic, multicellular, heterotrophic organisms with cells specialized to perform specific functions. Typically, they are capable of locomotion at some time during their life cycle, can respond adaptively to external stimuli, and can reproduce sexually.
* In sexual reproduction, sperm and egg unite to form a **zygote** that undergoes **cleavage**. Multiple cell divisions result in the development of a hollow ball of cells, a **blastula**. The blastula undergoes gastrulation, forming embryonic tissues.
* Many biologists have used the type of **body plan**, the basic structure of the body, to infer evolutionary relationships. For example, they hypothesized that cnidarians and ctenophores were closely related because they share **radial symmetry**; most other animals are **bilaterally symmetrical**, at least in their larval stages. However, analysis of more recent data suggests that cnidarians and ctenophores are not closely related. Adult echinoderms also have radial symmetry and are not related to these groups.
* Biologists have also inferred relationships based on level of tissue development and type of body cavity. Embryonic tissues, called **germ layers**, include the outer **ectoderm** which gives rise to the body covering and the nervous system; the inner, **endoderm**, which lines the gut and other digestive organs; and a middle, **mesoderm**, which gives rise to most other body structures.
* **Triploblastic** animals have traditionally been classified as **acoelomate** (no body cavity), **pseudocoelomate** (body cavity not completely lined with mesoderm), or **coelomate**, those with

a true **coelom,** a body cavity completely lined with mesoderm. Recent data indicate pseudocoelomate animals do not form a natural group and probably evolved from coelomate ancestors.

* Two major evolutionary branches of coelomates are **Protostomia** (mollusks, annelids, arthropods) and **Deuterostomia** (echinoderms and chordates). In protostomes the blastopore develops into the mouth; in deuterostomes the blastopore typically becomes the anus.
* Phylum **Porifera** consists of the sponges, animals characterized by flagellate **collar cells** (choanocytes). Sponges are the only members of the Parazoa.
* The sponge body is a sac with tiny openings through which water enters; a central cavity, or **spongocoel**; and an open end, or **osculum**, through which water exits. The cells of sponges are loosely associated; they do not form true.
* Phylum **Cnidaria** is characterized by radial symmetry, two tissue layers, and **cnidocytes**, cells that contain stinging organelles called **nematocysts**. The **gastrovascular** cavity has a single opening that serves as both mouth and anus. Nerve cells form irregular, nondirectional nerve nets that connect sensory cells with contractile and gland cells.
* The life cycle of many cnidarians includes a sessile **polyp** stage and a free-swimming **medusa** stage.
* Phylum Cnidaria includes three main classes. Class **Hydrozoa** (hydras, hydroids, and the Portuguese man-of-war) are typically polyps and may be solitary or colonial. Class **Scyphozoa** (the jellyfish) are generally medusae. Class **Anthozoa** (sea anemones and corals) are polyps and may be solitary or colonial; anthozoans differ from hydrozoans in the organization of the gastrovascular cavity.
* Phylum **Ctenophora** consists of the comb jellies, which are fragile, luminescent marine predators with bi-radial symmetry, and eight rows of cilia that resemble combs. They are diploblastic and have tentacles with adhesive glue cells.
* **Unique features of Porifera :**
  - Pores all over the body.
  - Cellular level of body organisation.
  - A canal system of intercommunicating cavities for the passage of a water current.
  - Lack of mouth and digestive cavity.
  - Choanocytes lining the main cavity (spongocoel) or certain canals (radial canals).
  - Presence of spongin fibres.
* **Unique features of Coelenterata**
  - Tissue level of organisaton of the body.
  - Special stinging cells, the cnidoblats, for defence and offence.
  - Epitheliomuscular cells with a dual role of epithelium and musculature.
  - Incomplete digestive tract bounded by body wall.
  - A simple nervous system in the form of a network of nerve cells and fibres.
  - Simple gonands without gonoducts.
* **Unique features of Ctenophora**
  - Skeletal, Excretory and Respiratory systems are Absent.
  - Animals are carnivorous. They feed on the eggs and larvae of Molluscs, fishes and crustaceans. A pair of long solid tentacles are present. In place of nematablasts on the tentacles a special type of cells are present called Lasso-cells which help in catching the prey. Anus is absent.
  - All animals are Bisexual .Complex type of sexual reproduction is found. Metagenesis is absent. Regeneration is normally found. Development is of indirect type. Life cycle involves a free living Cydippid larval stage. Cleavage is Holoblastic determinate and unequal.
  - Asexual reproduction is absent.
* **Unique features of Platyhelminthes**
  - Bilateral symmetry.
  - Organ-system level of organization.
  - Head with sense organs at the front end.
  - Three germ layers,
  - Muscle layers both in the body wall and gut
  - Brain ring and nerve cords,
  - Organised excretory system, and
  - Gonoducts and copulatory organs.
* **Unique features of Aschelminthes**
  - Syncytial epidermis.
  - Body wall musculature of longitudinal fibres only.
  - Pseudocoel, a body cavity without a lining of mesodermal coelomic epithehum.
  - Complete digestive tract

- Fluid-filled body cavity
- Separate sexes.

* **Unique features of Annelida**
- To suck impure blood by leach is called Phlebotomy.
- Metameric segmentation
- Nephridia for excretion and osmoregulation.
- Closed circulatory system with respiratory pigment dissolved in the plasma.
- Setae in the body wall in most forms.
- Head, appendages and respiratory organs in some cases,
- Ciruclar and longitudinal muscles in both body wall and gut wall.

* **Unique features of Arthropoda**
- Jointed appendages modified for a variety of functions.
- Tough, jointed exoskeleton of chitinous plates.
- Tracheae for respiration in majority of cases.
- Compound eyes.
- Malpighian tubules for excretion.
- Power of flight in most insects.
- Striped muscles arranged in bundles for moving particular parts,

* **Unique features of Mollusca**
- Three body regions: head, visceral mass and foot.
- A glandular fold, the mantle, over the body.
- Mantle cavity with anal, excretory and genital apertures in it.
- Calcareous shell around the body in most cases.
- A rasping organ, the radula, in the buccal cavity.
- Much better sense organs, such as eyes, statocysts, osphradia, etc.

* **Unique features of Echinodermata**
- Bilateral symmetry in the larva and radial symmetry in the adult.
- Mesodermal endoskeleton of calcarous plates, usually with spines.
- Modification of a part of the coelom into a water vascular system for aid in locomotion.
- Characteristic tube feet for locomotion.
- Peculiar pedicellariae for cleaning the body surface.

* **Characteristic features of Chondrichthyes :**
- These are marine animals with streamlined body and have cartilaginous endoskeleton.
- Mouth is located ventrally. Gill slits are separate and without operculum.
- In males, pelvic fins bear claspers, e.g., *Scoliodon* (dog fish).

* **Characteristic features of Osteichthyes**
- It includes both marine and fresh water fishes with body endoskeleton.
- The body is streamlined with terminal mouth.
- Skin is covered with cycloid/ctenoid scales.
- Air bladder is present which regulates buoyancy. e.g., *Exocoetus* (flying fish), *Labeo* (rohu).

* **Characteristic features of Urochordata :**
- Notochord is present only in larval tail. These are marine animals, e.g., *Ascidia, Salpa*, etc.

* **Characteristic features of Cephalochordata:**
- The notochord extends from head to tail region and is persistent throughout their life, e.g., *Branchiostoma* or Lancelet.

IMPORTANT POINTS

* *Hydra* has radial symmetry
* Fish has bilateral symmetry.
* *Hydra* is diploblastic.
* *Fasciola is* triploblastic.
* Protozoa - single celled animals
* Parazoa - Multicellular without tissue grade (sponges).
* Eumetazoa - Multicellular with tissue grade.
* Porifera includes the sponges.
* Presence of canal system is the characteristic feature of Porifera.
* Cnidaria or Coelenterates are diploblastic.
* Phylum Cnidaria (Coelenterata) possess nematocysts.
* The flatworms are first triploblastic animals.
* *Spongilla* is a fresh water sponge.
* Free-living flatworm is *Planaria.*
* The parasitic tapeworms do not have an alimentary canal because the digested food of the host is diffused directly through the general body surface.
* The symmetry in echinoderm larvae is bilateral
* The characteristic cells of coelenterates : Cnidoblasts or stinging cells.
* Cells the flatworms have for excretion : Flame cells.
* The first phylum including the triploblastic animals. Platyhelminthes.

* Phylum in which body cavity appeared for the first time : Aschelrninthes
* Segmented mollusca : *Neopilina.*
* Urochordates or Tunicates are mostly sessile and exclusively marine.
* Urochordata show retrogressive metamorphosis.
* Cephalochordates are small fish-like animals showing main chordate characters.
* *Balanoglossus* belongs to Hemichordata.
* *Petromyzon* (Lamprey) is a jaw-less vertebrate.
* Sharks and rays belong to Chondrichthyes.
* *Labeo* (Rohu), *Catla* (Katla) belongs to Osteichthyes.
* Osteichthyes include a large assemblage of true bony fishes. Their endskeleton is entirely bony.
* Poisonous snakes ; Cobra, Krait, Viper; Non-poisonous snakes ; *Python, Natrix* (Water snake).
* Amphibians are cold blooded vertebrates.
* Reptiles are cold blooded, true terrestrial vertebrates.
* Aves (birds) are warm blooded vertebrates.
* Mammals are tetrapod vertebrates.
* *Calotes versicolor* (Garden lizard) is well-known for changing colours.
* *Struthio* (Ostrich), *Apteryx* (Kiwi) are flightless birds.
* Hooks and suckers are present in parasitic platyhelminthes.
* **Animals** — **Locomotory Organ**
  Octopus : Tentacles
  Crocodile : Limbs
  Catla : Fins
  Ctenoplana : Comb plates
* **Animal** — **Characteristics**
  Pila : Presence of shell
  Cockroach : Jointed appendages
  Asterias : Water vascular system
  Torpedo : Placoid scales
  Parrot : Perching
  Dog fish : Electric organ
* **Animal** — **Excetory Organ/Unit**
  Balanoglossus : Proboscis gland
  Leech : Nephridia
  Locust : Malpighian tubule
  Liver fluke : Flame cells
  Sea urchin : absent
  Pila : Metanephridia
* Some animals that are found parasitic on human beings.

S.No.	Name of organism	Phylum
1.	*Taenia solium*	Platyhelminthes
2.	*Fasciola hepatica*	Platyhelminthes
3.	*Ascaris lumbricoides*	Aschelminthes
4.	*Wuchereria bancrofti*	Aschelminthes
5.	*Ancyclostoma*	Aschelminthes

* The largest RBCs are seen in *Amphibia*.
* Heart is four chambered in crocodile.
* Dolphin is not exclusively marine.
* Platypus lays eggs.
* True coelom is evolved in annelida.
* Coral belongs to phylum cnidaria.
* Metameric segmentation is the characteristic of annelida and arthropoda.
* *Nereis*, scorpion, cockroach and silver fish are all invertebrates and thus possess dorsal heart.
* Parrot (bird), platypus and kangaroo (mammals) are homoiothermic animals.
* **Animals** — **Morphological features**
  Crocodile : 4-chambered heart
  Obelia : Metagenesis
  Lemur : Thecodont
* Sea horse (*Hippocampus*) and flying fish (*Exocoetus*) belong to class osteichthyes of super class pisces. They have two chambered heart (one auricle and one ventricle) and are cold blooded animals.
* *Planaria* possesses high degree of regeneration.
* *Trichinella spiralis* is a minute nematode parasite that shows viviparity i.e., produces live youngs (larvae) not eggs.
* The protochoradates are considered as the fore runners of vertebrata.
* The vertebrates with two pairs of limbs adapted for locomotion on land are known as tetrapods.
* The tetrapods are identified by a cornified outer layer of skin and nasal passages communicating with mouth cavity and lungs.
* **National Bird :**
  The Indian peacock, *Pavo cristatus*, the national bird of India, is a colourful, swan-sized bird, with a fan-shaped crest of feathers, a white patch under the eye and a long, slender neck.

The male of the species is more colourful than the female, with a glistening blue breast and neck and a spectacular bronze-green tail of around 200 elongated feathers. The female is brownish, slightly smaller than the male and lacks the tail.

* **National Animal :**

The magnificent tiger, *Panthera tigris* is a striped animal. It has a thick yellow coat of fur with dark stripes. The combination of grace, strength, agility and enormous power has earned the tiger its pride of place as the national animal of India. Out of eight races of the species known, the Indian race, the Royal Bengal Tiger, is found throughout the country except in the north-western region and also in the neighbouring countries, Nepal, Bhutan and Bangladesh. To check the dwindling population of tigers in India, 'Project Tiger' was launched in April 1973. So far, 27 tiger reserves have been established in the country under this project, covering an area of 37,761 sq km.

* **National Aquatic Animal :**

River Dolphin is the National Aquatic Animal of India. The Ministry of Environment and Forests notified the Ganges River Dolphin as the National Aquatic Animal on 18th May 2010. River Dolphins are solitary creatures and females tend to be larger than males. They are locally known as susu, because of the noise it makes while breathing. This species inhabits parts of the Ganges, Meghna and Brahmaputra rivers in India, Nepal, Bhutan and Bangladesh, and the Karnaphuli River in Bangladesh. River dolphin is a critically endangered species in India.

* **Organ information of various Phylum/Class**

Phylum/ Class	Excretory Organ	Circulatory Organ	Respiratory Organ
Arthropoda	Malpighian tubules	Open	Lungs/ Gills/ Tracheal System
Annelida	Nephridia	Closed	Skin/ parapodia
Mollusca	Metanephridia	Open	Gills
Amphibia	Kidneys	Closed	Lung

Differences between Polyp and Medusa,

	Polyp		*Medusa*
(i)	Fixed, rarely free.	(i)	Free-swimming.
(ii)	Body cylindrically elongated.	(ii)	Body umbrella like.
(iii)	Base attached below so that manubrium is directed upwards	(iii)	Base above so that manubrium hangs downwards.
(iv)	Tentacles normally 24 and develop from the base of the manubrium.	(iv)	Sixteen tentacles in young and numerous in adult and they develop from the margin.
(v)	Mouth circular	(v)	Mouth rectangular
(vi)	Without gonads	(vi)	With four gonads on radial canals
(vii)	It is mainly a nutritive zooid	(v)	It is a sexual zooid which carry gonads to be released on maturation and also help in dispersal of species.

* Salient Features of Different Phyla in the Animal Kingdom

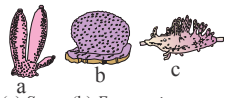
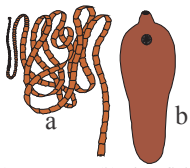
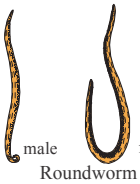
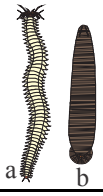
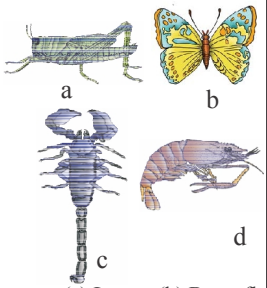
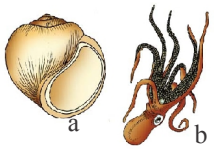
Phylum	Level of Organisation	Symmetry	Coelom	Segmentation	Digestive System	Circulatory System	Respiratory System	Distinctive Features	Examples
Porifera	Cellular	Various	Absent	Absent	Absent	Absent	Absent	Body with pores and canals in walls.	 (a) *Sycon* (b) *Euspongia* (c) *Spongilla*
Coelenterata (Cnidaria)	Tissue	Radial	Absent	Absent	Incomplete	Absent	Absent	Cnidoblasts present.	 (a) *Aurelia* (Medusa) (b) *Adamsia* (Polyp)
Ctenophora	Tissue	Radial	Absent	Absent	Incomplete	Absent	Absent	Comb plates for locomotion.	 Ctenophora *(Pleurobrachia)*
Platyhelminthes	Organ & Organ-system	Bilateral	Absent	Absent	Incomplete	Absent	Absent	Flat body, suckers.	 (a) Tape worm (b) Liver fluke
Aschelminthes	Organ-system	Bilateral	Pseudo coelomate	Absent	Complete	Absent	Absent	Often worm-shaped, elongated.	 Roundworm
Annelida	Organ-system	Bilateral	Coelomate	Present	Complete	Present	Absent	Body segmentation like rings.	 (a) *Nereis* (b) *Hirudinaria*
Arthropoda	Organ-system	Bilateral	Coelomate	Present	Complete	Present	Present	Exoskeleton of cuticle, jointed appendages.	 (a) Locust (b) Butterfly (c) Scorpion (d) Prawn
Mollusca	Organ-system	Bilateral	Coelomate	Absent	Complete	Present	Present	External skeleton of shell usually present.	 (a) *Pila* (b) *Octopus*

Table Major Orders of Mammals

Order	Typical Examples		Key Characteristics	Approximate Number of Living Species
Rodentia	Beavers, mice, porcupines, rats		Small plant-eaters Chisel-like incisor teeth	1814
Chiroptera	Bats		Flying mammals Primarily fruit- or insect-eaters; elongated fingers; thin wing membrane; nocturnal; navigate by sonar	986
Insectivora	Moles, shrews		Small, burrowing mammals Insect-eaters; most primitive placental mammals; spend most of their time underground	390
Marsupialia	Kangaroos, koalas		Pouched mammals Young develop in abdominal pouch	280
Carnivora	Bears, cats, raccoons, weasels, dogs		Carnivorous predators Teeth adapted for shearing flesh; no native families in Australia	240
Primates	Apes, humans, lemurs, monkeys		Tree-dwellers Large brain size; binocular vision; opposable thumb; end product of a line that branched off early from other mammals	233
Artiodactyla	Cattle, deer, giraffes, pigs		Hoofed mammals With two or four toes; mostly herbivores	211
Cetacea	Dolphins, porpoises, whales		Fully marine mammals Streamlined bodies; front limbs modified into flippers; no hind limbs; blowholes on top of head; no hair except on muzzle	79
Lagomorpha	Rabbits, hares, pikas		Rodentlike jumpers Four upper incisors (rather than the two seen in rodents); hind legs often longer than forelegs; an adaptation for jumping	69
Pinnipedia	Sea lions, seals, walruses		Marine carnivores Feed mainly on fish; limbs modified for swimming	34
Edentata	Anteaters, armadillos, sloths		Toothless insect-eaters Many are toothless, but some have degenerate, peglike teeth	30
Perissodactyla	Horses, rhinoceroses, zebras		Hoofed mammals with one or three toes Herbivorous teeth adapted for chewing	17
Proboscidea	Elephants		Long-trunked herbivores Two upper incisors elongated as tusks; largest living land animal	2

QUESTION BANK

EXERCISE - 1 (LEVEL-1) [NCERT EXTRACT]

SECTION - 1 (VOCABULARY BUILDER)

Choose one correct response for each question.

For Q.1-Q.6

Match the column I with columnII .

Q.1

	Column I		Column II
(a)	Asymmetrical.	(i)	Refers to body that cannot be divided into two equal halves in any direction.
(b)	Bilateral symmetry.	(ii)	Refers to the body that can be divided into two similar parts in one direction only.
(c)	Radial symmetry	(iii)	Refers to symmetry in which body can be divided into two equivalent halves if they are cut through any of the radial planes.

(A) (a) - i, (b)-ii, (c)-iii (B) (a) - iii, (b)-ii, (c)-i
(C) (a) - ii, (b)-i, (c)-iii (D) (a) - i, (b)-iii, (c)-ii

Q.2

	Column I		Column II
(a)	Acoelomate	(i)	Animals without body cavity.
(b)	Coelom.	(ii)	Cavity lined by mesoderm.
(c)	Coelomate	(iii)	The body cavity filled with blood.
(d)	Pseudocoelom	(iv)	A body cavity not completely lined with mesoderm.
		(v)	Animals with true body cavity or coelom.

(A) (a) - iii, (b)-ii, (c)-i, (d)-v
(B) (a) - i, (b)-ii, (c)-iii, (d)-iv
(C) (a) - i, (b)-ii, (c)-v, (d)-iv
(D) (a) - ii, (b)-i, (c)-iv, (d)-v

Q.3

	Column I		Column II
(a)	Diploblastic	(i)	Derived from two embryonic germ layers, ectoderm & endoderm.
(b)	Triploblastic	(ii)	Derived from three primary germ layers- ectoderm, mesoderm and endoderm.
(c)	Mesoglea	(iii)	Germinal layer between ectoderm & endoderm.
(d)	Mesoderm	(iv)	Undifferentiated layer present between ectoderm and endoderm.

(A) (a) - i, (b)-ii, (c)-iii, (d)-iv
(B) (a) - i, (b)-ii, (c)-iv, (d)-iii
(C) (a) - iii, (b)-ii, (c)-i, (d)-iv
(D) (a) - iv, (b)-iii, (c)-ii, (d)-i

Q.4

	Column I		Column II
(a)	Nephridia	(i)	Small tiny apertures present all over the body wall of sponge. These act as inhalent siphons.
(b)	Osculum	(ii)	Relatively large external opening of the central cavity (spongocoel) through which water leaves the sponge. It acts as exhalent siphon.
(c)	Ostia	(iii)	Tubular excretory structure characteristic of many invertebrates, such as annelids.

(A) (A)-i, (B)-ii, (C)-iii (B) (A)-iii, (B)-ii, (C)-i
(C) (A) - ii, (B)-i, (C)-iii (D) (A)-i, (B)-iii, (C)-ii

Q.5

Column I	Column II
(a) Notochord	(i) An elastic, solid skeletal rod lying below the nerve cord and above the alimentary canal in chordates.
(b) Pinna	(ii) Fixed, sessile, cylindrical, hydra-like form of coelenterates.
(c) Polyp	(iii) Refers to external ears of mammals.

(A) (a) - i, (b)-ii, (c)-iii
(B) (a) - iii, (b)-ii, (c)-i
(C) (a) - ii, (b)-i, (c)-iii
(D) (a) - i, (b)-iii, (c)-ii

Q.6

Column I	Column II
(a) Cellular level of organisation	1. Cnidarians
(b) Organ level of organisation	2. Platyhelminthes
(c) Tissue level of organisation	3. Porifera

Codes
(A) a-3, b-2, c-1
(B) a-2, b-1, c-3
(C) a-3, b-1, c-2
(D) a-1, b-2, c-3

SECTION - 2 (BASIC CONCEPTS BUILDER)

For Q.7 to Q.25 :

Choose one word for the given statement from the list.

Mollusca, Medusa, Gills, *Ctenoplana,* Platyhelminthes, flame, Malpighian tubules, True, False, Polyp, Arthropoda, Hemichordata, Open, Echinodermata, Aschelminthes, Chondrichthyes, Radula, Closed, Cyclostomata, Annelida, Kidneys

Q.7 Arthropods are coelomates. **[True / False]**

Q.8 Free-floating form of cnidaria is medusa. **[True / False]**

Q.9 The name cnidaria is derived from the cnidocytes which contain the stinging capsules. **[True / False]**

Q.10 Lateral appendages in aquatic annelids is parapodia. **[True / False]**

Q.11 The _____ is a sessile stage (in cnidarians) that typically reproduces asexually.

Q.12 In Platyhelminthes ___ cells help in osmoregulation and excretion.

Q.13 In Aschelminthes alimentary canal is complete with a well developed muscular pharynx. **[True / False]**

Q.14 ___ is a file-like rasping organ present in mollusca.

Q.15 ____ exhibit the phenomenon of bioluminescence.

Q.16 Fill up the blank spaces appropriately

Phylum/ Class	Excretory Organ	Circulatory Organ	Respiratory Organ
Arthropoda			Lungs/ Gills/ Tracheal System
	Nephridia	Closed	Skin/ parapodia
	Metanephridia	Open	
Amphibia		Closed	Lung

Q.17 *Balanoglossus* belongs to phylum _____.

Q.18 *Asterias* belongs to phylum _____.

Q.19 Apple snail belongs to phylum _____.

Q.20 Honey bee belongs to phylum _____.

Q.21 *Nereis* belongs to phylum _____.

Q.22 *Ascaris* belongs to phylum _____.

Q.23 *Taenia* belongs to phylum _____.

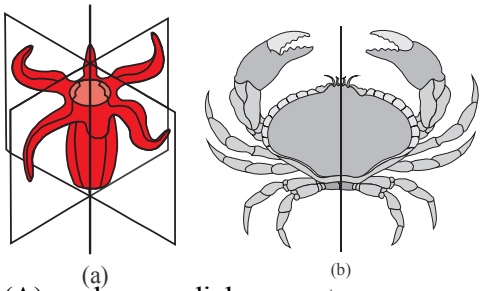
Q.24 Hagfish belongs to class _____.

Q.25 Dog fish belongs to class _____.

SECTION - 3 (ENHANCE DIAGRAM SKILLS)

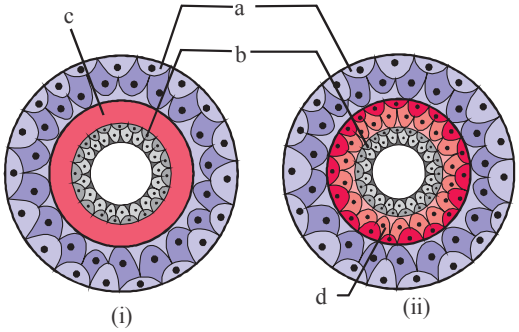
Choose one correct response for each question.

Q.26 Choose the correct statement for fig. (a) and (b).



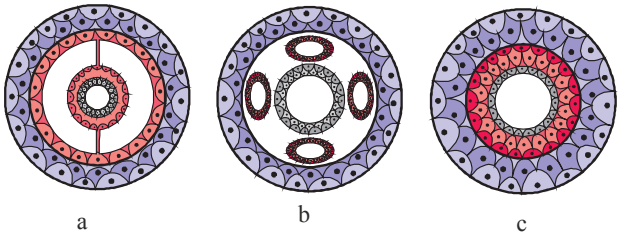
(A) a shows radial symmetry.
(B) b shows bilateral symmetry.
(C) Coelenterates shows symmetry as shown in figure (a).
(D) All of these

Q.27 Examine the figures of diploblastic (i) and triploblastic (ii) organization in animals given below and identify the labelled parts a to d.



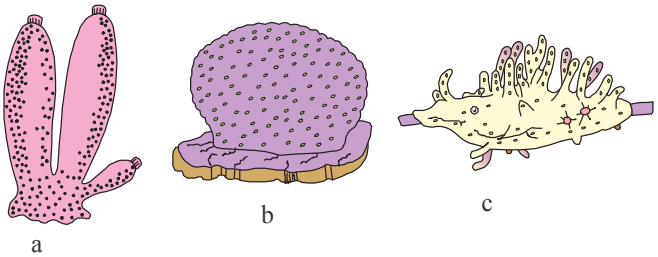
(A) a-Mesoglea, b-Ectoderm, c-Endoderm, d-Mesoderm
(B) a-Endoderm, b-Mesoderm, c-Mesoglea, d-Ectoderm
(C) a-Mesoderm, b-Mesoglea, c-Ectoderm, d-Endoderm
(D) a-Ectoderm, b-Endoderm, c-Mesoglea, d-Mesoderm

Q.28 The figures given below show the types of coelom. Identify them and select the correct group of organisms which possess them



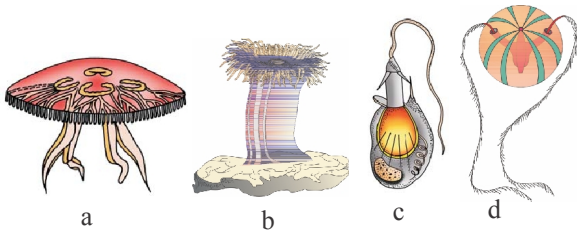
(A) a-Annelids, b-Aschelminthes, c-Platyhelminthes
(B) a-Molluscs, b- Arthropods, c-Platyhelminthes
(C) a-Echinoderms, b-Aschelminthes, c-Annelids
(D) a-Echinoderms, b-Arthropods, c-Platyhelminthes.

Q.29 Identify the figures a, b and c and select the correct option.



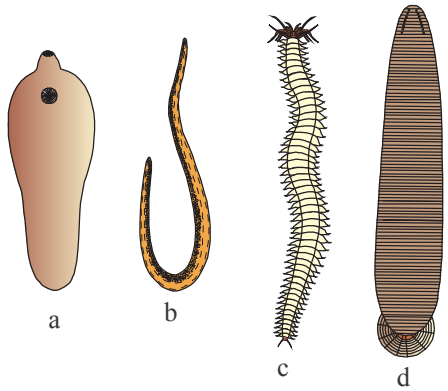
(A) a-*Sycon*, b-*Euspongia*, c-*Spongilla*
(B) a-*Euspongia*, b-*Spongilla*, c-*Sycon*
(C) a-*Spongill*a, b-*Sycon*, c-*Euspongia*
(D) a-*Euspongia*, b-*Sycon*, c-*Spongilla*

Q.30 Identify the figures a, b, c and d and select the correct option.



(A) a-*Pleurobrachia*, b-Cnidoblast, c-*Aurelia*, d-*Adamsia*
(B) a-*Aurelia*, b-*Adamsia*, c-Cnidoblast, d-*Pleurobrachia*
(C) a-Cnidoblast, b-*Pleurobrachia*, c-*Adamsia*, d-*Aurelia*
(D) a-*Adamsia*, b-*Aurelia*, c-*Pleurobrachia*, d-Cnidoblast

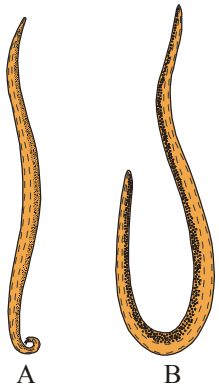
Q.31 Identify the figures a, b, c and d and select the correct option.



(A) a-Liver fluke; b-Male roundworm; c-*Hirudinaria*; d- *Nereis*
(B) a-Liver fluke; b-Female roundworm; c-*Hirudinaria*; d-*Nereis*
(C) a-Liver fluke; b-Male roundworm; c-*Nereis*; d-*Hirudinaria*
(D) a-Liver fluke; b-Female roundworm; c-*Nereis*; d-*Hirudinaria*

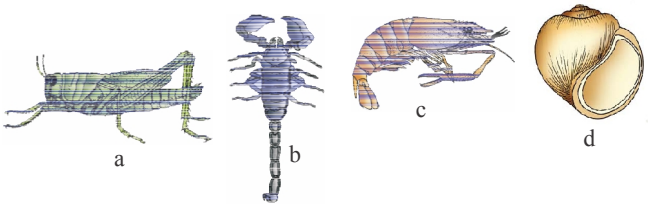
Q.32 Identify the figure a and b and choose the correct option.

1. Female *Ancylostoma* 2. Female *Ascaris*
3. Male *Taenia* 4. Female *Wuchereria*
5. Male *Ancylostoma* 6.Male *Ascaris*



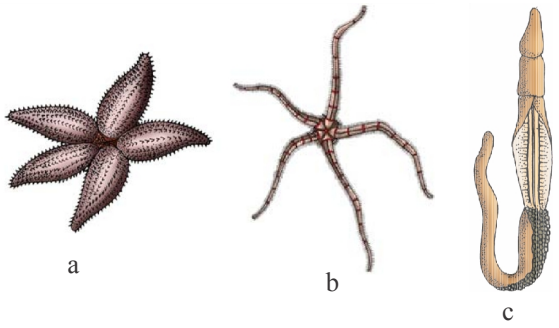
Codes
(A) a-2, b-3 (B) a-4, b-3
(C) a-6, b-2 (D) a-6, b-3

Q.33 Identify the figures a, b, c and d given below and select the correct option.



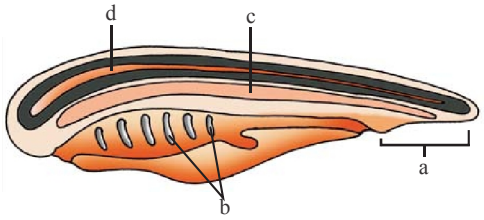
(A) a-Locust, b-Scorpion, c-Prawn, d-*Pila*
(B) a-Locust, b-Prawn, c-Scorpion, d-*Pila*
(C) a-Locust, b-Scorpion, c-Prawn, d-Snail
(D) a-Butterfly, b-Scorpion, c-Prawn, d-*Pila*

Q.34 Identify the figures a, b and c given below and select the correct option.



(A) a-*Asterias*, b-*Ophiura*, c-*Balanoglossus*
(B) a-*Asterias*, b-*Balanoglossus*, c-*Ophiura*
(C) a-*Balanoglossus*, b-*Ophiura*, c-*Asterias*
(D) a-*Ophiura*, b-*Asterias*, c-*Balanoglossus*

Q.35 Match the items labelled a, b, c and d in the given diagram with the given characters and choose the correct answer.



I. Nerve cord II. Post-anal part
III. Notochord IV. Gill Slits

Codes
(A) a-II, b-IV, c-III, d-I
(B) a-I, b-III, c-II, d-IV
(C) a-III, b-I, c-IV, d-III
(D) a-IV, b-II, c-III, d-I

Q.36 Choose the correct statement for the figure shown

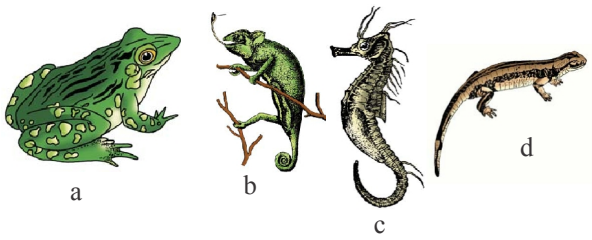
(A) It belongs to protochordates.
(B) It is exclusively marine.
(C) It represents *Ascidia*
(D) All of these

Q.37 Match the following columns.

Column I		Column II
A.		1. *Scoliodon*
B		2. *Pristis*
C.		3. *Myxine*
D.		4. *Catla*
		5. *Petromyzon*

Codes
(A) a-4, b-2, c-5, d-1
(B) a-4, b-2, c-3, d-1
(C) a-1, b-3, c-5, d-2
(D) a-1, b-4, c-5, d-3

Q.38 Which of the following are amphibians?



(A) a and c (B) b and d
(C) c and d (D) a and d

Q.39 Match the following columns.

Column I		Column II
a.		1. *Struthio*
b.		2. *Pavo*
c.		3. *Aptenodytes*
d.		4. *Columba*
		5. *Psittacula*
		6. *Neophron*

Codes
(A) a-5, b-4, c-6, d-1 (B) a-3, b-2, c-1, d-4
(C) a-4, b-2, c-3, d-1 (D) a-5, b-2, c-6, d-1

Q.40 Which of the following do not belong to class-Mammalia?

(A) b and e (B) a and c
(C) e and c (D) d and e

SECTION - 4 (ENHANCE PROBLEM SOLVING SKILLS)

Choose one correct response for each question.

PART A : BASIS OF CLASSIFICATION

Q.41 Animals are classified on the basis of which of the following features?

I. Coelomic cavity II. Level of organisation
III. Notochord IV. Skeletal structure
(A) I and II (B) I and III
(C) I, II and III (D) II and IV

Q.42 Choose the correct statement –

(A) Animals in which the cells are arranged in two embryonic layers are known as diploblastic animals.
(B) Platyhelminthes to Chordates are triploblastic animals .
(C) Platyhelminthes to Chordates are diploblastic animals.
(D) Both (A) and (B)

Q.43 When the body is externally and internally divided into segments, it is called

(A) true segmentation
(B) false segmentation
(C) pseudo segmentation
(D) asegmentation

Q.44 The type of symmetry belongs to animals is

(A) transverse symmetry
(B) lateral symmetry
(C) bilateral symmetry
(D) oblique symmetry

Q.45 Which of the following statements is incorrect with regard to bilateral symmetry ?

(A) Body can be divided into two equal halves by a single plane only.
(B) The organisms that show bilateral symmetry have paired body organs that occur on the two sides of a central axis.
(C) It is found in all invertebrates and few vertebrates.
(D) Spider and crab show bilateral symmetry.

Q.46 Differentiated embryonic layers are called

I. ectoderm II. endoderm
III. mesoderm IV. mesoglea
(A) I, II and IV (B) I, II and III
(C) II, III and IV (D) I, III and IV

Q.47 Choose the correct matching –

(A) Asymmetrical animals : Snails
(B) Radially symmetrical animals : Starfish
(C) Bilaterally symmetrical animals : Frog
(D) All of these

Q.48 A coelom is a

(A) cavity between body wall and gut wall
(B) body cavity lined by mesoderm
(C) body cavity not lined by mesoderm
(D) body cavity lined by endoderm

Q.49 Symmetry in Cnidaria is

(A) radial (B) bilateral
(C) pentamerous (D) spherical

Q.50 Organ system level of organisation is observed in
(A) chordates (B) annelids
(C) molluscs (D) All of these

Q.51 Higher phylum like echinoderms are
(A) triploblastic animals
(B) quadroblastic animals
(C) diploblastic animals
(D) uniblastic animals

Q.52 The notochord is derived from which of the following layers?
(A) Ectoderm (B) Mesoderm
(C) Endoderm (D) Placoderm

Q.53 Choose the INCORRECT statement –
(A) Animals in which the body cavity is absent are known as coelomates..
(B) Animals possessing the body cavity which is lined by the mesoderm are known as acoelomates
(C) Animals possessing the body cavity which is lined by the mesoderm are known as coelomates.
(D) Both (A) and (B)

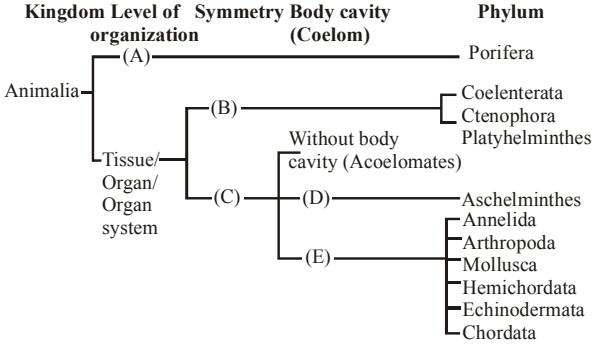
Q.54 Read the following statements
(i) In some animals, body is segmented externally and internally, with serial repetition of at least some organs. This phenomenon is known as metamerism.
(ii) Animals with notochord are known as non-chordates
(iii) Animals which do not form notochord are known as chordates.
Choose the correct statement –
(A) i, ii (B) only i
(C) only ii (D) i, ii and iii

Q.55 Pseudocoelomate animals belong to the phylum
(A) Platyhelminthes (B) Arthropoda
(C) Mollusca (D) None of these

Q.56 Notochord is
(A) endodermally derived structure, formed on the dorso ventral side.
(B) ectodermally derived structure, formed on the dorsal side.
(C) mesodermally derived structure, formed on the dorsal side.
(D) mesodermally derived structure, formed on the ventral side.

PART B : CLASSIFICATION OF ANIMALS

Q.57 Study carefully the given flowchart and fill in the blanks (A), (B), (C), (D) and (E).



(A) A-Cellular level, B-Bilateral symmetry, C-Radial symmetry, D-Pseudocoelomates, E-Coelomates
(B) A-Cellular level, B-Radial symmetry, C-Bilateral symmetry, D-Coelomates, E-Pseudocoelomates
(C) A-Cellular level, B-Bilateral symmetry, C-Radial symmetry, D-Coelomates, E-Pseudocoelomates
(D) A-Cellular level, B-Radial symmetry, C-Bilateral symmetry, D-Pseudocoelomates, E-Coelomates

PART B (i) : PHYLUM - PORIFERA

Q.58 Canal system in Porifera is concerned with
(A) food gathering
(B) respiratory exchange
(C) removal of waste
(D) All of these

Q.59 The statements given below shows some characteristics of a phylum. Identify it.
(i) Tissue absent
(ii) Internal fertilization
(iii) Development is indirect
(iv) Spongocoelate with ostia (many) and single osculum and canal system
(v) Sexes are hermaphrodite.
(A) Cnidaria (B) Porifera
(C) Platyhelminthes (D) Ctenophora

Q.60 The skeleton of animals belonging to phylum-Porifera are made up of
(A) spicules (B) spiracles
(C) spines (D) spongocytes

Q.61 Select the phylum that is neither bilaterally symmetrical nor radially symmetrical
(A) Ctenophora (B) Coelenterata
(C) Porifera (D) Annelida

Q.62 In most simple type of canal system of Porifera, which of the following ways exhibit water flow?
(A) ..... →Spongocoel→Osculum→ Exterior
(B) Spongocoel→Ostia→Osculum→ Exterior
(C) Osculum→Spongocoel→Ostia→ Exterior
(D) Osculum→Ostia→Spongocoel→ Exterior

Q.63 *Euspongia* and *Spongilla* belongs to phylum –
(A) Cnidaria (B) Porifera
(C) Platyhelminthes (D) Ctenophora

Q.64 Asexual reproduction in sponges takes place by
(A) binary fission (B) budding
(C) fragmentation (D) None of these

PART B (ii) : PHYLUM - COELENTERATA (CNIDARIA)

Q.65 Body forms present in Cnidarians are
(A) cylindrical and spherical-shaped
(B) corals and coral reefs
(C) polyp and medusa
(D) cnidoblasts and nematocytes

Q.66 Diploblastic animals belong to the phylum
(A) Aschelminthes (B) Annelida
(C) Coelenterates (D) Platyhelminthes

Q.67 Choose the correct statement –
(A) In some cnidaria polyps produce medusae asexually and medusae form the polyps sexually.
(B) In some cnidaria polyps produce medusae sexually and medusae form the polyps asexually.
(C) Some cnidaria shows metagenesis.
(D) Both (A) and (C).

Q.68 Which of the following is not true regarding phylum- Coelenterata?
(A) They are diploblastic animals.
(B) They have cellular level of organisation.
(C) They have nematocyte cells present on the tentacles.
(D) The gastro-vascular opening is called the hypostome.

Q.69 Sea-fan and Brain coral belongs to phylum –
(A) Cnidaria (B) Porifera
(C) Platyhelminthes (D) Ctenophora

Q.70 Metagenesis is seen in
(A) *Hydra* (B) *Aurelia*
(C) *Obelia* (D) *Adamsia*

PART B (iii) : PHYLUM - CTENOPHORA

Q.71 Which statement is incorrect about *Pleurobrachia?*
(A) They are diploblastic
(B) They have tissue level organisation
(C) They have comb plates
(D) They are triploblastic

Q.72 The characters given below are shown by
(i) Extracellular and intracellular digestion.
(ii) Exclusively marine, radially symmetrical, diploblastic, tissue level of organization.
(iii) Fertilization external & indirect development.
(iv) No asexual reproduction.
(v) Presence of comb plates.
(A) Cnidaria (B) Porifera
(C) Ctenophora (D) Rotifers

Q.73 Bioluminescence is seen in phylum
(A) Ctenoplana (B) Coelenterata
(C) Ctenophora (D) Platyhelminthes

PART B (iv) : PHYLUM - PLATYHELMINTHES

Q.74 High regeneration capacity is found in –
(A) *Adamsia* (B) *Pennatula*
(C) *Ctenoplana* (D) *Planaria*

Q.75 Which one of the following types of animals are triploblastic?
(A) Flatworms (B) Sponges
(C) Ctenophores (D) Corals

Q.76 Platyhelminthes are also called
(A) roundworms (B) flatworms
(C) ringworms (D) hookworms

Q.77 Which of the following animal phyla does not possess a coelom?
(A) Platyhelminthes (B) Annelida
(C) Mollusca (D) Echinodermata

Q.78 An acoelomate animal with bilateral symmetry is
(A) *Hydra* (B) Liver fluke
(C) *Physalia* (D) *Obelia*

Q.79 The characters given below are shown by
(i) Bilaterally symmetrical
(ii) Triploblastic and acoelomate
(iii) Organ level of organisation.
(iv) Hooks and suckers are present in the parasitic forms.
(v) Specialised cells called flame cells help in osmoregulation and excretion.
(A) Porifera (B) Coelenterata
(C) Ctenophora (D) Platyhelminthes

PART B (v) : PHYLUM - ASCHELMINTHES

Q.80 The pseudocoelomate among these is
(A) Porifera (B) Annelida
(C) Aschelminthes (D) Mollusca

Q.81 Aschelminthes are usually
(A) dioecious (B) hermaphrodites
(C) metagenic (D) coelomates

Q.82 Which one of the following statements about the given animals is correct?
(A) Roundworms (Aschelminthes) are pseudocoelomates
(B) Molluscs are acoelomates
(C) Insects are pseudocoelomates
(D) Flatworms (Platyhelminthes) are coelomates

Q.83 Given below are 3 statements regarding Aschelminthes.
(i) They are bilaterally symmetrical and triploblastic.
(ii) They are dioecious.
(iii) All are plants or animals parasites.
The corrects statements are
(A) (i) and (ii) (B) (i) and (iii)
(C) (ii) and (iii) (D) None of these

Q.84 *Wuchereria bancrofti* is a common filarial worm. It belongs to phylum –
(A) Platyhelminthes (B) Aschelminthes
(C) Annelida (D) Coelenterata

Q.85 Hookworm belongs to phylum –
(A) Platyhelminthes (B) Aschelminthes
(C) Annelida (D) Coelenterata

PART B (vi) : PHYLUM - ANNELIDA

Q.86 Mark the false statement for the phylum-Annelida.
(A) They are bilaterally symmetrical coelomate animals.
(B) They have both monoecious and dioecious animal representatives.
(C) Excretory system consists of flame cells.
(D) They do not have asexual reproduction.

Q.87 Blood sucking leech belongs to phylum –
(A) Platyhelminthes (B) Aschelminthes
(C) Annelida (D) Coelenterata

Q.88 Read the following statements for Annelida –
(i) Their body surface is distinctly marked out into segments or metameres
(ii) They possess longitudinal and circular muscles which help in swimming.
(iii) They possess parapodia which help in locomotion.
(iv) They have a closed circulatory system.
(v) They have Nephridia which helps in osmoregulation and excretion.
(vi) Their neural system consists of paired ganglia.
Choose the correct statement
(A) i, ii, iii, iv (B) i, iv, v, vi
(C) ii, iii, iv, v, vi (D) i, iii, v, vi

PART B (vii) : PHYLUM - ARTHROPODA

Q.89 Select the phylum that is the largest of the kingdom-Animalia.
(A) Phylum-Mollusca (B) Phylum-Arthropoda
(C) Phylum-Annelida (D) Phylum-Coelenterata

Q.90 The characters given below are shown by
(i) Jointed appendages modified for a variety of functions.
(ii) Tough, jointed exoskeleton of chitinous plates.
(iii) Tracheae for respiration in majority of cases.
(iv) Compound eyes.
(v) Malpighian tubules for excretion.
(vi) Power of flight in most insects.
(vii) Striped muscles arranged in bundles for moving particular parts
(A) Phylum-Mollusca (B) Phylum-Arthropoda
(C) Phylum-Annelida (D) Phylum-Coelenterata

Q.91 Which of the following animal is called a living fossil?
(A) King locust (B) *Limulus*
(C) *Bombyx* (D) *Balanoglossus*

PART B (viii) : PHYLUM - MOLLUSCA

Q.92 The generic name of tusk shell or elephant tusk shell is –
(A) *Dentalium* (B) *Chaetoderma*
(C) *Chiton* (D) *Neopilina*

Q.93 The animal's body belonging to phylum-Mollusca is divided into
(A) head, thorax and abdomen
(B) head, muscular foot and abdomen
(C) head, thorax and visceral hump
(D) head, muscular foot and visceral hump

Q.94 The second largest number of species containing phylum in the animal kingdom is –
(A) Annelida (B) Arthropoda
(C) Mollusca (D) Chordata

Q.95 Devil fish belongs to –
(A) Phylum-Mollusca (B) Phylum-Arthropoda
(C) Phylum-Annelida (D) Phylum-Coelenterata

Q.96 The feeding organ in phylum-Mollusca is
(A) ctenedia (B) undulating membrane
(C) sucker (D) radula

PART B (ix) : PHYLUM - ECHINODERMATA

Q.97 Characteristic feature of phylum-Echinodermata is
(A) radial symmetry
(B) water vascular system
(C) mantle cavity
(D) All of these

Q.98 The characters given below are shown by
(i) triploblastic and coelomate animals.
(ii) Digestive system is complete with mouth on the lower (ventral) side and anus on the upper (dorsal) side.
(iii) Sexes are separate.
(iv) Reproduction is sexual.
(A) Phylum-Mollusca
(B) Phylum-Echinodermata
(C) Phylum-Annelida
(D) Phylum-Coelenterata

Q.99 Scientific name of starfish is
(A) *Echinus* (B) *Limulus*
(C) *Echidna* (D) *Asterias*

Q.100 Choose the animals that belong to phylum-Echinodermata from the options.
(A) Sea urchin, cuttle fish and sea lily
(B) *Echinus,* sea hare and sea cucumber
(C) *Antedon*, *Ophiura* and *Echinus*
(D) *Ophiura, Chaetopleura* and *Echinus*

PART B (x) : PHYLUM - HEMICHORDATA

Q.101 Excretory organ in phylum-Hemichordata is
(A) proboscis gland (B) gills
(C) collar (D) None of these

Q.102 The characters given below are shown by
(i) Bilaterally symmetrical, triploblastic and coelomate animals.
(ii) The body is cylindrical
(iii) Circulatory system is of open type.
(iv) Respiration takes place through gills.
(A) Phylum-Mollusca
(B) Phylum-Echinodermata
(C) Phylum-Annelida
(D) Phylum-Hemichordata

Q.103 Phylum-Hemichordata includes –
(A) *Balanoglossus* (B) *Saccoglossus*
(C) Ascidia (D) Both (A) and (B)

PART B (xi) : PHYLUM - CHORDATA

Q.104 Which animals belong to sub-phylum Urochordata?
(A) Branchiostoma and *Lancelet*
(B) *Salpa* and *Lancelet*
(C) *Ascidia* and *Doliolum*
(D) *Salpa* and *Amphioxus*

Q.105 All chordates have the following characterstics.
(A) Bilaterally symmetrical, presence of coelom, triploblastic, closed or open circulatory system
(B) Bilaterally symmetrical, presence of coelom, diploblastic or triploblastic
(C) Open circulatory system, diploblastic or triploblastic, coelom & bilaterally symmetrical
(D) Bilaterally symmetrical, coelom present, triploblastic with closed circulatory system

Q.106 Urochordate animals have
(A) notochord that extends from head to tail region
(B) notochord is present throughout larval stages and adult life.
(C) notochord present only in adult stages.
(D) notochord present only in larval stage.

Q.107 Phylum-Chordata is divided into sub-phyla namely
(A) Vertebrata, Protochordata and Urochordata
(B) Urochordata, Gnathochordata & Vertebrata
(C) Urochordata, Tunicata and Vertebrata
(D) Tunicata, Cephalochordata and Vertebrata

PART C (i) : CLASS - CYCLOSTOMATA

Q.108 The jawless vertebrate is
(A) crocodile (B) loris
(C) *Hyla* (D) *Petromyzon*

Q.109 Class-Cyclostomata includes –
(A) *Petromyzon* (B) *Scoliodon*
(C) *Catla* (D) *Hyla*

PART C (ii) : CLASS - CHONDRICHTHYES

Q.110 Which statement is incorrect for animals belonging to class of Chondrichthyes?
(A) Presence of placoid scales
(B) Absence of air bladder
(C) Presence of cartilaginous endoskeleton
(D) Notochord is persistent only at larval stage, after that it disappears.

Q.111 Class-Chondrichthyes includes –
(A) *Petromyzon* (B) *Scoliodon*
(C) *Catla* (D) *Hyla*

Q.112 Chondrichthyes is characterised by –
(A) placoid scale
(B) ventral mouth
(C) ctenoid scale and ventral mouth
(D) placoid scale and ventral mouth

Q.113 Which of the following phylum or class exhibit the presence of a notochord?
(A) Arthropods (B) Echinodermata
(C) Chondrichthyes (D) Porifera

Q.114 *Trygon* has
(A) two chambered heart
(B) the males have claspers
(C) presence of gill slits
(D) All of the above

Q.115 Choose the cartilaginous fishes from the following.
(A) *Catla* and Sawfish
(B) *Pristis* and *Carcharodon*
(C) *Scoliodon* and Hagfish
(D) *Trygon* and Lamprey

PART C (iii) : CLASS - OSTEICHTHYES

Q.116 Class-Osteichthyes includes –
(A) *Petromyzon* (B) *Scoliodon*
(C) *Catla* (D) *Hyla*

Q.117 Choose the correct statement for class-Osteichthyes
(A) Their body is streamlined.
(B) They have four pairs of gills which are covered by an operculum.
(C) Skin is covered with cycloid/ctenoid scales.
(D) All of these

PART C (iv) : CLASS - AMPHIBIA

Q.118 Which of the following is observed in amphibians?
(A) Three chambered heart
(B) Cold blooded animals
(C) Absence of scales
(D) All of these

Q.119 Which of the following statements are correct or incorrect regarding class Amphibia?
(i) Has body divisible into head and trunk. Tail is present in some amphibians.
(ii) Show respiration by gills, lungs and through skin.
(iii) Has scales in all its members.

(iv) Can lead dual life (aquatic and terrestrial).
(v) Has eyelids.
(A) All are correct (B) (i) & (iv) are correct
(C) Only (iii) is incorrect (D) Only (ii) is incorrect.

Q.120 Class-Amphibia includes –
(A) *Petromyzon* (B) *Scoliodon*
(C) *Catla* (D) *Hyla*

PART C (v) : CLASS - REPTILIA

Q.121 Dry skin with scales or scutes without gland is a characteristic of –
(A) Fishes (B) Reptilia
(C) Amphibia (D) Aves

Q.122 The characteristics are associated with
(i) Body is covered by dry and cornified skin, epidermal scales or scutes
(ii) They have no external ear
(iii) Crawling, creeping habit
(iv) 3 chambered heart
(A) Reptile (B) Bird
(C) Amphibia (D) Mammals

Q.123 Class-Reptilia includes –
(A) *Hemidactylus* (B) *Vipera*
(C) *Corvus* (D) Both (A) and (B)

Q.124 In which of the following reptiles four chambered heart is present?
(A) Lizard (B) Snake
(C) Scorpion (D) Crocodile

PART C (vi) : CLASS - AVES

Q.125 Which of the following is incorrect for Aves?
(A) Heart is four chambered and animals are oviparous.
(B) Presence of air cavities in bones and presence of feathers on the body.
(C) Digestive tract has additional chambers and animals are homiothermous.
(D) The forelimbs are not modified into wings.

Q.126 Class-Aves includes –
(A) *Hemidactylus* (B) *Vipera*
(C) *Corvus* (D) Both (A) and (B)

Q.127 Pneumatic bones are expected to be found in
(A) house lizard (B) flying fish
(C) pigeon (D) tadpole of frog

PART C (vii) : CLASS - MAMMALIA

Q.128 The unique character of animals belonging to class-Mammalia is
(A) only mammals possesses hair on skin
(B) completely four chambered heart
(C) presence of mammary glands
(D) fertilisation is internal

Q.129 Birds and mammals share one of the following characteristics as a common feature.
(A) Pigmented skin
(B) Alimentary canal with some modification
(C) Viviparity
(D) Warm blooded nature

Q.130 Choose the correct matching
(A) Oviparous : Platypus
(B) Viviparous :Kangaroo
(C) *Pteropus* : Flying fox
(D) All of these

Q.131 *Balaenoptera* belongs to class –
(A) Reptilia (B) Aves
(C) Mammalia (D) Amphibia

Q.132 Which one of the following sets of animals share a four chambered heart?
(A) Amphibian, Reptiles, Birds
(B) Crocodiles, Birds, Mammals
(C) Crocodiles, Lizards, Turtles
(D) Lizards, Mammals, Birds

Q.133 Correct set of animals of class-Mammalia is –
(A) Lion, *Hippopotamus,* penguin, bat
(B) Lion, bat, whale, ostrich
(C) *Hippopotamus,* penguin, whale, kangaroo
(D) Whale, bat, kangaroo, *Hippopotamus*

EXERCISE - 2 (LEVEL-2)

Choose one correct response for each question.

Q.1 Phylum that exhibit bilateral symmetry are –
(A) Platyhelminthes (B) Aschelminthes
(C) Annelids (D) All of these

Q.2 Cells that are peculiar to the phylum-Porifera.
(A) Chimeras (B) Chondrocytes
(C) Dendrocytes (D) Choanocytes

Q.3 The radial symmetry is observed in –
I. Platyhelminthes II. Coelenterates
III. Aschelminthes IV. Annelids
V. Echinoderms
(A) II, III and V (B) I, II, III and V
(C) II, III and I (D) II and V

Q.4 Which of the following statements are true/false?
I. In higher phyla cellular level of organisation is seen.
II. Phylum-Platyhelminthes have cellular level of organisation.
III. Cellular level of organisation is seen when the cells are not arranged as loose cell aggregates.
IV. Molluscs exhibit tissue level of organisation.
Choose the correct option of the following.
(A) I and II are true, but III and IV are false.
(B) All statements are false.
(C) All statements are true.
(D) III and IV are true, but I and II are false.

Q.5 Among the following organisms which is a completely non-parasitic form?
(A) Sea anemone (B) Tapeworm
(C) Leech (D) Mosquito

Q.6 Which of the following features are present in chordates?
(A) Dorsal heart, presence of post-anal tail and central nervous system in dorsal.
(B) Ventral heart, presence of post-anal tail and presence of gill slits.
(C) Dorsal heart, pharynx perforated by gill silts and dorsal ventral system.
(D) Ventral heart, absence of notochord but presence of post-anal part of the tail.

Q.7 Which of the following animals have a single opening to the outside that serves both as mouth as well as anus?
(A) *Octopus* (B) *Asterias*
(C) *Ascidia* (D) *Fasciola*

Q.8 Metameric segmentation is the main feature of phylum
(A) Annelida (B) Echinodermata
(C) Arthropoda (D) Coelenterata

Q.9 Which one of the following groups of animals is correctly matched with its characteristic feature without any exception?
(A) Reptilia : possess 3-chambered heart with an incompletely divided ventricle.
(B) Chordata: possess a mouth with an upper and a lower jaw
(C) Chondrichthyes: possess cartilaginous endoskeleton
(D) Mammalia : give birth to young ones.

Q.10 Which of the following is not a Porifera
(A) *Sycon* (B) *Spirulina*
(C) *Euspongia* (D) *Spongilla*

Q.11 Fill in the blanks from the given characters with respect to a, b, c and d and choose the correct option.
I. Phylum-Echinodermata are __a__
II. Phylum-Mollusca have a __b__
III. __c__ of Echinoderms is its distinctive character.
IV. Echinodermata got their name from __d__
Given characters
1. radially symmetrical
2. larvae
3. endoskeleton of calcareous ossicles
4. water vascular system
5. radula
6. mantle cavity
(A) a-1, b-6, c-4, d-3
(B) a-1, b-5, c-3, d-2
(C) a-1, b-4, c-3, d-2
(D) a-1, b-2, c-5, d-6

Q.12 Which one of the following groups of animals is bilaterally symmetrical and triploblastic?
(A) Coelenterates (cnidarians)
(B) Aschelminthes (roundworms)
(C) Ctenophores
(D) Sponges

Q.13 *Laccifer* belongs to –
(A) Phylum-Mollusca
(B) Phylum-Arthropoda
(C) Phylum-Annelida
(D) Phylum-Coelenterata

Q.14 Which statement is incorrect about members of phylum-Porifera?
(A) have cellular level of organisation
(B) have separate sexes
(C) sexual reproduction takes place by gamete formation
(D) have a water canal system

Q.15 What is common between parrot, platypus and kangaroo?
(A) Toothless jaws (B) Functional postanal tail
(C) Oviparity (D) Homoiothermy

Q.16 Match the following columns.

	Column I	**Column II**
a.	*Amphioxus*	1. Hag fish
b.	*Petromyzon*	2. Lamprey
c.	*Trygon*	3. Sting ray
d.	*Myxine*	4. Ascidia
		5. Branchiostoma

Codes
(A) a-1, b-5, c-2, d-4
(B) a-3, b-1, c-2, d-5
(C) a-5, b-4, c-1, d-2
(D) a-5, b-2, c-3, d-1

Q.17 Match the following columns.

	Column I	**Column II**
a.	*Physalia*	1. Liverfluke
b.	*Taenia*	2. *Sycon*
c.	*Fasciola*	3. Tape worm
d.	*Scypha*	4. Portugese man of war

Codes
(A) a-2, b-1, c-3, d-4
(B) a-4, b-3, c-1, d-2
(C) a-1, b-3, c-2, d-4
(D) a-1, b-2, c-3, d-4

Q.18 The phylum-Mollusca lack, which one of the following.
(A) visceral hump (B) Malpighian tubules
(C) gills (D) radula

Q.19 Which one of the following pairs of animal comprises 'jawless fishes'?
(A) Lampreys and eels
(B) Mackerals and rohu
(C) Lampreys and hag fishes
(D) Guppies and hag fishes

Q.20 Which one is correct?
(A) Notochord is ectodermal in origin present in some animals.
(B) Notochord is a mesodermally derived rod like structure formed on the dorsal side in embryonic development in some animals.
(C) Arthropoda are non-chordates.
(D) Both (B) and (C)

Q.21 Which one of the following sets of animals belong to a single taxonomic group?
(A) Cuttlefish, Jellyfish, Silverfish, Dogfish, Starfish
(B) Bat, Pigeon, Butterfly
(C) Monkey, Chimpanzee, Man
(D) Silkworm, Tapeworm, Earthworm

Q.22 Match the following columns.

	Column I	**Column II**
a.	*Ancylostoma*	1. Hookworm
b.	*Wuchereria*	2. Filaria worm
c.	*Ascaris*	3. Roundworm
d.	*Fasciola*	4. Liverfluke
		5. Flatworms

Codes
(A) a-1, b-4, c-3, d-5
(B) a-2, b-5, c-1, d-3
(C) a-4, b-1, c-5, d-3
(D) a-1, b-2, c-3, d-4

Q.23 Choose the correct option.

(A) Annelida – Exhibit bilateral symmetry, metamerism and coelom
(B) Echinodermata – Exhibit tissue level organisation and radial symmetry
(C) Arthropoda – Exhibit incomplete digestive system and segmentation
(D) Notochord – is present on ventral side in vertebrate

Q.24 Which of the following is correctly matched?

(A) Radial symmetry – Coelenterates
(B) Coelomates – Aschelminthes
(C) Metamerism – Molluscs
(D) Triploblastic – Sponges

Q.25 Triploblastic, unsegmented, acoelomate exhibiting bilateral symmetry and reproducing both asexually and sexually, with some parasitic forms. The above description is the characteristic of phylum

(A) Annelida (B) Ctenophora
(C) Cnidaria (D) Platyhelminthes

Q.26 Medusa is the reproductive structure of

(A) *Hydra* (B) *Obelia*
(C) Sea anemone (D) None of these

Q.27 Match the following columns.

	Column I	**Column II**
a.	*Statocysts*	1. Radiating plates
b.	*Radula*	2. Respiratory function
c.	*Gills*	3. Organs of balance
d.	*Tentacles*	4. Sensory organs
		5. Organ of feeding
		6. Organs of locomotion

Codes
(A) a-4, b-1, c-3, d-6
(B) a-3, b-5, c-2, d-4
(C) a-4, b-1, c-5, d-3
(D) a-2, b-3, c-5, d-4

Q.28 Which of the following statement is true?

(A) All chordates are vertebrates
(B) All vertebrates are chordates
(C) Invertebrates possess a tubular nerve cord
(D) Non-chordates have a vertebral column

Q.29 Match Column-I with Column-II and select the correct option from the codes given below.

	Column-I	**Column-II**
a.	Choanocytes	(i) Platyhelminthes
b.	Cnidoblasts	(ii) Ctenophora
c.	Flame cells	(iii) Porifera
d.	Nephridia	(iv) Coelenterata
e.	Comb plates	(v) Annelida

(A) a-(ii), b-(i), c-(iv), d-(v), e-(iii)
(B) a-(ii), b-(iv), c-(i), d-(v), e-(iii)
(C) a-(v), b-(i), c-(iii), d-(ii), e-(iv)
(D) a-(iii), b-(iv), c-(i), d-(v), e-(ii)

Q.30 The cells that help in excretion in *Fasciola* are called

(A) choanocytes (B) nematocytes
(C) nephridia (D) flame cells

Q.31 Match the following columns.

	Column I	**Column II**
a.	Honey bee	1. *Aedes*
b.	Mosquito	2. *Apis*
c.	*Laccifer*	3. Lac insect
d.	*Bombyx*	4. Silkworm

Codes
(A) a-1, b-2, c-3, d-4
(B) a-3, b-1, c-2, d-4
(C) a-2, b-1, c-3, d-4
(D) a-4, b-1, c-3, d-2

Q.32 Match the following columns

	Column-I	**Column-II**
	Common name	**Zoological name**
a.	Star fish	(i) *Sepia*
b.	Jelly fish	(ii) *Astropecten*
c.	Devil fish	(iii) *Aurelia*
d.	Cuttle fish	(iv) *Octopus*
		(v) *Hippocampus*

(A) a-(ii), b-(iii), c-(iv), d-(i)
(B) a-(iii), b-(iv), c-(i), d-(v)
(C) a-(ii), b-(i), c-(iv), d-(iii)
(D) a-(v), b-(i), c-(iv), d-(ii)

Q.33 Which one of the following pairs is mismatched?
(A) *Pila globosa-Pearl*
(B) *Apis indica-Honey*
(C) *Kenia lacca-Lac*
(D) *Bombyx* mori-Silk

Q.34 Which of the following is a flightless bird?
(A) Ostrich (B) Emu
(C) Kiwi (D) All of these

Q.35 Which of the pairs of animals has non glandular skin
(A) Snake and Frog
(B) Chameleon and Turtle
(C) Frog and Pigeon
(D) Crocodile and Tiger

Q.36 Which one of the following statements is incorrect?
(A) Mesoglea is present in between ectoderm & endoderm in *Obelia*.
(B) Radial symmetry is found in *Asterias*
(C) *Fasciola* is a pseudocoelomate animal
(D) *Taenia* is a triploblastic animal

Q.37 Choose the correct statement for Chordates –
(A) Pharynx perforated by gill slits.
(B) Heart is ventral.
(C) A post-anal part is present.
(D) All of these

Q.38 Which one of the following is not a poisonous snake?
(A) Cobra (B) Viper
(C) Python (D) Krait

Q.39 Four-chambered heart is present in
(A) Crocodiles (B) Tortoise
(C) Lizard (D) Cobra

Q.40 Following salient features are true for –
Level of Organisation : Organ system
Symmetry : Bilateral
Coelom : Pseudocoelomate
Segmentation : Absent
Digestive System : Complete
Circulatory System : Absent
Respiratory System : Absent
(A) Annelida (B) Arthropoda
(C) Aschelminthes (D) All of these

Q.41 Choose the correct statement –
(i) Reptiles are poikilotherms.
(ii) Aves are warm-blooded (homoiothermous) animals,
(iii) Mammals are homoiothermous.
(iv) The ctenophores are marine animals with comb plates.
(A) i, ii (B) iii, iv
(C) i, ii, iii (D) i, ii, iii, iv

Q.42 Body cavity is the cavity present between body wall and gut wall. In some animals the body cavity is not lined by mesoderm. Such animals are called
(A) Acoelomate (B) Pseudocoelomate
(C) Coelomate (D) Haemocoelomate

Q.43 Choose the INCORRECT matching –
(i) Phylum : Porifera - e.g., comb jellies
(ii) Phylum : Cnidaria - e.g., *Hydra*
(iii) Phylum : Ctenophora - e.g ., *Sycon*
(iv) Phylum : Platyhelminthes - e.g., Cockroach
(v) Phylum : Aschelminthes - e.g., *Ascaris*
(vi) Phylum Annelida - e.g., Earthworm
(vii) Phylum Arthropoda - e.g., Tapeworm
(viii) Phylum Mollusca - e.g., *Pila*
(ix) Phylum Echinodermata - e.g., Starfish
(x) Phylum Hemichordata - e.g., *Balanoglossus*
(A) i, iii, iv, vii (B) ii, v, vi, viii
(C) v, vi, vii, viii, ix, x (D) i, ii, v, vi, viii, ix, x

Q.44 Match the column I with column II and choose the correct option

	Column I	**Column II**
a.	Porifera	i. Canal system
b.	Aschelminthes	ii. Water-vascular system
c.	Annelida	iii. Muscular Pharynx
d.	Arthropoda	iv. Jointed appendages
e.	Echinodermata	v. Metameres

(A) A-ii, B-iii, C-v, D-iv, E-i
(B) A-ii, B-v, C-iii, D-iv, E-i
(C) A-i, B-iii, C-v, D-iv, E-ii
(D) A-i, B-v, C-iii, D-iv, E-ii

Q.45 Choose the correct statement –

(A) Gnathostomata has two super classes, Pisces and Tetrapoda.

(B) Classes Chondrichthyes and Osteichthyes bear fins for locomotion and are grouped under Pisces.

(C) The Chondrichthyes are fishes with cartilaginous endoskeleton and are marine.

(D) All of these

Q.46 Choose the correct statement –

(i) Classes, Amphibia, Reptilia, Aves and Mammalia have two pairs of limbs and are thus grouped under Pisces.

(ii) Reptiles are characterised by the presence of dry and cornified skin.

(iii) Limbs are absent in snakes.

(A) ii and iii (B) i and iii

(C) i and ii (D) i, ii and iii

Q.47 Following salient features are true for –

Level of Organisation : Organ system

Symmetry : Bilateral

Coelom : Coelomate

Segmentation : Present

Digestive System : Complete

Circulatory System : Present

Respiratory System : Present

(A) Annelida (B) Arthropoda

(C) Chordata (D) All of these

Q.48 Match the following list of animals with their level of organisation.

	Division of Labour	**Animal**
a.	Organ level	i. *Pheritima*
b.	Cellular aggregate level	ii. *Fasciola*
c.	Tissue level	iii. *Spongilla*
d.	Organ system level	iv. *Obelia*

Choose the correct match showing division of labour with animal example.

(A) i-b, ii-c, iii-d, and iv-a

(B) i-b, ii-d, iii-c, and iv-a

(C) i-d, ii-a, iii-b, and iv-c

(D) i-a, ii-d, iii-c, and iv-b

Q.49 Choose the correct matching –

(i) Flying fish : *Exocoetus*

(ii) Hagfish : *Pristis*

(iii) Saw fish : *Myxine*

(iv) Angel fish : *Pterophyllum*

(v) Fighting fish : *Betta*

(A) i, iv, v (B) ii, iii, iv

(C) i, iii, v (D) i, ii, iii, iv, v

Q.50 The skeleton of corals is composed of –

(A) siliceous spicules (B) calcium sulphate

(C) calcium carbonate (D) potassium sulphate

EXERCISE - 3 (LEVEL-3)

Choose one correct response for each question.

Q.1 Choose the false option.
(A) *Amoeba*-Asymmetrical
(B) Coelenterates-Diploblastic, radial symmetry, nonchordates
(C) Chordates-*Petromyzon*, *Ornithorhynchus*, *Equus*
(D) Annelid-Pseudocoelomate

Q.2 Which one of the following animal has both exoskeletal and endoskeletal structures?
(A) Freshwater mussel (B) Tortoise
(C) Frog (D) Jelly fish

Q.3 Metameric segmentation is the characteristic of
(A) Platyhelminthes and Arthropoda
(B) Echinodermata and Annelida
(C) Annelida and Arthropoda
(D) Mollusca and Chordata

Q.4 Match the following columns.

	Column I	**Column II**
a.	These possess electric organs	1. *Trygon*
b.	Animals of this class are poikilothermic	2. *Cyclostomata*
c.	These possess poison sting	3. *Torpedo*
d.	These migrate for spawning to freshwater	4.*Chondrichthyes* 5. Hagfish 6. *Exocoetus*

Codes
(A) a-6, b-1, c-3, d-2
(B) a-1, b-4, c-6, d-5
(C) a-3, b-4, c-1, d-5
(D) a-3, b-4, c-6, d-2

Q.5 Match Column-I with Column-II and select the correct option from the codes given below.

	Column-I	**Column-II**
a.	Amphibia	(i) Air bladder
b.	Mammals	(ii) Cartilaginous notochord
c.	Chondrichthyes	(iii) Mammary glands
d.	Osteichthyes	(iv) Pneumatic bones
e.	Cyclostomata	(v) Dual habitat
f.	Aves	(vi) Sucking and circular mouth without jaws

(A) a-(i), b-(iii), c-(iv), d-(v), e-(ii), f-(vi)
(B) a-(ii), b-(v), c-(iv), d-(vi), e-(iii), f-(i)
(C) a-(v), b-(iii), c-(ii), d-(i), e-(vi), f-(iv)
(D) a-(vi), b-(ii), c-(iii), d-(i), e-(iv), f-(v)

Q.6 Some of the statements are given below.
I. Porifera to Echinodermata lack a notochord.
II. Platyhelminthes display tissue level organisation.
III. Mesoglea is present in coelenterates during development.
IV. Aschelminthes are coelomates.
Choose the correct options.
(A) I, II, III and IV are True
(B) I and II are True
(C) I and III are True
(D) II and III are True

Q.7 What is common between earthworm and Periplaneta?
(A) Both have red coloured blood
(B) Both possess anal styles
(C) Both have Malpighian tubules
(D) Both have segmented body

Q.8 A sagittal section
(A) passes dorsoventrally to the anteroposterior axis of the body.
(B) is a transverse section passing through the middle of the body.
(C) passes along the length perpendicular to the dorsoventral axis of the body.
(D) is a vertical section passing through the middle line of the body.

Q.9 Select the correct matching of animals, their symmetry, organisation and coelom type.
(A) Animals-Ctenophores, Symmetry -Radial, Organisation-Diploblastic, Coelom type-Pseudocoelomates
(B) Animals-Echinoderms, Symmetry-Bilateral Organisation-Triploblastic, Coelom type-Coelomates

(C) Animals-Platyhelminthes, Symmetry-Bilateral, Organisation-Triploblastic, Coelom type-Acoelomates
(D) Animals-Annelids, Symmetry-Biradial, Organisation-Diploblastic, Coelom type-Coelomates

Q.10 Which of the following have porous body and are diploblastic?
(A) *Aurelia* and *Obelia*
(B) *Adamsia* and *Euplectella*
(C) *Leucosolenia* and *Spongilla*
(D) *Sycon* and *Hydra*

Q.11 True segmentation is also called
(A) metagenesis (B) metamorphosis
(C) metamerism (D) metasegmerism

Q.12 Match the folloiwng columns. Give the most appropriate one match only.

	Column I	Column II
a.	Ctenophora	1. Bilateral symmetry
b.	Cnidaria	2. Comb plates
c.	Platyhelminthes	3. Radial symmetry
d.	Echinodermata	4. Tissue level of organisation

Codes
(A) a-4, b-1, c-2, d-3 (B) a-3, b-2, c-1, d-4
(C) a-2, b-4, c-1, d-3 (D) a-1, b-3, c-4, d-2

Q.13 Crocodile and penguin are similar to whale and dog fish in which one of the following features?
(A) Possess a solid single stranded central nervous system
(B) Lay eggs and guard them till they hatch
(C) Possess bony skeleton
(D) Have gill slits at some stage

Q.14 Tube feet is the locomotory organ in –
(A) star fish (B) jelly fish
(C) silver fish (D) scoliodon

Q.15 What is common among silver fish, scorpion, crab and honey bee?
(A) Jointed legs (B) Metamorphosis
(C) Compound eyes (D) Poison glands

Q.16 The first phylum to have a complete alimentary canal is
(A) Platyhelminthes (B) *Ascaris*
(C) Aschelminthes (D) Annelida

Q.17 Tissue level of organisation is seen in
(A) Platyhelminthes (B) Chordata
(C) Arthropoda (D) None of these

Q.18 A single opening of the digestive system is found in
(A) Protista (B) Ctenophora
(C) Porifera (D) Platyhelminthes

Q.19 Tube-within-tube body plan is found in which animal?
(A) *Euspongia* (B) *Fasciola*
(C) *Hydra* (D) None of these

Q.20 The mantle in the phylum-Mollusca is a
(A) calcareous shell
(B) chitinous outer covering
(C) soft spongy layer of skin
(D) None of these

Q.21 Reproduction in *Ctenoplana* takes place by
(A) budding (B) sexual reproduction
(C) binary fission (D) multiple fission

Q.22 Which of the following is not a correct match of animal and its habitat?
(A) *Hydra vulgaris* – sea water
(B) *Hydra gangetica* – fresh water
(C) *Obelia* – sea water
(D) *Physalia* – sea water

Q.23 Match the following columns.

	Column I	Column II
a.	Pseudocoelomates	1. Absence of mesoderm
b.	Asymmetrical	2. Annelida
c.	Metamerism	3. Porifera
d.	Diploblastic	4. Aschelminthes

(A) a-1, b-2, c-3, d-4
(B) a-2, b-3, c-4, d-1
(C) a-3, b-4, c-1, d-2
(D) a-4, b-3, c-2, d-1

Q.24 Which one of the following groups of three animals is correctly matched with their one characteristic morphological feature?

Animals		Morphological features
(A) Scorpion, spider, cockroach	-	Ventral solid central nervous system
(B) Cockroach, locust - *Taenia*	-	Metameric segmentation
(C) Liver fluke, sea anemone, sea cucumber	-	Bilateral symmetry
(D) Centipede, prawn, sea urchin	-	Jointed appendages

Q.25 Match Column-I with Column-II and select the correct option from the codes given below.

	Column-I	Column-II
a.	Cyclostomes	(i) Hemichordata
b.	Aves	(ii) Urochordata
c.	Tunicates	(iii) Agnatha
d.	*Balanoglossus*	(iv) Pisces
e.	Osteichthyes	(v) Tetrapod

(A) a-(i), b-(ii), c-(iii), d-(iv), e-(v)
(B) a-(ii), b-(iii), c-(iv), d-(i), e-(v)
(C) a-(iii), b-(v), c-(ii), d-(i), e-(iv)
(D) a-(iii), b-(i), c-(v), d-(ii), e-(iv)

Q.26 Which of the following groups of animals are uricotelic?
(A) Reptiles, birds, land snails, insects
(B) Reptiles, birds, land snails
(C) Aquatic amphibians, birds, land snails, insects
(D) Amphibians, reptiles, birds, insects

Q.27 Select the correct option in respect of characteristics of each group.

	Cyclostomes	Chondrichthyes	Osteichthyes
(i)	Sucking mouth	Ventral mouth	Terminal mouth
(ii)	Scales absent	Placoid scales	Cycioid/Ctenoid scales
(iii)	Marine	Marine	Marine
(iv)	6-15 pairs of gills	5-7 pairs of gills without operculum	4 pairs of gills with operculum

(A) (i) and (ii) are correct
(B) (i) and (iv) are correct
(C) All are correct
(D) Only (iii) is correct

Q.28 The body cavity of adult *Ascaris* is –
(A) haemocoel (B) amphicoel
(C) pseudocoel (D) schizocoel

Q.29 National bird of India is
(A) *Psittacula* (B) *Passer domesticus*
(C) *Pavo cristatus* (D) *Parakeet*

Q.30 Which one of the following arthropods is viviparous?
(A) *Palaemon* (B) *Palamnaeus*
(C) *Pediculus* (D) *Periplaneta*

Q.31 Pick the mammal with true placenta
(A) Kangaroo (B) Echidna
(C) Platypus (D) Mongoose

Q.32 Which one of the following has a biradial symmetry?
(A) *Paramecium* (B) Jellyfish
(C) Cockroach (D) Sea anemone

Note (Q.33-Q.39) :
Each questions contain STATEMENT-1 (Assertion) and STATEMENT-2 (Reason). Each question has 4 choices (A), (B), (C) and (D) out of which ONLY ONE is correct.
(A) Statement- 1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement -1
(B) Statement-1 is True, Statement -2 is True; Statement-2 is NOT a correct explanation for Statement - 1
(C) Statement - 1 is True, Statement- 2 is False
(D) Statement -1 is False, Statement -2 is False

Q.33 **Statement 1 :** Blood is colourless in the insects.
Statement 2 : Insect blood has no role in O_2 transport.

Q.34 **Statement 1 :** The skeleton of sponges is made up of spicules.
Statement 2 : Composition of spicules help in classification of sponges.

Q.35 **Statement 1 :** Cold blooded animals do not have fat layer.

Statement 2 : Cold blooded animals use their fat for metabolic process during hibernation.

Q.36 **Statement 1 :** Radial symmetry in animals is advantageous in detecting food and danger.
Statement 2 : It allows the animal to be able to respond to stimulus from any direction.

Q.37 **Statement 1 :** Sponges belong to Porifera.
Statement 2 : Sponges have canal system.

Q.38 **Statement 1 :** Birds have one ovary.
Statement 2 : This reduces the body weight for flight.

Q.39 **Statement 1 :** Bats and whales are classified as mammals.
Statement 2 : Bats and whales have four-chambered heart.

EXERCISE - 4 (PREVIOUS YEARS AIPMT/NEET EXAM QUESTIONS)

Choose one correct response for each question.

Q.1 Which of the following are correctly matched with respect to their taxonomic classification? **[NEET 2013]**

(A) House fly, butterfly, tse-tsefly, silverfish - Insecta
(B) Spiny anteater, sea urchin, sea cucumber- Echinodermata
(C) Flying fish, cuttlefish, silverfish - Pisces
(D) Centipede, millipede, spider, scorpion - Insecta

Q.2 Which group of animals belong to the same phylum? **[NEET 2013]**

(A) Prawn, Scorpion, *Locusta*
(B) Sponge, Sea anemone, Starfish
(C) Malarial parasite, *Amoeba*, Mosquito
(D) Earthworm, Pinworm, Tapeworm.

Q.3 Match the name of the animal (column I), with one characteristic (column II), and the phylum / class (column III) to which it belongs. **[NEET 2013]**

	Column I	Column II	Column III
(A)	*Limulus*	Body covered by chitinous exoskeleton	Pisces
(B)	*Adamsia*	Radially symmetrical	Porifera
(C)	*Petromyzon*	Ectoparasite	Cyclostomata
(D)	*Ichthyophis*	Terrestrial	Reptilia

Q.4 One of the representatives of Phylum Arthropoda is **[NEET 2013]**

(A) puffer fish (B) flying fish
(C) cuttle fish (D) silver fish.

Q.5 Select the taxon mentioned that represents both marine and fresh water species. **[AIPMT 2014]**

(A) Echinoderms (B) Ctenophora
(C) Cephalochordata (D) Cnidaria

Q.6 Which one of the following living organisms completely lacks a cell wall? **[AIPMT 2014]**

(A) Cyanobacteria (B) Sea - fan (Gorgonia)
(C) Saccharomyces (D) Blue- green algae

Q.7 Planaria possesses high capacity of **[AIPMT 2014]**

(A) metamorphosis
(B) regeneration
(C) alternation of generation
(D) bioluminescence.

Q.8 A marine cartilaginous fish that can produce electric current is **[AIPMT 2014]**

(A) *Pristis* (B) *Torpedo*
(C) *Trygon* (D) *Scoliodon*

Q.9 Which of the following endoparasites of humans does show viviparity? **[AIPMT 2015]**

(A) *Trichinella spiralis*
(B) *Ascaris lumbricoides*
(C) *Ancylostoma duodenale*
(D) *Enterobius vermiculari*

Q.10 Which of the following represents the correct combination without any exception? **[AIPMT 2015]**

	Characteristics	Class
(A)	Sucking and circular mouth; jaws absent, integument without scales; paired appendages.	Cyclostomata
(B)	Body covered with feathers; skin moist and glandular, fore-limbs form wings; lungs with air sacs.	Aves
(C)	Mammary gland; hair on body; pinnae; two pairs of limbs	Mammalia
(D)	Mouth ventral; gills without operculum; skin with placoid scales; persistent notochord.	Chondrichthyes

Q.11 Which of the following animals is not viviparous? **[AIPMT 2015]**

(A) Platypus (B) Whale
(C) Flying fox (Bat) (D) Elephant

Q.12 Which of the following characteristics is mainly responsible for diversification of insects on land? **[AIPMT 2015]**
(A) Exoskeleton (B) Eyes
(C) Segmentation (D) Bilateral symmetry

Q.13 Body having meshwork of cells, internal cavities lined with food filtering flagellated cells and indirect development are the characteristics of phylum – **[AIPMT 2015]**
(A) Mollusca (B) Protozoa
(C) Coelenterata (D) Porifera

Q.14 Metagenesis refers to **[RE-AIPMT 2015]**
(A) occurrence of a drastic change in form during post embryonic development.
(B) presence of a segmented body and parthenogenetic mode of reproduction.
(C) presence of different morphic forms.
(D) alternation of generation between asexual and sexual phases of an organism.

Q.15 A jawless fish, which lays eggs in fresh water and whose ammocoetes larvae after metamorphosis return to the ocean is – **[RE-AIPMT 2015]**
(A) *Neomyxine* (B) *Petromyzon*
(C) *Eptatretus* (D) *Myxine*

Q.16 Which of the following features is not present in the Phylum-Arthropoda? **[NEET 2016 PHASE 1]**
(A) Chitinous exoskeleton
(B) Metameric segmentation
(C) Parapodia
(D) Jointed appendages

Q.17 Which of the following characteristic features always holds true for the corresponding group of animals? **[NEET 2016 PHASE 1]**
(A) Cartilaginous endoskeleton — Chondrichthyes
(B) Viviparous — Mammalia
(C) Possess a mouth with an upper and a lower jaw — Chordata
(D) 3-chambered heart with one incompletely divided ventricle — Reptilia

Q.18 Which one of the following characteristics is not shared by birds and mammals? **[NEET 2016 PHASE 2]**
(A) Ossified endoskeleton
(B) Breathing using lungs
(C) Viviparity
(D) Warm blooded nature

Q.19 Choose the correct statement. **[NEET 2016 PHASE 2]**
(A) All mammals are viviparous.
(B) All cyclostomes do not possess jaws and paired fins.
(C) All reptiles have a three-chambered heart.
(D) All pisces have gills covered by an operculum.

Q.20 In case of poriferans the spongocoel is lined with flagellated cells called : **[NEET 2017]**
(A) Ostia (B) Oscula
(C) Choanocytes (D) Mesenchymal cells

Q.21 An important characteristic that Hemichordates share with Chordates is – **[NEET 2017]**
(A) Absence of notochord
(B) Ventral tubular nerve cord
(C) Pharynx with gill slits
(D) Pharynx without gill slits

Q.22 Which among these is the correct combination of aquatic mammals? **[NEET 2017]**
(A) Seals, Dolphins, Sharks
(B) Dolphins, Seals, Trygon
(C) Whales, Dolphins Seals
(D) Trygon, Whales, Seals

Q.23 Which of the following represents order of 'Horse'? **[NEET 2017]**
(A) Equidae (B) Perissodactyla
(C) Caballus (D) Ferus

Q.24 Identify the vertebrate group of animals characterized by crop and gizzard in its digestive system **[NEET 2018]**
(A) Aves (B) Reptilia
(C) Amphibia (D) Osteichthyes

Q.25 Which one of these animals is not a homeotherm? **[NEET 2018]**

(A) Camelus (B) Chelone
(C) Macropus (D) Psittacula

Q.26 Which of the following animals does not undergo metamorphosis? **[NEET 2018]**

(A) Moth (B) Tunicate
(C) Earthworm (D) Starfish

Q.27 Consider following features

(a) Organ system level of organisation.
(b) Bilateral symmetry.
(c) True coelomates with segmentation of body.

Select the correct option of animal groups which possess all the above characteristics **[NEET 2019]**

(A) Annelida, Arthropoda and Chordata.
(B) Annelida, Arthropoda and Mollusca.
(C) Arthropoda, Mollusca and Chordata.
(D) Annelida, Mollusca and Chordata.

Q.28 Match the following organisms with their respective characteristics : **[NEET 2019]**

(a) Pila	(i) Flame cells
(b) Bombyx	(ii) Comb plates
(c) Pleurobrachia	(iii) Radula
(d) Taenia	(iv) Malpighian tubules

Select the correct option from the following :

(A) a-(iii), b-(ii), c-(i), d-(iv)
(B) a-(iii), b-(iv), c-(ii), d-(i)
(C) a-(ii), b-(iv), c-(iii), d-(i)
(D) a-(iii), b-(ii), c-(iv), d-(i)

ANSWER KEY

EXERCISE-1 (SECTION-1&2)

(1) (A) **(2)** (C) **(3)** (B) **(4)** (B)
(5) (D) **(6)** (A) **(7)** True **(8)** True
(9) True **(10)** True **(11)** polyp
(12) flame **(13)** True **(14)** Radula
(15) *Ctenoplana*

(16)

Phylum/ Class	Excretory Organ	Circulatory Organ	Respiratory Organ
Arthropoda	Malpighian tubules	Open	Lungs/ Gills/ Tracheal System
Annelida	Nephridia	Closed	Skin/ parapodia
Mollusca	Metanephridia	Open	Gills
Amphibia	Kidneys	Closed	Lung

(17) Hemichordata. **(18)** Echinodermata
(19) Mollusca **(20)** Arthropoda
(21) Annelida **(22)** Aschelminthes
(23) Platyhelminthes **(24)** Cyclostomata
(25) Chondrichthyes

EXERCISE - 1 [SECTION-3 & 4]

Q	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
A	D	D	A	A	B	D	C	A	A	A	D	A	D	D	C	C	D	A	C	C	B	D	B	A	D
Q	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
A	A	B	D	B	D	C	D	D	B	A	C	A	B	C	C	C	D	B	A	C	D	C	C	D	A
Q	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
A	B	A	B	D	C	A	A	A	B	B	C	C	B	B	B	B	A	D	C	A	D	B	B	D	C
Q	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125
A	A	D	D	C	D	D	D	D	A	D	B	D	C	D	B	C	D	D	C	D	B	A	D	D	D
Q	126	127	128	129	130	131	132	133																	
A	C	C	C	D	D	C	B	D																	

EXERCISE - 2

Q	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
A	D	D	D	B	A	B	D	A	C	B	A	B	B	B	D	D	B	B	C	D	C	D	A	A	D
Q	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
A	B	B	B	D	D	C	A	A	D	B	C	D	C	A	C	D	B	A	C	D	A	D	C	A	C

EXERCISE - 3

Q	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
A	D	B	C	C	C	C	D	D	C	C	C	C	D	A	A	C	D	D	B	C	B	A	D	A	C
Q	26	27	28	29	30	31	32	33	34	35	36	37	38	39											
A	A	C	C	C	B	D	D	B	B	B	A	B	A	B											

EXERCISE - 4

Q	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
A	A	A	C	D	D	B	B	B	A	D	A	A	D	D	B	C	A	C	B	C	C	C	B	A	B	C	A	B

SOLUTIONS

EXERCISE-1

(1) **(A).** **Asymmetrical :** Refers to body that cannot be divided into two equal halves in any direction.
Bilateral : Refers to the body that symmetry can be divided into two similar parts in one direction only.
Radial : Refers to symmetry in symmetry which body can be divided into two equivalent halves if they are cut through any of the radial planes.

(2) **(C).** **Acoelomate :** Animals without body cavity.
Coelom : Cavity lined by mesoderm; it lies between the body wall and the digestive tract in which various internal organs are found suspended.
Coelomate : Animals with true body cavity or coelom.
Pseudocoelom : A body cavity not completely lined with mesoderm.

(3) **(B).** **Diploblastic :** Derived from two embryonic germ layers, ectoderm and endoderm.
Triploblastic : Derived from three primary germ layers-ectoderm, mesoderm and endoderm.
Mesoglea : Undifferentiated layer present between ectoderm and endoderm.
Mesoderm: Germinal layer between ectoderm and endoderm.

(4) **(B).** **Nephridia :** Tubular excretory structure characteristic of many invertebrates, such as annelids.
Osculum : Relatively large external opening of the central cavity (spongocoel) through which water leaves the sponge. It acts as exhalent siphon.
Ostia : Small tiny apertures present all over the body wall of sponge. These act as inhalent siphons.

(5) **(D).** **Notochord :** An elastic, solid skeletal rod lying below the nerve cord and above the alimentary canal in chordates.
Pinna : Refers to external ears of mammals.
Polyp : Fixed, sessile, cylindrical, hydra-like form of coelenterates.

(6) **(A).** Cellular level of organisation is seen in Porifera. Tissue level of organisation is observed in cnidarians. Organ level of organisation is observed in Platyhelminthes and organ-system level of organisation is seen in chordates.

(7) True

(8) True

(9) **True.** The name cnidaria is derived from the cnidocytes which contain the stinging capsules.

(10) True

(11) The **polyp** is a sessile stage that typically reproduces asexually.

(12) In Platyhelminthes **flame** cells help in osmoregulation and excretion.

(13) **True.** In Aschelminthes alimentary canal is complete with a well developed muscular pharynx.

(14) Radula is a file-like rasping organ present in mollusca.

(15) *Ctenoplana* exhibit the phenomenon of bioluminescence. It belongs to phylum-Ctenophora.

(16)

Phylum/ Class	Excretory Organ	Circulatory Organ	Respiratory Organ
Arthropoda	Malpighian tubules	Open	Lungs/ Gills/ Tracheal System
Annelida	Nephridia	Closed	Skin/ parapodia
Mollusca	Metanephridia	Open	Gills
Amphibia	Kidneys	Closed	Lung

(17) *Balanoglossus* belongs to phylum Hemichordata.

(18) *Asterias* belongs to phylum – Echinodermata

(19) Apple snail belongs to phylum Mollusca

(20) Honey bee belongs to phylum Arthropoda

(21) *Nereis* belongs to phylum Annelida

(22) *Ascaris* belongs to phylum Aschelminthes

(23) *Taenia* belongs to phylum Platyhelminthes

(24) Hagfish belongs to class Cyclostomata

(25) Dog fish belongs to class Chondrichthyes

(26) **(D).**

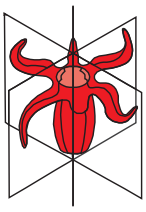


Figure : Radial symmetry

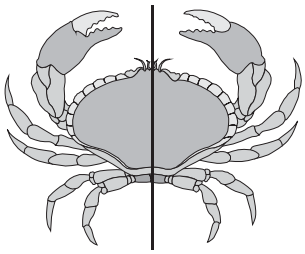


Figure : Bilateral symmetry

Radial Symmetry : Animals are said to exhibit radial symmetry, when any plane passing through the central axis of the body divides the organism into two identical halves. Example: Coelentrates, ctenophores and echinoderms.

Bilateral Symmetry : Animals where body can be divided into identical right and left halves are said to be bilaterally symmetrical. Example: Annelids, Arthropods,etc.

(27) **(D).**

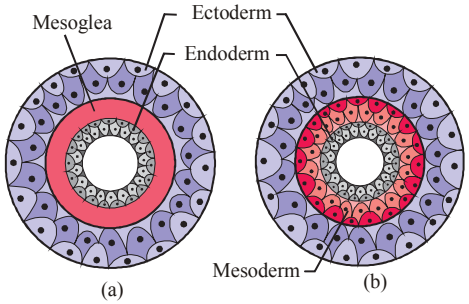


Figure : Showing germinal layers:
(a) Diploblastic (b) Triploblastic

(28) **(A).**

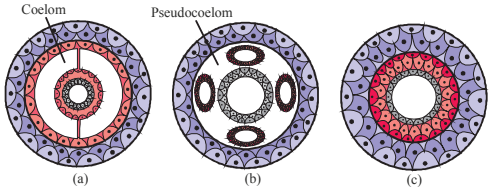
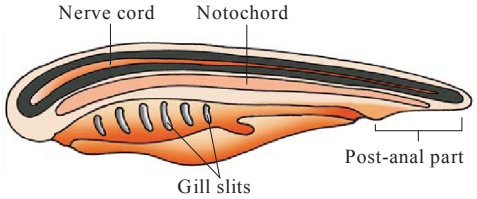


Figure : Diagrammatic sectional view of :
(a) Coelomate (b) Pseudocoelomate (c) Acoelomate

Coelomates, e.g., annelids, molluscs, arthropods, echinoderms, hemichordates and chordates.
Pseudocoelomates, e.g., aschelminthes.
Acoelomates, e.g., platyhelminthes

(29) (A) **(30)** (B) **(31)** (D)
(32) (C) **(33)** (A) **(34)** (A)

(35) **(A).**



(36) **(D).** Subphyla Urochordata and Cephalochordata are often referred to as protochordates and are exclusively marine.

(37) (A) **(38)** (D) **(39)** (D)
(40) (C)

(41) **(C).** Animals are classified based on coelomic cavity, level of organisation and presence or absence of notochord.

(42) **(D).** **Diploblastic Animals -** Animals in which the cells are arranged in two embryonic layers are known as diploblastic animals. Diploblastic animals have an external ectoderm and an internal endoderm. The middle mesoglea is the middle undifferentiated layer present between outer ectoderm and middle mesoderm. Example: Coelentrates.

Triploblastic Animals - Triploblastic animals are those, whose cells are arranged in three germinal layers, the outer ectoderm, inner endoderm and the third germinal layer mesoderm which is in between outer ectoderm and the endoderm. Example: Platyhelminthes to Chordates.

(43) **(A).** Metamerism or true segmentation is seen when the body is externally and internally divided into segments.

(44) **(C).** Only two types of symmetry are exhibited by animals, *i.e.,* rest of the animals are asymmetrical, *i.e.,* bilateral and radial.

(45) **(C).** Bilateral symmetry is found in few invertebrates and all vertebrates.

(46) **(B).** Mesoglea is the undifferentiated layer present in between the ectoderm and endoderm in sponges. The third germinal layer is a differentiated layer, which is present between the ectoderm and endoderm and is called mesoderm.

(47) **(D).** Asymmetrical animals : Snails
Radially symmetrical animals : Starfish
Bilaterally symmetrical animals : Frog

(48) **(B).** Body cavity lined by mesoderm is a coelomic cavity. Coelom is absent in acoelomate animals. When the mesoderm is present as scattered pouches in between ectoderm and endoderm, the animals are called pseudocoelomates.

(49) **(A).** Radial symmetry is a characteristic feature of coelenterates, ctenophores and echinoderms. Section of these animals in two or more planes produce halves, which are approximately mirror images of each other.

(50) **(D).** Organ system level of organisation is seen in chordates, annelids and mollusc. *i.e.,* in all the phyla from Platyhelminthes onwards.

(51) **(A).** Phylum-Echinodermata are triploblastic animals *i.e.,* form three germ layers during embryonic development. Phylum-Platyhelminthes, Aschelminthes, Annelida, Arthropoda, Mollusca, Echinodermata, Hemichordata and Chordata includes all triploblastic animals.

(52) **(B).** Notochord is a mesodermally derived rod-like structure formed on the dorsal side during embryonic development in some animals.

(53) **(D).** **Acoelomates -** Animals in which the body cavity is absent are known as acoelomates. Example: Platyhelminthes.
Coelomates - Animals possessing the body cavity which is lined by the mesoderm are known as coelomates. Example: Annelids, Mollusca, Arthropods, Echinoderms, chordates.

(54) **(B).** In some animals, body is segmented externally and internally, with serial repetition of at least some organs. This phenomenon is known as metamerism and the segmented body pattern is known as metameric segmentation. Example: Earthworm.
In some animals during embryonic development, a mesodermally derived rod-like structure is formed on the dorsal side, this is known as notochord. Animals with notochord are known as chordates and the animals which do not form notochord are known as non-chordates. Example: Porifera to Echinoderms.

(55) **(D).** Only animals belonging to the phylum-Aschelminthes are pseudocoelomates. Animals belonging to the phylum-Platyhelminthes are acoelomates, while Arthropoda and Mollusca are coelomates.

(56) **(C).** Notochord is derived from mesoderm and formed on the dorsal side, during embryonic development.

(57) **(D).**

(58) **(D).** Canal system in Porifera is concerned with food gathering, respiratory exchange and removal of waste.

(59) **(B).** Porifera

(60) **(A).** Animals belonging to the phylum-Porifera are supported by spicules or spongin fibres.

(61) **(C).** Phylum-Porifera consists of sponges that are considered as asymmetrical. Animals belonging to Phylum-Ctenophora and Coelenterata are radially symmetrical and animals belonging to Annelida are bilaterally symmetrical.

(62) **(A).** The central body cavity of sponges is called spongocoel. Their body is porous. The inhalent pores are called ostia and exhalent pores are known as oscula. The body of a sponge is organized in such a manner as to form a complex system of pores and canals. This system is called canal system. Water flows in through ostia to spongocoel and comes out to exterior via osculum. The continuous water current flowing through the canal system is very important for the life of a sponge.

(63) **(B).** Examples of Porifera : *Sycon* (Scypha), *Spongilla* (Fresh water sponge) and *Euspongia* (Bath sponge).

(64) **(C).** Asexual reproduction in sponges takes place by fragmentation, while the sexual reproduction takes place by formation of gametes.

(65) **(C).** Polyp and medusa are the two basic body forms present in Cnidarians.

(66) **(C).** Poriferans and Coelenterates are diploblastic animals, while all animals in and after Platyhelminthes are triploblastic animals. Protozoa are single celled animalcules and do not form any germ layers.

(67) **(D).** Cnidarians which exist in both forms exhibit alternation of generation (Metagenesis), i.e., polyps produce medusae asexually and medusae form the polyps sexually (e.g., *Obelia*).

(68) **(B).** Phylum-Coelenterata or Cnidaria have tissue level of organisation. Cellular level of organisation is only present in phylum-Porifera.

(69) **(A).** Examples of Phylum – Coelenterata (Cnidaria): *Physalia* (Portuguese man-of-war), *Adamsia* (Sea anemone), *Pennatula* (Sea-pen), *Gorgonia* (Sea-fan) and *Meandrina* (Brain coral).

(70) **(C).** Metagenesis is seen in those forms of phylum- Coelenterata that exist in both body forms, *i.e.,* polyp and medusa. Polyps produce through asexual reproduction and medusae also arise through budding form polyps. These are meant for sexual reproduction in *Obelia.* Metagenesis is alternation of generation.

(71) **(D).** *Pleurobrachia* belongs to phylum-Ctenophora. Ctenophora are diploblastic, with tissue level of organisation and presence of comb plates. Comb plates is characteristic feature of phylum-Ctenophora. *Plurobrachia* are not triploblastic.

(72) **(C).** Ctenophora

(73) **(C).** When living organisms emit light this property is called bioluminescence. This is usually seen in animals belonging to phylum-Ctenophores. *Ctenoplana* belongs to phylum-Ctenophores. Phylum-Coelenterata and Cnidaria do not exhibit bioluminescence.

(74) **(D).** High regeneration capacity is found in *planaria.*

(75) **(A).** Flatworms (phylum-Platyhelminthes) are triploblastic animals with organs. The cells of the body wall are arranged in three germ layers. Sponges, ctenophores and corals are diploblastic animals.

(76) **(B).** Platyhelminthes are also called flatworms, as they are dorso-ventrally flattened.

(77) **(A).** The animals of phylum-Platyhelminthes are triploblastic, bilaterally symmetrical, acoelomate (without coelom) and mostly parasitic.

(78) **(B).** Platyheminthes are bilaterally symmetrical animals. The body of animal belonging to this phylum can be divided into two identical halves (bilaterally symmetrical) *e.g.,* liver fluke *(Fasciola hepatica).*

(79) **(D).** Flatworms are bilaterally symmetrical, triploblastic and acoelomate animals with organ level of organisation. Hooks and suckers are present in the parasitic forms. Some of them absorb nutrients from the host directly through their body surface. Specialised cells called flame cells help in osmoregulation and excretion.

(80) **(C).** Aschelminthes are triploblastic, bilaterally symmetrical, pseudocoelomate (false coelom derived from embryonic blastocoel) and unsegmented organisms.

(81) **(A).** Aschelminthes are dioecious with separate sexes and females are usually longer than males.

(82) **(A).** Roundworms (phylum-Aschelminthes) are pseudocoelomates. False coelom is derived from embryonic blastocoel and flatworms (phylum-Platyhelminthes) are acoelomate animals.

(83) **(A).** Aschelminthes are bilaterally symmetrical, triploblastic and dioecious animals. They may be free-living, aquatic and terrestrial or parasitic on plants and animals.

(84) **(B).** *Wuchereria bancrofti* (the filarial worm) belongs to phylum-Aschelminthes.

(85) **(B).** Examples of Phylum – Aschelminthes : *Ascaris* (Round Worm), *Wuchereria* (Filaria worm), *Ancylostoma* (Hookworm).

(86) **(C).** The excretory system in Annelida consists of nephridia. Flame cells are part of the excretory system of animals belonging to phylum-Platyhelminthes.

(87) **(C).** Examples of phylum annelida : *Nereis, Pheretima* (Earthworm) and *Hirudinaria* (Blood sucking leech).

(88) **(B).** **Phylum – Annelida :** Their body surface is distinctly marked out into segments or metameres and, hence, the phylum name Annelida. They possess longitudinal and circular muscles which help in locomotion. Aquatic annelids like Nereis possess lateral appendages, parapodia, which help in swimming. A closed circulatory system is present. Nephridia help in osmoregulation and excretion. Neural system consists of paired ganglia.

(89) **(B).** Phylum-Arthropoda is the largest phylum of the kingdom-Animalia. It includes over 2/3rd of all known species.

(90) **(B).** Phylum-Arthropoda

(91) **(B).** *Limulus* or king crab is also called a living fossil.

(92) **(A).** The generic name of tusk shell is *Dentalium.*

(93) **(D).** The body of animals belonging to phylum-Arthropoda are divided into head, thorax and abdomen, while animals belonging to phylum-Mollusca are divided into head, muscular foot and visceral hump.

(94) **(C).** Phylum-Arthropoda is the first largest phylum, having most successful invertebrates, in terms of number of species (about 900000). Phylum-Mollusca is the second largest phylum containing more than 100000 species and probably the most sophisticated of all invertebrates.

(95) **(A).** Examples of Phylum-Mollusca : *Pila* (Apple snail), *Pinctada* (Pearl oyster), *Sepia* (Cuttlefish), *Loligo* (Squid), *Octopus* (Devil fish), *Aplysia* (Seahare), *Dentalium* (Tusk shell) and *Chaetopleura* (Chiton).

(96) **(D).** The feeding organ in phylum-Mollusca is a radula, it is a file like rasping organ. Undulating membranes and suctorial organs are present in ciliated protozoans.

(97) **(B).** Presence of water vascular system is the most distinctive characteristic of echinoderms.

(98) **(B).** The adult echinoderms are radially symmetrical but larvae are bilaterally symmetrical. They are triploblastic and coelomate animals. Digestive system is complete with mouth on the lower (ventral) side and anus on the upper (dorsal) side. The most distinctive feature of echinoderms is the presence of water vascular system which helps in locomotion, capture and transport of food and respiration. An excretory system is absent. Sexes are separate. Reproduction is sexual.

(99) **(D).** *Asterias* is the generic name of starfish.

(100) **(C).** Cuttlefish or *Sepia,* Chaetopleura or chiton and *Aplysea* or sea-hare belong to phylum-Mollusca. *Antedon* or sea lily, *Cucumaria* or sea cucumber, *Echinus* or sea urchins and *Ophiura* or brittle star belong to phylum- Echinodermata.

(101) **(A).** Excretory organ in animals belonging to phylum-Hemichordata is the proboscis gland.

(102) **(D).** Phylum-Hemichordata consists of a small group of worm-like marine animals with organ-system level of organisation. They are bilaterally symmetrical, triploblastic and coelomate animals. The body is cylindrical and is composed of an anterior proboscis, a collar and a long trunk. Circulatory system is of open type. Respiration takes place through gills. Excretory organ is proboscis gland. Sexes are separate. Fertilisation is external. Development is indirect.

(103) **(D).** Examples of Phylum-Hemichordata : *Balanoglossus* and *Saccoglossus.*

(104) **(C).** Animals belonging to sub-Phylum-Urochordata are *Ascidia, Salpa* & *Doliolum.*

(105) (D). All chordates are bilaterally symmetrical, coelomates, triploblastic with closed circulatory system and organ system level of organisation.

(106) (D). In Urochordata, the notochord is present only in larval tail, while in Cephalochordata notochord is present throughout life.

(107) (D). Phylum-Chordata is divided into three sub-phyla-Urochordata, Cephalochordata and Vertebrata.
Urochordata is also called as Tunicata. Urochordata and Cephalochordata are also called as Protochordata.

(108) (D). *Petromyzon* is a jawless vertebrate. It is also known as sea lamprey.

(109) (A). Examples of Class-Cyclostomata : *Petromyzon* (Lamprey) and *Myxine* (Hagfish).

(110) (D). Animals belonging to class-Chondrichthyes are so called because of the presence of cartilaginous endoskeleton. They lack air bladder thus, swim constantly and have placoid scales. Notochord is persistant through out the life.

(111) (B). Examples of Class-Chondrichthyes : *Scoliodon* (Dog fish), *Pristis* (Saw fish), *Carcharodon* (Great white shark), *Trygon* (Sting ray).

(112) (D). Chondrichthyes is one of the classes of super-class-Pisces, sub-phylum-Vertebrata and phylum-Chordata. The members of class-Chondrichthyes are marine animals with streamlined body and have cartilaginous endoskeleton.
Mouth is located ventrally. The skin is tough, containing minute placoid scales. The teeth are modified placoid scales, which are backwardly directed, e.g., dog fish *(Scoliodon)*, saw fish *(Pristis)*, great white shark *(Carcharodon)*, sting ray *(Trygon)*, etc.

(113) (C). Class-Chondrichthyes are part of super-class-Pisces that are of the phylum-Chordata. All chordates displays the presence of a notochord during embryonic development.

(114) (D). *Trygon* is also called sting ray and belongs to class-Chondrichthyes. They have two-chambered heart, males have claspers and respiration is by exchange of gases with the water through gills.

(115) (B). *Pristis* (sawfish). *Scoliodon* (dogfish), *Trygon, Carcharodon* (great white shark) are (cartilaginous) fishes while *Myxine (hagfish), Petromyzon* (lamprey) are boneless fishes.

(116) (C). Examples of Class-Osteichthyes :
Marine – *Exocoetus* (Flying fish), *Hippocampus* (Sea horse); Freshwater – *Labeo* (Rohu), *Catla* (Katla), *Clarias* (Magur); Aquarium – *Betta* (Fighting fish), *Pterophyllum* (Angel fish).

(117) (D). Class-Osteichthyes
(a) Their body is streamlined.
(b) They have four pairs of gills which are covered by an operculum.
(c) Skin is covered with cycloid/ctenoid scales.

(118) (D). Amphibians are characterised by three-chambered heart they are cold-blooded animals and their skin is moist and generally lack scales.

(119) (C). Amphibians do not have scales.

(120) (D). Examples of Class-Amphibia :
Bufo (Toad), *Rana* (Frog), *Hyla* (Tree frog), *Salamandra* (Salamander), *Ichthyophis* (Limbless amphibia).

(121) (B). The skin of reptiles is dry, cornified and devoid of glands.

(122) (A). Reptilia - are mostly terrestrial animals and their body is covered by dry and cornified skin, epidermal scales or scutes. They do not have external ear openings. Tympanum represents ear. Limbs, when present, are two pairs. Heart is usually three-chambered, but four-chambered in crocodiles.

(123) (D). Examples of Class-Reptilia :
Chelone (Turtle), *Testudo* (Tortoise), *Chameleon* (Tree lizard), *Calotes* (Garden lizard), *Crocodilus* (Crocodile), *Alligator* (Alligator). *Hemidactylus* (Wall lizard), Poisonous snakes – *Naja* (Cobra), *Bangarus* (Krait), *Vipera* (Viper).

(124) **(D).** Crocodiles *have* a completely four-chambered heart similar to the birds and mammals.

(125) **(D).** The forelimbs of *Aves* are modified into wings and *have* powerful flight muscles.

(126) **(C).** Examples of Class-Aves :
Corvus (Crow), *Columba* (Pigeon), *Psittacula* (Parrot), *Struthio* (Ostrich), *Pavo* (Peacock), *Aptenodytes* (Penguin), *Neophron* (Vulture).

(127) **(C).** Bones of *Aves* (e.g., pigeon) are pneumatic. Pneumatic bones contain air cavities to reduce body weight, thus aids in flying.

(128) **(C).** Mammalia is the only class, which has the presence of mammary glands. It is a unique characteristic among the members of this class but four chamber heart and internal fertilisation is found in the members of class-Mammalia as well as *Aves*.

(129) **(D).** Birds and mammals both are homeothermic (warm blooded) in nature i.e., they can regulate their body temperature to maintain homeostasis.

(130) **(D).** Examples: Oviparous-*Ornithorhynchus* (Platypus); Viviparous - *Macropus* (Kangaroo), *Pteropus* (Flying fox)

(131) **(C).** Examples of class - mammalia :
Camelus (Camel), *Macaca* (Monkey), *Rattus* (Rat), *Canis* (Dog), *Felis* (Cat), *Elephas* (Elephant), *Equus* (Horse), *Delphinus* (Common dolphin), *Balaenoptera* (Blue whale), *Panthera tigris* (Tiger), *Panthera leo* (Lion).

(132) **(B).** Amphibians have three-chambered heart, while reptiles have incomplete four-chambered heart (except crocodiles).Crocodiles, birds and mammals have complete, four-chambered hearts.

(133) **(D).** Penguin and ostrich are not mammals, while whale, bat, kangaroo, *Hippopotamus* are mammals.

EXERCISE-2

(1) **(D).** Platyhelminthes, Aschelminthes and Annelids exhibit bilateral symmetry.

(2) **(D).** Choanocytes or collar cells are flagellated cells characteristic of the phylum-Porifera.

(3) **(D).** In radial symmetry, body is in the form of a flat or tall cylinder. Body can be divided into similar halves by more than two planes passing through one main axis. Radial symmetry is found in some sponges and in the coelenterates, ctenophores and echinoderms.

(4) **(B).** All statements are false.
The correct statement are
(i) In higher phyla organ and organ system level of organisation is seen.
(ii) Phylum-Platyhelminthes have organ level of body organisation
(iii) Cellular level of organisation is seen when the cells are arranged as loose cell aggregates.
(iv) Molluscs exhibit organ level of body organisation.

(5) **(A).** Sea anemone is not parasitic. It shows mutualism with hermit crab. Tapeworm is an endoparasite while leech and mosquito are exoparasites.

(6) **(B).** Chordates have a notochord, central nervous system is dorsal with pharynx perforated by gill slits and heart is ventral, post anal tail is present.

(7) **(D).** *Fasciola hepatica* (sheep liverfluke) belongs to phylum-Platyhelminthes. These worms have incomplete alimentary canal, there is a single opening for both digestion and egestion. This is also called as blind sac body plan.

(8) **(A).** Metameric segmentation is a characteristics feature of phylum – Annelida.

(9) **(C).** Reptiles usually possess 3-chambered heart but crocodiles are an exception with 4-chambered heart. Not all chordates have a mouth with upper and lower jaw. Egg laying mammals include duck-billed platypus. Chondrichthyes (cartilaginous fishes) are the fishes that have cartilaginous endoskeleton. There is no exception to this.

(10) **(B).** *Spirulina* is a cyanobacteria and does not belong to phylum-Porifera.

(11) **(A).** Echinoderms are radially symmetrical with a distinctive water vascular system but got their names because of the presence of

calcareous ossicles present as an endoskeleton that gives a spiny body. Phylum-Mollusca have a mantle cavity.

(12) (B). Aschelminthes are bilaterally symmetrical and triploblastic animals, *e.g., Ascaris*. Coelenterates are radially symmetrical and diploblastic animals, *e.g., Obelia.* Ctenophores are bilaterally symmetrical and diploblastic animals, *e.g., Ctenoplana.* Sponges are asymmetrical (or radially symmetrical) and diploblastic animals, e.g. *Sycon.*

(13) (B). **Examples of Phylum-Arthropoda :**
Apis (Honey bee), *Bombyx* (Silkworm), *Laccifer* (Lac insect)
Vectors – *Anopheles, Culex* and *Aedes* (Mosquitoes)
Gregarious pest – *Locusta* (Locust)
Living fossil – *Limulus* (King crab).

(14) (B). Sponges are hermaphrodites, *i.e.,* sexes are not separate and sexual reproduction takes place by gamete formation. Both eggs and sperms are produced by the same individual.

(15) (D). Parrot belongs to the class Aves and platypus and kangaroo belong to the class Mammalia. Both aves and mammals are homoiotherms i.e. the temperature of their body remains constant irrespective of the temperature of the environment.

(16) (D). *Amphioxus* is also called *Branchiostoma, Petromyzon* is lamprey, *Trygon* is sting ray and *Myxine* is hagfish.

(17) (B). *Physalia* : Portugese man of war
Taenia : Tapeworm
Fasciola : Liver fluke
Scypha : *Sycons*

(18) (B). Phylum-Mollusca lack Malpighian tubules, instead have feather like gills in the mantle cavity that are useful for respiration and excretion.

(19) (C). *Lampreys* and *Myxine* (hag fish) belong to the class-Cyclostomata, group Agnatha of Vertebrata. Agnatha have mouth without jaws, the mouth is ventral, suctorial and circular.

(20) (D). All phyla from Porifera to Echinodermata, including phylum-Arthropoda are non-chordates, *i.e.,* lacking notochord.

(21) (C). Monkey, chimpanzee and man are primates belonging to class Mammalia.

(22) (D). *Fasciola* is also known as liver fluke and belongs to phylum-Platyhelminthes that are dorso-ventrally flattened worms and are also called flatworms. *Ancylostoma* or hookworms, *Wuchereria* or filarial worm and *Ascaris* or roundworms belongs to phylum-Aschelminthes.

(23) (A). Echinodermata exhibits organ system level of organisation and radial symmetry. Arthropoda exhibits complete digestive system. Notochord in present on the dorsal side in vertebrates.

(24) (A). Coelenterates have radial symmetry. Aschelminthes are pseudocoelomates. Molluscs do not show metamerism. Sponges are diploblastic.

(25) (D). Phylum-Platyhelminthes (flatworms) are the only forms, with triploblastic, unsegmented, acoelomate and bilateral symmetry. They reproduce both sexually and asexually and also have some parasitic forms, *e.g., Fasciola, Taenia,* etc.

(26) (B). Medusa is the reproductive structure found in *Obelia.*

(27) (B). *Statocysts* : Organ of balance
Radula : Organ of feeding
Gills : Respiratory function
Tentacles : Sensory organs

(28) (B). All vertebrates are chordates but not all chordates are vertebrates.

(29) (D).

(30) (D). Solenocytes or flame cells are the excretory organs of phylum-Platyhelminthes.

(31) (C). Honeybee – *Apis*
Mosquito – *Aedes*
Laccifer – Lac insects
Bombyx – Silkworm

(32) (A).

(33) (A). Pearl is obtained from pearl oyster *(Pinctada vulgaris)* while honey from *Apis indica,* lac from *Kenia lacca* and silk from *Bombyx mori.*

(34) **(D).** Flightless birds show discontinuous distribution. They *have* well developed powerful legs, small head, rudimentary eyes and wings, *e.g.,* ostrich, emu, kiwi, cassowary, etc.

(35) **(B).** Amphibians and mammals have glandular skin, while reptilians and aves (except for preen gland at tail) have non-glandular skin. Hence, (B) is the correct answer, i.e., chameleon and turtle since both are reptiles.

(36) **(C).** *Fasciola* (a platyhelminth) is an acoelomate animal.

(37) **(D).** Chordates :
(A) Pharynx perforated by gill slits.
(B) Heart is ventral.
(C) A post-anal part is present.

(38) **(C).** Python is a larqe and non-poisonous snake. It kills its prey by coiling around and crushing before swallowing it.

(39) **(A).** Class – Reptilia : Heart is usually three-chambered, but four-chambered in crocodiles.

(40) **(C).** Salient features of Aschelminthes :
Level of Organisation : Organ system
Symmetry : Bilateral
Coelom : Pseudocoelomate
Segmentation : Absent
Digestive System : Complete
Circulatory System : Absent
Respiratory System : Absent

(41) **(D).**
(i) Reptiles are poikilotherms.
(ii) Aves are warm-blooded (homoiothermous) animals,
(iii) Mammals are homoiothermous.
(iv) The ctenophores are marine animals with comb plates.

(42) **(B).** Acoelomates are characterized by absence of coelom or body cavity while coelomates are those organisms where mesoderm lines the coelom. Pseudocoelomates are those, which have a body cavity (derived from blastocoel of embryo) but is not lined with mesoderm, e.g., roundworms.

(43) **(A).**
1. Phylum : Porifera - e.g., *Sycon*
2. Phylum : Cnidaria (Coelenterata) - e.g., *Hydra*
3. Phylum : Ctenophora - e.g .., comb jellies
4. Phylum : Platyhelminthes - e.g., Tapeworm
5. Phylum : Aschelminthes - e.g., *Ascaris*
6. Phylum Annelida - e.g., Earthworm
7. Phylum Arthropoda - e.g., Cockroach
8. Phylum Mollusca - e.g., *Pila*
9. Phylum Echinodermata - e.g., Starfish
10. Phylum Hemichordata *Balanoglossus*

(44) **(C).** A-i, B-iii, C-v, D-iv, E-ii

(45) **(D).** Gnathostomata has two super classes, Pisces and Tetrapoda. Classes Chondrichthyes and Osteichthyes bear fins for locomotion and are grouped under Pisces. The Chondrichthyes are fishes with cartilaginous endoskeleton and are marine.

(46) **(A).**
(i) Classes, Amphibia, Reptilia, Aves and Mammalia have two pairs of limbs and are thus grouped under Tetrapoda.
(ii) Reptiles are characterised by the presence of dry and cornified skin.
(iii) Limbs are absent in snakes.

(47) **(D).** Salient features of Annelida, Arthropoda and
Chordata are :
Level of Organisation : Organ system
Symmetry : Bilateral
Coelom : Coelomate
Segmentation : Present
Digestive System : Complete
Circulatory System : Present
Respiratory System : Present

(48) **(C).** i-D, ii-A, iii-B, and iv-C

(49) **(A).**
(i) Flying fish : *Exocoetus*
(ii) Hagfish : *Myxine*
(iii) Saw fish : *Pristis*
(iv) Angel fish : *Pterophyllum*
(v) Fighting fish : *Betta*

(50) **(C).** Skeleton of corals is composed of calcium carbonate. Siliceous spicules and calcareous spicules are present in phylum-Porifera.

EXERCISE-3

(1) **(D).** Annelids are true coelomates.

(2) **(B).** In tortoise *(Testudo),* class-Reptilia, phylum-Chordata, both exoskeleton and endoskeleton are found.

(3) **(C).** Metameric segmentation is the characteristic feature of phylum-Annelida *(e. g.,* earthworm) and Arthropoda *(e. g.* cockroach). Metamerism is body structure having repeated segments. It aids in specialisation of organs.

(4) **(C).** Electric organs are present in *Torpedo* and poison sting in present in *Trygon* or sting ray. Animals of class Chondrichthyes are cold-blooded or poikilothermic. Animals of class-Cyclostomata like hagfish or *Myxine* migrate to freshwater for spawning.

(5) **(C).** a-(v), b-(iii), c-(ii), d-(i), E-(vi), F-(iv)

(6) **(C).** Platyhelminthes exhibits organ level of organisation. Aschelminthes are pseudo-coelomates.

(7) **(D).** Both earthworm (annelid) and *Periplaneta* (arthropod) have segmented bodies. In earthworm, the body is metamerically segmented while in *Periplaneta*, it is externally segmented.

(8) **(D).** Options (A) and (B) is a transverse section, option (C) is a horizontal section and option (D) is a vertical section or a sagittal section.

(9) **(C).** Platyhelminthes are triploblastic, acoelomate organisms showing bilateral symmetry. Ctenophores have biradial symmetry, are acoelomates having diploblastic organisation. In echinoderms, larvae have bilateral symmetry while adults have radial symmetry. They are coelomates with triploblastic organisation. Annelids are triploblastic, coelomate organisms showing bilateral symmetry.

(10) **(C).** *Leucosolenia* and *Spongilla* belong to the phylum Porifera and thus have porous body (body is provided with pores) and are diploblastic (i.e. derived from two germ layers – ectoderm and endoderm.)

(11) **(C).** True segmentation is also called metamerism.

(12) **(C).** Ctenophora, Cnidaria and Echinodermata all show radial symmetry but comb plates is characteristic of Ctenophora and tissue level organisation is only seen in Cnidaria and Ctenophora. Platyhelminthes displays bilateral symmetry.

(13) **(D).** Crocodile, penguin, whale and dog fish are all chordates and having pharyngeal gill slits at some stage of life history. This is the characteristic feature of chordates.

(14) **(A).** Tube feet are the soft, hollow, extensile and retractile appendages of echinoderms. e.g. Star fish.

(15) **(A).** Silver fish, scorpion, crab and honey bee, all belong to the phylum Arthropoda. The members of this phylum have characteristic feature of jointed appendages.

(16) **(C).** Phylum-Platyhelminthes have an incomplete alimentary canal, but the alimentary canal is complete in phylum-Aschelminthes with a mouth and anus. This is the first phylum with a complete alimentary canal.

(17) **(D).** Tissue level organisation is seen in phylum-Coelenterata and Ctenophora.

(18) **(D).** Platyhelminthes has a single opening within the body that serves as both mouth and anus.

(19) **(B).** Tube-within-tube is a body plan in which two tubes are present, an outer body wall and an inner digestive tract. The body cavity between the two tubes is filled with a fluid. All animals from phylum-Platyhelminthes to Chordates have tube-within-tube body plan and may be either protostomous or deuterostomous.

(20) **(C).** The body of Mollusca is covered by a calcareous shell but the mantle is a soft and spongy layer of skin over the visceral hump.

(21) **(B).** *Ctenoplana* belongs to phylum-Ctenophora. Reproduction in all the animals belonging to phylum-Ctenophora takes place by sexual reproduction only.

(22) **(A).** *Hydra vulgaris* is a fresh water animal.

(23) **(D).** Phylum-Aschelminthes is the only phylum that has pseudocoelomate animals. Porifera are generally asymmetrical. Metamerism is a characteristic feature of phylum-Annelida. Diploblastic animals have two differentiated

germinal layers during embryonic stages and lacks the third germinal layer, mesoderm.

(24) **(A).** Scorpion, spider and cockroach are invertebrates and belong to the phylum Arthropoda, therefore they have ventral solid central nervous system. In cockroach and locust, the body is segmented externally. In *Taenia*, the body is without true segments. Liver fluke has bilateral symmetry, sea anemone has radial symmetry and sea-cucumber has bilateral symmetry in larval form and radial symmetry in adultform. Centipede and prawn have jointed appendages while sea urchin does not have jointed appendages.

(25) **(C).** a-(iii), b-(v), c-(ii), d-(i), E-(iv)

(26) **(A).** Uricotelic animals are those animals that excrete their waste matter in the form of uric acid. Reptiles, birds, land snails and insects are uricotelic animals.

(27) **(C).**

	Cyclostomes	**Chondrichthyes**	**Osteichthyes**
(i)	Sucking mouth	Ventral mouth	Terminal mouth
(ii)	Scales absent	Placoid scales	Cycioid/Ctenoid scales
(iii)	Marine	Marine	Marine
(iv)	6-15 pairs of gills	5-7 pairs of gills without operculum	4 pairs of gills with operculum

(28) **(C).** *Ascaris* belongs to phylum-Aschelminthes. The members of this phylum are pseudocoelomates.

(29) **(C).** The common peafowl or peacock, *Pavo cristatus*, called 'Mor ' or Mayur' in hindi, is the national bird of India. It occurs throughout India upto 1650 meters in the himalayas. It displays a well-marked sexual dimorphism, the male having a gorgeous ocellated tail.

(30) **(B).** The scorpions are the oldest known terrestrial arthropods, about 800 species have been described, some common genera are *Palamnaeus, Buthus,* etc. All scorpions are viviparous and the females carry the young ones on their backs for sometime, for about a week.

(31) **(D).** Kangaroo = pouched mammal.
(B) and (C) are egg laying mammals

(32) **(D).** In biradial symmetry, the body can be divided into two similar halves by one or two vertical planes only, *e.g.,* sea anemones. The animals which show radial and biradial symmetry have oral and aboral sides.

(33) **(B).** Insect blood is colourless. The blood also does not play any role in transport of oxygen. Insects have tracheal respiration.

(34) **(B).** Spicules help in making skeleton of sponges. These are made up of silica, calcium or spongin substances. The structure of spicules also help in classification of sponges.

(35) **(B).** In cold blooded animals, there is no fat layer below skin and their temperature varies with the environment.

(36) **(A).** Radial symmetry is advantageous allowing the animal to respond to stimulus from any direction, allowing it to detect food and danger easily.

(37) **(B).** Sponges belong to Porifera and they have characteristic cannal system.

(38) **(A).** Birds have many adaptations for flight. They have pneumatic bones and only one ovary which reduces the body weight.

(39) **(B).** Bats and whales are the members of class Mammalia (L. Mamma = breast). The bats are the only mammals which have wings and can really fly while whales are the largest animals in existence. Both bats and whales have four chambered heart but birds and crocodiles also have four chambered heart.

EXERCISE-4

(1) **(A).** Spiny anteater (*Echidna*) is a prototherian mammal whereas, sea urchins and sea cucumber are echinoderms. Silver fish (*Lepisma*) is an insect, Cuttle fish (*Sepia*) is a mollusc and flying fish (*Exocoetus*) is a bony fish. Centipede is class chilopoda, Millipede is class diplopoda and Scorpion and Spider are class arachnida of phylum arthropoda.

(2) **(A).** Prawn, Scorpion and Locusta belong to the phylum Arthropoda.

(3) **(C).** *Limulus* belongs to phylum Arthropoda. *Adamsia* belongs to phylum Coelenterata. *Petromyzon* (lamprey) (cyclostomata) is a sanguivorous ectoparasite of larger fishes.

Ichthyophis is a limbless amphibian and belongs to class Amphibia.

(4) **(D).** One of the representatives of Phylum Arthropoda is silver fish.

(5) **(D).** Cnidarians are the sac-like animals which are aquatic, mostly marine except a few like *Hydra*, are fresh water. They are the simplest organisms that have attained a tissue level of organization. Members of Ctenophora, Cephalochordata and Echinodermata are exclusively marine.

(6) **(B).** *Gorgonia* (sea fan) is an animal belonging to phylum Coelenterata. All animals lack cell wall.

(7) **(B).** *Planaria* possesses high degree of regeneration. Both epimorphosis, in which the missing parts are formed and morphallaxis, in which the whole body can be regenerated from a fragment of the body, occurs.

(8) **(B).** Torpedo (electric ray) produces electric current with the help of specialized muscles. Where as *Pristis* is Saw fish, *Trygon* is Sting ray, *Scoliodon* is Dog fish.

(9) **(A).** *Trichinella spiralis* is a minute nematode parasite that shows viviparity i.e., produces live youngs (larvae) not eggs. The adults of *T. spiralis* live in the human small intestine, where the females release large numbers of larvae. These larvae bore through the intestine and can cause trichinosis or trichiniasis which has symptoms like diarrohea, nausea, vertigo, pain in limbs and fever etc. Humans get infected after eating imperfectly cooked meat infected with the parasite's larval cysts.

(10) **(D).** Cyclostomes do not have paired appendages. Skin in Aves is neither moist nor glandular. Only preen gland is present at the base of tail Chondrichthyes members have gills without operculum, except *Chimaera*. Prototherian mammals do not have ear pinnae and aquatic mammals lack hindlimbs (like whales and dolphins).

(11) **(A).** Platypus is not viviparous.

(12) **(A).** Exoskeleton made of cuticle has enabled insects to live on land and to diversify to almost all the possible habitats. It gives them protection, support and also helps to prevent desiccation.

(13) **(D).** Phylum Porifera (the sponges) has cellular level of body organisation, with inner cellular layer consisting of highly specialised flagellated cells called choanocytes (or collar cells). The development in this phylum is indirect as it includes a free swimming larva called amphiblastula or parenchymula for dispersal of the species.

(14) **(D).** An alternation of generation between asexual an sexual phases of an organism is referred to as metageness E.g. in *Obelia* (a coelenterate), polyps reproduce asexuals and medusae reproduce sexually.

(15) **(B).** *Petromyzon* is a A jawless fish, which lays eggs in fresh water and whose ammocoetes larvae after metamorphosis return to the ocean.

(16) **(C).** Parapodia are present in aquatic annelids like Nereis and helps in swimming.

(17) **(A).** Reptiles have 3-chambered heart except crocodiles. Mammals are viviparous except prototherian mammals; chordates have jaws except protochordates & cyclostomes.

(18) **(C).** Mammals are viviparous while birds are oviparous.

(19) **(B).** Cyclostomes belong to the division agnatha. They are jawless vertebrates without paired fins.

(20) **(C).**Choanocytes (collar cells) form lining of spongocoel in poriferans (sponges). Flagella in collar cells provide circulation to water in water canal system.

(21) **(C).** Pharyngeal gill slits are present in hemichordates as well as in chordates. Notochord is present in chordates only. Ventral tubular nerve cord is characteristic feature of nonchordates.

(22) **(C).** Sharks and Trygon (sting ray) are the members of chondrichthyes (cartilaginous fish) while whale, dolphin & seals are aquatic mammals belong to class mammalia.

(23) **(B).** Horse belongs to order perissodactyla of class mammalia. Perissodactyla includes odd-toed mammals.

(24) **(A).** The digestive tract of Aves has additional chambers in their digestive system as crop and Gizzard.
Crop is concerned with storage of food grains. Gizzard is a masticatory organ in birds used to crush food grain.

(25) **(B).** Homeotherm are animals that maintain constant body temperature, irrespective of surrounding temperature.
Birds and mammals are homeotherm. Chelone (Turtle) belongs to class reptilia which is Poikilotherm or cold blood.

(26) **(C).** Metamorphosis refers to transformation of larva into adult. Animal that perform metamorphosis are said to have indirect development.
In earthworm development is direct which means no larval stage and hence no metamorphosis.

(27) **(A).** True segmentation is present in Annelida, Arthropoda and Chordata. They also have organ system level of organisation, bilateral symmetry and are true coelomates.

(28) **(B).**
(a) *Pila* is a Mollusc. The mouth contains a file - like rasping organ for feeding called radula.
(b) *Bombyx* is an Arthropod. In *Bombyx* excretion takes place through malpighan tubules.
(c) *Pleurobrachia* is Ctenophore. The body bears eight external rows of ciliated comb plates, which help in locomotion.
(d) *Taenia* is a platyhelminth specialised cells called flame cells helps in osmoregulation and excretion.