

CHAPTER 5**ANIMAL KINGDOM
(NONCHORDATES)****Topics Discussed**

INTRODUCTION

METAZOA

BASIS FOR CLASSIFICATION

CLASSIFICATION OF ANIMAL KINGDOM

1. Introduction

Animals as we hear this word we have an image of several creatures in the nearby areas like dogs, cats, cows, goats, horses, etc. the list goes on. When we look around in our environment, we observe different animals that are different in their structures and forms. There are a million species of animals that have been known and studied till now, the need for classification is thus all the more important to understand all of them well. The classification not only includes existing species but also creates a systematic position for the newly described species. The basis for classification includes the fundamental features of the animals such as level of organisation, symmetry, cell organisation, coelom, segmentation, notochord etc. that allows us to broadly classify the animal kingdom completely. There are many other distinctive characters, specific for each phylum or class which are considered in the classification and this will be discussed in this chapter.

To understand the classification system in Animal Kingdom, we will first discuss the basis for their classification, understand them and then classify organisms. Metazoans are included in Animal Kingdom. Animal Kingdom includes Phylum Protozoa, where some animals are included which is classified in fact in Kingdom Protista, whereas, rest of protists will be discussed in Botany classes. Then the following classes are studied. Let's have a look in history of classification:

Objectives of the chapter

At the end of this chapter, you will be able to:

- Categorize all the animals ranging from unicellular ones to largest ones.
- Describe each of them in terms of their characteristics and importance.
- Evaluate the classification system.
- Understand basis of classification systems and terms related to it.
- Distinguish the animals as per their body structure and system.
- Describe each phylum (total 12) with relevant examples.
- Classify chordates and non-chordates.

Historical Background of Taxonomy

Aristotle – the “father of zoology”. (Book: Historia Animalium)

He is also known as the father of ancient animal classification.

Carolus Linnaeus – in 1735 gave a detailed information of the Binomial system of Nomenclature which was earlier devised by Gaspard –Bauhin. In 1758 in the 10th edition of his book “Systema Naturae” 4236 known animals were classified and presented the Binomial system of nomenclature of animal. Thus he is also known as “Father of Modern-Taxonomy”.

Sequence of Classification

Smallest unit of classification is “Species”.

Genus includes various types of species.

Family is made up of various similar genera.

Many families are clubbed to form an order.

Many orders join together to form a class.

Many classes combine to form a Phylum.

Largest unit is made from all the phyla i.e. Kingdom.

Various grouping levels or ranks in classification known as obligate categories.

E.g. Kingdom-phylum-class-order-family-genus-species

Based on this, all animals are included in the animal kingdom-groups and written in the following hierarchical manner. For example obligate category of man can be written as

Taxons	Categories
Kingdom	- Animalia
Phylum	- Chordata
Class	- Mammalia
Order	- Primates
Family	- Hominidae
Genus	- <i>Homo</i>
Species	- <i>Sapiens</i>

Important Phyla

Storer and Usinger compiled the whole animal kingdom into large groups of 31 phyla. Among them, 10 are major and 21 are minor phyla. Main phyla are:

Protozoa	- <i>Amoeba, Paramecium</i> etc
Porifera	- Sponges etc
Coelenterate	- Hydra, jellyfish
Ctenophora	- <i>Pleurobrachia</i>
Platyhelminthes	- Tape worm
Nemathelminthes-Nematoda	- <i>Ascaris</i>
Annelid	- Earthworm, Leech
Arthropoda	- Insects, Scorpion, Fly
Mollusca	- Snail, Pila, Octopus
Echinodermata	- Star fishes
Hemichordata	- <i>Balanoglossus</i>
Chordata	- Fish, Frog, Snake, Birds, Monkey

2. Metazoa

Animals are motile and thus this motility forms a characteristic features for this kingdom and also have a sensory or a nervous system. The sensory systems respond to the received stimuli from the environment by exhibiting actionable behaviour. Poriferans (pore-bearers) or the sponges lack any cell that can form a nervous system. Animals similar to plant life, have originated from the sea and later grew on land. The animals living on the sea floor are called as Benthonic (e.g., echinoderms, corals and deep and sea fishes), whereas the animals swimming in the sea are called as Nektons.

The multicellular eukaryotic organisms that have holozoic nutrition mode are called as metazoans. Metazoans are further classified into two sub-kingdoms, based on the complexity of organisation of the organism namely, Parazoa and Eumetazoa.

- Parazoa: Parazoa include the sponges which lacks tissues or organs and the cells are loosely arranged.
- Eumetazoa: Eumetazoa includes the remaining animals which has the cells in an organised structural and functional units called as the tissues, organs and organ systems.

3. Basis for Classification

3.1 Levels of organisation

3.1.1 Cellular Level

Animals are multicellular yet there is a difference in the pattern of organisation of cells. For example, sponges have loosely arranged cell aggregates, i.e., they lack cellular level of organisation. There is division of labour (activities) among the cells to some extent.

3.1.2 Tissue Level

As we move to higher organisms like, coelenterates and ctenophores, the arrangement of cells becomes more complex. The cells that have the same function are arranged into tissues, hence it is called as the tissue level of organisation.

3.1.3 Organ Level

Platyhelminthes and other higher phyla have higher level of cell organisation, i.e., organ level is present. The tissues having similar function are grouped together into organs. In animals of phylum Annelids, Arthropods, Molluscs, Echinoderms and Chordates, the organs have associated to form a functional system. The systems are concerned with a specific physiological function. This pattern is called as organ system in the level of organisation. For example, the digestive system in Platyhelminthes has only a single outward opening of the body which is common to both mouth and anus, and is hence called as incomplete. A complete digestive system has two separate openings, each for mouth and anus.

3.2 Body Plan

Animals have various organs in their body that function together. Though these organs are diverse in shape and size, all the animals have body type that fall into the three basic plans:

3.2.1 Cell Aggregate

Cell aggregate are clusters of cells that have a rudimentary type of labour division among them. The cells have less or no coordination among them. There are no tissues, or organs. This type of body plan is present in sponges.

3.2.2 Blind Sac

Blind sac type of body plan has only one opening in the alimentary canal common for both mouth and anus. There is tissue or organ system organisation in the animals. E.g. Coelenterates and Platyhelminthes.

3.2.3. Tube within Tube

Tube-within tube type of body has the digestive system as a continuous tube that opens at both the ends. It is present in Nematelminthes, Annelida, Arthropoda, Mollusca, Echinodermata and Chordata.

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Tube-within-a-tube body plan has two different ways along with the two evolutionary lines.

- Protostomous: The mouth is the first opening developed in the embryonic digestive tube while the anus develops later. This is observed in the annelid, mollusc and arthropod phylum.
- Deuterostomous: The anus is developed first then the mouth is developed. This occurs in the echinoderms and chordates (including the vertebrates).

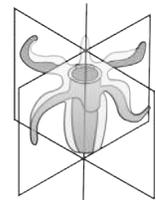
We are thus evolutionarily closer to the echinoderms (starfish) than to insects or molluscs.

3.3 Symmetry

The animals can be categorised on the basis of their body symmetry:

3.3.1 Radial Symmetry

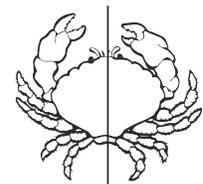
When the organism's body is divided in any plane and it passes across the central axis of the body dividing the organism into two identical halves, it is called radial symmetry. The animals with radial symmetry are present in the group *Radiata*. For example, cnidarians (hydra and jelly fish). Biradial symmetry is also present in sea anemone, ctenophores.



A

3.3.2 Bilateral symmetry

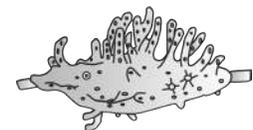
The animals with bilateral symmetry are put in group *Bilateria*. The organism's body has a central axis which can cross by one plane and divide it into identical right and left halves in only one plane. For example, Platyhelminthes, annelids, arthropods etc. (Platyhelminthes to chordates).



B

3.3.3 Asymmetry

Asymmetric organisms have a body that cannot be divided by any plane and thus there are no two equivalent halves. Sponges are mostly asymmetrical.



C

Figure 5.1: Body symmetry **A.** Biradial symmetry in a sea; **B.** Bilateral symmetry in a crab; **C.** Asymmetrical (fish) has none of the sides similar.



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- The sessile animals have radial symmetry which is helpful, as it allows food to be taken in from all sides. They may develop pseudopodia all-round the mouth to capture the prey and take into it. Their sensory and nerve coordination areas surround the mouth. E.g. in coelenterates.
- Bilateral symmetry in animals started when animals became mobile on the ocean floor. A crawling animal has more chances to encounter food from the open end that goes ahead which is the mouth. Along with mouth, all sensory organs and a controlling brain also develops at the front end of the body. These organs together approach the food by sensing it. Hence the head, which has the brain, is associated with the mouth end which is called as cephalization.

3.4 Body Cavity or Coelom

An important factor for classification is presence or absence of cavity between body wall and gut wall.

3.4.1 Acoelomate

The animals which do not have the coelom are called as acoelomates, for example poriferans, coelenterates, ctenophores, flatworms. Flatworms have the spaces between various organs that are filled with special tissue termed as parenchyma.

3.4.2 Pseudocoelomate

The body cavity has incomplete lining of mesoderm. Instead, the mesoderm is like scattered pouches present in between the ectoderm and endoderm layers. Such a body cavity is called as pseudocoelom e.g. in roundworm.

3.4.3 Eucoelomate

The true coelom in a body cavity arises as a cavity in embryonic mesoderm of the embryo that provides a cellular lining i.e. coelomic epithelium or peritoneum around the cavity. The coelom has coelomic fluid which is secreted by the peritoneum. True coelom is found in annelids, echinoderms and chordates. True coelom is of two types:

(i) **Schizocoelom:** Developing through the splitting of mesoderm. It is found in annelids, arthropods and molluscs. Body cavity in arthropods and non-cephalopod molluscs is thus called as hemocoel.

(ii) **Entericoelom:** The mesoderm arises from the embryonic gut wall or enteron like hollow outgrowths or enterocoelomic pouches. It is found in echinoderms and chordates.

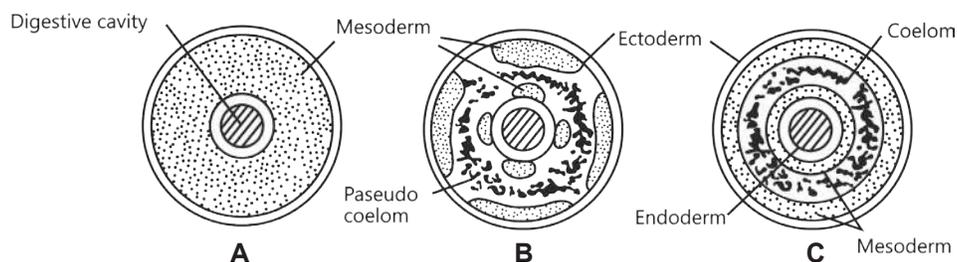


Figure 5.2: Body cavity with their details. **A.** Acoelomate, **B.** Pseudocoelomate, **C.** Eucoelomate

3.5 Germ Layers

Germ layers are the first formed layers in the body which give rise to all the tissues/organs of the individual. Animals can be classified on the basis of number of germ layers in the body

3.5.1 Diploblastic

The body cells are arranged in two layers - an outer ectoderm and an inner endoderm with an intervening undifferentiated mesoglea. E.g., Coelenterates.

3.5.2 Triploblastic

The animals in which body cells are arranged in three germ layers, namely ectoderm, mesoderm and endoderm are called as triploblastic animals. E.g., Platyhelminthes to chordates.

3.6 Respiratory System

The animals in sponges and coelenterates have each cell in the body in direct contact with the surrounding water and thus exchange the gases through their body surface. Higher animals have a thicker body wall and so they have organs that are dedicated to the respiratory work for the body.

Table 5.1: Various Respiratory Modes in Animals

Mode of respiration	Respiratory organ	Examples
Body-surface respiration	Body-surface	Sponges Ctenophores and coelenterates (Hydra)
Branchial respiration	Gills	Crustaceans (Prawn), Cartilage and bony fishes.
Cutaneous respiration	Skin	Annelids (earthworm) and amphibians (frog)
Tracheal respiration	Tracheae (ectodermal tubes)	Insects (cockroach). Centipedes, millipedes.
Pulmonary respiration	Lungs.	Most of tetrapods.
Book-lung respiration	Book-lungs.	Arachnids (spiders and scorpions).
Book-gill respiration	Book-gills.	Limulus (King-crab)
Cloacal respiration	Cloaca	Some turtles.

3.7 Blood Vascular System

Blood vascular system is basically of two types: open and closed.

Table 5.2: Difference among Open and Closed Systems of Circulation

Open Systems	Closed Systems
<p>These are usually low pressure systems</p> <p>Blood returns to the heart slowly.</p> <p>Found in leeches, most arthropods, non-cephalopod molluscs and tunicates.</p> <p>The blood is pumped out from the heart to directly reach the cells and tissues.</p> <p>The blood moves slowly between the tissues, then, returns to the heart through the open-ended blood vessel.</p> <p>The blood from the heart is pumped into the blood vessels which open into blood spaces (body cavity called as haemocoel).</p> <p>They lack a capillary system (e.g., in most arthropods, non-cephalopod molluscs and tunicates).</p> <p>The pigments carrying oxygen, is dissolved in the blood plasma.</p> <p>Body tissues and visceral organs exchange respiratory gases, nutrients and waste products directly with the blood.</p>	<p>These are usually high pressure systems.</p> <p>Blood returns to the heart rapidly.</p> <p>In annelids (except leeches), cephalopods (octopus, squids) and vertebrates.</p> <p>Blood flows around the body through blood vessels of various diameters (arteries, veins and capillaries).</p> <p>The blood in high pressure is regularly circulated in the body and it returns to the heart without moving out of the vessels.</p> <p>The heart pumps the blood into the aorta, branching into the arteries, near the tissues into the arterioles that finally form the capillary network.</p> <p>The capillary network venules carry the blood back to the heart via veins and vena cava.</p> <p>The pigment that carry the blood are in the blood and blood vessels.</p> <p>This helps in supplying the nutrients and oxygen to the tissues and in removing waste materials and carbon dioxide from it.</p>

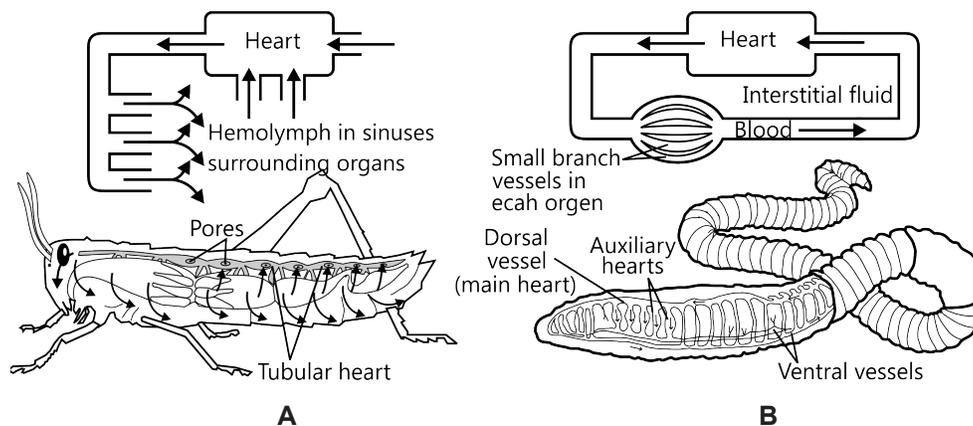


Figure 5.3: Circulatory systems in **A.** Cockroach having open system and **B.** Earthworm having closed circulatory system

3.8 Segmentation

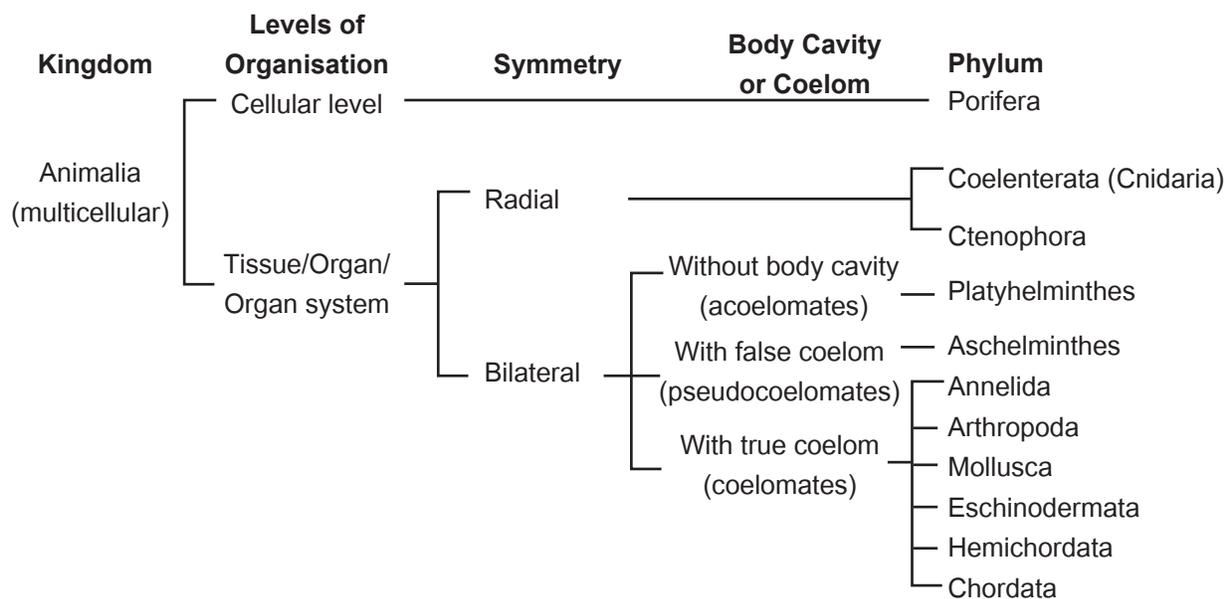
Some animals have the body externally and internally divided into segments with a serial repetition of at least some organs. For example, earthworm's body shows this pattern called as the metameric segmentation and the phenomenon is known as metamerism. Metameric segmentation is also present in arthropods, annelids and chordates.

Pseudo metameric – e.g. Tapeworms

Metameric – In Annelids, arthropods and chordates.

3.9 Notochord

Some animals have a Notochord, developed during the embryonic growth, is a mesodermal rod-like structure formed on the dorsal side. Animals that possess notochord are called as chordates and those animals which lack notochord are called as non-chordates, e.g., Porifera to echinoderms.



Flowchart 5.1: Division of animal kingdom on basis of their body structure and type.

3.10 Excretory System

Nitrogenous wastes is excreted out from the body which if not excreted out regularly can imbalance the homoeostasis inside the body.

The system who takes care of the excretion is called as excretory system.

The excretory organs are dedicated for excretion and osmoregulation (to maintain the water level in the body).

On the basis of nature of main nitrogenous waste, excretion is of three types:

3.10.1 Ammonotelism

The major nitrogenous waste excreted is NH_3 in the animals which are called as ammonotelic animals. Aquatic animals excrete ammonia e.g. sponges, coelenterates, ctenophores, crustaceans, echinoderms and bony fishes.

3.10.2 Ureotelism

The major nitrogenous waste excreted out is urea from the animals which are called as ureotelic animals. E.g. amphibians, mammals and cartilage fishes.

3.10.3 Uricotelism

The major nitrogenous waste excreted is uric acid from animals which are called as uricotelic animals. E.g. reptiles, birds and insects.

Table 5.3: Various Phylum of Animals with their Excretory Organs

Animal Groups	Excretory Organs
Porifera and Coelenterata	By diffusion through body surface
Platyhelminthes (Flatworms)	Protonephridia (flame cells)
Aschelminthes (Round worms)	Excretory canals (Renett cell)
Annelids (Segmented worms)	Nephridia
Crustaceans (e.g. Prawn)	Antennary or green glands
Arachnids (e.g. Scorpion)	Coxal glands and Malpighian tubules (in some spiders)
Insects, centipedes and millipedes	Malpighian tubules and urate cells.
Molluscs	Metanephridia
Vertebrates	Kidneys

3.11 Nervous System

The body functions are in control and coordination with the organs in the body to maintain homeostasis inside the body. Some organisms lack this system like sponges. There are different types of nervous system in different groups of animals

Type of nervous system found in different animal groups.

Table 5.4: Animal Phylum that have Specific Nervous System

Animals Group	Type of Nervous System
Coelenterates	Diffused type (nerve fibres not differentiated into Dendron and axon).
Flatworms and roundworms	Ladder type (formed of a nerve ring and many nerve cords which are interconnected by connectives).

Annelids	Central nervous system (CNS) that has a circumpharyngeal nerve ring and ventral solid and ganglionated nerve cord.
Arthropods	CNS formed of a circum-oesophageal nerve ring and a double, ventral solid and ganglionated nerve cord.
Molluscs	Formed of a few ganglia interconnected by some commissures and connectives.
Echinoderms	Two nerve rings (oral and away from oral) and radial nerves.
Vertebrates	CNS formed of anterior broader brain and posterior long narrow spinal cord. CNS is dorsal, hollow and non-ganglionated.

3.12 Reproduction

The ultimate function is reproduction in all the living organisms and is essential for the species to exist in the world. Reproduction is sexual and asexual. Several species use asexual methods to reproduce e.g. Binary fission (parent divides in two daughters in favourable conditions e.g. *Amoeba*); Multiple fission (parent divides in many daughter cells in unfavourable conditions e.g. *Amoeba*); Budding (parent develops an external or internal outgrowth called as buds that grows in new organism e.g. *Hydra*) and fragmentation. The other common method is sexual reproduction (which involves formation and fusion of gametes). Gametes are the sex cells formed in the sex organs called as the gonads. Gonads are different, male has testes and female has ovaries while sex cells are called as sperms and ova respectively. The two types of gonads can be present in different animals which are called as unisexual or dioecious e.g. human beings, frog, cockroach etc. The two sexes have extremely different structure called as sexual dimorphism e.g., peacock and peahen, human beings etc. However some animals have both the types of gonads (tests and ovaries) in the same animal, called as bisexual or monoecious or hermaphrodite e.g., earthworm, leech, *Taenia* etc. Sperm and ovum fuse to form zygote called as fertilisation. Fertilisation can be external (e.g. echinoderms, bony fishes and amphibians) or internal (e.g. land vertebrates and cartilage fishes) if fusion is outside or inside the female.

The sperms and ova are derived from different animals which is called as cross-fertilization. In some of the bisexual animals, sperm and ovum from the same animal fuse and form zygote, which is called as self-fertilization e.g., in *Taenia*. Cross-fertilization occurs in two ways: protandrous and protogynous. In protandrous condition (proto = first, androus = male), testes mature first followed by the ovaries e.g., leech, earthworm etc. In protogynous condition (proto = first, gynae = female), ovaries mature first than the testes e.g., *Scypha*, *Herdmania* (Sea squirt).

Table 5.5: Difference between Oviparity and Viviparity

Oviparity	Viviparity
Female lays eggs.	Give birth to young-ones
Fertilisation may be external or internal	Always internal
Egg has yolk thus has large size.	Egg is small sized without yolk.

Development occurs outside female.	Always inside female.
Placenta is not formed. E.g., All birds, amphibians, most of fishes and insects.	Placenta is formed e.g., Most of mammals.

3.13 Body Temperature

The body temperature varies in animals, thus they are divided, into two categories:

- Homeothermal (Warm-blooded or endothermic animals): the body temperature is constant throughout in any environmental temperature e.g., birds and mammals.
- Poikilothermal (Cold-blooded or ectothermic animals): the body temperature changes as the environmental temperature changes. E.g. amphibians and lizards.

Table 5.6: Difference between Poikilothermal and Homeothermal animals

Characters	Poikilothermal (Cold-Blooded)	Homeothermal (Warm-Blooded)
Body temperature	Comparatively low and changes with changes in environmental temperature	High and constant so does not change with change in environmental temperature.
Metabolic rate	Low	High.
Hibernation	Undergo hibernation during winter months.	Do not undergo hibernation.
Examples	Fishes, amphibians and reptiles.	Birds and mammals.

3.14 Skeleton

The structure of the body which gives it the shape, support and protection is called as skeleton. The skeleton is of two types:

- Endoskeleton: It is formed of living structure and is present inside the body e.g., cartilages and bones e.g., vertebrates.
- Exoskeleton: It is formed of dead structures always covering the outside body. e.g., chitinous plates called sclerites in arthropods; calcareous shell in molluscs; epidermal scales in reptiles; epidermal feathers in birds; epidermal hair, nails, claws, horns and hoofs in mammals.

Table 5.7: Difference between Endoskeleton and Exoskeleton

Characters	Endoskeleton	Exoskeleton
Position	Inside the body.	Outside the body.
Nature of elements	Living structures	Dead structures.
Type of elements	Cartilages and bones.	Sclerites of arthropods Shell of molluscs; Epidermal scales in reptiles; Feathers in birds; Hair, nails, horns, hoofs in mammals.

4. Classification of Animal Kingdom

4.1 Phylum - Protoza (Unicellular Protists)

4.1.1 General characteristics of Protozoans

- Around 15,000 species of protozoans are known and described that exist in the world.
- The organisms are microscopic heterotrophs where a single cell has the ability to perform all the vital activities. For this reason, protozoans are also called as acellular organisms.
- They are aquatic (both fresh water and marine) and omnipresent. Some are predators and some parasites.
- The protozoan body can be naked, like, *Amoeba*, or surrounded by a non-rigid non-cellulosic pellicle.
- Some protozoan body secretes various inorganic shells as external covers (foraminiferans).
- Different types of locomotory organs are found in protozoans like flagella (flagellates), cilia (ciliates) or pseudopodia (sarcodines).
- Parasites lack locomotory structures (Sporozoa).
- Neurofibrils and contractile myofibrils are under the cell surface.
- Many protozoans are free-living and aquatic in nature.
- The nutrition is holozoic and depend on bacteria, microscopic algae and minute animals like rotifers or on other members of protozoa, even members of their own species for nutrition.
- Respiration and excretion in protozoans occurs through the exchange of gases from the body surface. Nitrogenous waste is ammonia.
- Some protozoans contain chlorophyll and thus can prepare their own food from photosynthesis (e.g., *Euglena*).
- The protozoans having parasitic mode, feed on compounds that is obtained from the living hosts (e.g., *Monocystis*).
- All the fresh water protozoans contain contractile vacuole that helps in the maintenance of osmotic concentration and excretion of wastes in the cellular body. This phenomenon is known as osmoregulation. Sporozoon parasites are usually harmless, however some can be harmful as well. E.g., *Plasmodium vivax* and *Plasmodium falciparum* cause malaria in humans.
- Protozoans have one nucleus, however those with cilia and many amoeboid types have many nucleus.
- Reproduction methods are specialised for different types of protozoans. Many sarcodines, flagellates and ciliates reproduce via asexual methods like binary fission, multiple fission or budding. Some ciliates, like, *Paramecium* reproduce sexually where two individuals come closer to interchange genetic information with a process called as conjugation. Gamete formation is absent in this process. Sporozoa has gamete formation in some stages of life cycle, which are morphologically different.

Examples:

Free living – *Euglena*, *Amoeba*, *Paramecium*, *Elphidium* etc.

Parasitic – *Monocystis*, *Entamoeba*, *Plasmodium*, *Trypanosoma*, *Giardia* etc.

Some examples of protozoans with different types of locomotory structures:

- Trypanosoma* having flagellum (flagellate);
- Heliozoan* having axopodia;
- Tetraymena* having cilia.

4.1.2 Classification of Protozoans

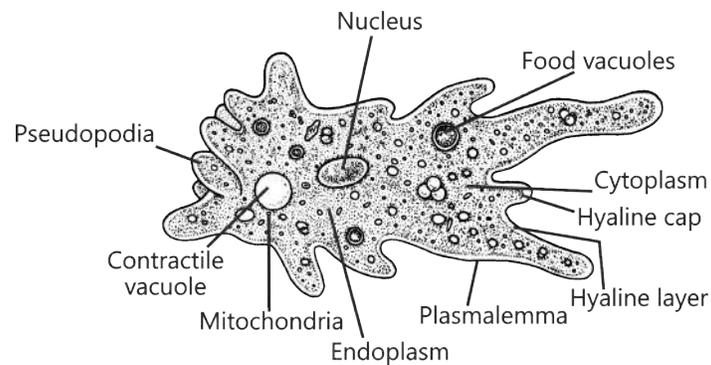
Phylum protozoa is divided into 4 groups

Group I: Rhizopoda or Sarcodina

- Locomotion: pseudopodia,
- Body shape flexible and can change.
- E.g., *Amoeba* (free-living), *Entamoeba* (Parasitic or commensal).

Table 5.8: Various Locomotory Organs in Protozoans

Lobopodia	(<i>Amoeba</i>)
Filopodia	(<i>Euglypha</i>)
Reticulopodia	(<i>Globigerina</i>)
Axopodia	(<i>Actinophrys sol</i>)

**Figure 5.4:** Cell structure of *Amoeba*

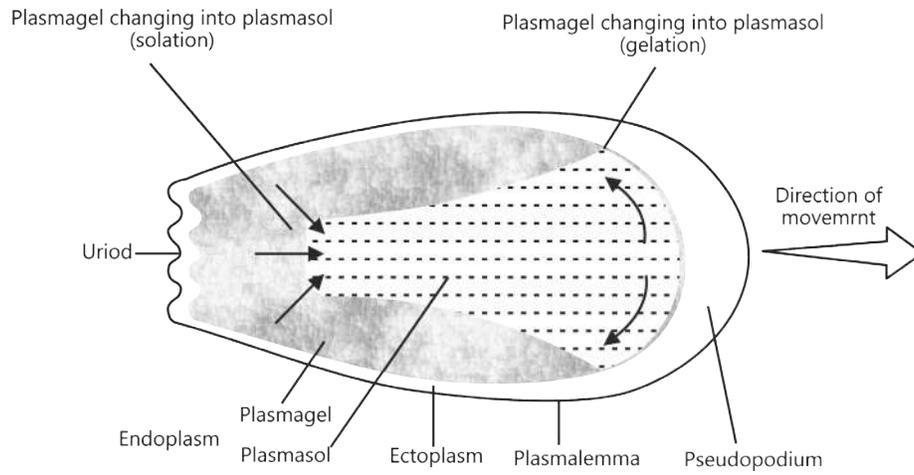


Figure 5.5: Pseudopodia of a protozoan showing the changes in plasma during its movement

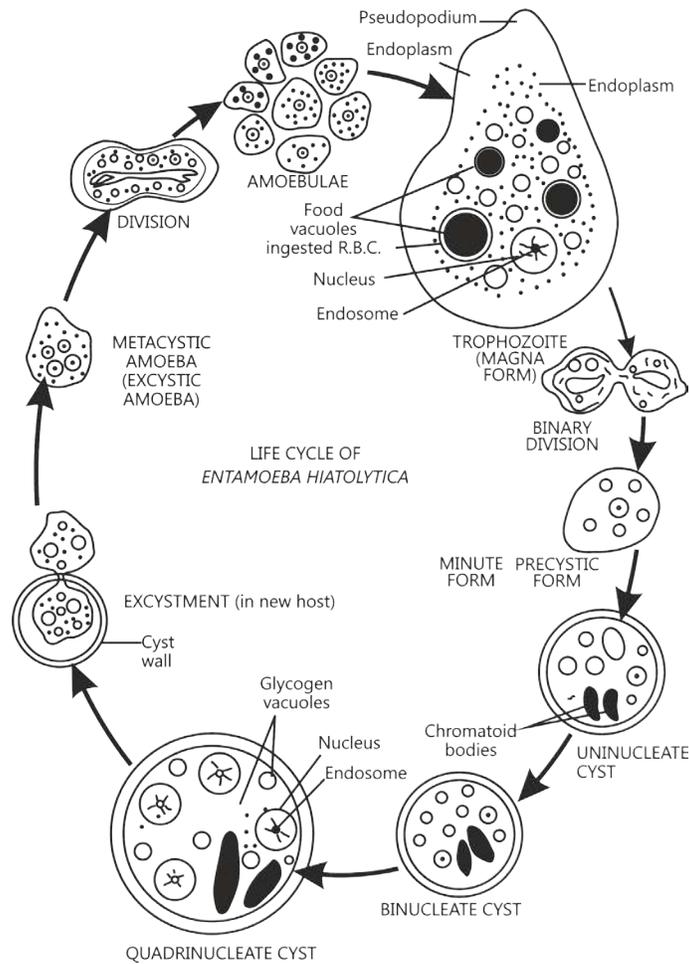


Figure 5.6: Reproduction phases in *Amoeba*

Group II: Mastigophora or Flagellata

Locomotion can be through one or more thread-like flagella. They are free living or parasitic.

- Euglena* - Connecting link between plants and animals
- Trypanosoma* - Parasite causing sleeping sickness
- Leishmania* - Parasite causing kala-azar
- Giardia* - Parasite causing diarrhoea
- Trichomonas* - Parasite causing vaginitis in human female
- Trichonumpha* - Symbiont found in gut of terminate helping in cellulose digestion
- Proterospongia* - Colonial with collar cells, a connecting link between Protozoa and Porifera.

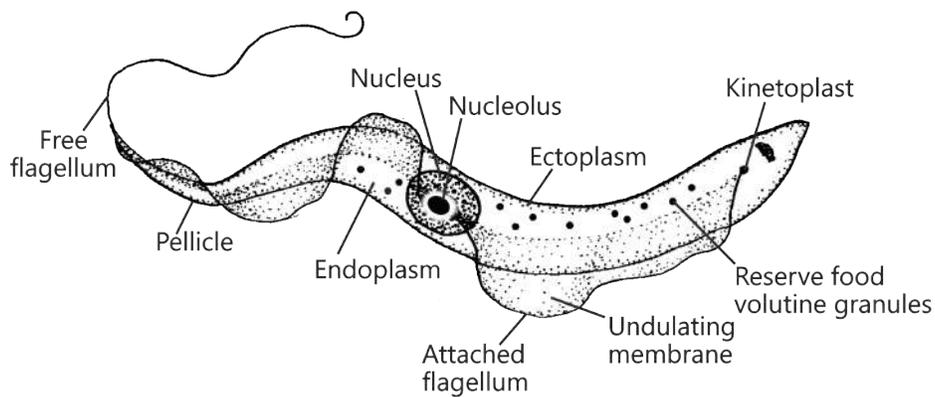


Figure 5.7: Structure of *Trypanosoma gambiense*

Two types of flagellates are:

Phytomastigina – with chloroplast, that are plant-like e.g., *Euglena*, *Chlamydomonas* etc.

Zoomastigina – without chloroplast, that are animal-like e.g., *Trypanosoma*, *Leishmania*, etc.

Group III: Sporozoa

All members are parasites that have spore forming stage, and lack special locomotory organelles, contractile vacuole (associated with parasitism), and complex life history.

e.g., *Plasmodium* – causes malaria, spread by vector female *Anopheles*

Monocystis – a parasite in the seminal vesicles of earthworm

Eimeria – causes coccidiosis in rabbit and chicken.

Babesia – causes hemoglobinuric fever/tick fever in cattle.

Babesia is a protozoan parasite that is spread through ticks which causes tick fever in India.

The parasite enters into red blood cells (RBCs) and destroys them in humans.

Group IV: Ciliata

Locomotory organelles are cilia, nuclei are two or more in a cell.

e.g., *Paramecium* – free-living, slipper animalcule

Balantidium – causes balantidial dysentery in man

Nyctotherus – rectal ciliate and endocommensal in frog

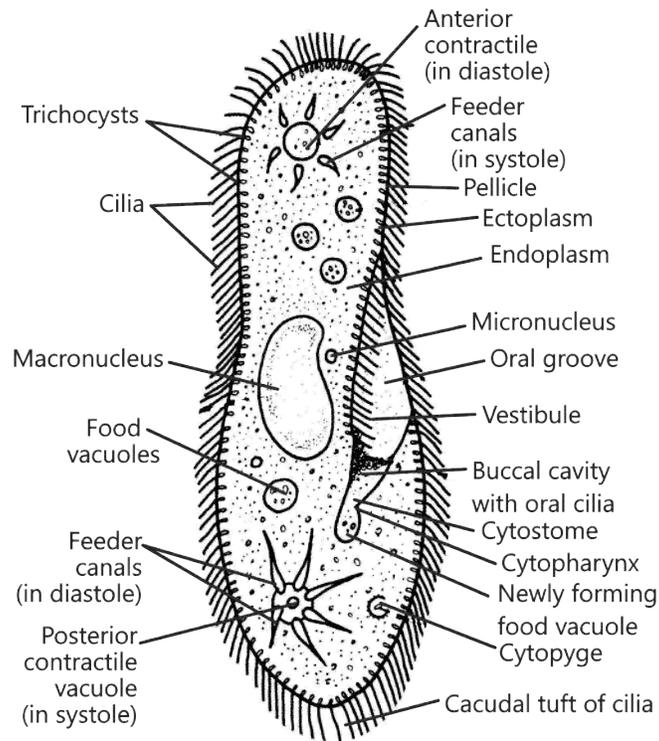


Figure 5.8: Structure of a *Paramecium*

TRY IT YOURSELF

- Animal which have a well-marked digestive cavity are put under-

(A) Parazoa	(B) Neterozoa
(C) Metazoan	(D) Bryzoa
- The cell anus in some protozoans is known as

(A) Cytopharynx	(B) Cytosome
(C) Cytoproct	(D) Peristome

TRY IT YOURSELF

3. In which of the following the nuclear dimorphism is seen –

(A) <i>Entamoeba</i>	(B) <i>Leishmania</i>
(C) <i>Trypanosoma</i>	(D) <i>Paramecium</i>
4. Class sporozoa of phylum protozoa is characterized by

(A) Flagella	(B) Cilia
(C) Parasitism	(D) None
5. The vector for causing sleeping sickness in man is

(A) House fly	(B) Mosquito
(C) Tse-tse fly	(D) Butter fly
6. Which of the protozoan is considered as connecting link between plants and animals

(A) <i>Entamoeba</i>	(B) <i>Paramecium</i>
(C) <i>Euglena</i>	(D) <i>Monocystis</i>
7. In which of the following classes locomotory organs are absent

(A) <i>Rhizopoda</i>	(B) <i>Sporozoa</i>
(C) <i>Suctoria</i>	(D) <i>Mastigophora</i>
8. Pick the odd pair out

(A) Monera : eukaryote	(B) Porifera : choanocytes
(C) Coelenterate : nematocyst	(D) Annelid : metamerism
9. Who divided animals into Enaima and Anaima

(A) Aristotle	(B) Linnaeus
(C) Cuvier	(D) Lamarck
10. Proterospongia is a connecting link between

(A) Protozoa and porifera	(B) Porifera and coelenterate
(C) Protozoa and annelid	(D) Porifera and annelid



4.2 Phylum – Porifera (Common Name-Sponge)

- Robert Grant named the animals in this group as Porifera.
- The science that deals with the Study of sponges is known as Parazology.
- Phylogenetically sponges are evolved from choanoflagellates (Proterospongia).
- Sponges are multicellular primitive forms.
- All sponges are aquatic, mainly marine however few of them are in fresh water also.
- The body is sessile, solitary or colonial.
- Entire body has pores on its surface i.e. numerous small mouth lets called as Ostia and one main opening for exit called as Osculum.

4.2.1 General Characters of Poriferans

- Sponges show diversity in the body forms and shapes that have irregular shape usually asymmetrical. (Radial symmetry in *Leucosolenia*).
- Sponges show cellular level of organization in the body with two germ layers i.e. Diploblastic.
- They lack head and appendages in their structure.
- Body wall in adults have
 - Outer ectoderm or dermal layer or pinacoderm in pinacocytes (Flat cells), porocytes (oval cells)
 - Inner endoderm (Choanocytic layer) or choanoderm collar cell or choanocytes (Flagellated)
 - Between the two germinal layers, gelatinous non-cellular material mesenchyme is present in the sponge. It has fine dispersed spongy fibres and many spicules.

Consist of Amoebocytes that are Modified in the Following Types:

- Scleroblast – Secrete spicules, they are called as calcoblasts and in silicious sponges that may be called as silicoblasts. Helps in formation of skeleton
- Spongioblast – Secrete sponging fibres.
- Thesocytes – For food storage in granules (Glycogen)
- Phagocytes – To engulf food with pseudopodia by phagocytosis, even engulf excreta and damages tissues.
- Trophocytes – Help in distribution of food to growing cells hence also called as nurse cells.
- Archaeocytes – They can form ova and spermatozoa, even convert into other types of cells (Totipotent cells).
- Collencytes – Secrete connective tissue cell and collagen fibres.
- Chromocytes – Have pigment granules and excretory substances.
- Myocytes – Are highly contractile regulating the opening and closing of osculum.

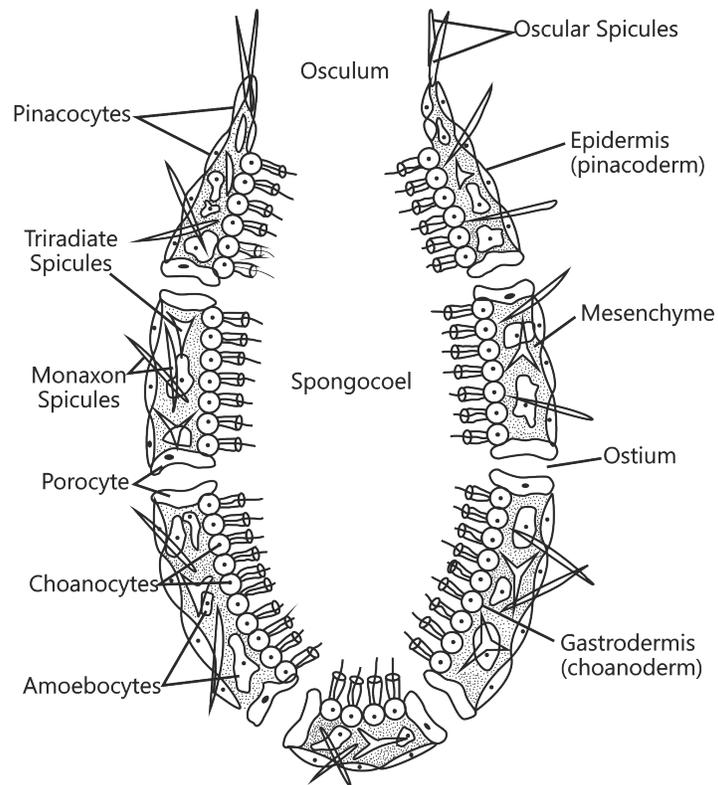


Figure 5.9: Structure of *Leucosolenia* (most primitive Sponge)

- o The body wall encloses a large central cavity of a sponge that is called as the spongocoel or paragastric cavity.
- o Choanocytes contain flagella that forms the outer lining in Spongocoel and also in some canals.
- o Choanocytes beating of flagella causes water currents which is very important for sponge to survive. Water that enters in the sponge through ostia perforating porocytes and several canals and then enters in spongocoel and finally exit out through the large aperture osculum.
- o Canal system or water transport system: Canal system in poriferans help in grasping food (nutrition), respiration and excretion processes.

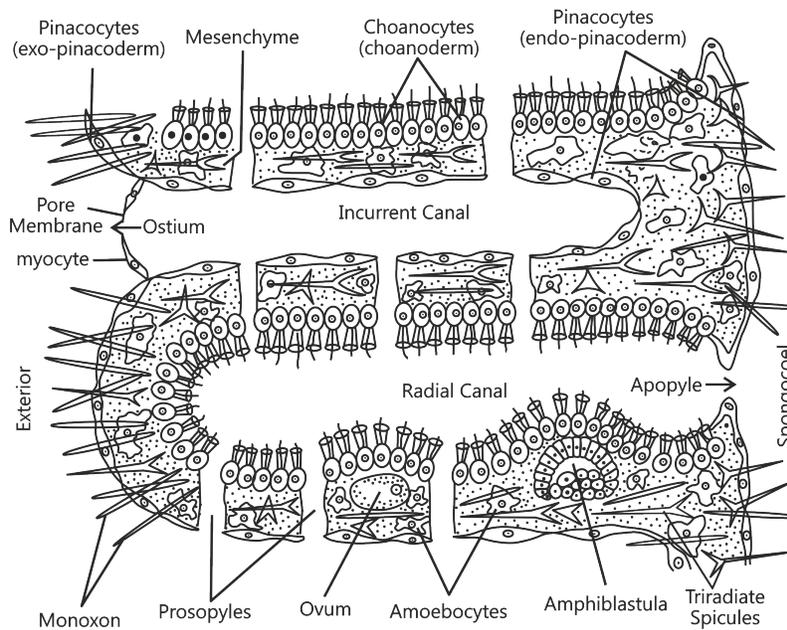


Figure 5.10: Structure of *Leucosolenia* (most primitive Sponge)

- Skeleton is located internally (endoskeleton), made up of tiny calcareous spicules called as calcoblast or siliceous spicules called as silicoblast or fine spongy fibre called as spongioblast, which is located in mesenchyme.
 - Spicules are secreted by scleroblast and spongy fibres are secreted by spongioblast.
 - Sponges lack digestive cavity and opening for mouth. Nutrition method is holozoic. Digestion occurs in food vacuoles of choanocytes intracellularly.
 - The movable amoeboid cell (Trophocytes) help in food distribution from collar cells to other cells.
 - Respiration and excretion occurs through diffusion of gases from the body surface. Excretory matter produced by sponges is ammonia.
 - Reproduction occurs through
- (i) Asexual means – By budding and fragmentation. Budding can be of two types:
- a. Exogenous budding – occurs during favourable conditions.
 - b. Endogenous budding – gemmules formation takes place during adverse conditions.
They contain Archaeocyte cells and covered by thick protective coat.
- (ii) Sexual means – Sponges are Hermaphrodite or monoecious, fertilisation is internal and cross (Protogynous condition). Development is indirect with larvae formation.
- Names of larva and the organism in which it is formed:
- Amphiblastula (*Scypha*)
 - Parenchymula (*Leucosolenia*)
 - Stereogastrula (*Euplectella*)

Classification of Porifera based on the skeleton**Table 5.10:** Classification of Porifera based on the skeleton

	Calcarea or Calcispongiae	Hexactinellida or Hylaspongiae	Demospongia
Skeleton (endo)	Spicules are Calcareous (monoaxon, triaxons)	6 rayed siliceous spicules (Glass sponge)	1 or 4 rayed siliceous spicules or sponging fibre
Inhabit	All are marine, in shallow water	All are marine in deep water	Marine or fresh, deep or shallow water.
e.g.	<i>Leucosolenia</i> (smallest) <i>Scypha</i> (<i>Sycon</i>) – Urn sponge	<i>Euplectella</i> – (Venus flower basket, Bridal gift in Japan) Ref. <i>Hyalonema</i> – (Glass rope sponge) <i>Pheronema</i> – (Bowl sponge)	<i>Spongia</i> (Euspongia) – (Bathing sponge) <i>Spongilla</i> – (Fresh water sponge) <i>Cliona</i> – (Boring sponge) harmful to Oyster (marine) <i>Chalina</i> – Marmaid's gloves Ref. <i>Poterion</i> – Neptun's Cup <i>Oscarella</i> – Skeleton absent <i>Chondrosina</i> – Skeleton absent <i>Halichondria</i> – Bread sponge <i>Haliclona</i> – Finger sponge <i>Ephydatia</i> – Sulphur sponge Freshwater <i>Hippospongia</i> – Horse – sponge or Horny sponge

Unique Features of Porifera

- Pores all over the body.
- Cellular body organization.
- A canal system for water currents that are intercommunicating cavities through which the water current pass.
- Lack of mouth and digestive cavity.
- Choanocytes that cover the main cavity (spongocoel) or certain canals (radial canals).
- Presence of sponging fibres.

KNOWLEDGE BUILDER

- Using sponges: For centuries, people around the world have used natural sponges with spongy skeletons for cleaning, bathing by taking advantage of soft flexible and highly porous bodies of these sponges.
- An example is *Euspongia*. The ancient Greeks also used sponges as padding inside helmets.
- Spongin fibers are elongated protein fibers which form a fibrous network.
- Digestion in sponges is intracellular.
- Sponge cells, separated by straining pieces of sponge through a fine net, can segregate and grow into a sponge. So, a sponge is a republic of cells which identify one another, aggregate, and grow together.
- Sponges reproduce asexually by fragmentation. During sexual reproduction, some cells become egg or sperm cells. After fertilization, the zygote develops into a flagellated larva which swims, settles in a new place, and grows into a sponge.

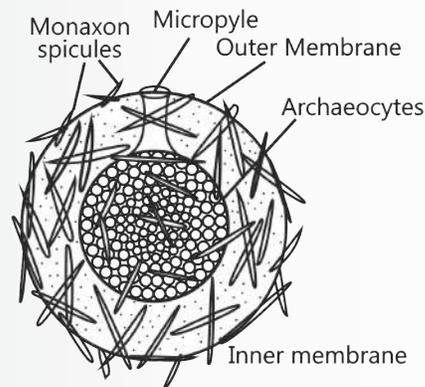


Figure 5.11: Structure of a *Gemmule*

- Proterospongia is a connecting link between protozoa and porifera.
- In *Hyalonema*, the root tuft consists of a bundle of long anchoring spicules. These may pass through the columella (body axis) as gastral cone. It is commonly known as glass rope sponge.
- *Euspongia* is commonly known as bath sponge.
- *Amphiblastula* is the hollow larva of *Sycon*, etc., whereas parenchymula is the solid larva of most of the sponges, e.g., *Leucosolenia*.

TRY IT YOURSELF

- Sponges are characterized by –
(A) Amoeboid cells (B) Choanocytes cells
(C) Pigmented cells (D) Gland cells
- In sponges the food is stored in
(A) Trophocytes (B) Desmocytes
(C) Archeocytes (D) Thesocytes
- Which one of the sponge part corresponds to the mouth of other animals
(A) Osculum (B) Incurrent canal
(C) Ostia (D) Excurrent canal
- Bath sponge is common name of –
(A) *Spongilla* (B) *Euspongia*
(C) *Euplectella* (D) *Leucosolenia*
- Classification of porifera is based up on
(A) Spicules (B) Canal system
(C) Amoebocytes cells (D) Nutrition
- Which of the following animals is marine
(A) *Amoeba* (B) *Hydra*
(C) *Sycon* (D) *Pheretima*
- Cellular grade organization is found in
(A) Helminthes (B) Coelenterate
(C) Porifera (D) All of these
- Porifera has
(A) Water vascular system (B) Canal system
(C) Haemo coelomic system (D) None



TRY IT YOURSELF

9. Paragastric cavity is related with
- (A) Sponge (B) Coelenterate
(C) Nematodes (D) All
10. Asexual reproductive structures of most porifera are called
- (A) Fragmentation / Budding (B) Parenchymula
(C) Amphiblastula (D) Sterogastrula

4.3 Phylum – Coelenterata

- Coelenterata was given its name by Leuckart. Hatschek gave another name Cnidaria which was based on the capability of stinging cells.
- Around 9000 species, many of the organisms are marine, however few of them are fresh-water (Hydra) carnivorous members. Some are fixed to substratum or can be free floating also.
- Body forms are basic (Dimorphic)

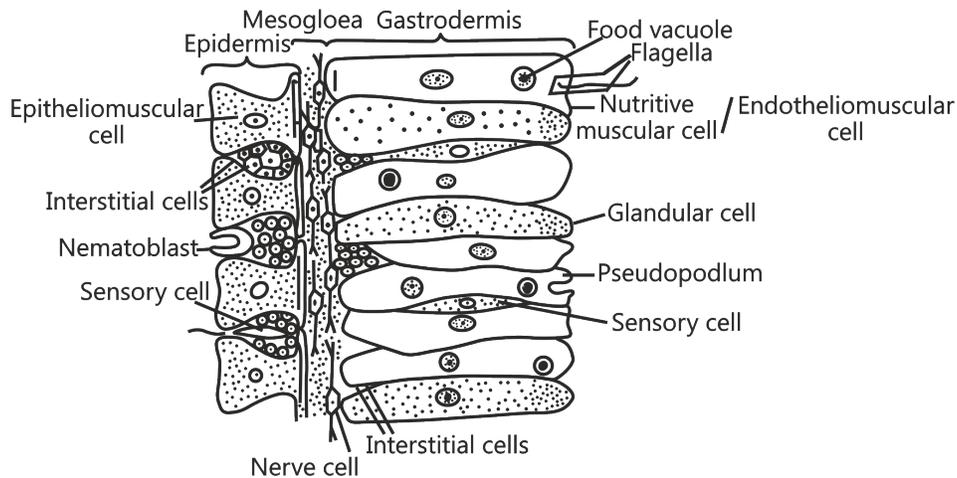


Figure 5.12: Longitudinal section of a body wall in *Hydra*

Table 5.11: Difference between Polyp and Medusa

Polyp	Medusa
Body is Cylindrical in shape like <i>Hydra</i> , <i>Adamsia</i> etc.	Body is umbrella shaped like <i>Aurelia</i> or jelly fish
Many of them are sessile, but sometimes can be motile	Freely swimming in water
May be free living or Colonial	Always solitary or can be free living also
The mouth and tentacles are directed in upward way	The mouth and tentacles are directed in downward way
Asexual reproduction form <i>Adamsia</i> (Polyp)	Sexual reproduction form <i>Aurelia</i> (Medusa)

- Either or both zooids may occur in a species. If both zooids are found in a species, the two forms are in alternate ways in life cycle. Polyps form medusa asexually and medusa develop the polyps sexually (Alternation of generation or Metagenesis) e.g. – *Obelia*. Group of different types of zooids in polyp or medusa shows polymorphism in pattern.
- Coelenterates usually have radial symmetry.
- Coelenterates consists of two germs layers ectoderm and endoderm i.e. They are diploblastic (mesogloea between two layers)
- Interstitial cells are totipotent cells of coelenterates that are present in both the layers of the body wall.
- Coelenterates have higher level of organization from cell i.e. tissue.
- Cnidoblast or Cnidocyte (have the stinging capsule called as Nematocyst) present on the tentacles and body of the organism, are used for anchorage on the substratum, defence and for the prey capture.
- Horny or calcareous exoskeleton can be present to support the body of coelenterates. E.g. – *Corals*
- There is just a central cavity called as coelenteron that has a single aperture, mouth and thus the body has incomplete digestion tract (Blind sac).
- Digestion is both extracellular and intracellular i.e. digestion takes place in coelenteron as well as in food vacuole of gastrodermal cells.
- Coelenterons distribute the food that is partly digested by it. This dual role in the coelenterons was named as gastrovascular cavity.
- Respiration and excretion occurs through diffusion of gases from the body surface.
- Excretory matter is ammonia.
- Nervous system is of the diffused type and consist of non-polar neurons. These are the first phylum that have nerve cells that conduct impulses in all directions.

- Colenterates have epidermis which consist of epithelia-muscular cells of which the muscular part drives inward while the epithelial part drives out of the body. They also have glandulo muscular cells which secrete sticky substance that attaches the body to the substratum.
- Larva of obelia – Planula (free living).
- Larva of aurelia – Ephyra.

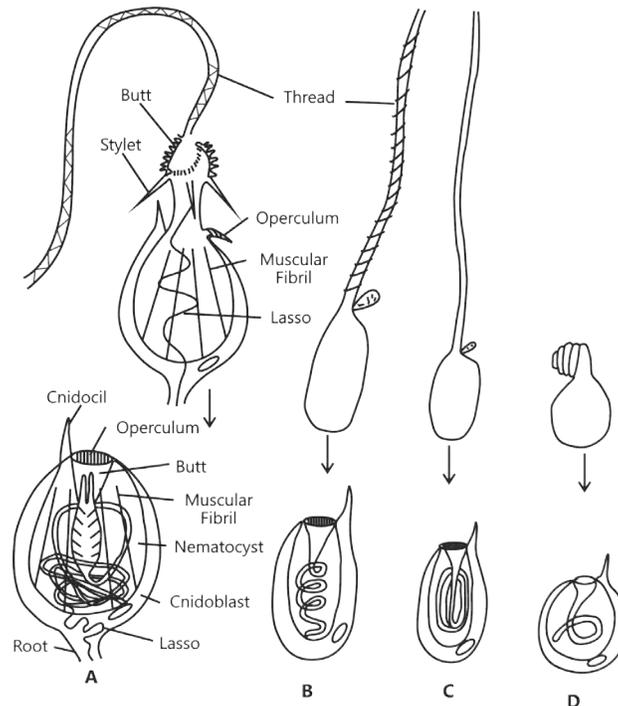


Figure 5.13: *Hydra* nematocyst where upper one is discharged and lower one is undischarged nematocysts. **A.** Penetrant, **B.** Streptoline glutinant, **C.** Stereoline glutinant and **D.** Volvent

- Coelenterate is classified into three classes is based on the dominant medusoid or polypoid phase in the life cycle.

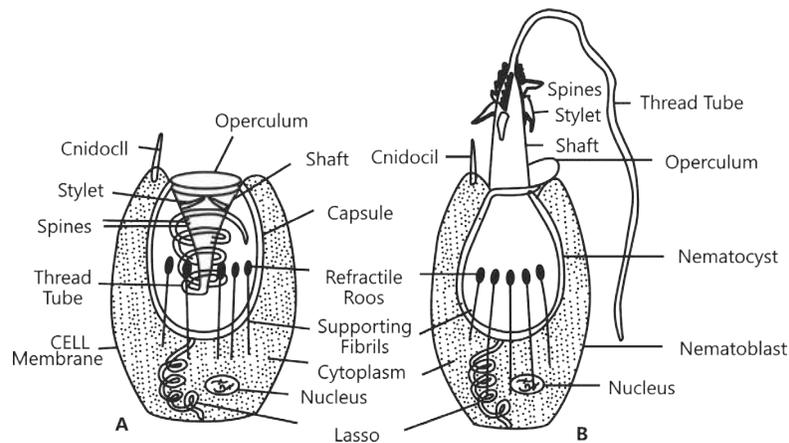


Figure 5.14: **A.** Undischarged and **B.** Discharged Cnidoblast

Classification of Phylum Cnidaria

- Chiefly on the basis of the dominance of medusoid or polypoid phase in the life cycle, phylum Classification of Phylum Coelenterata.

Table 5.12: Classification of Phylum Coelenterata

Hydrozoa	Scyphozoa	Anthozoa (Actinozoa)
Fresh water as well as marine	Exclusively marine	Exclusively marine
Polyp and medusa often show polymorphism and metagenesis	Medusa form is more common	Only polyp form
Mesogloea is acellular	Mesogloea is thick, gelatinous, and contains cells	Mesogloea contains cells and fibers
Gastrovascular cavity undivided	Gastrovascular cavity undivided	Gastrovascular cavity has compartments, i.e., mesenteries
Gonads are ectodermal and shed gametes directly in to the surrounding water	Gonads are endodermal and shed the gametes into the digestive tract when escape through the mouth	Gonads are endodermal and shed gametes into the digestive tract escape via mouth
Cnidoblast is present only in epidermis	Cnidoblast is present in epidermis and gastrodermis	Cnidoblast is present in epidermis and gastrodermis
Examples, <i>Hydra</i> (fresh water polyp), <i>Physalia</i> (Portuguese man of war; neurotoxic, gas gland present)	Examples, <i>Aurelia</i> (jelly fish, moon jelly), larva: <i>Ephyra</i>	This class has two types of animals: <i>Anemones</i> (skeleton absent) – <i>Adamisa</i> (sea anemone) and <i>Corals</i> (CaCO ₃ skeleton) – <i>Pennautula</i> (sea pen), <i>Gorgonia</i> (sea fan)

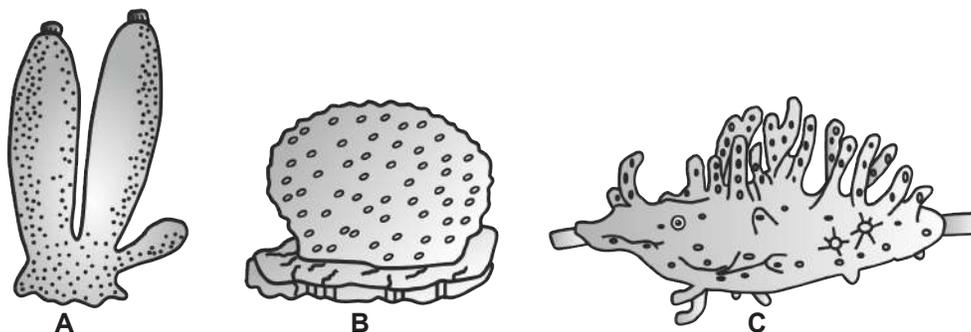


Figure 5.15: A. *Hydra*, B. *Aurelia* and C. *Anemones*

**KNOWLEDGE BUILDER**

- The green color of *Chlorohydra viridissima* comes from alga *Chlorella vulgaris* (Zoochlorella) that lives inside the gastrodermal cells of *Hydra* in symbiotic relationship.
- *Corallium rubrum* (red coral) has been used widely in jewellery and known as red moonga.

Unique Features

- Tissue level of organization is found in the body.
- Special stinging properties in the cells of the cnidoblasts that helps for defence and food adherence.
- Incomplete digestive tract with one mouth opening is present in the body wall.
- A simple nervous system with nerve cells in the network arrangement and fibres.
- Simple gonads that lack the gonoducts.

**TRY IT YOURSELF**

1. *Hydra* is a coelenterate because it has

(A) Tentacles	(B) Mesogloea
(C) Coelenterons and cnidoblast	(D) Hypostome
2. Phylum Coelenterata has remained at which level of body organization

(A) Cellular level	(B) Cell-tissue grade
(C) Tissue organ level	(D) Tissue organ and system level
3. True jelly fishes belongs to the class

(A) Both anthozoa and scyphozoa	(B) Hydrozoa
(C) Anthozoa	(D) Scyphozoa
4. Which one of the following is diploblastic

(A) <i>Pennatula</i>	(B) <i>Paramecium</i>
(C) <i>Polystomella</i>	(D) <i>Entamoeba</i>
5. Term "Cnidaria" is given by

(A) Hatscheck	(B) Lamarck
(C) Cuvier	(D) Linnaeus

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4.4 Phylum – Ctenophora

- Eschscholtz named the phylum as Ctenophore. These animals have a beautiful structure and delicate body and are also famous for the same. The body has a comb plate that glows in sunlight and gives the effect of a rainbow. The Ctenophorans are known as “Sea-gooseberries” or “Comb-jellies” or “Sea-walnuts”. They lack nematoblasts, hence are also called as “acnidarians”.
- All the animals of this phylum are marine and pelagic (floating on sea surface) and have Bioluminescence (Property of emitting light in the dark) in the cell.

4.4.1 General Characters of Ctenophora

- Body can be spherical, cylindrical or pear-shaped in structure.
- Body has soft, transparent, jelly like appearance that has radial symmetry (biradial symmetry) with tissue level of body organization.
- Animals are diploblastic with two germ layers present.
- They lack skeleton, circulators, respiratory and excretory systems.
- The body surface has cilia that join together to form 8 ciliary comb plates that helps in the locomotion of the organism.
- Digestion occurs through extracellular and intracellular methods.
- Animals are carnivorous.
- Tentacles may be present in a pair, are long solid structures that have colloblasts (lassocells) instead of nematoblasts on the tentacles which help in prey catching.
- All animals are bisexual and reproduce sexually. Fertilisation is an external process taking place in water.
- Development of the zygote is of indirect type. Life cycle involves a free living immature ciliated cydippid larva stage, found in some organisms.

E.g.: *Pleurobrachia*

Hormiphora – sea walnut

Ctenoplana – Commensal with *Alcyonium*

Cestum – Swimming eye of Cat.

Euchlora rubra – Ctenophore with cnidoblast. (Exception)

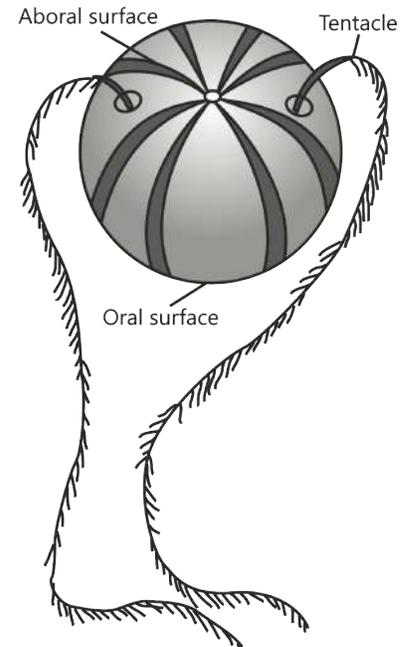


Figure 5.16: Structure of Ctenophora



DID YOU KNOW

- Sponges are considered as the most primitive multicellular animals.
- Canal system is either ascon type (e.g., *Leucosolenia*) or sycon type (e.g., *Scypha*) or leucon type (e.g., *Euspongia*).
- Parenchyma is a layer in flatworms that acts as hydraulic skeleton and circulation.
- *Ascaris* is an endoparasite nematode growing in children causing ascariasis. It has sexual dimorphism. Life cycle is monogenetic. Male *Ascaris* is smaller in size, has curved posterior end, cloacal aperture (anus in female) and two spicules.
- Male *Ascaris* is monarchic (with single set of male reproductive system).
- Female *Ascaris* is didelphic (with double set of female reproductive system).
- *Ancylostoma* (commonly called hook worm) is an endoparasite growing in the duodenum of small intestine of man.
- Amphids are olfactory chemoreceptors of nematodes, while phasmids are glandulosecretory structures of nematodes.
- Recently discovered new phylum is *Loricifera*.
- Nematodes show axenic growth (the increase in size of cells).



TRY IT YOURSELF

1. A mature proglottid of *Taenia* is one which has
 - (A) Only female reproductive organs
 - (B) Both female and male reproductive organs
 - (C) Only eggs and degenerated reproductive organs
 - (D) Hexacanth embryos
2. The gravid proglottids having fertilised eggs in uterus of Tape worm are regularly detached, this process is known as

(A) Apolysis	(B) Proliferation	(C) Strobilation	(D) Topolysis
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3. Filaria worm is

(A) <i>Trichuris</i>	(B) <i>Wuchereria bancrofti</i>
(C) <i>Ascaris lumbricoides</i>	(D) <i>Ancylostoma</i>

TRY IT YOURSELF

- 
3. Annelids are

(A) Radially symmetrical	(B) Externally segmented
(C) Triploblastic	(D) Pseudocoelomate
 4. Animals showing metameric segmentation are

(A) Porifera	(B) Annelids
(C) Tape-worms	(D) Nematelminthes
 5. Elephantiasis is caused by

(A) <i>Trichinella</i>	(B) <i>Desmoscolex</i>
(C) <i>Enterobius</i>	(D) <i>Wuchereria</i>
 6. Which of the following, endoparasite of man is viviparous

(A) <i>Ascaris</i>	(B) <i>Wuchereria</i>
(C) <i>Taenia</i>	(D) <i>Dracunculus</i>
 7. Body cavity in members of Annelids are

(A) Schizocoel	(B) Pseudocoel
(C) Enterocoel	(D) Body cavity absent
 8. Animals of which phylum exhibit “tube within tube” structure

(A) Coelenterate	(B) Platyhelminthes
(C) Cestoda	(D) Annelid
 11. Aphrodite, commonly known as “sea mouse” is an

(A) Annelid	(B) Mollusc
(C) Insect	(D) Mammals

4.5 Phylum – Platyhelminthes

- Gagenbaur was a naturalist to name the Platyhelminthes. This phylum includes flat worms that are dorsoventrally flattened structures, most primitive bilateral symmetrical animals, can be free living (terrestrial, fresh water or marine) or as a parasite on a hosts.

- The Study of worms that cause parasitic infestation in the human is called as helminthology. Most of the members in this phylum are the endoparasite having hosts as vertebrates. Some organisms are found growing in aquatic habitat as well.

4.5.1 General characteristics of Platyhelminthes

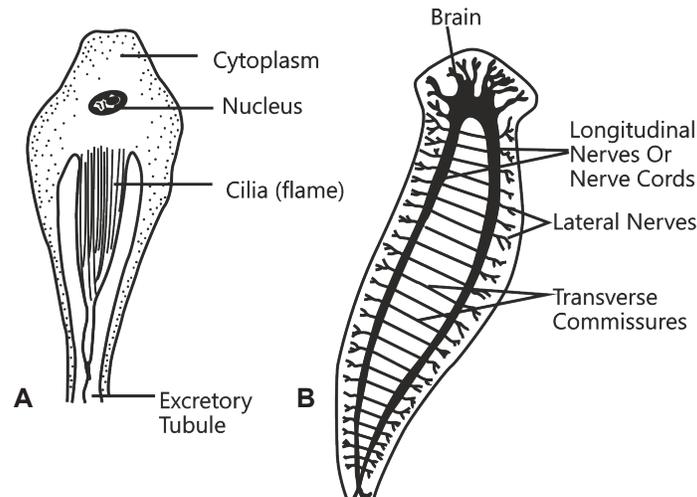


Figure 5.16: A. Excretory and B. Nervous system of a Sucker

- Body organization has organ grading of the tissues.
- Body is triploblastic i.e. body has originated from all the three germinal layers called as ectoderm, endoderm and mesoderm.
- Body has bilateral symmetry.
- The body lacks locomotory organs instead have adhesive organs like suckers, hook, etc. in the parasitic forms that helps in attachment and also to take in the food.
- Epidermis is syncytial that may have cilia on the surface. The body wall of parasitic animals contain a thick cuticle which is called as tegument which protects the parasite from the hosts digestive-enzymes secreted by the body surfaces (Epidermis).
- Digestive tract if present has mouth and lacks anus or completely absent like in Tapeworm. Food enters through mouth or through body surface.
- These are acoelomate i.e. lack body cavity.
- The body lacks skeleton and circulatory systems. The body form is maintained by the turgid fluid present in the parenchymal meshes (Hydroskeleton).
- The respiration occurs through the body surface. Anaerobic respiration is also found, in internal parasite like *Taenia*.

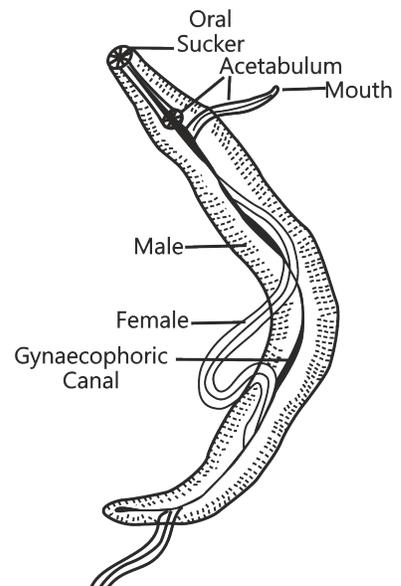


Figure 5.17: External structure of Sucker

- Excretion takes place with the organs protonephridia or flame-cells (Solenocytes). Also they perform osmoregulation.
- Nervous system is made up of the nerve ring, nerve cord and peripheral nerves (ladder like)
- Platyhelminthes are bisexual animals who have complex and well-developed reproductive system.
- Fertilization is internal which is either self or cross. Development of the zygote may be direct or indirect.

4.5.2 Classification of Phylum Platyhelminthes

Phylum Platyhelminthes is divided into three classes as given in Table

Table 5.13: Phylum Platyhelminthes divided into Three Classes

Turbellaria	Trematoda	Cestoda
Free living fresh water or marine known as planarian or Eddy worm.	Endoparasite, known as flukes, or flat worms.	Endoparasite, intestinal parasite, known as tape worm
Body is unsegmented and leaf like covered by delicate ciliated epidermis. Rod-shaped rhabdites in epidermis.	Body unsegmented and leaf like, covered by tegument (fine spines), no epidermis in adult.	Body ribbon like, covered by tegument. No epidermis in adults.
Mouth is often ventral and anus absent. Alimentary canal is present (branched).	Mouth on anterior side and anus is absent. Alimentary canal is branched.	Mouth and anus absent (food from body surface). Alimentary canal absent
Reproduction is asexual as well as sexual and shows good power of regeneration; no larva.	Life history includes larval stage and involves more than one host.	Life history includes larval stage and involves more than one host. Each proglottid has one or two sets of male and female reproductive organs.
Suckers absent	Suckers are present for attachment in the host.	Scolex has suckers and hooks for attachment, Body divided into scolex, neck, and strobilla of few to numerous proglottids. No true segments.
Example, <i>Dugesia</i> (Planaria).	Example, <i>Fasciola</i> (sheep liver flukes) Causes liver rot disease. Primary host: Sheep and goat Secondary host: Snail (<i>Planorbis</i> , <i>Lymnaea</i> , <i>Bulinus</i>) Shows polyembryony, life-cycle involves miracidium (free-swimming larva), sporocyst, redia, cercaria, and metacercaria larval form.	Example, <i>Taenia solium</i> (pork tapeworm) Primary host = Man (cysticercus in the infective stage). Secondary host = Pig (concosphere is the infective stage). Shows multiplication in larva Stage, namely, oncosphere, hexacanth, bladder –worm, and cysticercus. Cause disease taemiasis or cysticercosis.

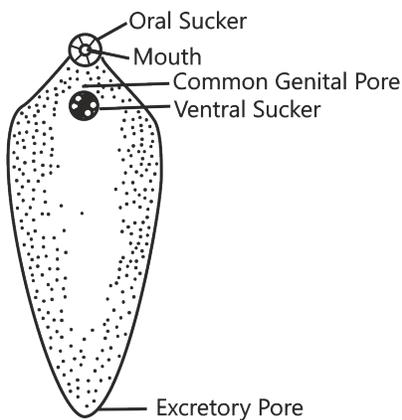


Figure 5.18: Structure of *Liver fluke*

Unique Features

- Bilateral symmetry
- Organ level of body organization.
- Head is present that has sense organs located at the front end,
- Body made from three germ layers,
- Muscle layers are found in the body wall and gut.
- Nervous system with brain ring and nerve cords,
- Organized excretory system with flame cells, and Gonoducts and copulatory organs

TRY IT YOURSELF

1. Tapeworm gets nutrition in the alimentary canal of vertebrates :
 - (A) By absorbing liquid food through general body surface
 - (B) By suckers
 - (C) Both
 - (D) None
2. Flat worms are at
 - (A) Organs grade
 - (B) Tissue grade
 - (C) Cellular grade
 - (D) None

TRY IT YOURSELF

3. Whose body remains segmented?
 (A) Porifera (B) Coelenterate
 (C) Mollusca (D) None
4. Which animal do not possess larval stage in its life cycle?
 (A) *Ascaris* (B) Frog (C) *Taenia* (D) *Pheritima*
5. Tape worm with only two or three proglottids
 (A) *Taenia solium* (B) *Moniezia*
 (C) *Taenia saginata* (D) *Echinococcus*
6. Blood fluke is
 (A) *Opisthorchis* (B) *Schistosoma*
 (C) *Fasciola* (D) None
7. *Ascaris* is
 (A) Radially symmetrical (B) Bilaterally symmetrical
 (C) Asymmetrical (D) None
8. One to the following is not hermaphrodite
 (A) *Earthworm* (B) *Leech* (C) *Taenia* (D) *Ascaris*
9. One of the following is commonly known as "whipworm"
 (A) *Oxyuris* (B) *Trichuris* (C) *Wuchereria* (D) None
10. One of the following is not Annelid
 (A) *Pheretima* (B) *Hirudinaria* (C) *Ureotyphlus* (D) *Aphrodite*
11. Parapodia are locomotary in function in
 (A) *Scolopendra* (B) *Nereis* (C) *Centipede* (D) *Earth worm*
12. *Planaria*, *liver fluke* and *Taenia* are
 (A) Flat worms (B) *Parasites* (C) Segmented (D) None



4.6 Phylum – Aschelminthes or Nematelminthes

- Gegenbaur named the Phylum as Nematelminthes. The phylum includes round worms (Circular in cross section).
- Nematodes are omnipresent, growing in fresh water, sea water, soil, humus-rich soil. Many of them are as a parasite in plants and animals.

4.6.1 General characters of Nematelminthes

- Animals have cylindrical body, tapering at both the ends, are without any segmentation.
- Body has Bilateral symmetry with organ Level of organization and having tube within a tube body plan.

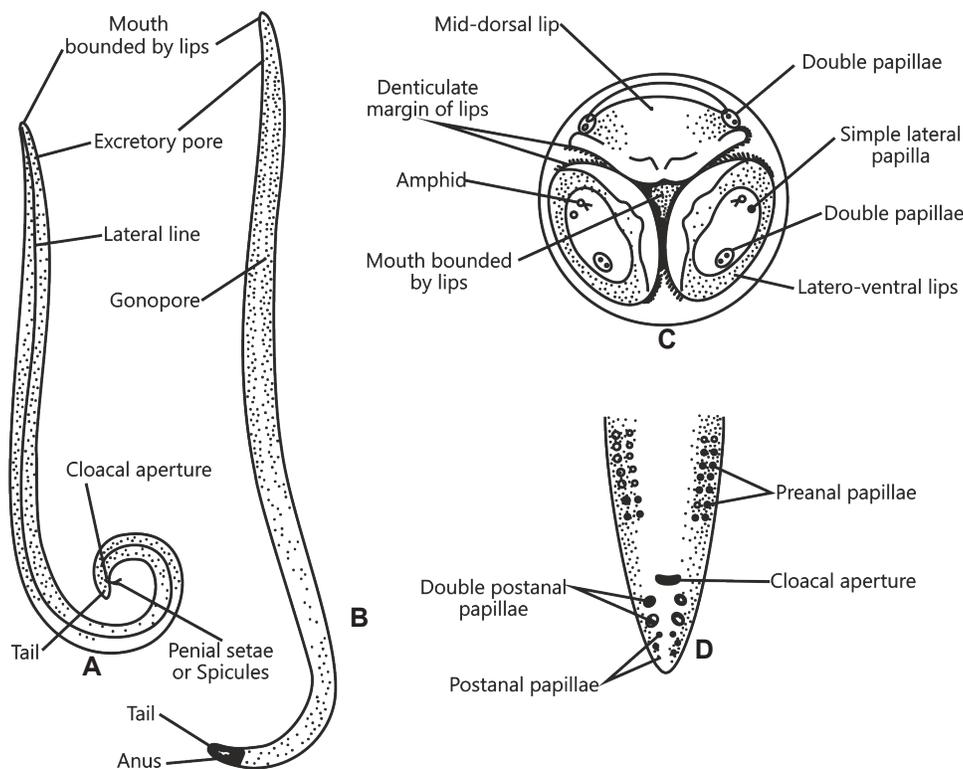


Figure 5.19: *Ascaris*, **A.** Male *Ascaris* and **B.** Female *Ascaris*, **C.** Mouth and lips of *Ascaris* and **D.** Posterior end of male showing its papillae

- Body has been originated from triploblastic germ layers.
- Body wall includes cuticle, epidermis (Syncytial) and muscle layer (only Longitudinal).
- Body cavity is pseudocoel, and lacks a mesoderm lining (developed from embryonic blastocoel) and it contains pseudo coelomic fluid.
- Skeleton is not mineralized, instead a pseudocoelom with high fluid pressure maintains the body shape which is called hydro skeleton.

- Digestive tract has both the openings of mouth and anus along with differentiated, muscular pharynx and intestine and thus is a complete system.
- Respiration occurs via the body surface through diffusion.
- The body lacks circulatory system.
- Nervous system is made up of nerve ring (Brain) and longitudinal nerve cords.
- Excretory system has H-shape excretory tube (intracellular canal) or Protonephridia – (Renette cell).
- Excretory matter produced by the body is ammonia.
- Reproduction system is developed and sexes are in separate organisms (Dioecious).
- Sexual dimorphism is present (sexes differ in size and structure).
- Male is shorter than the female with a curved caudal end, while female is straight.
- Male contains penial spicules for copulation. Genital tract and digestive tract are connected and form cloaca.

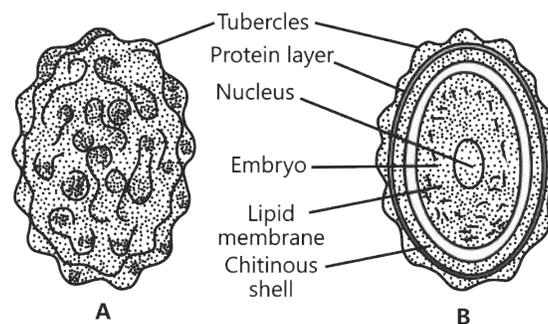


Figure 5.20: A. *Ascaris* mammilated egg and B. its section

- Genital tract opens independently. (Cloaca absent).
- Fertilisation occurs internally and development can be either direct or indirect.
- Number of cells in the body are fixed from larva to adult and this phenomenon is called as Eutely.

Table 5.14: Various examples of Nematelminthes with their common names

Organism	Common name
<i>Ascaris</i>	Intestinal round worm
<i>Enterobius</i>	Pin worm or seat worm
<i>Ancylostoma</i>	Hookworm
<i>Wuchereria</i>	Filarial worm (Causes elephantiasis)
<i>Loa-loa</i>	Eye worm
<i>Trichuris</i>	Rhabditis
<i>Trichinella</i>	Dracunculus

Unique Features

- Syncytial epidermis lining all over.
- Body wall muscular of longitudinal fibres only.
- Pseudocoel, a body cavity that lacks mesodermal coelomic epithelium lining.
- Complete digestive tract with mouth and anus
- Fluid- filled body cavity,
- Separate sexes.

TRY IT YOURSELF

1. True Coelom has evolved for the first time in
 - (A) Arthropoda
 - (B) Mollusca
 - (C) Annelid
 - (D) Platyhelminthes
2. Platyhelminthes are
 - (A) Diploblastic, radially symmetrical and coelomate
 - (B) Diploblastic, radially, symmetrical and acoelomate
 - (C) Triploblastic, bilaterally symmetrical and acoelomate
 - (D) Triploblastic, bilaterally symmetrical and Pseudocoelomate
3. Which of the following is miss-matched
 - (A) *Trichuris*-whip worm
 - (B) *Loa-loa*-eye worm
 - (C) *Ancylostoma* – pin worm
 - (D) *Ascaris* – round worm
4. Largest Earth worm is
 - (A) *Pheretima*
 - (B) *Lumbricus*
 - (C) *Megascolex*
 - (D) *Dravida*



4.7 Phylum – Annelida

- Lamarck termed the phylum as Annelida.
- Free living found in moist soil, fresh water, sea or few are parasite.
- Body has soft touch, elongated, cylindrical or flattened shape.
- Body is divided into segments or metameres with ring like groves called as Annuli.

4.7.1 General Characters in Annelids

- Body has Bilateral symmetry.
- Triploblastic germ layers present.
- Level of organization is organ system which has tube within tube body plan.
- A distinct head is present at the anterior end of the body with sense organ in some of the annelids. (Cephalisation)
- Locomotion takes place with chitinous setae on fleshy parapodia, or with muscular contraction.

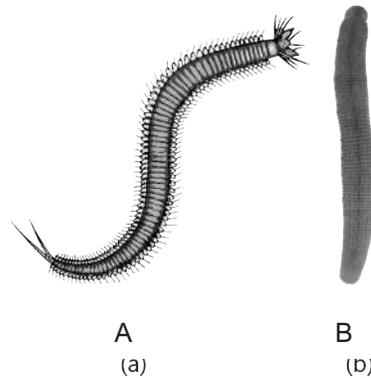


Figure 5.21: A. *Nereis*, B. *Hirudinaria*

- Body wall consist of Cuticle, epidermis and Muscle layer (both circular and longitudinal)
- First animals that have Protostomi eucoelomate i.e. the body has coelom divided into compartments with septae.
- Body cavity has true coelom which is lined with mesodermal coelomic epithelium. (Schizocoel).
- Skeleton is absent however fluid filled coelom functions like a hydrostatic skeleton.
- Digestive tract is with mouth and anus, straight, extending through the entire body. The gut is made

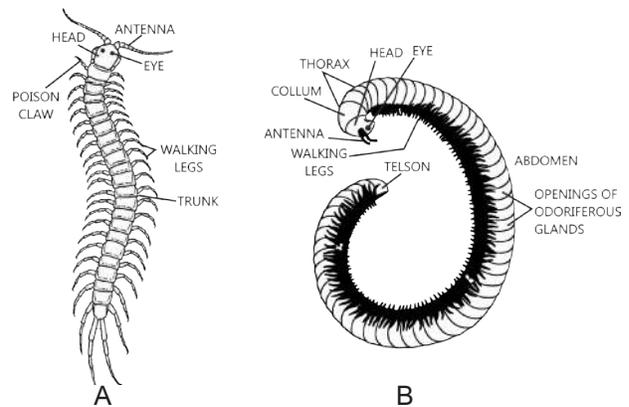


Figure 5.21: Morphology of A. *Nereis*
B. *Hirudinaria*

up of circular as well as longitudinal muscles. Digestive gland are present and developed in Annelida which are the first organisms to have one.

- Respiration is through skin i.e. cutaneous respiration. Some annelids though have gills (branchial respiration).
- Circulatory system is of closed type. Some blood vessels get enlarged and function instead of pumping heart. (Heart appears first time in annelids). Blood is red in colour due to haemoglobin which is dissolved in plasma (Erythrocrurin).
- Nephridia is excretory organ which helps in osmoregulation along with Coiled tubules in it.
- Excretory matter Ammonia for aquatic forms while it is Urea for terrestrial forms
- A pharyngeal nerve ring, double and mid ventral, nerve cord along with the paired ganglia make up the Nervous system in annelids.
- Sexes are either separate like Dioecious, e.g. *Nereis* or united like Monoecious, e.g. – Earthworm and leeches. Sexual reproduction is dominant.
- Development is either direct or indirect. If indirect it is through trochophore larva.

Unique Features

- Leech feeds itself with haemoglobin containing blood and thus it is used to suck impure blood which is called as Phlebotomy.
- Metameric segmentation throughout the body.
- Nephridia is present for excretion and osmoregulation.
- The circulatory system is closed with respiratory pigment being dissolved in the plasma.
- Setae for locomotion is present in the body wall in many forms.
- Head, appendages and respiratory organs are found in some cases,
- Circular and longitudinal muscles are found in both the body wall and the gut wall.

“Annelida” is classified into 4 classes on the basis of presence or absence of series organ and position of setae

Table 5.15: “Annelida” classified into 4 classes on the basis of presence or absence of series organ and position of setae

Polychaeta	Oligochaeta	Hirudinea	Archiannelida
<ul style="list-style-type: none"> • Marine water dwellers. • Cephalisation is more distinct. • Setae are numerous and present in parapodia helps in locomotion and also in respiration. • Clitellum is absent • Unisexual and development is indirect through larval stage which is called as the trochophore. 	<ul style="list-style-type: none"> • Terrestrial animals with some organisms in aquatic world. • Cephalisation is absent. • Setae for locomotion. Number of setae is limited and situated in micro bags present in body wall. • Clitellum is present throughout life for cocoon formation. • Bisexual or hermaphrodite and development is direct. (No larva). 	<ul style="list-style-type: none"> • Aquatic, terrestrial, ectoparasite and sanguivorous. • Cephalisation is absent. • Parapodia and setae are absent. Suckers are present at both the ends. • Clitellum (9-11 segments) developed only in breeding season. • Bisexual and development is direct (No larva). 	<ul style="list-style-type: none"> • Marine water dwellers. • Cephalisation is absent. • Parapodia and setae are absent. • Clitellum absent. • Animals are unisexual and development is indirect through larval stage which is called as the Trochophore.

Polychaeta	Oligochaeta	Hirudinea	Archiannelida
<ul style="list-style-type: none"> e.g. <i>Nereis</i> – Sand worm <i>Aphrodite</i> – Sea mouse <i>Chaetopterus</i> – paddle worm shows bio-florescence, great power of regeneration Ref. <i>Arenicola</i> – Lug worm <i>Seballa</i> – Peacock worm 	<ul style="list-style-type: none"> e.g. <i>Pheretima eutyphaeus</i> N. Indian earthworms <i>Pheretima lumbricus</i> – European earthworm <i>Pheretima megascolex</i> – Largest earth worm. Dravida (S. India) <i>Dero</i> – Fresh watered <i>Nais</i> – Fresh watered <i>Tubifex</i> – Blood worm (Fresh water) indicator of organic loading 	<ul style="list-style-type: none"> Number of segments are fixed i.e. 33 segments. Anticoagulant hirudin is present in the saliva. Haemocoelomic system is present. A special mesodermal tissue called as botryoidal tissue made up of adipose tissue for fat storage is present. e.g. <i>Hirudinaria</i> – Fresh water leech <i>Bonellia</i> – Sea leech – male is undeveloped and survives permanently in the uterus of female. (unisexual) <i>Pontobdella</i> – Skate sucker. <i>Hirudo</i> – Medicinal leech (Highly modified) <i>Glossiphonia</i> – Fresh water leech <i>Haemadipsa</i> – Terrestrial leech <i>Haemopsis</i> – Horse leech 	<ul style="list-style-type: none"> External segmentation is not very distinct. e.g. <i>Polygordius</i> – Connecting Link between Annelida and Mollusca (living fossil) Larva known as Loven's Larva

- The sense organs, nervous control, etc getting concentrated, at the anterior end of the body, that makes a head and brain, both during evolution and in the course of an embryo's development



DID YOU KNOW

- **Cephalisation** is the name given to organisms where the differentiation of head is at the anterior end of body.
- **Schizocoelic coelom:** Body cavity is formed by splitting of the mesoderm germ layer e.g., annelids, arthropods and molluscs.
- **Enterocoelic coelom:** Body cavity is formed from the enteron of gastrula e.g., echinoderms and chordates.
- Alimentary canal is absent in sponges and tapeworms.
- Pseudocoel is developed from blastocoel.



TRY IT YOURSELF

- Which of the following is an Annelid?

(A) Sea horse	(B) Sea mouse
(C) Sea cow	(D) Sea pen
- An example of blood fluke is

(A) <i>Polystomum</i>	(B) <i>Paramphistomum</i>
(C) <i>Schistosoma</i>	(D) <i>Paragonimus</i>
- Excretion in most Annelids take place by

(A) Kidneys	(B) Flame cells
(C) Nephridia	(D) Ciliated funnel
- In Annelids formation of larva is usually absent but when present the larva is called

(A) <i>Tadpole</i>	(B) <i>Planula</i>
(C) <i>Trochophora</i>	(D) <i>Ephyra</i>
- Lasso cells are present in

(A) Coelenterate	(B) Ctenophore
(C) Porifera	(D) Protozoa

4.8 Phylum – Arthropoda

- Arthropoda has maximum organisms making this the biggest phylum. Two-third of the named species on earth are Arthropods. Around 900,000 species are present among which 750,000 are only insects.
- Some or all segments in the organism have paired locomotory appendages. Hence, the name of the phylum where arthro is joints and poda is foot.
- Arthropods are omnipresent, found in water, land, sea, inside the plant and animal. They are colonial, gregarious, shows parental care.
- Sometime organisms reproduce through “Parthenogenesis Phenomenon” which means development of an unfertilised egg into an offspring. (E.g. Honey bee)
- Earlier arthropoda exists as Fossil marine arthropoda now which are called as Trilobites.

4.8.1 General Characteristics of Arthropoda

- Body has Bilateral symmetry.
- Triploblastic (three germ layers) and have organ systems in the level of organization.
- The body shows presence of distinct head [High degree of cephalisation], well-developed sensory organs like simple eyes, compound eyes, antennae, and statocyst or balance organ.
- They have compound eyes which has many similar units called as ommatidia, having lens that has the ability of forming image (mosaic).
- Arthropoda show diversity in shapes of the body and is externally segmented. Body has three regions: head, thorax and abdomen. In some organisms head is fused with body called as cephalothorax.
- There is a chitinous exoskeleton that is a cover on the body for the protection. This chitin is excreted by the underlying epidermis.
- Muscles are striated, arranged in bundles to form muscles, and are voluntary (first time appeared in the Arthropods).
- Body cavity contains blood which is haemolymph and is called as the haemocoel.
- Digestive tract is complete with mouth and anus. Mouth has modifications which helps in

Biting and chewing type – Grasshopper, Cockroach, Termites, Caterpillars.

Piercing, Sucking type – Mosquitoes, Bugs, and Fleas.

Chewing, Lapping type – Honey Bee

Sponging type – Housefly, fruit fly.

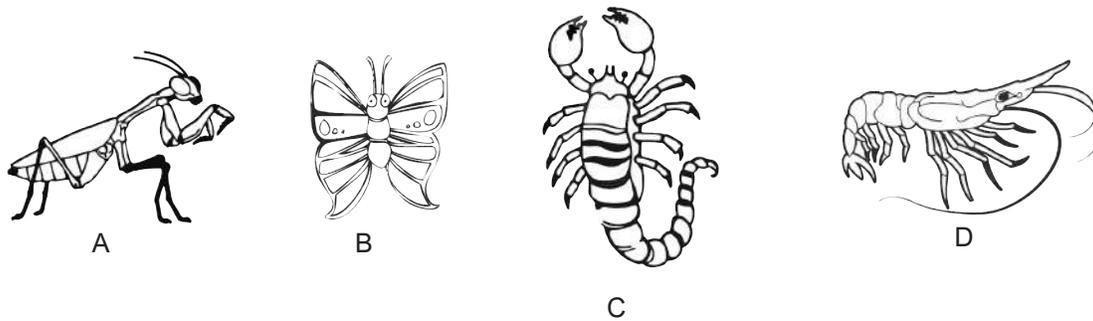


Figure 5.23: A. Locust; B. Butterfly; C. Scorpion; D. Prawn

- Respiration occurs through the body surface. Some organisms also have special structures like gills (e.g. Prawn), Trachea (e.g. Insects), Book-lungs (e.g. Scorpion), Book-gills (e.g. King crabs). Trachea transport oxygen directly to the cells.
- The heart is located in dorsal position with a circulatory system of open type.
- Blood is usually colourless called – Haemolymph. (e.g. Insect).
- Copper containing pigment called as haemocyanin is found in some organisms (e.g. Prawn)
- Heart is a dorsal, tubular pulsatile, which shows one or many chambered tubular structure.
- Excretory organs are – antennary / green glands / maxillary gland (e.g. Crustaceans) which opens directly into the exterior end or anus, coxal gland (e.g. Arachnids) and malpighian tubules which opens into the gut (e.g. Insects).
- Excretory matter is ammonia excreted by aquatic species and uric acid by terrestrial species
- Nervous system is developed and is made up of a ring (Brain) and a double, solid, mid ventral nerve cord which has a pair of ganglia connected through commissures to central nerve cord (Ganglia).
- Sexes are separate, with sexual dimorphism among the organs is also common. Fertilisation is internal however some aquatic species have external fertilisation as well. Gonads have ducts. Larva stage undergoes degree of metamorphosis getting converted to the organism. Most organisms show oviparous reproduction while few show viviparous methods also. Development is direct or indirect.

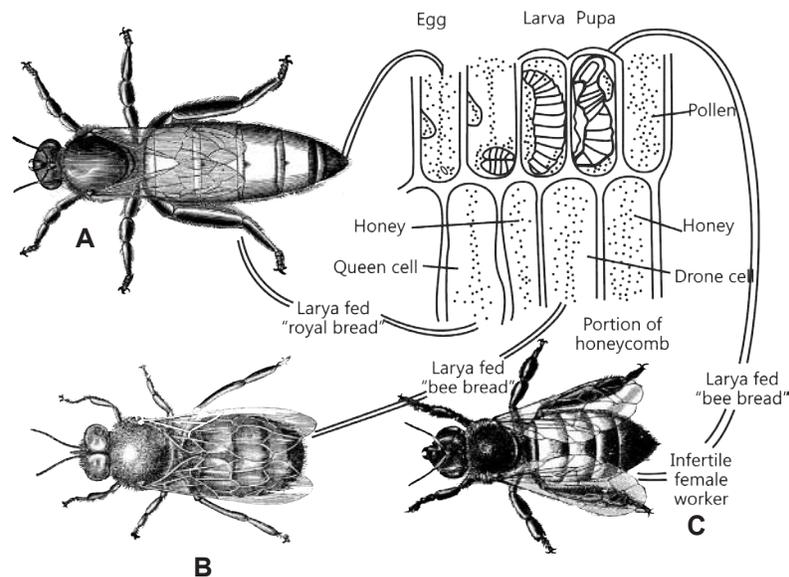


Figure 5.24: A. Queen in a bee hive; B. Drone in a hive and C. Worker in a hive

- The animals have endocrine system with some of them secreting pheromones to attract opposite sex.
- Arthropoda are most successful terrestrial environment invaders under the group of invertebrates as these animals include presence of (1) cuticle (2) appendages and (3) wings that help them survive better.
- Examples:
- Economically important insects – *Apis* (Honey bee), *Bombyx* (Silk worm), *Laccifer* (Lac insect).
 - Vectors – *Anopheles*, *Culex*, *Aedes* (mosquitoes)
 - Gregarious pest – *Locusta* (Locust)
 - Living Fossil – *Limulus* (King crab)
 - Others – Butterfly, Scorpion, Prawn, Spider, Cyclops, Centipede, Millipede, Peripatus etc.

The evolution from annelid to arthropod is:

- Head is differentiated in all the organisms.
- Endocrine glands.
- Striped muscles,
- Sense organs
- Well-developed respiratory organs

Table 5.16: Classification of Arthropoda on the Basis of Differences among their Body Structure

Class 1 Crustacea	Class 2 Chilopoda	Class 3 Diplopoda	Class 4 Insecta	Class 5 Arachnida
Two pairs of antennae and one pair of compound eyes.	Single pair of antennae and ocelli.	Single pair of antennae and ocelli.	Pair of antennae and compound eyes.	Simple eyes
Segments of legs called as pereopods.	Each trunk segment has a pair of legs.	Each thoracic segment has a pair of legs, except first one.	Three segments with legs and two pairs of wings.	Six pairs of appendages.
Respiration is through gills, or body surface	Respiration is through trachae	Respiration is through trachae	Respiration is through trachae	Respiration is through lungs or trachea or both.
Sexes are separate and have dimorphism.	Sexes are separate.	Sexes are separate	Sexes are separate	Sexes are separate.
Excretion occurs through antennary glands	Excretion occurs through malpighian tubules.	Excretion occurs through malpighian tubules.	Excretion occurs through malpighian tubules.	Excretion occurs through malpighian tubules.
Development is indirect	Development is direct	Development is direct	Development is either direct or indirect.	Development is generally direct

KNOWLEDGE BUILDER

- *Peripatus* is considered as connecting link between Annelida and Arthropoda as it has unjoined legs and breaths by trachea.
- Larvae of different arthropods:
 - Bombyx* (silkworm) – Caterpillar / silkworm.
 - Beetles* – honey bee grub
 - Musca* (housefly) – Maggot
 - Culex, Anopheles* – Wiggler
 - Pennaeus* (marine prawn), Mysis, Nauplius – protozoa
 - Cancer* (crab) – Megalopa
- Terga are dorsal plates whereas sterna are ventral plates of exoskeleton.
- Arthrodistal membranes join different sclerites.



KNOWLEDGE BUILDER

- Halteres are drumstick-shaped, second pair of reduced wings of housefly and mosquito which help in balancing.
- The eggs of *Culex* are cigar shaped; they are laid vertically on the surface of water in clusters; airfloats are absent; whereas in *Anopheles*, eggs are boat-shaped, laid singly and horizontally; they have airfloat.
- The larva of *Culex* is bottom feeder whereas the larva *Anopheles* is surface feeder.
- The adult of *Culex* lies parallel to the surface and both ends of body deflected whereas in *Anopheles*, the body is inclined at an angle of 45° to the surface. So, they can be distinguished with the help of sitting posture.
- In spider, spinnerets are present anterior to the terminal anus. They produce silken thread.
- Von Frisch described the process of communication of food source in honey bees.

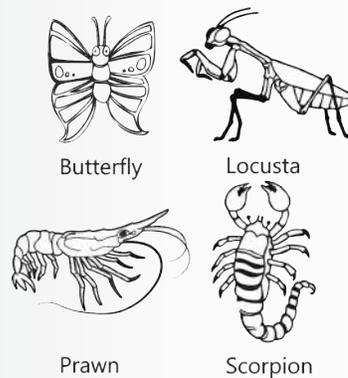


Figure 5.25: Various organisms in Arthropod

- Insecticides sprayed over the mosquitoes desensitise their nervous system as well as chemoreceptors and mechanoreceptors of the antennae.
- Johnston's organs are present on the antennae of mosquitoes.
- The life cycle is generally accompanied with metamorphosis. Larvae and adults may show different feeding habits and occupy different habitats.
- Insects such as bees, wasps, beetles, moths and butterflies are good pollination for important crops.
- Ants, termites, and locusts are eaten by Chinese and Indians; the eggs of aquatic bugs are used as food by Mexicans; ox-warbles are eaten by Red Indians.
- Dragon flies feed on the larvae of mosquitoes.



KNOWLEDGE BUILDER

- Glow worm (firefly) shows bioluminescence.
- Adult *Culex* and *Anopheles* can be distinguished with the help of sitting posture.
- The insects may be divided into five groups on the basis of their mode of development.
 - Ametabola insects: Metamorphosis absent. The young resemble adult.
Eggs → Young → Adult
Example: *Lepisma* (silver fish)
 - Paurometabola insects: Gradual metamorphosis.
Eggs → Nymph → Adult
Example: Cockroach, grasshopper, locusts, etc.
 - Hemimetabola insects: Incomplete metamorphosis. Habitat of young ones is different from adults.
Eggs → Naiads → Adult
Example: Dragon flies (naiads aquatic but adults aerial)
 - Holometabola insects: Complete metamorphosis.
Eggs → Larva → Pupa → Adult
Examples: House flies, butterflies, mosquitoes, etc.
 - Hypermetabola insects: Various forms of larvae.
Eggs → Larva (1) → Larva (2) → Pupa → Adult
Example: *Blister beetle*.

Unique Features

- Jointed appendages that were modified to function in various ways.
- Tough exoskeleton made up of chitinous plates secreted by epidermis.
- Tracheae is for respiration in majority of the members, gills, lungs are found in some of them.
- Compound eyes with lens.
- Malpighian tubules for excretion with nephridia.
- Power of flight in most insects with the wings.
- Movement through striped muscles arranged in bundles.

**DID YOU KNOW**

- **Metamorphosis:** The sum of all the changes that is responsible for transforming a larva into the adult.
- **Progressive metamorphosis:** Simple larva changes that cause maturity into a complex adult e.g., frog.
- **Retgressive metamorphosis:** Advanced larva that changes into a degenerate (less developed) adult e.g., Herdmania
- **Hibernation:** Period of inactivity of the organism in winter months is also called as winter sleep e.g. amphibians (frog) and lizards.
- **Aestivation:** Period of inactivity of the organism in summer months is also called as summer sleep e.g. frog.
- Cold blooded animals cannot survive in cold alpine and arctic areas. These are active in hot deserts for limited period only.
- **Aminotelism:** Main nitrogenous wastes are amino acids. It is found in star fish, sea cucumber, Unio, etc.

**TRY IT YOURSELF**

1. Which of the following animal is not an Insect-
 (A) Ticks (B) Honey bee (C) Beetle (D) Wasp
2. Example of living fossil in Arthropoda is –
 (A) *Cimex* (B) *Triarthrus* (C) *Peripatus* (D) *Eupagurus*
3. Excretion in animals Arthropoda take place by
 (A) Malpighian tubules (B) Green glands
 (C) Coxal glands (D) All of the above
4. Book – lungs are found in
 (A) Myriapoda (B) Crustacean (C) Arachnida (D) Insect
5. Millipede and centipede belongs to
 (A) Myriapoda (B) Crustacean (C) Insect (D) Arachnida

- Respiration occurs through feather like gills called as Ctenidia which are present in the mantle cavity.
- Circulatory system is made up of dorsal pulsatile heart that transports blood through arteries which open into sinuses. The system is of open type. Blood is blue or green in colour as it has respiratory transport molecule made of copper called as Haemocyanin.
- Excretory system includes 1 - 2 pairs of sac like kidneys that secrete their wastes into the mantle cavity. The kidney has Meta nephridia called as Keber's organs or Organ of Bojanus in Unio. Excretory matter is ammonia in aquatic forms or uric acid in terrestrial forms.
- Nervous system includes three pairs of ganglia. It includes
 - Cerebral (above the mouth)
 - Pedal (in the foot)
 - Visceral (in visceral mass)
- Sense organ includes
 - Eye- present over a stalk called ommatophore (Gastropoda).
 - Statocyst/Lithocyst – For equilibrium in foot
 - Osphradia – Chemoreceptor / Olfactory as well as for testing chemical and physical nature of water.

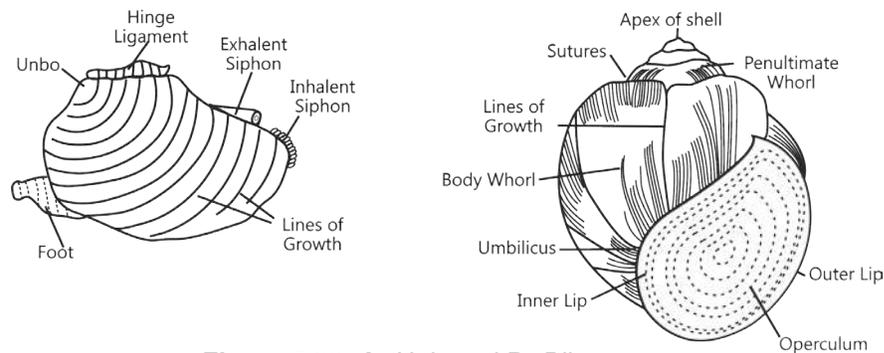


Figure 5.28: A. *Unio* and B. *Pila*

- Sexes are dioecious and organisms are oviparous. Fertilisation may be external or internal.
- Development is indirect through larva. Trochophore is very common larva, however Larva Glochidium (Fresh water mussel) and Veliger (*Pila*) are also found.

Classification of Molluscs:

Monoplacophora

- Marine animals that share characters with both Annelida and Mollusca.
- Shell has Dome shape with mantle covering.
- Broad and flat foot is found.

e.g. *Neopilina* - Living fossils - Connecting link between Annelida and Mollusca.

Polyplacophora/Amphineura*

- Marine,
- Shell can be present with 8 dorsal plates or absent.
- Flat foot is present at the ventral surface.

e.g. *Chiton*- The coat of mail shell (Sea – mica)

Scaphopoda

- Marine.
- Shell is Tubular and open at both the ends It has tusk like shell.
- Foot is in conical shape to help in digging.

e.g. *Dentalium* –Tusk shell - Respire by mantle

Gastropoda

- Marine or fresh water or moist soil are common habitats.
- Shell is spirally coiled (*Univalvia*).
- The foot is attached into the stomach

e.g. *Pila* – Apple – snail (Shell used in buttons), *Aplysia* – Sea hare, *Cypraea* – Old currency, *Limex* – Slug (Shell less), *Turbinella* – Shankh, *Turbo*- Cat's eye, *Doris* – Sea lemon, *Planorbis* – Land snail.

Pelecypoda

- Marine / fresh water.
- Shell is made of two valves that can move by dorsal hinge.
- Foot has wedge shape.

e.g. *Unio*- Mussel (fresh water), *Mytilus* – Mussel (marine), *Lamellidens* – Mussel, *Teredo* – Ship worm.
Pinctada- Pearl oysters.

Cephalopoda

- Marine
- Shell is either Internal (sepia) or external (Nautilus) or absent (Octopus).
- Foot is flat and muscular.
- Exhalant siphon present and closed blood circulation.
- Ink gland produces ink used for offence and defence mechanism and larva is absent.

e.g. *Octopus* – Devil fish with 8 arms

Unique Features

- Body has three regions: head, visceral mass and foot.
- A glandular fold, the mantle over the body.
- Mantle cavity is connected directly to anal, excretory and genital apertures in it.
- Calcareous shell is secreted by the epidermal shells that covers the body in most forms.
- A rasping / feeding organ called the radula is present in the buccal cavity.
- Sense organs are advanced, eyes, statocysts, osphradia, etc., are common.
- Precious pearl with tennis ball size is produced in a molluscs – Tridekna
- “Nacre layer” is called “Mother of Pearl”: This layer is made up of CaCO_3 and conchiolin protein.
- Father of pearl industry – Kokichi Mikimoto as he was the first one to start the pearl industry and cultured them.
- Molluscs include a large number of organisms that are classified on the basis of shell, Foot, Nervous system and gills into seven classes.

TRY IT YOURSELF

1. Organ of bojanus found in –
 (A) Chordate (B) Echinodermata
 (C) Annelid (D) Mollusca
2. Molluscan which form hole in wood –
 (A) *Doris* (B) *Chiton* (C) *Taredo* (D) *Limax*
3. Second largest phylum of animal kingdom is –
 (A) Arthropoda (B) Protozoa
 (C) Mollusca (D) Pisces
4. Secretion of shell take place by
 (A) Foot (B) Ink gland (C) Radula (D) Mantle
5. Cephalopod with exoskeleton-
 (A) *Pila* (B) *Chiton* (C) *Unio* (D) *Nautilus*



4.10 Phylum – Echinodermata

- Jacob Klein named the organisms in this phylum as Echinodermata.
- All animals are marine, live to grow and live at bottom, have slow locomotory movements. The phylum lacks any parasitic forms.

4.10.1 General Characters of Echinodermata

- Body shape is variable ranging from star-like, cylindrical-like, melon-like disc-like, flower-like and the body lacks head.
- Body lacks segments on the surface, has bilateral symmetry in larva stage and radial pentamerous (arranged in five or multiple) symmetry after the larva mature into an adult.
- Echinoderms have triploblastic germ layer that show organ system in level of organization.
- Skin has spines (tubercles), between which there are pincer like structures called as pedicellariae and endoskeleton made of calcareous plate (ossicle).
- Minute pedicellariae keeps the body surface free from debris.
- Echinoderms have true coelom in the body and are enterocoelic.
- Water vascular system is unique to echinoderms which is a water filled ambulacral or water vascular system with tube feet in which the water enters through a perforated plate called as madreporite. It helps in locomotion of body, capture and transport of food and also in respiration.
- Respiration is through the body surface called as dermal branchiae (gills) or papulae in most of the echinoderms like Star fish.
- Digestive tract is made of mouth digestive system ending in anus (incomplete – brittle star). Mouth here is on lower side and anus is on the upper side.
- Circulation system is open type and reduced with no heart or any pumping vessel.
- There is no specific excretory system and the nitrogenous waste produced by cells are (ammonia) diffused out through the body surface.
- Nervous system is simple, with less developed organs like a nerve ring and radial nerves that have simple sensory organs. They lack brain.

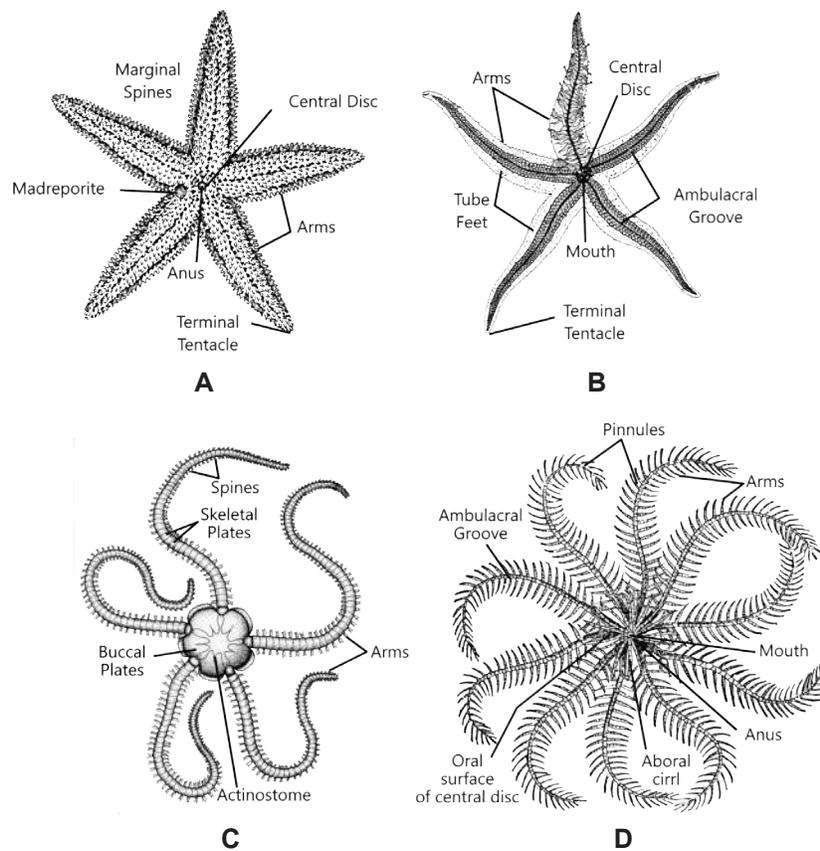


Figure 5.29: **A.** Dorsal view and **B.** Ventral view of Star fish, **C.** Brittle star and **D.** Feather star

- Echinoderms have male and female sexes separately.
- Fertilisation is external after sexual mating. Ciliated, free swimming larva that has bilateral symmetry is formed which later undergoes metamorphosis to develop into an adult.
- Similarities echinoderms share with the chordates.
- Early embryonic development in both the phylum includes deuterostomus and enterocoelomic condition.
- Few echinoderms (star fish) are able to regenerate into new organisms. They use their arms for defence purposes which is known as autotomy.
- Evisceration is a phenomenon where angry or frightened echinoderms vomit out viscera from the internal organ.

Table 5. 17: Classification of Echinodermata

Holothuroidea	Echinoidea	Crinoidea	Asteroidea	Ophiuroidea
<ul style="list-style-type: none"> Body form is long and cylindrical Arms are absent Larva is called as auricularia Respiration by cloacal respiratory tree. <p>e.g. <i>Cucumaria</i> – Sea cucumber <i>Holothuria synapta</i> – Only fresh water echinoderm</p>	<ul style="list-style-type: none"> Body form is Globular or disc like. Arms are absent Larva is called as Echinopluteus Respiration by peristomial gills. Mouth has biting and chewing teeth apparatus Aristotle's lantern (Masticating apparatus with 5 teeth) <p>e.g. <i>Echinus</i> – sea urchin</p>	<ul style="list-style-type: none"> Body form is Plant like fixed with cirri. Arms are numerous and branched. Larva is called as doliolaria <p>e.g. <i>Antedon</i> – Sea lily (most primitive) without spine and pedicellaria</p>	<ul style="list-style-type: none"> Body form is flat and star like. Arms are five, thick, short and lack central disc Larva is called as bipinnaria, dipleura etc. Respiration by dermal branchie <p>e.g. <i>Asterias</i> – Starfish</p>	<ul style="list-style-type: none"> Body form is flat and star like. Arms are five, thin, long and brittle Larva- ophiopluteus Respiration by genital bursae <p>e.g. <i>Ophiura</i> – Brittle star <i>Ophiothrix</i></p>

KNOWLEDGE BUILDER

- The starfish uses the suction-cup-like ends of the tube feet of one arm to hold on to rocks, as it moves the other arms. It can open bivalves (molluscs) by attaching two arms to either sides of a bivalve and pulling them apart. The bivalve opens out; the stomach of starfish is then everted through its mouth and introduced into the open molluscs which is partly digested before being ingested.
- Echinoderms predate on coral polyps also.

Unique Features

- Larva has Bilateral symmetry which matures into adult that has radial symmetry.
- Mesodermal endoskeleton made from the calcareous spiny plates (1-8).
- A water vascular system which is modified part of the coelom to help in locomotion.
- Characteristic tube feet is present that helps in locomotion.
- Peculiar pedicellariae cleans the body surface.

TRY IT YOURSELF

1. Member of Echinodermata has a specific system, which is not found in other phylum, it is –

(A) Canal system	(B) Water vascular system
(C) Respiratory system	(D) Reproductive system
2. Presence of pedicellariae is the characteristic feature of class –

(A) Hydrozoa	(B) Asteroidean
(C) Crustacean	(D) Cephalopoda
3. Which of the following is found in both coelenterates and echinoderms in adult stage –

(A) Coelenterons	(B) Radial symmetry
(C) Tube-feet	(D) Bilateral symmetry
4. The animal with tube-feet is

(A) Star-fish	(B) Jelly-fish
(C) Silver-fish	(D) Cray-fish
5. The system of vessels conveying water for the purpose of feeding respiration and locomotion in Echinoderms is called

(A) Canal system	(B) Water vascular system
(C) Vascular system	(D) None of the above

4.11. Phylum – Hemichordata

- Hemichordate was thought to be a sub-phylum of the phylum chordate. However, presently it is placed under non-chordate which is separate phylum.
- Animals of this phylum are all fossorial.

- Body of the organisms are worm-like, brittle and soft. Body shows three parts-
 - Proboscis
 - Collar
 - Trunk

4.11.1 General Characters of Hemichordate

- Body has enterocoelus cavity that is differentiated as protocoel, mesocoel and metacoel.
- Mostly organisms are ciliary feeders. Alimentary canal is complete in the digestive system.
- Pigment vanadium is colourless in the blood which is responsible for respiration and the organ is gill or the body surface.
- Circulatory system is of the open type. Blood has amoeboid corpuscles. Heart is in dorsal side.
- Buccal cavity has a notochord like structure that is called as the “Buccal diverticulum” or “Stomochord” (outgrowth structure of gut).
- True notochord and post anal tail is absent.
- Central nervous system is similar to non-chordates. Brain is like nerve ring.
- A single glomerulus situated in the proboscis takes care of excretion which is called as proboscis gland.
- Mostly, unisexual animals that reproduce sexually.
- External fertilisation.
- Development is indirect, tornaria larva (freely swimming) just like bipinnaria larva of echinodermata in their developmental stages.
e.g. *Balanoglossus* – Tongue worm or Acorn worm, *Saccoglossus*, *Protoglossus*, *Rhabdopleura*, *Cephalodiscus*
- Hemichordata acts as a connecting link between non-chordata and chordata.

Summary

- The basic fundamental features that are common in almost all the animals are used to classify organisms. The basis for classification are level of organisation, symmetry, cell organisation, coelom, segmentation, notochord, etc. Along with these fundamental features, several distinctive characters specialised to which are specific for each phyla or class.
- Phylum Porifera: includes animals that are multicellular i.e. exhibit cellular level of organisation. It has characteristic flagellated choanocytes. Ostia is present all over the body, with only an opening as osculum on the top. Members are hermaphrodite. Skeleton is made up of calcareous or siliceous spicules or spongin fibres.
- Phylum Coelentera: have tentacles and cnidoblasts in the body. The organisms are aquatic, sessile or free-floating. The body has radial symmetry, are typical acoelomates, diploblastic and have gastrovascular cavity. Few of the cnidarians show metagenesis also.
- Phylum Ctenophora: exclusively marine animals, diploblastic acoelomate with radial symmetry. They are without cnidoblasts however have colloblasts. Locomotion is with comb plates.
- Phylum Platyhelminthes: first triploblastic animals. The body is acoelomate, has bilateral symmetry and also has blind sac body plan. They are hermaphrodite. They are common parasites and have various types of suckers and hooks that helps in attachment.
- Phylum Aschelminthes: triploblastic, unsegmented animals that have bilateral symmetry. The animals are pseudocoelomate that have complete alimentary canal and are dioecious.
- Phylum Annelida: first to have the metameric segmentation on the body and have true coelom. Body includes the appendages for locomotion made up of chitinous setae or parapodia.
- Phylum Arthropoda: are the most abundant group of animals that are characterised to have jointed appendages. They are triploblastic, coelomates with metamericly segmented body and have open circulatory system. Exoskeleton is made up of Chitin.
- Phylum Mollusca: have soft unsegmented body which has hard calcareous shell as covering secreted by a fold of skin mantle that covers the visceral mass.
- Phylum Echinodermata: marine animals that possess spiny skin. Their body has most distinctive feature the water vascular system. Symmetry changes in life cycle as larva has bilateral symmetry and adult has radial symmetry.
- Phylum Hemichordata: small group of worm like animals found in marine waters. The body is cylindrical with proboscis, collar and trunk.

EXERCISE

Objective Questions

Q.1 The animals in which the cells are organised into structural and functional units called as tissues, organs and organ systems are grouped under which sub-kingdom?

- (A) Parazoa (B) Eumetazoa (C) Metazoa (D) Bilateria

Q.2 When any plane passing through the central axis of the body divides the organism into two identical halves it is radial symmetry. Which of the following set of animals have radial symmetry?

- (A) Housefly, fish, human beings
 (B) Sponges, hydra, crabs
 (C) Coelenterates, ctenophores, echinoderms
 (D) Annelids, arthropods, housefly

Q.3 Closed circulatory system is found in

- (A) Earthworm (B) Arthropoda (C) Unio (D) Leech

Q.4 Sponges are most primitive multicellular organisms with which of the following levels of organisation?

- (A) Acellular (B) Cellular (C) Tissue (D) Organ system

Q.5 Incomplete alimentary canal with blind sac type of body plan is present in

- (A) Annelids (B) Arthropods (C) Platyhelminthes (D) Sponges

Q.6 Select correct matching of animals, their body symmetry and coelom.

S. No.	Animals	Symmetry	Coelom
1.	Ctenophores	Radial	Acoelomate
2.	Platyhelminthes	Bilateral	Acoelomate
3.	Aschelminthes	Bilateral	Pseudocoelomate
4.	Annelids	Radial	Coelomate

Q.7 Acoelomate diploblastic animal phylum is

- (A) Platyhelminthes (B) Cnidaria (C) Aschelminthes (D) Hemichordate

Q.8 Which of the following animal/s has tube within tube type of body plan evolved along deuterostomic evolutionary line?

- (A) Annelids (B) Arthropods (C) Aschelminthes (D) Molluscs

Q.9 In the course of evolution true coelom appeared for the first time in

- (A) Annelida (B) Chordata (C) Aschelminthes (D) Echinodermata

Q.10 Which of the following is incorrect matching of the phylum, their alimentary canal and metamerism segmentation?

S. No.	Animals	Symmetry	Coelom
(1)	Annelida	Complete	Present
(2)	Arthropoda	Complete	Present
(3)	Mollusca	Complete	Absent
(4)	Platyhelminthes	Incomplete	Present

Q.11 If *Amoeba* is kept in distilled water, its contractile vacuole

- (A) Works slowly (B) Works faster (C) Remains unaffected (D) Disappears

Q.12 *Paramecium* feeds through

- (A) Undulating membrane (B) General body surface
(C) Oral groove (D) Cytopyge

Q.13 Total parasites belong to protozoan group

- (A) Sporozoa (B) Ciliata (C) Sarcodina (D) Zooflagellata

Q.14 Common trait between *Amoeba* and leucocyte is

- (A) Encystment (B) Pseudopodia (C) Sporulation (D) Contractile vacuoles

Q.15 Sporozoites of malaria parasite enter

- (A) Stomach of mosquito (B) Salivary glands of human
(C) Liver cells of humans (D) Erythrocytes of human

Q.16 Exflagellation in *Plasmodium* occurs in

- (A) Merozoites (B) Megagametocytes
(C) Microgametocytes (D) Metacryptomerozoites

Q.17 Which one is non pathogenic?

- (A) *Entamoeba coli* (B) *Entamoeba histolytica*
(C) *Entamoeba gingivalis* (D) *Plasmodium ovale*

Q.18 The trophic form in *Entamoeba histolytica* is

- (A) Magna form (B) Minuta form (C) Monogenetic form (D) Digenetic form

Q.19 Cellulose digestion in termites is carried out by

- (A) *Lophomonas* (B) *Trichomonas* (C) *Trichonympha* (D) *Monocystis*

Q.20 Which phase of *Plasmodium* is resistant to drugs?

- (A) Golgi cycle (B) Erythrocytic phase
(C) Posterythrocytic phase (D) Gamogonic phase

Q.21 *Sycon* belongs to a group of animals which are best described as

- (A) Unicellular or cellular
(B) Multicellular with cellular level of organisation, without any tissue organisation
(C) Multicellular with a gastrovascular cavity
(D) Multicellular having tissue level of organisation

Q.22. Canal system of porifera is not connected with

- (A) Food gathering (B) Respiratory gas exchange
(C) Removal of waste (D) Locomotion

Q.23. Digestion of food in sponges is

- (A) Intracellular in choanocytes
(B) Intracellular in choanocytes and extracellular in paragastric cavity
(C) Extracellular occurs in spongocoel
(D) Intracellular

Q.24 The characteristic cells of sponges are

- (A) Nerve cells (B) Choanocytes / Collar cells
(C) Amoebocytes (D) Chromocytes

Q.25 Which of the following is not a character of phylum porifera?

- (A) Sexes are not separate
(B) Fertilization is internal
(C) Development is indirect
(D) They are exclusively present in marine water and are mostly asymmetrical

Q.26 Which of the following is incorrect matching?

- (A) *Sycon* - Scypta (B) *Spongilia* - Freshwater sponge
(C) *Euspongia* - Bath sponge (D) *Chalina* - Boring sponge

Q.27 Parenchymula is the larva of

- (A) *Hydra* (B) *Leucosolenia* (C) Most sponges (D) Both (B) and (C)

Q.28 The simplest type of canal system in phylum porifera is

- (A) Ascon type (B) Leucon type (C) Rhagon type (D) Sycon type

Q.29 Sponges have evolved from

- (A) Ciliates (B) Flagellates (C) Protozoans (D) Choanoflagellates

Q.30 Carmine particle put above osculum of a sponge would be

- (A) Left there (B) Ingested and digested
(C) Thrown away (D) Ingested and thrown away by ostia

Q.31 Which of the following is a characteristic feature of cnidarians?

- (A) They are aquatic, marine, diploblastic animals
(B) They exhibit tissue level organisation
(C) They have central gastro-vascular cavity with a single opening.
(D) Digestion is only extracellular

Q.32 Which is the most appropriate term used for the life cycle of *Obelia*?

- (A) Alternation of generation
- (B) Metagenesis
- (C) Alternation of generation
- (D) Neoteny

Q.33 The free swimming level of coelenterates is

- (A) Planula
- (B) Cydippid
- (C) Parenchymula
- (D) Amphiblastula

Q.34 The characteristic cells of coelenterates are

- (A) Colloblasts present in epidermis only
- (B) Cnidoblasts present in epidermis only
- (C) Cnidoblasts present in both epidermis and gastrodermis
- (D) Flame cells

Q.35 Which of the following is incorrect match?

- (A) *Physalia* – Portuguese man of war
- (B) *Meandrina* – Staghorn coral
- (C) *Gorgonia* – Sea fan
- (D) *Pennatula* – Sea pen

Q.36 Sea walnuts or comb jellies belong to phylum

- (A) Cnidaria
- (B) Mollusca
- (C) Ctenophora
- (D) Porifera

Q.37 Which of the following is not character of phylum ctenophore?

- (A) Exclusively marine and radially symmetrical
- (B) Diploblastic with tissue level organisation
- (C) Monoecious and exhibit bioluminescence
- (D) Reproduction is internal with indirect development

Q.38 Tentacles of ctenophores contain

- (A) Cnidoblasts
- (B) Colloblasts
- (C) Comb plates
- (D) Statocysts

Q.39 Which of the following is incorrect match regarding the phylum and its two examples?

- (A) Ctenophora – *Pleurobrachia*, *Ctenoplana*
- (B) Cnidaria – *Adamsia*, *Obelia*
- (C) Porifera – *Euspongia*, *Hormiphora*
- (D) Platyhelminthes – *Taenia*, *Fasciola*

Q.40 *Hydra* is

- (A) Fresh water form, radially symmetrical and diploblastic
- (B) Marine, radially symmetrical and diploblastic
- (C) Fresh water form, bilaterally symmetrical and diploblastic
- (D) Marine, radially symmetrical and triploblastic

Q.41 In *Taenia* (tape worm) alimentary canal is absent because

- (A) It is endoparasite
- (B) It does not require food
- (C) They absorb the nutrients from the host directly through the body surface
- (D) It does not require solid food

Q.42 Which of the following is not a characteristic features of the phylum-platyhelminthes?

- (A) Sexes are not separate (hermaphrodite)
- (B) Fertilization is internal and is cross fertilization
- (C) Development is indirect through many larval stages
- (D) Lives in intestine of sheep

Q.43. Specialised cells called as flame cells which help in osmoregulation and excretion are characteristic feature of

- (A) *Ctenoplana* (B) *Tubipora* (C) *Fasciola* (D) *Spongilla*

Q.44 Which of the following is not a characteristic feature of *Fasciola hepatica*?

- (A) Sexes are not separate (hermaphrodite)
- (B) Fertilization is internal and is cross fertilization
- (C) Development is indirect through many larval stages
- (D) Lives in intestine of sheep

Q.45 In the life, history of liver fluke are present, A-Cercaria, B-Metacercaria, C-Sporocyst, D-Redia, E- Miracidium. What is their proper sequence?

- (A) B, E, C, D, A (B) B, C, E, D, A (C) E, C, D, A, B (D) A, B, C, D, E

Q.46 *Taenia solium* is attached to the intestinal mucosa by

- (A) Rostellum (B) Scolex (C) Proglottids (D) Acetabulum

Q.47 Transfer of *Taenia* to secondary host occurs through

- (A) Oncosphere (B) Cysticercus (C) Egg (D) Miracidium

Q.48 Blood fluke is

- (A) *Hymenolepis nana* (B) *Paragonimus*
(C) *Schistosoma haematobium* (D) *Echinococcus granulosus*

Q.49 Cysticercus larva of *Taenia* develops in

- (A) Man (B) Goat (C) Sheep (D) Pig

Q.50 Free swimming ciliated larva of liver fluke is

- (A) Redia (B) Miracidium (C) Metacercaria (D) Cercaria

Q.51 Which of the following is not a characteristic feature of phylum aschelminthes?

- (A) Bilaterally symmetrical, triploblastic animals
(B) Pseudocoelomate animals and unsegmented animals
(C) Incomplete alimentary canal
(D) They are dioecious

Q.52 Syncytial epidermis occurs in

- (A) *Ascaris* (B) *Hydra* (C) *Taenia* (D) *Pheretima*

Q.53 An intermediate host is present in

- (A) *Ascaris* (B) *Wuchereria* (C) *Ancylostoma* (D) *Enterobius*

Q.54 Female *Ascaris* can be differentiated from male by

- (A) Presence of cloaca (B) Presence of penial setae
(C) Shorter size (D) Longer than male and straight posterior end

Q.55 The disease filariasis transmitted through the secondary host of *Wuchereria*

- (A) *Anopheles* (B) *Sand fly* (C) *Tse tse fly* (D) *Culex*

Q.56 Which of the following enters the body through the skin of feet in man if, he walks bare footed in contaminated soil?

- (A) *Ancylostoma* (B) *Ascaris* (C) *Schistosoma* (D) *Enterobius*

Q.57 Which of the following statement is incorrect about Annelida?

- (A) They are triploblastic, metamerically segmented coelomate animals
(B) They possess both longitudinal and circular muscles which help in locomotion
(C) A closed circulatory system is present
(D) All are monoecious and reproduction is sexual

Q.58 Which of the following is dioecious?

- (A) *Pheretima* (B) *Hirudinaria* (C) *Nereis* (D) *Lumbricus*

Q.59 *Nereis* possesses lateral appendages called as parapodia which help in

- (A) Locomotion (B) Swimming (C) Respiration (D) All of these

Q.60 Which of the following is incorrect?

- (A) Oligochaeta – *Pheretima* (B) Hirudinea – *Hirudo*
(C) Polychaeta – *Lumbricus* (D) Nematoda – *Ascaris*

Q.61 Which of the following is the largest phylum of kingdom Animalia?

- (A) Mollusca (B) Annelida (C) Arthropoda (D) Echinodermata

Q.62 Which of the following is not an exclusive trait of arthropoda?

- (A) Presence of wings (B) Jointed appendages
(C) Hemocoel (D) Chitinous exoskeleton

Q.63 Arthropoda is characterised by

- (A) Triploblastic, bilateral symmetry and abdominal appendages
(B) Bilateral symmetry and pair of wings
(C) Acoelomate and radial symmetry
(D) Exoskeleton, metameric segmentation and jointed appendages

Q.64 Choose the incorrect match

- (A) Gregarious pest – *Locusta* (B) Living fossil – *Limulus*
(C) Vector – *Lucifer* (D) Economically important insect - *Apis*

Q.65 Body of insect is divisible into

- (A) head, thorax and abdomen (B) Head, trunk abdomen
(C) Cephalothorax, head and abdomen (D) Trunk, thorax and abdomen

Q.66 In insects, respiratory gas exchange occurs through

- (A) Gills (B) Tracheae (C) Skin (D) Lungs

Q.67 What is common between earthworm and cockroach?

- (A) Nephridia (B) Solid ventral nerve cord
(C) Cuticle (D) Malpighian tubule

Q.68 Open blood circulation is found in

- (A) Earthworm (B) Human (C) Cockroach (D) Reptiles

Q.69 Blood colour of arthropods is

- (A) Colourless (B) Red (C) Blue (D) Yellow

Q.70 Excretory organs of arthropods are

- (A) Green glands (B) Green gland and malpighian tubules
(C) Nephridia (D) Malpighian tubules

Q.71 Which of the following is not a characteristic features of phylum Mollusca?

- (A) They are bilaterally symmetrical, triploblastic and coelomate animals
(B) Unsegmented animals
(C) They are usually dioecious and oviparous with indirect development
(D) Respiratory organs are feather like gills which are present in the visceral hump, help in respiration and excretion

Q.72 File-like rasping organ for feeding called as radula is present in all molluscs, except

- (A) *Pila* (Apple snail) (B) *Sepia* (Cuttle fish)
(C) *Aplysia* (Sea hare) (D) *Pinctada* (Pearl oyster)

Q.73 Mollusca is differentiated from other by

- (A) Bilateral symmetry and external skeleton
(B) Mantle and gills
(C) Shell and unsegmented body
(D) Mantle and unsegmented body

Q.74 Osphradium of *Pila* is meant for

- (A) Excretion (B) Nutrition
(C) Grinding of food (D) Selection and rejection of food

Q.75 In which of the following class of phylum Mollusca, torsion occurs?

- (A) Gastropoda (B) Pelecypoda
(C) Cephalopoda (D) Monoplacophora

Q.76 Ink glands for protection and locomotion by jet propulsion mechanism is a characteristic feature of

- (A) *Pila* (Apple snail) (B) *Loligo* (Squid)
(C) *Dentalium* (Tusk shell) (D) *Chaetopleura* (Chiton)

Q.77 Trochophore larva occurs in

- (A) Annelida and Porifera (B) Coelenterata and Annelida
(C) Mollusca and Echinodermata (D) Annelida and Mollusca

Q.78 Pearls are obtained from

- (A) *Sepia* (B) *Pinctada* (C) *Dentalium* (D) Octopus

Q.79 Which of the following statement is incorrect about circulatory of molluscs?

- (A) Blood contains a respiratory pigment haemocyanin
(B) Non-cephalopod molluscs have open circulatory system
(C) Cephalopod molluscs have closed circulatory system
(D) Respiratory pigment is haemoglobin dissolved in plasma

Q.80 Eye of which molluscan group resembles vertebrate eye?

- (A) Bivalvia (B) Gastropoda (C) Pelecypoda (D) Cephalopoda

Q.81 In which of the following phylum larvae are bilaterally symmetrical and adult are radially symmetrical?

- (A) Mollusca (B) Echinodermata (C) Annelida (D) Arthropoda

Q.82 Which of the following is not a characteristic feature of phylum Echinodermata?

- (A) Excretory system is absent
(B) Presence of water vascular system which helps in locomotion
(C) Sexes are separate
(D) Fertilization is internal development is indirect with free swimming larva

Q.83 Aristotle's lantern which helps in mastication is a characteristic feature of

- (A) *Asterias* (Star fish) (B) *Echinus* (Sea urchin) (C) *Antedon* (Sea lily) (D) *Ophiura* (Brittle star)

Q.84 Ambulacral grooves are absent in

- (A) Asteroidea (B) Crinoidea (C) Ophiuroidea (D) Star fish

Q.85 In which of the following phylum all the animals are exclusively marine with organ system level of organisation?

- (A) Coelenterata (B) Porifera (C) Echinodermata (D) Mollusca

Q.86 Bipinnaria is the larval stage of

- (A) *Asterias* (B) *Echinus* (C) *Antedon* (D) *Cucumaria*

Q.87 Which one of the following occurs in Molluscs but not Echinoderms?

- (A) Aristotle's lantern (B) Kidneys
(C) Organ system level of organisation (D) Dioecious condition

Q.88 In Echinodermata, the members of which class have mouth and anus on the same surface of body?

- (A) Holothuroidea (B) Crinoidea (C) Ophiuroidea (D) Echinoidea

Q.89 The structures which help in respiration as well as excretion are

- (A) Dermal branchiae (B) Pedicellariae (C) Calcareous spines (D) Tubercles

Q.90 Which of the following is mismatched?

- (A) *Clypeaster* - Cake urchin (B) *Pentaceros* – Star fish
(C) *Ophiocoma* – Sand dollar (D) *Echinocardium* – Heart urchin

Q.91 Excretory organ in hemichordates is

- (A) Neural gland (B) Solenocyte (C) Coxal gland (D) Proboscis gland

Q.92 Stomochord is present in

- (A) Amphioxus (B) Herdmania (C) Balanoglossus (D) Proboscis gland

Q.93 Which is correct about Acorn worm?

- (A) Sexes are united and fertilisation is internal (B) Sexes are separate and fertilisation is internal
(C) Sexes are separate but fertilisation is external (D) Sexes are united but fertilisation is external

Q.94 Find the correct match w.r.t. hemichordate phylum.

- (A) Circulatory system – Open (B) Body cavity – Schizocoelom
(C) Respiratory pigment – Haemocyanin (D) Gill slits – Absent

Q.95 The anterior most part of body of *Balanoglossus* is

- (A) Collar (B) Proboscis (C) Head (D) Branchia region

Q.96 Which is not true?

- (A) Acorn worm is worm like but not parasitic in nature
(B) Tongue worm is also known as acorn worm
(C) Stomochord, also known as 'buccal diverticulum' is present in the collar
(D) Tornaria is the larva of Balanoglossus

Q.97 Which feature of hemichordate shows its affinity with chordate?

- (A) Presence of dorsal heart (B) Presence of pharyngeal gill slits
(C) Presence of marine habitat (D) Absence of respiratory pigment

Q.98 Which of the following statement is incorrect about the phylum hemichordate?

- (A) They are bilaterally symmetrical triploblastic and coelomate animals
- (B) Circulatory system is closed
- (C) Excretory organ is proboscis gland
- (D) Fertilisation is external and development is indirect

Q.99 Which of the following set of animals belong to phylum hemichordate?

- (A) *Balanoglossus*, *Saccoglossus*
- (B) *Salpa*, *Doliolum*
- (C) *Petromyzon*, *Myxine*
- (D) *Dentalium*, *Chaetopleura*

Q.100 Acorn worms are included in which of the following phylum?

- (A) Echinodermata
- (B) Hemichordata
- (C) Mollusca
- (D) Annelida

Q.101 Sponges in which the cells are loosely aggregated and do not form tissues or organs are grouped under which sub-kingdom?

- (A) Metazoa
- (B) Eumetazoa
- (C) Parazoa
- (D) Bilateria

Q.102 Level of organization in coelenterates is

- (A) Acellular
- (B) Cellular
- (C) Tissue
- (D) Organ system

Q.103 Blind sac body plan is found in

- (A) Sponges
- (B) Annelids
- (C) Coelenterates
- (D) Round worms

Q.104 Annelids possess

- (A) Cell aggregate plan
- (B) Blind sac plan
- (C) Tube within a tube plan
- (D) Hollow sac plan

Q.105 'Tube in a tube' plan is not exhibited by one of the following phyla

- (A) Coelenterata
- (B) Aschelminthes
- (C) Annelida
- (D) Arthropoda

Q.106 An animal having triploblastic acoelomic condition is

- (A) *Ascaris*
- (B) *Periplanata*
- (C) *Planaria*
- (D) *Sycon*

Q.107 Animals which are triploblastic with tube within tube type of body plan and embryonic blastopore forms anus (deuterostomia) are

- (A) Annelids (B) Molluscs (C) Platyhelminthes (D) Echinoderms

Q.108 Echinoderms and chordates have

- (A) Pseudocoel (B) Shizocoelom (C) Enterocoelom (D) Haemocoel

Q.109 Body cavity of arthropods is called

- (A) Coelom (B) Haemocoel (C) Pseudocoel (D) Gastrovascular cavity

Q.110 A deuterostomic animal is

- (A) Star fish (B) Sea Anemone (C) Pearl oyster (D) Octopus

Q.111 True segmentation (metameric) occurred for the first time in

- (A) Platyhelminthes (B) Aschelminthes (C) Annelids (D) Arthropods

Q.112 Animals processing pseudocoelom are

- (A) Flatworms (B) Round worms (C) Annelids (D) Molluscs

Q.113 True coelom appeared first in the course of evolution in

- (A) Echinodermata (B) Annelida (C) Chordata (D) Aschelminthes

Q.114 Biradial symmetry is found in

- (A) *Obelia* (B) *Sea Anemone* (C) *Hydra* (D) *Aurelia*

Q.115 Which is the only phylum in the animal kingdom without any nerve cell?

- (A) Porifera (B) Coelenterata (C) Annelida (D) Eumetazoa

Q.116 The basis of classification of protozoa is

- (A) Mode of nutrition (B) Mode of reproduction
(C) Mode of locomotion (D) Mode of respiration

Q.117 Dum-dum fever is caused by

- (A) *Leishmania donovani* (B) *Glossina palpalis*
(C) *Giardia intestinalis* (D) *Trypanosoma gambiense*

Q.118 The relationship between Lophomonas and wood cockroach is of

- (A) Parasitism (B) Commensalism (C) Symbiosis (D) Ammensalism

Q.119 Oriental sore disease in man is caused by which one of the following?

- (A) *Leishmania tropica* (B) *L. donovani*
(C) *L. brasiliensis* (D) *Phlebotomus intermedium*

Q.120 *Trypanosoma gambiense* causes

- (A) Sleeping sickness (B) Yellow fever (C) Kala-azar (D) Oriental sore

Q.121 The vector of *Trypanosoma gambiense* is

- (A) Sand fly (B) Fruit fly (C) Tse-Tse fly (D) House fly

Q.122 A sarcodine dysentery is

- (A) *Giardia* (B) *Entamoeba* (C) *Amoeba* (D) *Trypanosoma*

Q.123 Silica shells may or may not occur in one of the following

- (A) Amoeboids (B) Heliozoans (C) Radiolarians (D) Foraminiferans

Q.124 Time period from the initial infection to first appearance of symptoms is known as

- (A) Pre-patent period (B) Incubation period
(C) Pre-erythrocytic period (D) Exo-erythrocytic period

Q.125 Tetranucleated cyst stage is found in

- (A) *Entamoeba coli* (B) *Entamoeba histolytica*
(C) *Leishmania* (D) *Trypanosoma*

Q.126 Which of the following organisms is known to form abscesses in human liver, lungs, brain etc.?

- (A) *Entamoeba histolytica* (B) *Monocystis*
(C) *Plasmodium* (D) *Fasciola hepatica*

Q.127 Which one of the following constitute the reserve food material in the cyst of *Entamoeba histolytica*?

- (A) Volutin granules (B) Starch granules (C) Glycogen granules (D) Fat droplets

Q.128 Slipper animalcule is the name of

- (A) *Pelomyxa* (B) *Actinophrys* (C) *Euglena* (D) *Paramecium*

Q.129 Organelle concerned with offence and defence in *Paramecium* is

- (A) Trichocyst (B) Radial canals (C) Kappa particles (D) Peristome

Q.130 Conjugation in *Paramecium* is by

- (A) Exchange of micronucleus (B) Exchange of macronucleus
(C) Exchange of + and – nuclei (D) Exchange of nuclei

Q.131 The function of cytophyge in *Paramecium* is to

- (A) Filter food particles (B) Form the bolus of the food material
(C) Segregate debris from useful food material (D) Egest the indigestible waste

Q.132 Contractile vacuoles of *Paramecium* are analogous to

- (A) Sweat glands of mammals (B) Uriniferous tubules
(C) Gastrovascular cavity of *Hydra* (D) Typhlosole of Earthworm

Q.133 Removal of micronucleus in *Paramecium* will impair the function of

- (A) Reproduction (B) Excretion (C) Osmoregulation (D) Locomotion

Q.134 Locomotion in sporozoans occur by

- (A) Flagella (B) Cilia (C) Pseudopodia (D) Wriggling movement

Q.135 Aestivo-autumnal fever is due to

- (A) *Plasmodium malariae* (B) *Leishmania donovani*
(C) *Plasmodium vivax* (D) *Plasmodium falciparum*

Q.136 In *Plasmodium*, gametocytes are formed in man, but do not develop fully in the R.B.C. because of

- (A) Antibodies present in blood (B) Antigens present in blood
(C) Higher temperature of blood (D) Lower temperature of blood

Q.152 In the absence of a closed vascular system, how do sponges manage to distribute the nutritive substances from choanocytes to rest of the cells?

- (A) Through cell to cell diffusion
- (B) Through mesoglea which acts as the food reservoir and distribution system
- (C) Through the wandering cells, amoebocytes
- (D) Through cell to cell diffusion and amoebocytes

Q.153 *Hydra* and *Obelia* are

- (E) Diploblastic, blind sac body plan, radial symmetry, acoelomate
- (F) Diploblastic, bilaterally symmetrical and acoelomate
- (G) Triploblastic, radially symmetrical and coelomate
- (A) Triploblastic, bilaterally symmetrical and coelomate

Q.154 The most important characteristic of phylum Cnidaris is

- (A) Cnidoblasts
- (B) Choanocytes
- (C) Thesocytes
- (D) Archaeocytes

Q.155 Digestion in *Hydra* is

- (A) Extracellular
- (B) Intracellular
- (C) Extracellular and intracellular
- (D) Holozoic

Q.156 Metagenesis is found in

- (A) *Physalia* (Portuguese man of war)
- (B) *Hydra*
- (C) *Obelia*
- (D) Both (A) and (C)

Q.157 Which of the following statement is incorrect about metagenesis?

- (A) Alternation of asexual and sexual phases in the life cycle of *Obelia* is called metagenesis
- (B) Metagenesis is similar to alteration of generations as found in plants
- (C) Both the medusa and polyp are diploid
- (D) Medusa is the sexual phase and polyp is the asexual phase

Q.158 Jelly fish belongs to class

- (A) Hydrozoa
- (B) Scyphozoa
- (C) Anthozoa
- (D) None of these

Q.159 Sea anemone belong to

- (A) Anthozoa (B) Hydrazoa (C) Scyphozoa (D) Coelenterata

Q.160 Which one of the following is coelenterate?

- (A) Sea pen (B) Sea horse (C) Sea urchin (D) Sea cucumber

Q.161 Tick mark the incorrect match

- (A) *Obelia* – Planula larva (B) *Aurelia* – Ephyra larva
(C) *Nereis* – trochophore (D) *Hydra* – Hydrula larva

Q.162 The hypnotoxin is produced by

- (A) Penetrant (B) Volvent (C) Large glutinant (D) Small glutiant

Q.163 During discharge of nematocyst the function of lasso is to

- (A) Press and squeeze out the thread tube
(B) Trigger the stimulus
(C) Prevent the detachment of nematocyst from nematoblast
(D) None of these

Q.164 A piece of *Hydra* will regenerate into a full *Hydra* if it contains a part of

- (A) Epidermis (B) Epidermis, gastrodermis and interstitial cells
(C) Basal disc (D) Epidermis, gastrodermis and tentacles

Q.165 Which one of the following (cell types) contains the symbiotic zoochlorellae in *Hydra*?

- (A) Epithelio muscular cells of epidermis (B) Endothelio muscular cells of gastrodermis
(C) Interstitial cells (D) Algae embedded in the mesoglea

Q.166 If the body stalk of *Hydra* is cut transversely into several segments, then in these fragments, tentacles would regenerate

- (A) At the end that was close to the hypostome
(B) At the end that was close to the basal disc
(C) Randomly at either ends of the cut segments
(D) In none of the segments

Q.167 Main function of interstitial cells is

- (A) Replacement of lost cells (B) Excretion
(C) Digestion (D) Defence

Q.168 Organ pipe coral is

- (A) Tubipora (B) Gorgonia (C) Pennatula (D) Meandrina

Q.169 Which animal has been placed in wrong habitat?

- (A) *Hydra vulgaris* – sea water (B) *Hydra gangetica* – fresh water
(C) *Obelia* – Sea water (D) *Physalia* – sea water

Q.170 Which of the following belong to phylum ctenophore?

- (A) Hormiphora (B) Cestum (C) Beroe (D) All of these

Q.171 Which of the following are triploblastic, acoelomate with blind sac type of body plan and parenchyma cells originating from mesoderm fill up the cavities of the body?

- (A) Cnidarians (B) Platyhelminthes (C) Annelids (D) Arthropoda

Q.172 In platyhelminthes, the excretory organs are

- (A) Nephridia (B) Nephrons (C) Flame cells (D) Archeocytes

Q.173 Tapeworm is placed in a class

- (A) Cestoda (B) Trematoda (C) Sporozoa (D) Turbellaria

Q.174 Which one of the following stages in the life history of liver fluke infects the sheep?

- (A) Miracidium (B) Redia (C) Cercaria (D) Metacercaria

Q.175 The correct sequence of various larvae in liver fluke is

- (A) Miracidium, sporocyst, cercaria, redia, metacercaria.
(B) Miracidium, sporocyst, redia, cercaria, metacercaria
(C) Sporocyst, redia, miracidium, cercaria, metacercaria
(D) Cercaria, sporocyst, redia, miracidium, metacercaria

Q.176 Branched uterus containing fertilized capsules can be seen in tapeworm in

- (A) Lammture proglottid (B) Mature proglottid
(C) Gravid proglottid (D) Lammediately below neck

Q.177 The mature proglottids having fertilized eggs in uterus of tapeworm are regularly detached. This process is known as

- (A) Apolysis (B) Proliferation (C) Strobilation (D) Topolysis

Q.178 *Taenia saginata* from *Taenia solium* in

- (A) Absence of scolex hooks
(B) Scolex devoid of hooks and difference in secondary host
(C) Absence of scolex hooks and presence of both male and female reproductive organs
(D) Presence of scolex hooks

Q.179 Fluke occurring in human beings is

- (A) *Fasciolopsis* (B) *Fasciola* (C) *Dugesia* (D) Male *Ascaris*

Q.180 *Schistosoma* is known as

- (A) Blood fluke (B) Chinese liver fluke (C) Dog tapeworm (D) Lung fluke

Q.181 Ladder like nervous system, with ventral nerve chord is present in

- (A) Cnidaria (B) Platyhelminthes (C) Annelida (D) Arthropoda

Q.182 The larva of *Taenia solium* is

- (A) Cysticercus (B) Megascolex (C) Planula (D) Ephyra

Q.183 Alimentary canal is absent in

- (A) Planaria (B) Tapeworm (C) Blood fluke (D) Liver fluke

Q.184 Male *Ascaris* differs from female in having

- (A) Lips (B) Amphids (C) Pineal spicules (D) Tail

Q.185 The epidermis of *Ascaris* is

- (A) Multicellular (B) Syncytial (C) Columnar (D) Cuboidal

Q.186 A free living roundworm is

- (A) *Enterobius* (B) *Rhabditis* (C) *Dracunculus* (D) *Trichinella*

Q.187 The commonest worm in children is

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

Q.188 Which is the infective stage of *Ascaris* for man?

- (A) First larval stage (B) Second larval stage (Rhaditiform larva)
(C) Encysted egg (D) Adult

Q.189 What name is given to the condition of testis in *Ascaris*?

- (A) Monodelphic (B) Didelphic (C) Monorchic (D) Alarctic

Q.190 Filariasis is caused by

- (A) *Wuchereria* (B) *Ancylostoma* (C) *Trichinella* (D) *Enterobius*

Q.191 Anal itching is caused by

- (A) Female *Ancylostoma* (B) Male *Ancylostoma*
(C) Female *Enterobius* (D) Male *Enterobius*

Q.192 The alternate / intermediate host of Guinea worm is

- (A) Fish (B) Dog (C) Cyclop (D) Domesticated animals

Q.193 Blisters are produced on the body due to infection of worm called

- (A) *Trichinella* (B) *Dracunculus* (C) *Wuchereria* (D) *Echinococcus*

Q.194 Leech belongs to the class

- (A) Polychaeta (B) Oligochaeta (C) Hirudinea (D) Archiannelida

Q.195 Aphrodite (sea mouse) belongs to glass

- (A) Hirudinea (B) Oligochaeta (C) Archiannelida (D) Polychaeta

Q.196 Parapodia for locomotion are found in one of the following

- (A) Earthworm (B) Hirudinaria (C) Nereis (D) Polygordius

Q.197 In earthworm, the function of chloragogen cells is

- (A) Excretion (B) Reproduction (C) Digestion (D) Regeneration

Q.198 A temporary clitellum occurs during the breeding season in

- (A) *Pheretima* (B) *Heteronereis* (C) *Hirudinaria* (D) *Aphrodite*

Q.199 The septal and pharyngeal nephridia open into alimentary canal and are of enteronephric type. It is an adaption for

- (A) Conservation of water (osmoregulation) (B) Conservation of heat
(C) Regulation of temperature (D) Regulation of amino acids

Q.200 Blood of *Pheretima* is

- (A) Blue with haemocyanin in corpuscles (B) Blue with haemocyanin in plasma
(C) Red with haemocyanin in corpuscles (D) Red with haemocyanin in plasma

Q.201 *Hirudinaria* shows locomotion by

- (A) Looping (B) Swimming (C) Both (1) and (2) (D) Creeping

Q.202 In earthworm, fertilisation occurs in

- (A) Oviduct (B) Spermathecae (C) Clitellum (D) Cocoon

Q.203 One of the following is considered as a connecting link between annelida and arthropoda

- (A) *Peripatus* (B) *Limulus* (C) *Balanoglossus* (D) *Sphenodon*

Q.204 *Peripatus* breathes by

- (A) Skin (B) Gills (C) Trachea (D) Book lung

Q.205 Respiration in mollusca takes place by

- (A) Body surface (B) Gills or ctenidia (C) Pulmonary sac (D) All of these

Q.206 A fold of dorsal body wall which covers the visceral mass in molluscs, is called as

- (A) Operculum (B) Mantle (C) Shell (D) None of these

Q.207 The only segmented mollusca is

- (A) *Neopilina* (B) *Teredo* (C) *Nautilus* (D) *Chiton*

Q.208 Which of the following is terrestrial gastropod?

- (A) *Limax* (B) *Unio* (C) *Sepia* (D) *Octopus*

Q.209 Pearls are produced by

- (A) *Mytilus* (B) *Doris* (C) *Pecten* (D) *Ostrea*

Q.210 The larva which is characteristic of gastropoda is

- (A) Glochidium (B) Auricularia
(C) Trochophore and veliger (D) None of these

Q.211 *Octopus* is commonly called

- (A) Cuttle fish (B) Devil fish (C) Hag fish (D) Silver fish

Q.212 Buccal cavity of gastropods contains a special rasping organ called

- (A) Dental plate (B) Tongue (C) Radula (D) Osphradium

Q.213 When chased by an enemy, a cloud of black ink is emitted by

- (A) *Nautilus* (B) *Pila* (C) *Loligo* (D) *Patella*

Q.214 The colour change in cephalopods occurs due to

- (A) Internal secretions (B) Chromatophores (C) Ink sac (D) Mantle

Q.215 *Sepia* and octopus are marine animals and their swift locomotion in water is effected by

- (A) Adhering with the help of suckers to another moving animals
(B) Characteristic undulation of their lateral fins
(C) Lashing movement of their cephalic arms
(D) Expelling water in a jet through siphon

Q.227 A spider spins the web by means of a secretion of

- (A) Abdominal glands (B) Salivary glands (C) Thoracic glands (D) Mouth

Q.228 Class Arachnida is characterised by

- (A) A pair each of pedipalpi and chelicerae (B) Four pairs of legs
(C) Both (A) and (B) (D) Three pairs of legs

Q.229 Diplopods (e.g. millipeda) differ from Chilopods (eg. centipede) in

- (A) Occurrence of two pairs of legs on each abdominal segment
(B) Presence of pedipalpi
(C) Presence of chelicerae
(D) Tracheal system of respiration

Q.230 Mouth parts of cockroach are of

- (A) Cutting type (B) Biting and chewing type
(C) Siphoning type (D) Lapping type

Q.231 An insect without mandibles is

- (A) *Musca* (B) *Apis* (C) *Anopheles* (D) *Blatta*

Q.232 Which if the following is *Holometabolous*?

- (A) Silver fish (B) Gypsy moth (C) Bed Bug (D) Grasshopper

Q.233 Tick mark the wrong match

- (A) Housefly – Grub (B) Mosquito – Wiggler (C) Beetle – Grub (D) Butterfly – Caterpillar

Q.234 Maggot is

- (A) Larva of *Anopheles/Culex* (B) Pupa of Housefly
(C) Larva of Housefly (D) Larva of Dragonfly

Q.235 *Pasteruella pestis* (casual agent of Bubonic Plague) is transmitted by

- (A) Bed bug (B) Rat flea (C) Louse (D) Mosquito

Q.236 Which of the following is ametabolous?

- (A) Silver fish (B) Gypsy moth (C) Bed Bug (D) Grasshopper

Q.237 Life history of cockroach belongs to

- (A) Ametabola (B) Hemimetabola (C) Paurometabola (D) Holometabola

Q.238 An insect without pupa stage is

- (A) Mosquito (B) Silk moth (C) Bed bug (D) Butterfly

Q.239 Silk thread is obtained from silk moth during

- (A) Cocoon stage (B) Larval state (C) Nymph state (D) Adult state

Q.240 In housefly, the mouth parts are specialised for

- (A) Sponging liquid food (B) Blood sucking (C) Chewing (D) Sucking flower juice

Q.241 Housefly feeds on sugar by

- (A) Crushing its crystals and then sucking the powder
(B) Crushing and eating
(C) Sucking
(D) Dissolving in saliva and sucking

Q.242 Metamorphosis of insects is regulated through

- (A) Haemolymph (B) Thyroxine (C) Ecdysone (D) All of these

Q.243 Kala-azar and Oriental sore are spread by

- (A) Housefly (B) Bed bug (C) Sand fly (D) Fruit fly

Q.244 Yellow fever and dengue haemorrhagic fever is transmitted by

- (A) *Culex* (B) *Aedes* (C) *Anopheles* (D) *Bed bug*

Q.245 Adult *Culex* and *Anopheles* can be distinguished with the help of

- (A) Mouth parts/ colour (B) Sitting posture (C) Antennae/wings (D) Feeding habits

Q.246 In which of the following group of animals larvae are bilaterally symmetrical and the adult are radially symmetrical?

- (A) Molluscs (B) Cnidarians (C) Echinoderms (D) Platyhelminthes

Q.247 Which of the following statement is incorrect for echinoderms?

- (A) The most distinctive feature of echinoderms is the presence of water vascular system, which is a part of the coelom
(B) The main function of water vascular system is locomotion and the capture of food
(C) Echinoderms have no proper excretory system
(D) They have well developed circulatory system

Q.248 Echinoderms are closely related to chordates due to following characters

- (A) Tube within tube type of body plan, developed along deuterostomic evolutionary line
(B) They have enterocoelom
(C) They have mesodermal endoskeleton
(D) All of these

Q.249 Tick mark the wrong match

- (A) Sea lily – Crinoidea (B) Brittle star – Ophiuroidea
(C) Sea urchin – Echinoidea (D) Sea cucumber – Asteroidea

Q.250 Which of the following is incorrect match?

- (A) Asterias – Bipinnaria larva (B) Holothuria – Auricularia larva
(C) Antedon – Doliolaria (D) Echinoidea – Trochophore

Q.251 Which of the following is the common ancestral larva of chinoderms, hemichordates and chordates?

- (A) Trochophore (B) Dipleura (C) Pluteus (D) Nauplius

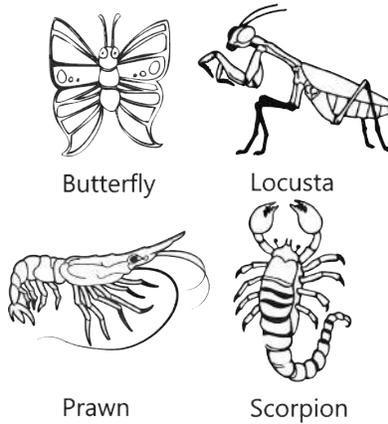
Q.252 Aristotle's lantern (masticatory apparatus) is found in

- (A) Sea urchin (B) Asterias (C) Ophiothrix (D) Sea anemone

Q.253 Which phylum includes exclusively marine no parasitic forms of animals?

- (A) Porifera (B) Cnidaria (C) Molluscs (D) Echinoderms

Q.262 The illustration below shows four animals. Use the illustration to answer the question that follows:



What type of respiratory organ and number of antennae do they possess? Choose the correct options:

Butterfly	Locusta	Prawn	Scorpion
(A) Tracheal system, one pair of antennae.	Tracheal system one pair of antennae.	Book gills, two pairs of antennae.	Book lungs antennae absent.
(B) Tracheal system one pair of antennae.	Tracheal system one pair of antennae.	Gills, two pairs of antennae.	Book lungs antennae absent.
(C) Tracheal system one pair of antennae.	Tracheal system two pairs of antennae.	Book lungs, two pairs of antennae.	Book gills antennae absent.
(D) Tracheal system two pairs of antennae.	Tracheal system one pair of antennae.	Gills, one pair of antennae.	Book lungs one pair of antennae.

Q.263 Millipedes and centipedes differ in that millipedes

- (A) Are terrestrial and segmented (B) Have one pair of legs on each segment
(C) Have poisonous fangs (D) Are herbivores

Q.264 A Portuguese man of war (*Physalia*) and a *Hydra* are similar in that both

- (A) Are colonial (B) Contain medusas and polyps
(C) Are hydrozoans (D) Produce planulae

Q.265 Base your answer to question on the dichotomous key below:

	Key of simple animal phyla	
(i)	Cells are not organised into tissues cells are organised to form tissues	Phylum W 90 to 2
(ii)	Tissues are not organised into organs. Tissues are organised into organs.	Phylum X 90 to 3
(iii)	The body does not have a body cavity. The body has a body cavity	Phylum Y 90 to 4
(iv)	The body cavity is not true coelom.	Phylum Z

What is the name of phylum W, X, Y and Z?

	W	X	Y	Z
(A)	Protozoa	Cnidaria	Platyhelminthes	Aschelminthes
(B)	Coelenterata	Ctenophora	Platyhelminthes	Aschelminthes
(C)	Porifera	Cnidaria	Platyhelminthes	Aschelminthes
(D)	Porifera	Ctenophora	Aschelminthes	Platyhelminthes

Previous Years' Questions

Q.1 Which one of the following animals lack tissue or organ level of organization ?

(Orissa JEE 2007, UPCPMT 2009)

- (A) Sponges (B) Nematodes (C) Trematodes (D) Annelids

Q.2 Fresh water sponge is

(HP PMT 2007)

- (A) *Euplectella* (B) *Spongilla* (C) *Euspongia* (D) *Cliona*

Q.3 Sponges are mostly

(Orissa 2007)

- (A) Biradial (B) Bilateral (C) Radial (D) Asymmetrical

Q.4 Flagellated choanocytes is the characteristic of the phylum

(HP PMT 2010)

- (A) Porifera (B) Cnidaria (C) Ctenophora (D) Platyhelminthes

Q.5 Which one of the following statements about all the four of Spongilla, Leech, Dolphin and Penguin is correct ? **(CBSE PMT Prelims 2010)**

- (A) Penguin is homoeothermic while the remaining three are poikilothermic
- (B) Leech is a fresh water form while all others are marine
- (C) Spongilla has special collared cells called choanocytes, not found in the remaining three
- (D) All are bilaterally symmetrical

Q.6 Which is the only phylum in the kingdom Animalia without any nerve cell ? **(AMU 2012)**

- (A) Porifera
- (B) Coelenterata
- (C) Annelida
- (D) Nematoda

Q.7 Which of the following is concerned with asexual reproduction ? **(Chandigarh CET 2012)**

- (A) Gemmules
- (B) Gametes
- (C) Gonads
- (D) Genitalia

Q.8 Gemmule formation is a characteristic feature of **(HP PMT 2012)**

- (A) *Euglena*
- (B) *Hydra*
- (C) *Amoeba*
- (D) Water sponges.

Q.9 Ephyra is the larva and a stage in the life cycle of **(AFMC 2009)**

- (A) Sea anemone
- (B) *Obelia*
- (C) *Aurelia*
- (D) *Physalia*

Q.10 Find the odd example **(Karnataka CEET 2007; UP CPMT 2008)**

- (A) Sea lily
- (B) Sea fan
- (C) Sea cucumber
- (D) Sea urchin

Q.11 Absence of circulatory system in *Hydra* is compensated by **(UPCPMT 2007)**

- (A) Pseudocoelomic fluid
- (B) Gastrovascular cavity
- (C) Presence of tentacles
- (D) None of these

Q.12 Polyp phase is absent in **(UPCPMT 2008)**

- (A) *Hydra*
- (B) *Aurelia*
- (C) *Physalia*
- (D) *Obelia*

Q.13 Highest degree of polymorphism is found in **(J&K CET 2008)**

- (A) Protozoa
- (B) Cnidaria
- (C) Platyhelminthes
- (D) Arthropoda

Q.14 Digestion in *Hydra* is **(AK CET 2008)**

- (A) Intercellular (B) Intracellular (C) Both (A) & (B) (D) None of these

Q.15 "Primitive nervous system" is formed in **(UPCPMT 2009)**

- (A) Sponge (B) Cnidarian (C) Echinodermata (D) Annelida

Q.16 Which of the following animals belongs to phylum Coelenterata? **(HP PMT 2011)**

- (A) Spa horse (B) Sea hare (C) Sea pen (D) Sea cucumber

Q.17 Asexual reproductive structure of *Hydra* is **(HP PMT 2011)**

- (A) Gemmules (B) Buds (C) Conidia (D) None of the above

Q.18 Match the following and choose the correct option. **(Kerala PMT 2012)**

1.	<i>Physalia</i>	i	Sea anemone
2.	<i>Meandrina</i>	ii	Brain coral
3.	<i>Gorgonia</i>	iii	Sea fan
4.	<i>Adamsia</i>	iv	Portuguese man-of-war

- (A) 1 - iii, 2 - ii, 4 - iv (B) 1 - iv, 2 - iii, 3 - ii, 4 - i (C) 1 - iv, 3 - iii, 4 - i
(D) 1 - ii, 2 - iii, 4 - iv (E) 1 - i, 2 - ii, 4 - iv

Q.19 Comb plates are found in **(J&K CET 2008)**

- (A) *Adamsia* (B) *Aurelia* (C) *Neries* (D) *Pleurobrachia*

Q.20 Bioluminescence is well marked in **(AFMC 2009)**

- (A) Flatworms (B) Ctenophores (C) Cnidarians (D) Aschelminthes

Q.21 Which of the following is not the character of *Taenia solium*? **(UPCPMT 2007)**

- (A) Apolysis (B) Proglottid (C) Metamerism (D) Strobila

Q.22 In which of the following organisms, self-fertilisation is seen? **(KCET 2007)**

- (A) Fish (B) Roundworm (C) Earthworm (D) Liver fluke

Q.23 The intermediate host of *Schistosoma* is **(UP CPMT 2008)**

- (A) Snail (B) Mosquito (C) Housefly (D) Sheep

Q.24 *Fasciola hepatica* is **(AFMC 2008)**

- (A) Hermaphrodite, self fertilizing (B) Hermaphrodite, cross fertilising
(C) Unisexual (D) Both (A) and (B)

Q.25 Excretory structures of Platyhelminths are **(BHU 2008)**

- (A) Gills (B) Flame cells (C) Nephridia (D) Tracheae

Q.26 Circulatory system is absent in **(Chandigarh CET 2010)**

- (A) Annelids (B) Flatworms (C) Arthropods (D) Cephalopods

Q.27 One example of animals having a single opening to the outside that serves both as Mouth as well as anus is **(CBSE PMT Prelims 2010)**

- (A) *Octopus* (B) *Asterias* (C) *Ascidia* (D) *Fasciola*

Q.28 *Ascaris* is characterized by the **(CBSE 2008)**

- (A) presence of neither true coelom nor metamerism
(B) presence of true coelom but absence of metamerism
(C) presence of true coelom and metamerism (metamerisation)
(D) absence of true coelom by presence of metamerism

Q.29 Which one of the following kinds of animals are triploblastic? **(CBSE PMT Prelims 2010)**

- (A) Flat worms (B) Sponges (C) Ctenophores (D) Corals

Q.30 Which one of the following statements about certain given animals is correct?

(CBSE PMT Prelims 2010)

- (A) Round worms (Aschelminthes) are pseudocoelomates
(B) Molluscs are acoelomates
(C) Insects are pseudocoelomates
(D) Flat worms (Platyhelminthes) are coelomates

Q.31 Filarial worm is transmitted by **(Chandigarh CET 2012)**

- (A) Mosquito (B) Tsetse fly (C) Sand fly (D) Kissing bug

Q.40 Which is not correctly matched? **(Pb. PMT 2008)**

- (A) Annelida - Enterocoelomate (B) Arthropoda - Schizocoelomate
(C) Platyhelminthes - Acoelomate (D) Nematelminthes - Pseudocoelomate

Q.41 (A) It is fresh water metamerically segmented protostome **(EAMCET (AP) 2009)**

- (1) The clitellum is absent (2) It is unisexual
(3) Its larval form is Trochophore (4) The nervous system is found in the epidermis

Which of the above is true of 'Paddle worm'?

- (A) 1, 2 and 5 (B) 2, 3 and 5 (C) 2, 3 and 4 (D) 3, 4 and 5

Q.42 A pair of male genital pores in earthworm are present on the ventro-lateral sides of the **(Chandigarh CET 2009)**

- (A) 14th segment (B) 18th segment (C) 10th segment (D) 15th segment

Q.43 Which of the these statements are wrong? **(Kerala CEE 2011)**

- I. Parapodia are lateral appendages in arthropods used for swimming.
II. Radula in molluscs are structures involved in excretion.
III. Aschelminthes are dioecious.
IV. Echinoderm adults show radial symmetry.
V. Ctenophorans are diploblastic.

- (A) I and II (B) I and III
(C) I, IV and V (D) III and V (E) II, III and IV

Q.44 Specialized chemoreceptors located on the anterior part of earthworms are **(Kerala PMT 2012)**

- (A) Heat receptors (B) Photo receptors
(C) Taste receptors (D) Pressure receptors (E) Auditory receptors

Q.45 Which one of the following groups of three animals each is correctly matched with their characteristic morphological feature? **(CBSE 2008)**

Animals Morphological feature

Animals	Morphological feature
(A) Centipede, Prawn, Sea urchin	Jointed appendages
(B) Scorpion, Spider Cockroach	Ventral solid central nervous system
(C) Cockroach, Locust Taenia	Metameric segmentation
(D) Liver fluke, Sea anemone, Sea cucumber	Bilateral symmetry

Q.46 Name one disease of mulberry silk worm caused by Protozoa an (*Nosema bombycis*)

(Karnataka 2009)

- (A) Pebrine (B) Graseri (C) Flacheri (D) Mascardine

Q.47 In which of these animals antenna gland functions as excretory organ?

(Kerala PMT 2008)

- (A) Human being (B) Cockroach (C) Planaria (D) Prawn
(E) Earthworm

Q.48 A dorsal horn is present on the of mulberry silk worm (caterpillar).

(Karnataka CET 2009)

- (A) 5th abdominal segment (B) 2nd thoracic segment
(C) Head (D) 8th abdominal segment

Q.49 Book lungs are respiratory organs of

(AFMC 2009)

- (A) Mollusca (B) Mammals (C) Arachnida (D) Earthworm

Q.50 Worker bees are

(UPCPMT 2009)

- (A) Sterile females
(B) Fertile females
(C) When queen is absent then act as fertile females
(D) Sterile drones

Q.51 Which of the following have the highest number of species in nature?

(CBSE AIPMT 2011)

- (A) Insects (B) Birds (C) Angiosperms (D) Fungi

Q.52 Which one of the following species of bees is used for the commercial production of honey?

(AMU 2012)

- (A) *Apis dorsata* (B) *Apis indica* (C) *Apis florea* (D) *Apis mellifera*

Q.53 In cockroaches, digestive juice is secreted by the **(Kerala PMT 2012)**

- (A) Gizzard (B) Malpighian tubules (C) Hepatic caeca (D) Oesophagus

Q.54 Excretion in prawn is performed by **(HP PMT 2012)**

- (A) Protonephridia (B) Malpighian tubules (C) Mushroom gland (D) Green gland

Q.55 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.56 Which of the following are correctly matched with respect to their taxonomic classification?

(NEET 2013)

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

Q.57 One of the representatives of Phylum Arthro poda is **(NEET 2013)**

- (A) Pufferfish (B) Flying fish (C) Cuttlefish (D) Silverfish

Q.58 Which of the following animal belongs to the phylum molluscs? **(AMU 2012)**

- (A) Devil fish (B) Dog fish (C) Silver fish (D) Jelly fish

Q.59 In which one of the following, the genus name, its two characters and its phylum are not' correctly matched, whereas the remaining three are correct? **(CBSE PMT Prelims 2012)**

Genus	Two characters	Phylum
(A) <i>Asterias</i>	(i) Spiny skinned (ii) Water vascular system	Echinodermata
(B) <i>Sycon</i>	(i) Pore bearing (ii) Canal system	Porifera
(C) <i>Periplaneta</i>	(i) Jointed appendages (ii) Chitinous exoskeleton	Arthropods
(D) <i>Pila</i>	(i) Body segmented (ii) Mouth with Radula	Molluscs

Q.60 It can regenerate entire alimentary canal. **(Gujarat CET 2007)**

- (A) Fish (B) Bird (C) Amphibians (D) Sea cucumber

Q.61 Find the odd example. **(Karnataka CET 2007)**

- (A) Sea fan (B) Sea lily (C) Sea urchin (D) Sea cucumber

Q.62 The radial symmetry is' observed in **(Kerala PMT 2007)**

- I. Platyhelminthes II. Coelenterates III. Aschelminthes'
IV. Annelids V. Echinoderms

The correct statements are

- (A) II, III and V only (B) I, II, III and V only (C) II, III and I only
(D) I, III and V only (E) II and V only

Q.63 In which of these following phyla, the adult shows radial symmetry, while the larva shows bilateral symmetry? **(Kerala PMT 2008)**

- (A) Annelids (B) Arthropods (C) Molluscs
(D) Echinoderms (E) Porifera

Q.64 Water vascular system is characteristic of **(Chhatisgarh PMT 2009)**

- (1) Protozoa (2) Porifera (3) Annelida (4) Echinodermata

ANSWER KEY**Objective Questions**

Q.1 B	Q.2 C	Q.3 A	Q.4 B	Q.5 C	Q.6 D
Q.7 B	Q.8 C	Q.9 A	Q.10 D	Q.11 B	Q.12 C
Q.13 A	Q.14 B	Q.15 C	Q.16 C	Q.17 A	Q.18 A
Q.19 C	Q.20 C	Q.21 B	Q.22 D	Q.23 A	Q.24 B
Q.25 D	Q.26 D	Q.27 D	Q.28 A	Q.29 D	Q.30 C
Q.31 C	Q.32 B	Q.33 A	Q.34 B	Q.35 B	Q.36 C
Q.37 D	Q.38 B	Q.39 C	Q.40 A	Q.41 C	Q.42 D
Q.43 C	Q.44 D	Q.45 C	Q.46 B	Q.47 A	Q.48 C
Q.49 D	Q.50 B	Q.51 C	Q.52 A	Q.53 B	Q.54 D
Q.55 D	Q.56 A	Q.57 D	Q.58 C	Q.59 D	Q.60 C
Q.61 C	Q.62 A	Q.63 D	Q.64 C	Q.65 A	Q.66 B
Q.67 B	Q.68 C	Q.69 A	Q.70 B	Q.71 D	Q.72 D
Q.73 D	Q.74 D	Q.75 A	Q.76 B	Q.77 D	Q.78 B
Q.79 D	Q.80 D	Q.81 B	Q.82 D	Q.83 B	Q.84 C
Q.85 C	Q.86 A	Q.87 B	Q.88 B	Q.89 A	Q.90 C
Q.91 D	Q.92 C	Q.93 C	Q.94 A	Q.95 B	Q.96 C
Q.97 B	Q.98 B	Q.99 A	Q.100 B	Q.101 C	Q.102 C
Q.103 C	Q.104 C	Q.105 A	Q.106 C	Q.107 D	Q.108 C
Q.109 B	Q.110 A	Q.111 C	Q.112 B	Q.113 B	Q.114 B
Q.115 A	Q.116 C	Q.117 A	Q.118 C	Q.119 A	Q.120 A
Q.121 C	Q.122 B	Q.123 B	Q.124 B	Q.125 B	Q.126 A
Q.127 C	Q.128 D	Q.129 A	Q.130 A	Q.131 D	Q.132 D
Q.133 A	Q.134 D	Q.135 D	Q.136 C	Q.137 C	Q.138 C
Q.139 C	Q.140 C	Q.141 C	Q.142 B	Q.143 B	Q.144 B
Q.145 C	Q.146 A	Q.147 D	Q.148 B	Q.149 A	Q.150 A

Previous Years' Questions

Q.1 A	Q.2 B	Q.3 D	Q.4 C	Q.5 A	Q.6 A
Q.7 D	Q.8 C	Q.9 B	Q.10 B	Q.11 B	Q.12 C
Q.13 B	Q.14 A	Q.15 C	Q.16 B	Q.17 C	Q.18 D
Q.19 B	Q.20 C	Q.21 D	Q.22 A	Q.23 D	Q.24 B
Q.25 B	Q.26 D	Q.27 A	Q.28 A	Q.29 A	Q.30 A
Q.31 A	Q.32 D	Q.33 B	Q.34 C	Q.35 C	Q.36 E
Q.37 C	Q.38 D	Q.39 A	Q.40 C	Q.41 B	Q.42 A
Q.43 C	Q.44 B	Q.45 A	Q.46 D	Q.47 D	Q.48 C
Q.49 A	Q.50 D	Q.51 C	Q.52 D	Q.53 A	Q.54 A
Q.55 D	Q.56 A	Q.57 D	Q.58 D	Q.59 A	Q.60 D
Q.61 D	Q.62 D	Q.63 D	Q.64 D		