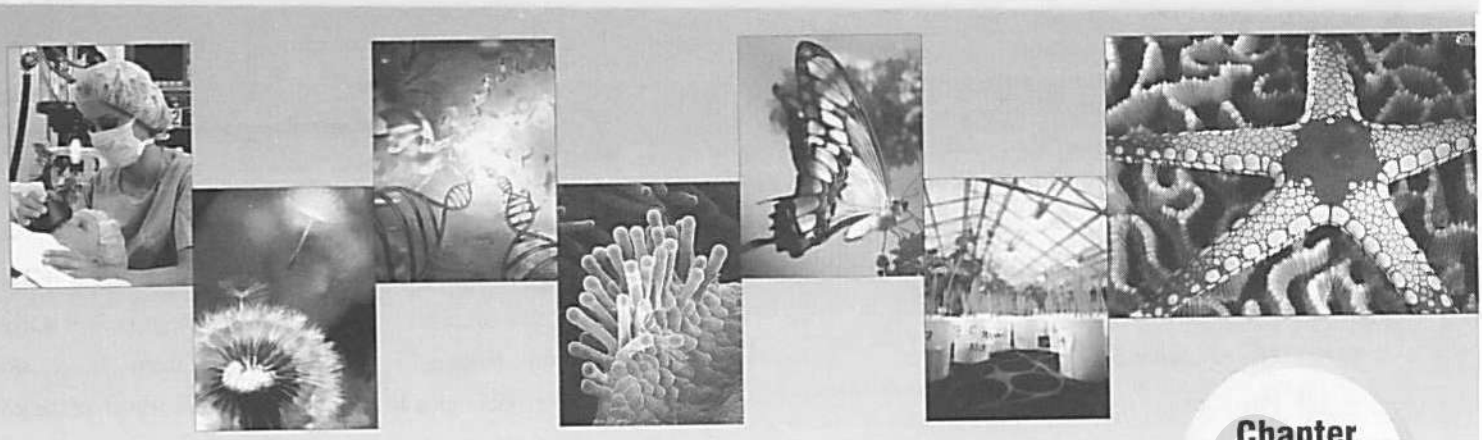


Chapter

1.7

Animal Kingdom

Important terms and Classification of animals

The kingdom animalia or animal kingdom is the kingdom of consumer organisms having ingestive type of nutrition. It is the largest kingdom, with 1.2 million members. It has numerous organisms having different type of form, structure, organisation, complexity and development.

General features of animals

The animals possess several general features which taken together, distinguish them from the members of other kingdom.

(1) Animals are multicellular eukaryotes and in most cases their body cells form tissues that become arranged as organs and organ systems.

(2) Animals have heterotrophic mode of nutrition. They get carbon and energy by ingesting other organism or by absorbing nutrients from them. Animals may be herbivores, carnivores, omnivores, parasites, suspension feeders or deposit feeders.

(3) Animals require oxygen for aerobic respiration.

(4) Animals are motile, possess active movement during some stage of their life cycle. Even the sessile sponges have free swimming larval stages.

(5) The animal body cells of nearly all species have diploid chromosome number.

(6) Animal cells lack a cell wall; this provides flexibility to their cells, the most striking characteristic of animals.

(7) Animals are able to make rapid responses to external stimuli as a result of the activity of nerve cells, muscle or contractile tissue or both.

(8) Animals can reproduce sexually. Although some exhibit remarkable diversity of reproductive behaviour, all are capable of sexual reproduction.

(9) Animal life cycle includes stages of embryonic development. Mitotic cell divisions (cleavage) transform the animal zygote into a multicellular embryo.

Terms related to classification

(1) **Anaima :** Animals without red blood e.g., sponges, cnidaria, mollusca, arthropoda, echinodermata, etc.

(2) **Enaima :** Animals with red blood *e.g.*, vertebrates.

(3) **Vivipara :** Animals which give birth to young ones are included in this subgroup *e.g.*, man, dogs, cows, etc.

(4) **Ovipara :** Animals which lay eggs are included in this subgroup *e.g.*, frogs, toads, lizards, snakes, birds, etc.

(5) **Anamniotes :** Vertebrates without embryonic membranes *e.g.*, fishes, amphibians.

(6) **Amniotes :** Vertebrates with embryonic membranes (chorion, amnion, allantois, yolk sac) *e.g.*, reptiles, birds, mammals.

(7) **Acraniata or Protochordata :** Chordates without cranium (brain box). It includes urochordata and cephalochordata.

(8) **Chordates :** Animals with notochord dorsal tubular nerve cord, paired pharyngeal gill slits. All urochordates, cephalochordates and vertebrates are called chordates.

(9) **Craniata or Vertebrate :** Chordates with cranium. It includes cyclostomes, pisces, amphibians, reptiles, birds and mammals.

(10) **Nonchordates :** Animals without notochord (a rod like elastic structure which supports the body). Phylum Porifera to phylum Hemichordata are called nonchordates.

(11) **Invertebrates :** Animals without vertebral coloumn (backbone). All the nonchordates, urochordates and cephalochordates are collectively called invertebrates.

(12) **Levels / Grades of organization :** Four levels of organization are found in multicellular animals.

(i) **Acellular or Molecular or Protoplasmic level :** It is present in protozoans.

(ii) **Cellular level :** The body consists of many cells which may be similar or show minor division of labour. Distinct tissues are not formed, *e.g.*, sponges.

(iii) **Tissue level :** The body is multicellular. The cells form poorly defined tissues. The cells occur in two distinct layers or tissues of specialized cells *e.g.*, coelenterates.

(iv) **Organ-system level :** The body is multicellular. The cells are organised into tissues, tissues into organs and organs into organ systems. Except sponges and coelenterates, all the animals of the kingdom animalia have organ-system level of organization.

(13) **Animal body plans :** It have three types of body plans :

(i) **Cell aggregate plan :** The body consists of a cluster or aggregation of cells which have rudimentary differentiation but are not organized into tissues or organs. It is found in sponges.

(ii) **Blind sac plan :** The body has a single cavity which function as digestive tract and coelom both and have one opening to the outside. The single opening functions as both mouth for ingestion (intake of food) and anus for egestion (undigested waste is passed out) such a digestive tract is called incomplete animals having blind sac body plan show tissue grade body organisation. The cells are specialized, organised into tissues and show division of labour. It is found in coelenterates and flatworms.

(iii) **Tube-within-a-Tube plan :** The body has two tubes, one formed by the body wall and the second formed within it by the digestive tract. Digestive tract is a continuous tube-like structure that has two opening, a mouth for ingestion and anus for egestion such a digestive tract is called complete. In between two tubes is present coelom in which are present a number of organs. Food is digested and absorbed in the digestive tract. This type of body plan is found in Aschelminthes upto chordates.

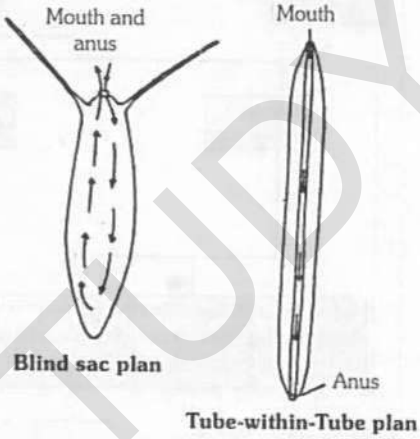


Fig : 1.7-1 Types of body plan

(14) **Animal symmetry :** Body symmetry is the similarity of parts in different regions and directions of the body. When the body is not divisible into equal halves by any plane it is called asymmetrical or asymmetric as found in *Amoeba* and some sponges. An animal is said to be symmetrical if its body is divisible into equal halves by one or more planes. Four types of symmetry found in animals are –

(i) **Spherical symmetry :** In this type of symmetry, any plane passing through the centre divides the body into equivalent or mirrored, halves. It is found in animals whose body resembles a sphere. e.g., Protozoans such as *Volvox*, *Heliozoa*, *Radiolaria*.

(ii) **Radial symmetry :** In this type of symmetry, a number of similar parts radiate out from a central axis. The body of the individual can be divided into equal halves by any plane passing through the centre from top to bottom. This type of symmetry is found in some sponges (*Sycon*), coelenterates (*e.g.*, *Hydra*, jelly fish), echinoderms (*e.g.*, star fish).

(iii) **Biradial symmetry :** In this type of symmetry, only two planes passing through the longitudinal axis. The body can be divided into two similar halves by one or two vertical planes only. This type of symmetry is found in sea walnuts (phylum ctenophora) and sea anemones (Anthozoa). The animals which show radial and biradial symmetry have oral and aboral sides. The oral sides is that which has mouth, whereas the aboral side is one which is opposite to oral side.

(iv) **Bilateral symmetry :** In this type of symmetry, the body can be divided into two equal halves by a median longitudinal or sagittal plan only. The appearance of bilateral symmetry in animal evolution was a major advancement, because bilateral animals are much better fitted for directional (forward) movement than in radially symmetrical animals. This type of symmetry is found in many invertebrates and all vertebrates.

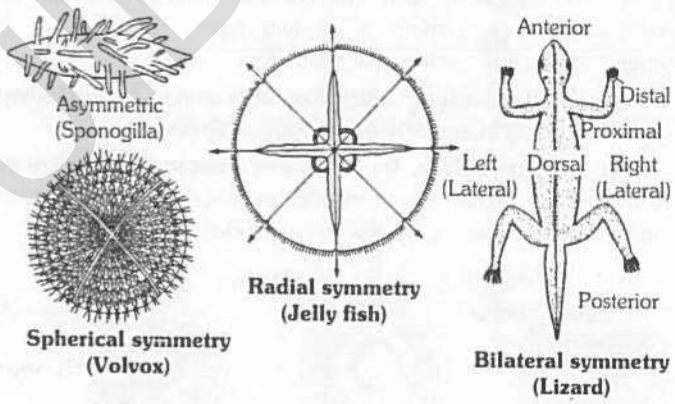


Fig : 1.7-2 Types of symmetry

(15) **Germ layers :** They are primary layers of cells which differentiate in the animal embryos at the gastrulation stage. The germ layers give rise to all the tissues/organs of the fully formed individual. The embryos of poriferans and coelenterates have two germ layers, the ectoderm and endoderm. These animals are called diploblastic. The embryos of all other animals (from phylum Platyhelminthes to phylum Chordata) have three layers – the ectoderm, mesoderm and endoderm. These animals are called triploblastic animals.

(16) **Segmentation :** Segmentation is a type of body form having a linear sequence of units of segments possessing a similar or modified structure. It occurs in three animal phyla–Annelida, Arthropoda and Chordata.

(17) **Metameric segmentation (True metamerism or True segmentation) :** It is a type of segmentation where external divisions correspond to internal divisions. The body is often divided both externally and internally into a number of segments (metameres) *e.g.*, annelids. Segmentation is mostly external in arthropods and mainly internal in man and other chordates (vertebrae, body muscles, some blood vessels and nerves).

(18) **Pseudometamerism (False segmentation) :** It is found in tapeworms. In tapeworms, the proglottides (segments of tapeworms) are budded off from the neck, hence this segmentation is called pseudometamerism (pseudosegmentation). It differs from true segmentation of embryonic origin as found in annelids, arthropods and chordates.

(19) **Body cavity or Coelom :** A body cavity or coelom is a fluid-filled space between the gut and the outer body wall of an animal. It contains the major internal organs.

(i) **Acoelomates :** The animals which do not have coelom are called acoelomates *e.g.* sponges, coelenterates, ctenophorans and flat worms.

(ii) **Pseudocoelomates :** The animals which have body cavity, called pseudocoel (false coelom) derived from blastocoel of the embryo are called pseudocoelomates. Round worms (Nemathelminthes) are psuedocoelomates.

(iii) **Eucoelomates (Coelomates) :** The animal which possess true coelom are called eucoelomates or coelomates. The true coelom is a body cavity which arises as a cavity in embryonic mesoderm. In this case, the mesoderm of the embryo provides a cellular lining, called coelomic epithelium or peritoneum, to the cavity. The coelom is filled with coelomic fluid secreted by the peritoneum. True coelom is of two types; schizocoelom or schizocoel and enterocoelom or enterocoel.

(a) Schizocoelom. It develops as a split in the mesoderm sheet. It is found in annelids, arthropods, molluscs.

(b) Enterocoelom. The mesoderm arises from the wall of the embryonic gut archentron or enteron as hollow outgrowths which form this type of coelom. It occurs in echinoderms and chordates.

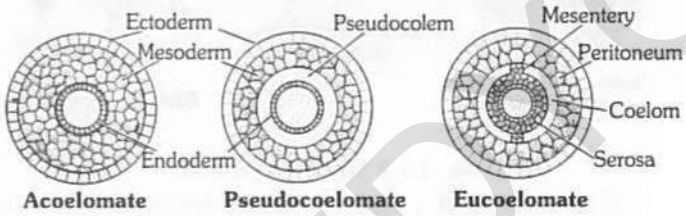


Fig : 1.7-3 Different types of coelom

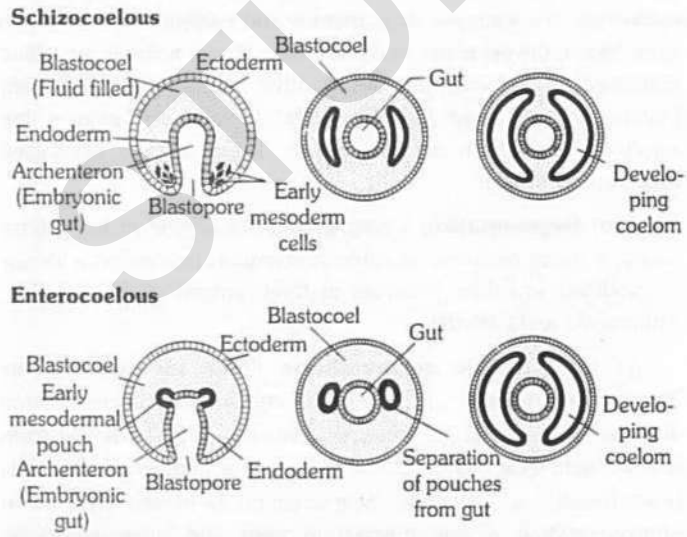


Fig : 1.7-4 Two different types of coelom formation

(iv) **Haemocoelomates :** The primary body cavity or blastocoel persists to some extent in many animals either enclosed within narrow blood vessels as in annelids or open as blood-containing space called a haemocoel and such animals are called haemocoelomates. Haemocoels occur in Mollusca and Arthropoda.

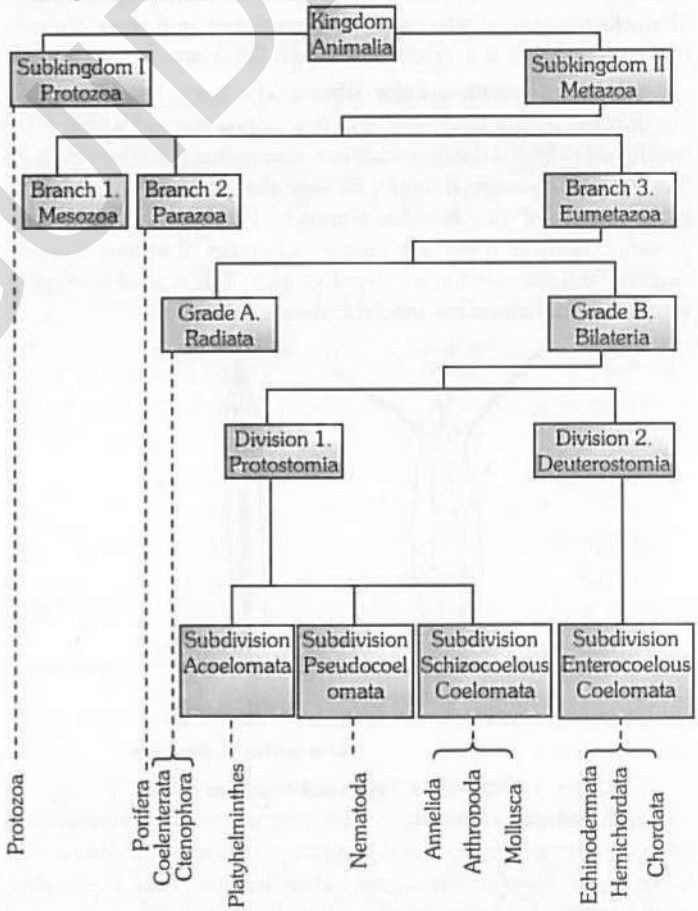
(20) **Protostomes and Deuterostomes :** The terms protostome and deuterostome denote the differences in the embryonic origin of the mouth.

In protostomes (first mouth) the mouth forms from the first opening of the embryo namely blastopore, the opening from outside into the archenteron, cleavage is determinate and spiral e.g. Platyhelminthes, Aschelminthes, Annelida, Arthropoda and Mollusca.

In deuterostomes (second mouth) the mouth never develops from the blastopore, although the blastopore may give rise to the anus cleavage which is indeterminate and radial. e.g. Echinodermata and chordata.

Outline classification of animal kingdom

The animal kingdom is subdivided into two sub-kingdoms, namely Protozoa and Metazoa.



Subkingdom 1. Protozoa : It includes microscopic, unicellular animals. It contains a single Phylum called protozoa. e.g. *Euglena*, *Amoeba*, *Paramecium* etc.

Subkingdom 2. Metazoa : This subkingdom includes multicellular animals. e.g. Porifera to Chordata. The subkingdom Metazoa is divided into three branches, namely Mesozoa, Parazoa and Eumetazoa.

Branch 1. Mesozoa : It is intermediate between Protozoa and Metazoa. It includes endoparasitic animals. e.g. *Dicyema*, *Rhopalura* etc.

Branch 2. Parazoa : It includes sponges.

Branch 3. Eumetazoa : It includes true multicellular organisms. They have tissue organ and organ system grade of organization. e.g. Coelenterata to Chordata. Eumetazoa is further divided into two grades, namely Radiata and Bilateria.

Grade A. Radiata : It includes radially symmetrical animals. e.g. Coelenterata.

Grade B. Bilateria : It includes bilaterally symmetrical animals. e.g. Platyhelminthes to Chordata. The grade Bilateria is further divided into two divisions namely proterostomia and deuterostomia.

Division 1. Protostomia : In this group of animals, the blastopore develops into the mouth. It is further divided into 3 subdivision.

Subdivision 1. Acoelomata : In this group of animals, a coelom (Cavity lying between the gut and the body wall) is absent. e.g. Platyhelminthes

Subdivision 2. Pseudocoelomata : In this group of animals, a false coelom (cavity not lined with coelomic epithelium) is present. e.g. Aschelminthes or Nematoda.

Subdivision 3. Schizocoelous Coelomata : In this group, a true coelom is present. e.g. Annelida to chordata.

Division 2. Deuterostomia : In this group of animals, the blastopore develops into the anus. It consist of one subdivision.

Subdivision Enterocoelous coelomata : Coelom is enterocoel which originates as pouches of embryonic gut (archenteron)

Characters of Non Chordata (Invertebrates) : The animals which lack vertebral coloumn are called invertebrates. e.g. *Amoeba*, sponges, *Hydra*, worms, insects, etc., Invertebrates are characterised by the following salient features –

(1) The vertebral column is absent.

(2) The nerve cord is solid in nature.

(3) The nerve cord is present on the ventral side and never on the dorsal side.

(4) When alimentary canal is present, it lies dorsal to the nerve cord.

(5) Invertebrates may be acoelomate or pseudocoelomate or true coelomate.

(6) They have either asymmetry or radial symmetry or bilateral symmetry.

(7) The circulatory system is open type or closed type.

(8) They exhibit all possible types of reproduction.

The invertebrates are grouped into about 30 phyla. These phyla are of two types, namely minor phyla and major phyla.

Minor phyla : (1) Mesozoa (2) Nemertinea (3) Endoprocta (4) Acanthocephala (5) Rotifera (6) Gastrotricha (7) Kinorhyncha (8) Nematomorpha (9) Ectoprocta (10) Brachiopods (11) Phoronida (12) Chaetognatha (13) Priapulida (14) Sipunculida (15) Echiuroidea (16) Pogonophora etc.

Table : 1.7-1 Major phyla : It include following phylum

Phylum	Some representatives	Existing species
Porifera	Sponges	5,000
Cnidaria	Hydrozoans, jellyfishes, corals, sea anemones	9,000
Ctenophora	Venus's girdle	100
Platyhelminthes	Turbellarians, flukes, tapeworm	13,000
Nemathelminthes	Pinworms, hookworms	15,000
Annelida	Polychaetes, earthworms, leeches	9,000
Mollusca	Snails, slugs, clams, squids, octopuses	60,000
Arthropoda	Crustaceans, spiders, insects	900,000
Echinodermata	Sea, stars, sea urchins	6,000
Chordata	Protochordates (nonverte- brate chordates), vertebrates	2,100
	Fishes	25,600
	Amphibians	3,000
	Reptiles	6,000
	Birds	9,000
	Mammals	4,000

Phylum Porifera : The sponges (pore bearing animals)

(Gk. *Porus* = Pore; *ferre* = To bear)

Brief History : Robert Grant (1825) finally proved that sponges are animals, and coined the name 'Porifera' for these. Schulze (1878), Butschli (1884), Sollas (1884) and Delage (1898) separated sponges from other metazoans on the basis of embryological studies, and suggested a separate group, "Parazoa" for these.

General Characters

(1) All the sponges are aquatic, sedentary, asymmetrical or radially symmetrical. These are the first multicellular organisms and have cellular grade of organization.

(2) They are diploblastic. Ectoderm is formed by pinacocyte and endoderm is formed by choanocyte. Both layers are called pinachoderm and choanoderm. A gelatinous noncellular mesenchyme is present in between them.

Choanocytes (flagellated collar cells) are present only in sponges.

(3) Mesenchyme contains free amoebocytes and skeletal elements.

(4) Different types of amoebocytes are :

Archaeocytes	:	undifferentiated totipotent cells.
Chromocytes	:	with pigment granules.
Thesocytes	:	with reserve food granules.
Myocytes	:	highly contractile, spindle-shaped cells.
Trophocytes	:	supply nutrients to developing cells (nurse cells)
Gland cells	:	secrete slimy substance.
Sex cells	:	develop from archaeocytes only during breeding season.

(5) The body is perforated by numerous minute pores called ostia.

(6) The ostia open into a large cavity called spongocoel or paragastric cavity.

(7) The spongocoel opens to the outside by a large opening called osculum.

(8) Sponges have a canal system and they need a continuous current of water flowing through their bodies for respiration, excretion, nutrition and reproduction.

(9) Different types of canal system in sponges are asconoid, syconoid and leuconoid.

(10) The simplest type of canal system in porifera is asconoid type.

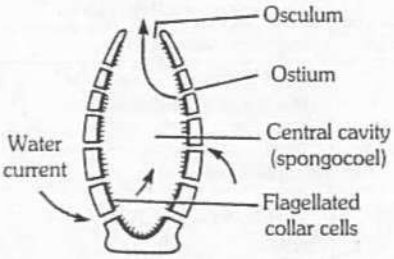


Fig : 1.7-5 Asconoid Type of canal system

(11) The course taken by the water current way be shown as under –

Ingressing water $\xrightarrow{\text{Ostia}}$ Spongocoel $\xrightarrow{\text{Osculum}}$ To outside

(12) The sponges possess an endoskeleton in the form of calcareous spicules, siliceous spicules and spongin fibres.

(13) Excretion and respiration occur by diffusion.

(14) They have greater power of regeneration due to totipotent archaeocytes.

(15) Digestion in sponges is intracellular like protozoans. Digestion takes place in the choanocytes.

(16) All sponges are hermaphrodite, reproduction takes place by asexual or sexual methods.

(17) Gemmules are internal buds containing archaeocytes, mostly found in fresh water sponges, concerned with asexual reproduction.

(18) Development is indirect or direct. The common larval forms are parenchymula (*leucosolenia* and *Clathrina*), amphiblastula (*Sycon*), etc.

Classification of porifera : On the basis of types of endoskeleton, phylum porifera is divisible into three classes

Class 1. Calcarea or Calcispongiae

(1) Skeleton is formed of Calcareous spicules.

(2) Radially symmetrical.

(3) Choanocyte cells are large and conspicuous.

(4) Canal system asconoid (ascon) or syconoid (sycon) type.

(5) These are also known as limy sponges.

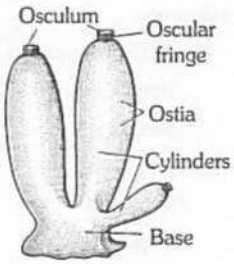


Fig : 1.7-6 *Sycon*

Examples : *Clathrina, Leucosolenia, Sycon, Grantia*, etc.,

❑ *Leucosolenia* is a smallest sponge with asconoid type of canal system.

Class 2. Hexactinellida Or Hyalospongiae

(1) Skeleton is formed of six rayed triaxon, siliceous spicules,

(2) Canal system is branched or unbranched.

(3) Radially symmetrical.

(4) These are also known as glass sponges.

Examples : *Pheronema, Hyalonema, Euplectella*, etc.,

❑ *Euplectella* is the sponge which is given as a Gift in Japan and known as "venus flower basket". It show commensalism with shrimps of the genus spongicola, 'life upto death'.

Class 3. Demospongia

(1) Skeleton either absent or present. When present it is either formed of spongin fibres or combination of spongin fibres and siliceous spicules.

(2) The siliceous spicules when present are never six rayed.

(3) The canal system is complicated Rhagon type or leuconoid type.

(4) Rhagon larva is formed.

(5) These sponges are of great economic importance.

Examples : *Cliona, Spongilla, Chalina, Euspongia, Hippospongia, Oscarella*, etc.,

❑ *Spongilla* is a fresh water sponge.

❑ *Cliona* is harmful to oyster industry.

❑ Spheclospongia is the largest sponge.

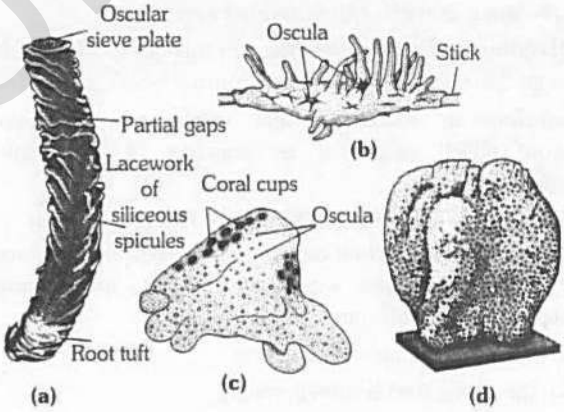


Fig : 1.7-7 Some economically important – sponges
(a) *Euplectella* (b) *Spongilla*
(c) *Cliona* (d) *Euspongia*

Table : 1.7-2 Common Names

Scypha (= Sycon)	–	Urn sponge, Crown sponge
Euplectella	–	Venus' flower-basket
Phyllospongia	–	*Leaf sponge*
Pheronema	–	Bowl sponge
Hyalonema	–	Glass-rope sponge
Cliona	–	Boring sponge
Chalina	–	Mermaids gloves (Dead man's fingers)
Spongilla	–	Freshwater sponge
Euspongia	–	Bath sponge, Horse sponge
Poterion	–	Neptune's goblet
Hippospongia	–	Horse sponge
Hircinia	–	Horny sponge

Phylum-Cnidaria (Coelenterata)

(Gk. *knide* = nettle or stinging cell)

Brief History : Peyssonel (1723) and Trembley (1744) proved these to be animals. Hence, Linnaeus (1758), Cuvier (1796) and Lamarck (1801) included these under 'Zoophyta', together with sponges. Leuckart (1847) included sponges and cnidarians under his phylum Coelenterata. Finally, Hatschek (1888) divided "Coelenterata" into three phyla–Spongiaria (= Porifera), Cnidaria and Ctenophora.

General characters

(1) Coelenterates are radially symmetrical animals with tissue grade of body organization.

(2) All the members of this phylum are aquatic, mostly marine.

(3) They are solitary or colonial, sedentary or free swimming.

(4) The body wall is diploblastic. It is made up of two layers of cells, namely the ectoderm and the endoderm with a non-cellular layer called mesogloea in between.

(5) Cnidarians exhibit dimorphism with polypoid and medusoid stage (Metagenesis or alternation of generation).

(6) Asexual phase is generally polyp and sexual phase is medusa.

(7) Coelom is absent; Hence coelenterates are acoelomate animals.

(8) A gastrovascular cavity or coelenteron is present. It can be compared to the gut of higher animals.

(9) Mouth is present but anus is absent (blind-sac body plan). Mouth is surrounded by tentacles.

(10) The most characteristic feature of coelenterates is the presence of nematocysts or stinging cells.

(11) Digestion is extracellular as well as intracellular.

(12) Respiratory, excretory and circulatory system are absent. Oxygen is carried to various tissues through general body surface by diffusion.

(13) Primitive nervous system with synaptic or non-synaptic nerve net but no brain.

(14) Sense organs are statocysts (tentaculocysts), ocelli and olfactory pits.

(15) Reproduction both asexual and sexual.

(16) Development is indirect as there are one or two larval forms, Planula (*Obelia*) and Ephyra (*Aurelia*).

Classification of coelenterata : On the basis of the dominance of medusoid or polypoid phase in the life cycle, phylum coelenterata is divided into three classes –

Class 1. Hydrozoa (Gr. hydros, water, zoios, animal)

(1) Hydrozoa are solitary and fresh water or mostly colonial and marine, sessile and free-swimming forms.

(2) They exhibit tetramerous or polymerous radial symmetry.

(3) Body wall consists of an outer ectoderm and an inner endoderm separated by a non-cellular gelatinous mesogloea.

(4) Gastrovascular cavity is without stomodaeum, septa or nematocysts bearing gastric filament.

(5) Skeleton or horny structure is horny perisarc in some forms, while coenosarc secretes a skeleton of calcium carbonate forming massive stony structure or coral in other forms.

(6) They exhibit polymorphism. There are two main types of zooids, the polyp and medusa. Medusa is provided with true muscular velum.

(7) Many hydrozoa exhibit alternation of generation.

(8) Reproductive products of sex cells are usually ectodermal in origin and discharged externally.

(9) Cleavage is holoblastic, embryo ciliated planula.

(10) Both polypoid and medusoid stages are present.

Examples : *Hydra, Tubularia, Bougainvillea, Hydractinia, Eudendrium, Pennaria, Obelia, Sertularia, Plumularia, Companularia, Millepora, Stylaster, Geryonia, Physalia, Porpita, Velella, Pericolpa, Periphylla, Cynaea, Rhizostoma or Pilema Cassiopeia*, etc.,

- Obelia is trimorphic and marine colony.
- Hydranth of *obelia* bears twenty four (24) tentacles while medusa bears sixteen (16) tentacles in addition to tentaculocysts.

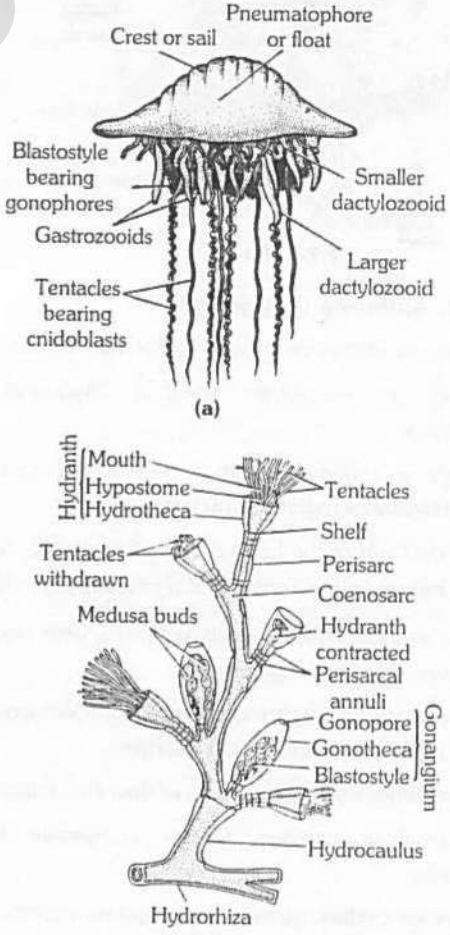


Fig : 1.7-8 (a) Physalia (b) Obelia

Class 2. Scyphozoa (Gr. skyphos, cup, zoios, animal)

(1) Scyphozoa include large jellyfishes or true medusae.

(2) They are exclusively marine.

(3) Medusae are large, bell or umbrella-shaped and without true velum. They are free swimming or attached by an aboral stalk.

(4) Marginal sense organs are tentaculocysts.

(5) Polypoid generation is absent or represented by small polyp, the scyphistoma which gives rise to medusae by strobilization or transverse fission.

(6) Gastrovascular system is without stomodaeum, with gastric filaments and it may or may not be divided into four inter-radial pockets by septa.

(7) Mesogloea is usually cellular.

(8) Gonads are endodermal and the sex cells are discharged into the stomach.

Examples : *Lucernaria, Haliclysus, Aurelia, Rhizostoma, Charybdea, Periphylla, Chrysaora.*

❑ *Rhizostoma* is a polystomous scyphozoan with many mouth bearing structures called scapuletes.

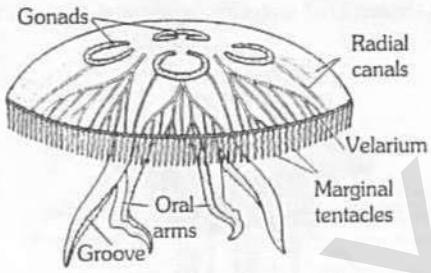


Fig : 1.7-9 *Aurelia*

Class 3. Anthozoa (Actinozoa)

(1) These are solitary or colonial exclusively marine forms.

(2) They are exclusively polypoid. Medusoid stage is altogether absent.

(3) Body is cylindrical with hexamerous, octomerous or polymerous biradial or radiobilateral symmetry.

(4) The oral end of the body is expanded radially into an oral disc bearing hollow tentacles surrounding the mouth in the centre.

(5) The stomodaeum is often provided with one or more ciliated grooves, the siphonoglyphs.

(6) Gastrovascular cavity is divided into compartments by complete or incomplete septa or mesenteries.

(7) Mesenteries bear nematocysts at their free edges.

(8) Mesogloea contains fibrous connective tissue and amoeboid cells.

(9) They are exclusively marine, many forms corals.

Subclass 1. Alcyonaria (Octocorallia)

(1) These are colonial marine forms.

(2) Polyps are long or short cylinders terminating orally into a flat circular oral disc having the oval or elongated mouth in the centre.

(3) Polyps always bear eight pinnate, hollow tentacles.

(4) Eight complete mesenteries are present.

(5) Single ventral siphonoglyph is present

(6) Endoskeleton is the product of mesogloeal cells comprised of calcareous spicules either calcareous or horny in nature.

(7) Polyps are dimorphic in some forms.

Examples : *Tubipora, Clavularia, Alcyonium, Xenia, Heliopora, Gorgonia, Corallium,Testudo,* etc.,

❑ Corals form rocks in the sea, called the coral reefs. The largest coral reef is the great barrier reef which is 1200 miles long and surrounds Australia complete.

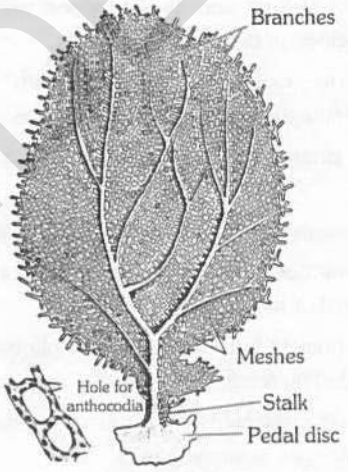


Fig : 1.7-10 *Gorgonia*

Subclass 2. Zoantharia (Hexacorallia)

(1) These are solitary or colonial marine forms.

(2) Tentacles simple, rarely branched, hollow cone shaped, numerous arranged in the multiple of five and six but never eight.

(3) Mesenteries are numerous arranged in the multiple of five or six, may be complete or incomplete.

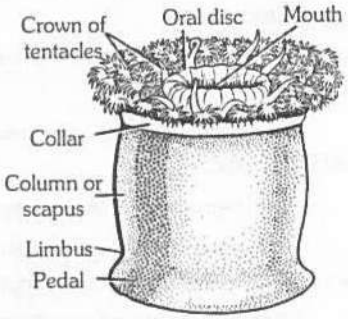


Fig : 1.7-11 *Metridium*

(4) Two siphonoglyphs are commonly present.

(5) Endoskeleton when present is calcareous, derived from ectoderm.

(6) Polyps are usually monomorphic.

Examples : *Actinia, Metridium, Adamsia, Edwardsia, Astraea, Fungia, Zoanthus, Antipathes, Aeropora or Madrepora,* etc.

❑ Metridium shows commensalism with *Eupagurus*.

Some representative animals

Hydra

(1) *Hydra* belongs to class Hydrozoa of phylum coelenterata.

(2) **Trembly** (1744), a Swiss biologist discovered *Hydra*.

Linnaeus (1758) gave the name *Hydra*, a Greek word, means 'Water serpent' based on its ability to regenerate its lost parts.

(3) *Hydra* is a solitary polyp found in freshwater (stagnant). Among coelenterates *Hydra* is one of the smallest polyps.

(4) It is colourless carnivorous coelenterate having radial symmetry.

(5) *Hydra* is diploblastic and has tissue grade of organization with division of labour on morphological basis.

(6) *Chlorohydra viridissima* is called green *hydra*. It is green because of symbiotic association with a unicellular green algae *Chlorella vulgaris*. Algae live in the musculonutritive cells of *Hydra*.

(7) *Hydra* has a cylindrical body with 6-10 hollow tentacles. It helps in locomotion and food capture, so analogous (correspond functionally) to pseudopodia of *Amoeba*.

(8) Mouth is situated on a manubrium or hypostome. It is most sensitive in the body. *Hydra* has no anus.

(9) The body wall of *Hydra* consists of ectoderm and endoderm, in between a thin, delicate, transparent and non-cellular mesogloea.

(10) Ectoderm consists of epithelio-muscular cells, sensory cells, nerve cells, interstitial cells (totipotent) and stinging cells or cnidocytes having nematocysts.

(11) Inner gastrodermis has nutritive muscular cells, gland cells, nerve cells, sensory and interstitial cells. Nutritive muscular cells bear both flagella and pseudopodia.

(12) The contraction of muscle fibres in endothelio-muscular cells or nutritive muscle cells reduces the diameter of the body and works like circular muscles.

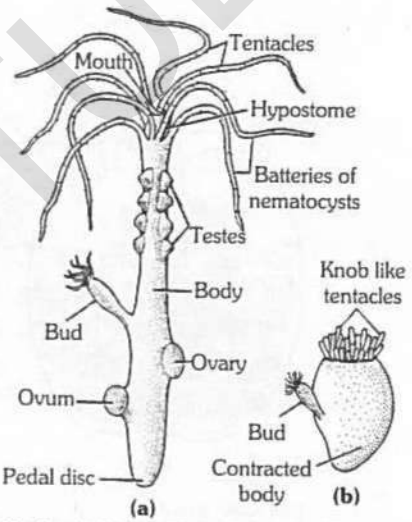


Fig : 1.7-12 *Hydra* (a) Expanded body with bud and gonads (b) Contracted body bearing bud

(13) Mesogloea is thin and acellular consisting of a proteinaceous matrix and it can be crossed by interstitial cells. It is neither cellular nor fibrous.

(14) Cnidoblasts or nematocysts are derived from interstitial cells of epidermis.

(15) Body cavity of *Hydra* is called coelenteron or gastrovascular cavity. Coelenteron serves the double purpose of digestion and circulation.

(16) Nematocysts are found only in epidermis mainly on tentacles. Nematocysts are also known as "independent effectors".

(17) *Hydra* paralyses its prey by nematocyst. If all nematocysts of a *Hydra* are removed it would affect its capacity to capture prey.

(18) Nematocyst plays an important role in locomotion, food capture both offence and defence.

(19) *Hydra* has four types of nematocysts : Penetrants or stenoteles (largest), valvents (smallest), stereoline glutinants (small, atrichous) and streptoline glutinants (large holotrichous)

(20) Digestion in *Hydra* is first extracellular (in gastrovascular cavity) and then intracellular (in endoderm cells).

(21) *Hydra* has no specialized cells for respiration, it respires by means of general body surface.

(22) Nitrogenous excretory product in *Hydra* is ammonia and it is removed through general body surface.

(23) *Hydra* possesses a very primitive nervous system consisting of a synaptic network of bipolar and multipolar nerve cells, but brain is absent.

(24) *Hydra* is monoecious or dioecious. Most species are dioecious or unisexual. Bisexual species of *Hydra* are protandrous, so avoid self-fertilization.

(25) *Hydra* reproduces asexually by exogenous budding, a type of vegetative propagation, and sexually by formation of gametes. *Hydra* reproduces by budding when plenty of food is available.

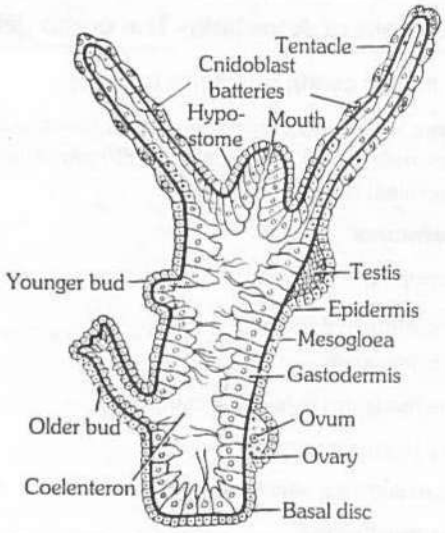


Fig : 1.7-13 Longitudinal section of entire animal

(26) *Hydra* normally possesses a single ovary (in aboral region) and many testes (in oral region).

(27) Fertilization occurs externally on the body by the entry of sperm into ovum.

(28) The developing embryo in *Hydra* drops down from the body of parent after the formation of gastrula.

(29) In the development of *Hydra* there is no moulting or ecdysis.

(30) No free larval stage (only a planula like stage) occurs in *Hydra*.

(31) *Hydra* has great regeneration capacities. A piece of *Hydra* will regenerate into a full *Hydra* if it contains a part of epidermis and gastrodermis and size is not less than 1/6 mm in diameter.

Table : 1.7-3 Common Names

Obelia	–	Sea fur
Millipora	–	Stinging coral
Physalia	–	Portuguese man-of-war
Velella	–	Little sail, Purple sail
Chiropsalmus	–	Sea wasp
Aurelia	–	Jellyfish
Metridium	–	Sea anemone
Adamsia	–	Sea anemone
Pennatula	–	Sea pen
Corallium	–	Precious red coral
Meandrina	–	Brain coral
Tubipora	–	Organ pipe coral
Heliopora	–	Blue coral
Astraea	–	Stony coral
Virgularia	–	Walking stick
Fungia	–	Mushroom coral
Alcyonium	–	Dead man's finger

Phylum-Ctenophora or Acnidaria- The comb Jellies

(Gk. *kteis* = comb; *pherein* = To bear)

Brief History : The ctenophores as a distinct group were first recognized by *Escscholtz* (1829). *Hatschek* (1889) placed it under a separate phylum called ctenophora.

General characters

(1) All the ctenophores are marine.

(2) They are solitary and pelagic.

(3) They are transparent.

(4) They have tissue-grade of organization.

(5) They have biradial symmetry.

(6) They are acoelomate animals.

(7) They are unsegmented.

(8) Their body-wall is diploblastic.

(9) The mesogloea contains cells.

(10) Nematocysts are absent.

(11) Special adhesive cells called colloblasts are present in all ctenophores.

(12) The gastrovascular system is well developed.

(13) Two anal openings are present.

(14) Skeletal system is absent.

(15) Excretion and respiration are carried out by diffusion.

(16) The nervous system is in the form of nerve net.

(17) An aboral sense organ is present in the form of statocyst.

(18) Cilia are used for locomotion.

(19) They are hermaphrodites.

(20) Development is indirect. It includes a cydippid larva.

Classification of Ctenophora

Class 1. Tentaculata

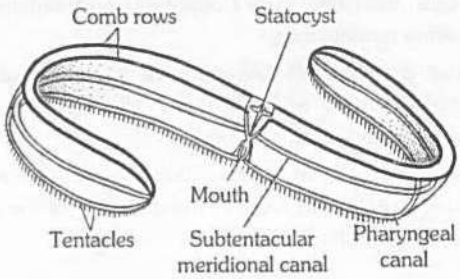
(1) The body is simple, rounded or oval or ribbon-like.

(2) Two long aboral tentacles are present.

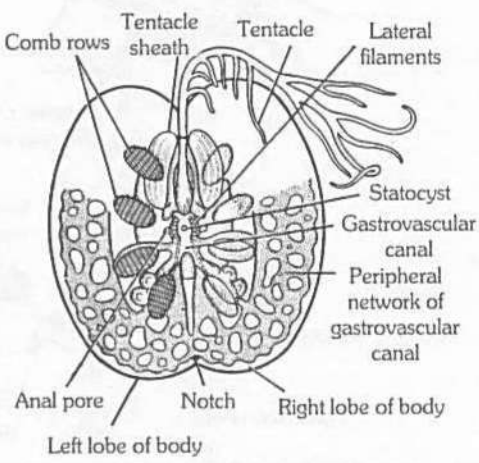
(3) Mouth is narrow and pharynx is small.

Examples : *Pleurobrachia, Hormiphora, Mertensia Mnemiopsis, Bolinopsis, Velamen, Cestum, Ctenoplana, Coeloplana*, etc.

- *Cestum* is commonly called "venus's girdle".
- *Ctenoplana* shows commensallism with *Alcyonea*.



(a)



(b)

Fig : 1.7-14 (a) *Velamen* (b) *Ctenoplana*

Class 2. Nuda

(1) Body is large thimble-shaped or conical.

(2) Tentacles are absent.

(3) Mouth is wide and pharynx is large.

(4) The meridional vessels are produced into a complex system of anastomosing branches.

Example : *Beroe*

❑ *Beroe* is commonly called "Swimming eye of cat".

Phylum Platyhelminthes : The flat worms

(Gk. *platys* = broad or flat; *helmin* = worm)

Brief History : Aristotle mentioned tapeworms, but scientific studies of flatworms began only in the 18th century. It was Gegenbaur (1859) who placed these in a separate group and suggested the present name of the phylum.

General Characters

(1) They are dorso-ventrally flattened like a leaf.

(2) They show organ grade of organization.

(3) They are acoelomate animals. The cavity in platyhelminthes is filled with mesenchyme or parenchyma.

(4) They are triploblastic animals. The cells of the body wall are arranged in three layers.They are the ectoderm, the mesoderm and the endoderm.

(5) They are bilaterally symmetrical animals. The body of the animal can be divided into two equal similar halves through only one plane. Animals with this symmetry have definite polarity of anterior and posterior ends.

(6) Some members have segmented body. The segmentation in platyhelminthes is called pseudometamerism.

(7) Many of the parenchyma cells give rise to muscle fibres.The muscle fibres are arranged in circular, longitudinal and vertical layers.

(8) The digestive system is completely absent from Cestoda and Acoela. The alimentary canal is branched in Turbellarians. The anus is absent from them.

(9) The respiratory organs are absent. In parasites respiration is anaerobic.

(10) There is no circulatory system.

(11) The excretory system is formed of protonephridia (flame cells or solenocytes).

(12) Anus is absent like coelenterates, with blind sac body plan.

(13) The nervous system is well developed. It is formed of longitudinal nerve cords with ganglia. A pair of anterior ganglia form the brain. The longitudinal nerve cords are connected together by transverse connectives.

(14) They are hermaphrodites, *i.e.*, both male and female reproductive organs are present in the same animal.

(15) Fertilization is internal in them. Self or cross fertilization takes place in them.

(16) Their development is direct or indirect. Endoparasites show usually indirect development with many larval stages. Their life cycle is completed in one or two hosts.

(17) They are free living or parasitic. In parasitic worms adhesive organs like hooks, spines, suckers and adhesive secretions are present.

Classification of platyhelminthes : On the basis of digestive tract and free living or parasitic nature phylum platyhelminthes has been divided into three classes –

Class 1. Turbellaria (L. turbella, a string)

(1) Most of the turbellarians are free living but some of them are ecto commensal or parasitic, commonly called planarians or flat worms.

(2) The body epidermis is either cellular or syncytial and covered with cilia. Epidermis contains rhabdites.

(3) Segmentation is absent.

(4) Digestive system is present except in a few.

(5) Suckers are absent.

(6) Life cycle is simple, development direct.

Example : *Dugesia, Notoplana, Bipalium, Thysanozoon*, etc.

❑ *Bipalium* is the only terrestrial planarian.

Class 2. Trematoda (Gr. trema, hole)

(1) Ecto or endoparasites of vertebrates; commonly called flukes.

(2) Body mostly oval, unsegmented.

(3) Body wall without cilia, but covered by a thick, resistant, syncytial tegument.

(4) Suckers, and often hooks and spines, present for attachment to host tissues.

(5) Sense organs usually absent in adults.

(6) Digestive system well developed with terminal mouth, but no anus.

(7) Mostly hermaphrodite. Life cycle simple or complicated.

Examples : *Polystomum, Fasciola, Schistosoma* (blood fluke of man and other mammals), *Opisthorchis*, etc.

❑ *Opisthorchis sinensis* is commonly known as chinese liver fluke of man.

Class 3. Cestoda

(1) All endoparasites. Mostly in alimentary canal of vertebrates; commonly called tapeworms.

(2) Body long and slender, tape-like, usually divided into small segments (= proglottids).

(3) Body wall non-ciliated, with a thick tegument.

(4) Anterior end with suckers and other attachment organs.

(5) No mouth, digestive system absent, digested liquid food is absorbed from host tissues by diffusion through body wall.

(6) Sense organs absent.

(7) Each proglottid contains one or two complete sets of hermaphrodite (bisexual) reproductive organs.

(8) Life-cycle usually complicated with alternation of hosts. Embryo hooked.

Examples – *Taenia, Echinococcus, Hymenolepsis, Diphyllobothrium, Echinococcus, Dipylidium.*

- *Hymenolepsis* is dwarf tapeworm. It is monogenetic tapeworm of man.
- *Dipylidium* is dog tapeworm.
- *Diphyllobothrium* is the largest tapeworms.
- *Echinococcus* is also called hydatid worm. Its hydatid cyst shows exogenous as well as endogenous budding. Parasite of small intestine of dogs, cats, etc. It has only 3-4 proglottids.

Some representative animals

Planaria

(1) *Dugesia* (Planaria) is found commonly in freshwater ponds, lakes, streams and shallow rivers.

(2) Planaria are gregarious, i.e., they live in groups.

(3) The head bears a pair of lateral projections called auricles.

(4) The mouth opens on the mid ventral surface near the middle of the animal.

(5) The pharynx is a tubular structure that can be everted beyond the mouth.

(6) Planarians have remarkable power of regeneration.

(7) If an individual is cut transversely into two parts, the anterior fragment will regenerate a new tail and a posterior piece will develop a new head.

(8) Neoblast cells found in planarians which is help in regeneration.

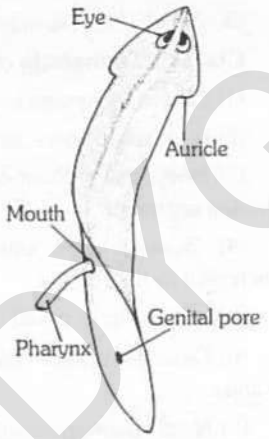


Fig : 1.7-15 *Dugesia* (planaria)

Fasciola hepatica

(1) *Fasciola hepatica*, commonly known as sheep liver fluke is an endoparasite of sheep which reside in the liver and bile duct.

(2) The liver fluke has a dorsoventrally flat, unsegmented body with two suckers, oral sucker (anterior sucker) and acetabulum (ventral sucker).

(3) Liver fluke is covered with a cuticle, lacks ciliated epidermis.

(4) There are three permanent apertures on the body-mouth (surrounded by oral sucker), genital pore (located between the two suckers), excretory pore (At the extreme posterior end). During breeding season a temporary opening, the aperture of laurer's canal is also developed. Laurer's canal is present between the genital aperture and the uterus.

(5) Suctorial pharynx with bifurcated intestine. A large number of caeca or diverticulae arise from each branch of intestine.

(6) Digestion is holozoic. The parasite obtains nourishment from bile, blood, lymph and epithelial cells.

(7) Respiration is anaerobic.

(8) Excretion occurs with the help of flame cells.

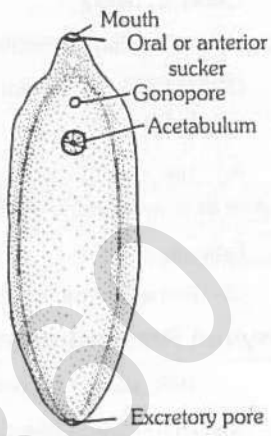


Fig : 1.7-16 *Fasciola hepatica*

(9) *Fasciola* is a digenetic endoparasite. Its primary host is sheep causing 'liver rot' and the secondary or intermediate host is the snail of genus *Limnaea* and *Planorbis.*

(10) *Fasciola hepatica* is a hermaphrodite. Male has a pair of testes and female has an ovary, vitelline gland for yolk formation and mehlis's gland for lubrication.

(11) Fertilization is internal. Cross fertilization commonly occurs.

(12) Different larval stages of *Fasciola hepatica* according to development sequence are : miracidium-sporocyst-Redia-Cercaria-Metacercaria.

(13) Stage in the life cycle of Fasciola when it infects intermediate host (snail) is miracidium and primary host is metacercaria.

(14) Miracidium and cercaria larva are free swimming form in water. Redia and sporocyst are formed in snail.

(15) *Fasciola* exhibits both alternation of generation and alternation of host.

Schistosoma

(1) *Schistosoma* is commonly known as human blood fluke and it is found in the blood vesseles and hepatic portal system of man, cat, pig, dog, etc.

(2) Phenomenon of sexual dimorphism occurs. Thus male and female are separate but they live in close association.

(3) Male is flattened while female is slender. Both possess oral and ventral suckers.

(4) The ventral folding from the male's body forms a groove known as 'Gynaecophoric canal' in which the female individual lives.

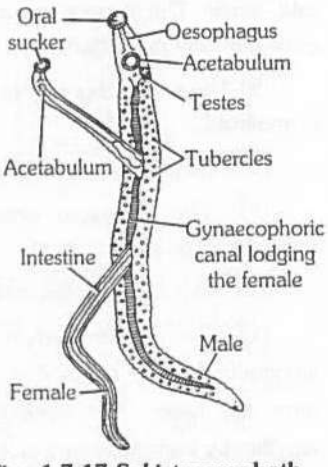


Fig : 1.7-17 *Schistosoma* both male and female

(5) Blood fluke feeds on blood. It respires anaerobically. Excretion occurs with the help of flame cells.

(6) Blood fluke is digenetic, primary host is man and secondary host is snail.

(7) Fertilization is internal. After fertilization the egg develops into miracidium larva which is free swimming. Later on it penetrates snail body and get converted into cercaria larva. The cercaria infect man by penetrating his skin.

(8) Redia and metacercaria stage do not occurs in blood fluke.

(9) Blood fluke causes schistosomiasis or bilharzia.

Taenia solium

(1) *Taenia solium* is commonly known as pork-tape-worm.

(2) Adult tapeworm lives in the small intestine of man (primary host), larval stage in the secondary or intermediate host pig or cattle.

(3) *Taenia solium* possesses elongated ribbon or tape like segmented body (pseudometamerism).

(4) Body is divided into three parts, namely scolex, neck and strobila. Scolex has a rostellum bearing two circles of chitinous hooks and four suckers for holding onto the host. Neck is the region of proliferation of new proglottids. Strobila is long tapering part having large number of proglottids. Proglottids are of three types-young, mature and gravid.

(5) Young or immature proglottids are behind neck without reproductive organs.

(6) Mature proglottids are in the middle having reproductive organs, both male and female.

(7) Gravid proglottids (rectangular in shape) are with branched uterus containing fertilized eggs.

(8) Apolysis is the process of separation of gravid proglottids.

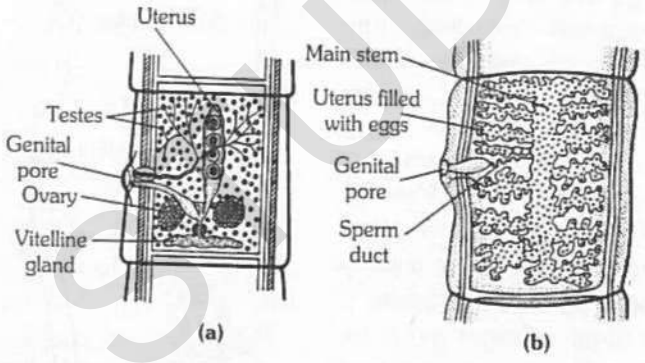


Fig : 1.7-18 (a) Mature proglottid, (b) Gravid proglotid

(9) Body wall lacks a cellular epidermis. It consists of cuticle (parasitic adaptation), musculature and mesodermal tissue called parenchyma.

(10) Digestive system is simple without alimentary canal. Food is absorbed through body surface.

(11) Respiration is anaerobic in *Taenia solium*.

(12) Flame-cells (solenocytes) are excretory in function.

(13) All tapeworms are hermaphrodites, and a complete reproductive system occurs in each mature proglottid. Fertilization is internal, cross type within the same proglottid or between two proglottids of the same strobilla.

(14) The fertilised eggs develop into an embryo that gets covered by a shell. The shelled embyros are called onchospheres. Secondary host pig acquires infection by ingesting the onchospheres. Hexacanth is developed in shell with six hooks.

(15) Hexacanth stage is the infective stage to pig. In the stomach of pig, hexacanth will be released, it goes through blood circulation and on reaching muscles get encysted in the form of bladderworm (cysticercus). Human host gets infection by eating raw or poorly cooked 'measly pork'. Cysticercus is infective stage to man.

(16) Cysticerci in pig muscle can remain viable for several years.

(17) *Taenia saginata* (*Taeniarhynchus saginatus*) is commonly known as 'the beef tapeworm'.

(18) Like *Taenia solium*, it is digenetic, man is the primary host and cattle is the intermediate host.

(19) It is also called 'unarmed tapeworm' because the scolex does not possess hooks.

(20) During infection with taenia necrosis of brain and epilepsy may appear.

(21) The disease caused by bladderworm is known as cysticercosis. Cysticercosis is more dangerous than taeniasis.

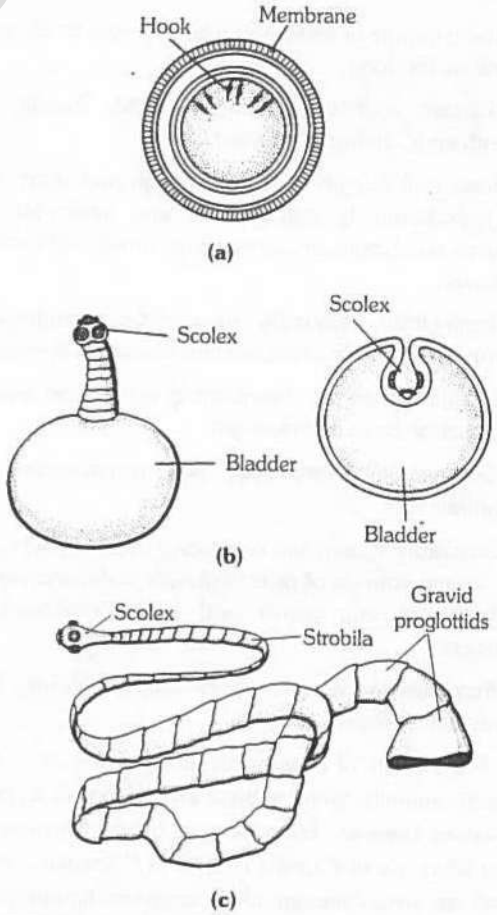


Fig : 1.7-19 Life cycle of *Taenia solium* (a) Onchosphere (b) Bladderworm (Cysticercus) (c) Adult tapeworm

Table : 1.7-4 Common Names

Fasciola hepatica	–	Sheep liver fluke
Fasciola gigantica	–	Cattle liver fluke
Schistosoma mansoni	–	Human blood fluke
Fasciolopsis buski	–	Intestinal fluke
Paragonimus westermani	–	Lung fluke
Taenia solium	–	Pork tapeworm
Taenia saginata	–	Beef tapeworm
Echinococcus granulosus	–	Dog tapeworm

Phylum Aschelminthes (Nemathelminthes)- The round worms

(Gk. *nema* = thread; *helmin* = worm)

Brief History : Ancient people were familiar with certain large-sized nematode parasites of domestic animals. Minute nematodes were discovered only after the invention of microscope. Linnaeus (1758) included these in *"Vermes"* Rudophi (1793, 1819) included these under "Nematoidea" Gegenbaur (1859) ultimately proposed "Nemathelminthes" for these.

General Characters

(1) Many endoparasites of various animals and plants; others free–living and widely distributed in all sorts of water and damp soil.

(2) Mostly minute or small; some large (1 mm to 25 cm); some upto several meters long.

(3) Slender, cylindrical, elongated body usually tapering towards both ends, and unsegmented.

(4) Body wall formed of a thick, tough and shiny cuticle, a syncytial hypodermis beneath cuticle, and innermost layer of peculiar, large and longitudinally extended muscle cells arranged in four quadrants.

(5) Triploblastic, bilaterally symmetrical, pseudocoelomate, false coelom derived from embryonic blastocoel, unsegmented.

(6) Straight alimentary tract terminal mouth and anus. These are first animals to have complete gut.

(7) 'Tube within a tube body' plan, organ-system grade of body organization.

(8) Circulatory system and respiratory organs absent. A simple excretory system consists of protonephridia, comparatively simpler or complicated sensory organs, and a well–developed nervous system present

(9) Reproductive system well–developed. Usually unisexual with sexual dimorphism.

(10) Many kinds of Nematodes are parasites of useful plants and domestic animals. Some of these are pathogenic to their hosts, causing serious diseases. Even man is a host for more than 50 species, of which *Ascaris lumbricoides* and *Enterobius vermicularis* (pin worm) are very common. Other common human nematodes are *Wuchereria* which causes Filaria, *Trichinella* causing trichinosis, and *Ancylostoma* causing hookworm disease.

Classification of Nemathelminthes : On basis of the presence or absence of some specialized sense organs and caudal glands, and characteristics of excretory system, nematodes are classified into two classes –

Class 1. Phasmidia or Secernentea or Rhabditea

(1) Mostly parasitic.

(2) Possess a pair of unicellular, pouch-like sense organs, called phasmids, near hind end of body.

(3) Another pair of reduced, pore–like sense organs, called amphids, present near anterior end.

(4) Excretory system with paired lateral canals.

(5) Caudal glands absent.

Examples – *Ascaris, Enterobius, Ancylostoma, Wuchereria, Trichuris, Trichinella, Dioctophyma, Rhabditis Necator, Gnathostoma, Dracunculus, Loa,* etc.

Class 2. Aphasmidia or Adenophorea or Enoplea

(1) Mostly small, free-living.

(2) No phasmids.

(3) Amphids spiral, cord like or disc like, seldom pore like.

(4) No lateral excretory canals.

(5) Caudal glands present.

Examples : *Enoplus, Dorylaimus, Mermis, Halichoanolaimus, Monohystera, Desmoscolex,* etc.

Some representative animals

Ascaris

(1) *Ascaris lumbricoides,* the common roundworm belong to the class Rhabditea of the phylum Nemathelminthes. It is the most common endoparasite in the small intestine of human beings. It is monogenetic, i.e., without any secondary host. The worm is more common in children.

(2) The body is elongated, unsegmented, cylindrical with tapering ends and four streaks- two lateral, one ventral and one dorsal.

(3) Sexes are separate with sexual dimorphism. Male is smaller than female with curved tail, two penial setae (copulatory organs) and cloaca. Female is with straight posterior end of the body and posterior transverse anus and separate gonopore situated ventrally 1/3 from the anterior end. In both the excretory pore is situated mid-ventrally, a little behind the mouth. Ventral surface of male bears fifty pairs preanal and five pairs postanal papillae. These sensory papillae are absent in female.

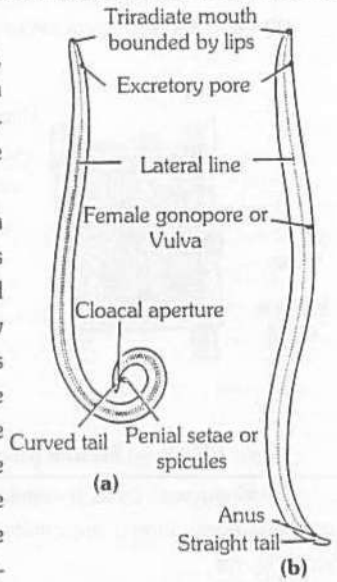


Fig : 1.7-20 *Ascaris*
(a) Male (b) Female

(4) Mouth both in male and female is terminal, triradiate surrounded by three denticulate lips. One median dorsal and two ventrolateral. Dorsal lip bears two sensory double papillae (tangoreceptors). Both sensory papillae and amphids (chemoreceptors) are present on ventrolateral lips.

(5) Body wall consists of outer cuticle, middle epidermis and inner longitudinal muscle layer. Circular layer is absent. Cuticle is thick which protects the body of the parasite from mechanical injury and also resistant to action of digestive enzymes of the host. The epidermis is syncytial (coenocytic) with scattered nuclei and without partition walls.

(6) The body cavity of *Ascaris* is pseudocoel formed by vacuoles originated from persistent embryonic blastocoel.

(7) There is no alimentary canal and digestive gland. The parasite absorbs digested food of the host so their is no need of digestive organs. Absorption occurs through the general body surface. Salivary glands do not occurs in *Ascaris*.

(8) Respiratory system is absent, respiration is anaerobic.

(9) Excretory system is H-shaped. It is consists of a single excretory cell or renette cell. Excretory products are ammonia and urea.

(10) Sense organs are simple like labial papillae, cervical papillae, anal papillae, amphids and phasmids.

(11) *Ascaris* is dioecious or unisexual. Testes is single and median, so male *Ascaris* is monarchic (monodelphic). Only anterior part of testis is functional, so testis (also ovary) is telogonic.

(12) *Ascaris* sperm is peculiar without flagellum, tail less, asymmetrical and amoeboidal.

(13) Female *Ascaris* has paired ovaries so female *Ascaris* is didelphic.

(14) Copulation occurs in the intestine of host. Fertilization in the lower part of uteri. The egg is mammilated, oval, m-shape with three protective covering–outer protein layer, middle chitinous shell and inner membrane made of esterified glycosides.

(15) Embryonic development takes place only outside the body of human host in soil because it requires low temperature, more oxygen and suitable moisture.

(16) Inside the shell the zygote develops into rhabditiform larva or first stage juvenile in 10-14 days.

(17) The larva of first stage is not infective . It rests for a week and completes first moult within egg and becomes second stage rhabditiform larva which is infective.

(18) The transmission of infective stage through embryonated egg takes place by contaminated food and water.

(19) The embryonated egg passes into the intestine of man and second stage larva hatches out from the egg.

(20) Three types of migration by *Ascaris* larva are – primary migration, secondary migration and aberrant migration.

(21) Primary migration is from intestinal wall → hepatic portal → liver → hepatic vein → heart → pulmonary artery → lungs.

(22) Secondary migration is from lungs back to intestine of the host ; lungs → bronchi → trachea → pharynx → gullet → oesophagus → stomach → intestine.

(23) In lungs, larva complete its second and third moulting (becomes third and fourth stage larva). In small intestine it completes fourth or final moulting and becomes fifth stage of larva.

(24) Duration of wandering journey from intestine to intestine is about three weeks. Within 8-10 weeks adult *Ascaris* starts reproduction.

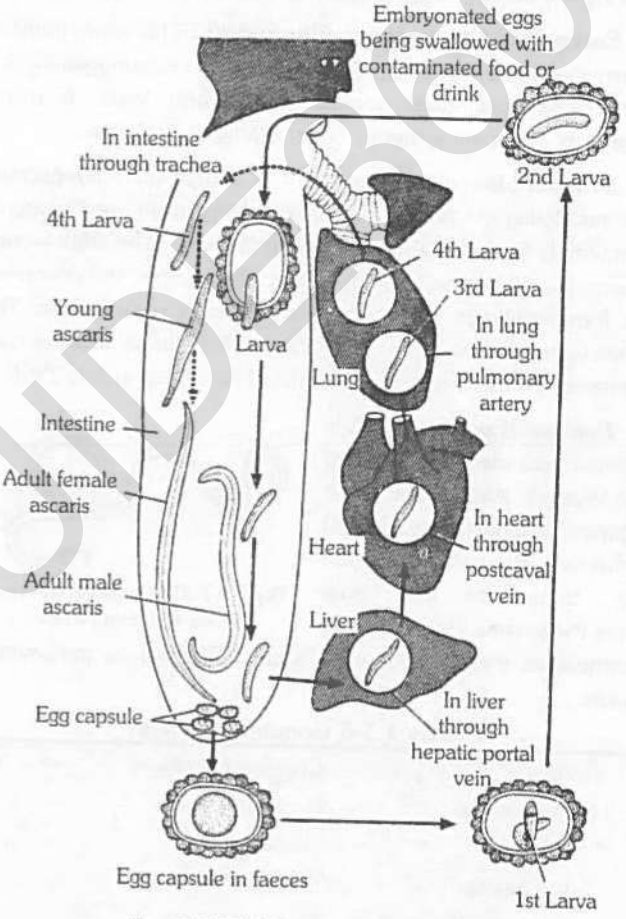


Fig : 1.7-21 Life cycle of *Ascaris*

(25) Aberrant migration is the migration from lungs to brain, spinal cord, eyes, etc.

(26) *Ascaris* is pathogenic. It cause the disease, ascariasis. Most pathogenic larva of *Ascaris* is fourth stage larva.

(27) Main symptoms of ascariasis are – abdominal discomfort, nausea, vomiting, diarrhoea and colic pain.

(28) Toxin produced by *Ascaris* may interfere with protein digestion.

(29) Ascariasis can be treated by antihelminthetic drugs such as oil of Chenopodium, Santonin, Antipar, Tetrachloroethylene, Alcopar, Decaris, Diethylcarbamazine, etc.

Some other nematode parasite :

***Ancylostoma duodenale* :** It is an endoparasite of human small intestine. The parasite is monogenetic. It is popularly called old world hookworm. Adults live in the intestine of man and feed upon blood. No secondary host. Juveniles penetrate through the skin of hand and feet. It causes 'Ancylostomiasis'.

Wuchereria bancrofti **:** It is a digenetic parasite. Human being are primary host while female mosquito mostly of *culex* and *Aedes* species is the secondary or intermediate host.

Adults live in human lymph vessel and lymph glands. It is a viviparous nematode, larvae called 'microfilaria. Larvae appear in cutaneous blood (superficial blood) in midnight. Presence of few worms not harmful. They block lymph glands and lymph vessels, swell body parts like arms, scrotum and mammary glands. This results in the disease 'Elephantiasis' or 'Filariasis'

Enterobius Vermicularis **(Pin worm) :** This worm inhabits human caecum, colon, appendix and rectum. It is monogenetic, no intermediate host. Eggs contain rhabditiform larva. It cause 'Oxyurasis', the main symptom being itching of anal parts.

Dracunculus medinensis **:** It is a digenetic endoparasite with man being the primary host and cyclops as the secondary or intermediate host. It is also called 'Fiery serpent'. The adult worms occur in the subcutaneous tissue, especially of arms, shoulders and legs, forming blisters. Female is very long while male is short. The guinea worm disease has been eradicated from India. The last case was reported from the Jodhpur district of Rajasthan in July 1996.

Loa loa **(Eye worm) :** It is a filarial roundworm of central and Western Africa. The adult migrates through the subdermal connective tissues of human host. Sometimes they pass across the eyeball. Local swelling accompanies these migrations. Tabanid flies act as transmitting vectors.

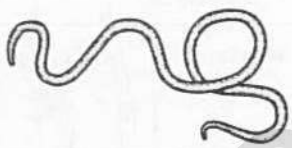


Fig : 1.7-22 Adult eye worm, *Loa loa*, from eye

Table : 1.7-5 Common Names

Ascaris	–	*Common roundworm*
Ancylostoma	–	Hookworm
Necator	–	Hookworm
Wuchereria	–	Filarial worm
Enterobius (Oxyuris)	–	Pinworm
Trichuris	–	Whipworm
Dracunculus	–	Guinea worm
Loa loa	–	Eye worm
Strongyloides	–	Thread worm

Phylum Annelida – The segmented Animals

(L.*annelus* = ring, *eidos* = form)

Brief History : Linnaeus (1758) included all soft-bodied worms in "*Vermes*". Lamarck (1801) established phylum annelida for higher types of worms.

General characters

(1) Annelids are bilaterally symmetrical animals.

(2) They have organ-system grade of organization.

(3) They are coelomate (schizocoelomate) animals.

(4) They have triploblastic body wall.

(5) The muscle layers are thick in the body wall. Hence the body wall is said to be dermomuscular.

(6) The body is divided into a numerous segments called the metameres or somites. The segmentation is known as metamerism.

(7) The body is covered with a thin cuticle.

(8) Locomotory organs are setae.

(9) Digestive system is well developed. These have tube-within-a-tube body plan.

(10) Blood vascular system is a closed type

(11) Excretory system is formed of segmentally arranged nephridia.

(12) These always show cutaneous or skin respiration.

(13) Nervous system is formed of a pair of cerebral ganglia (brain) and a double ventral nerve cord.

(14) Mostly annelids are hermaphrodites. Fertilization is generally cross and may be external or internal.

(15) The gonoducts are formed from coelom (coelomoducts). The coelomoducts have connection with nephridia.

(16) Regeneration is common character in this phylum.

(17) Their development is direct or indirect and includes a free-swimming trochophore larva.

Classification of annelida : On the basis of position and arrangement of setae when present, absence and presence of sense organ, phylum annelida has been divided into four classes –

Class 1. Polychaeta (Gr. polus, many, chaite, hair)

(1) Polychaeta are marine and carnivorous.

(2) Body is elongated and segmented.

(3) Head consists of prostomium and peristomium and bear eyes, tentacles, cirri and palps, etc.

(4) Setae are numerous and are borne upon lateral prominances of the body wall known as parapodia.

(5) Locomotory organs are parapodia.

(6) Clitellum is absent.

(7) Cirri or branchiae or both may be present for respiration.

(8) Coelom is spacious usually divided by inter segmented septa.

(9) Alimentary canal is provided with an eversible buccal region and protrusible pharynx.

(10) Excretory organs are segmentally paired nephridia.

(11) Sexes are separate.

(12) Fertilization is external; free swimming larval stage is trochophore.

(13) Asexual reproduction occurs by budding.

Examples : *Nereis, Aphrodite, Polynae, Chaetopterus, Glycera, Arenicola, Amphitrite, Terebella, Sabella, Eunice,* etc.

❑ *Arenicola, Amphitrite* and *Terebella* have external gills.

❑ *Chaetopterus* exhibits luminescence and great power of regeneration.

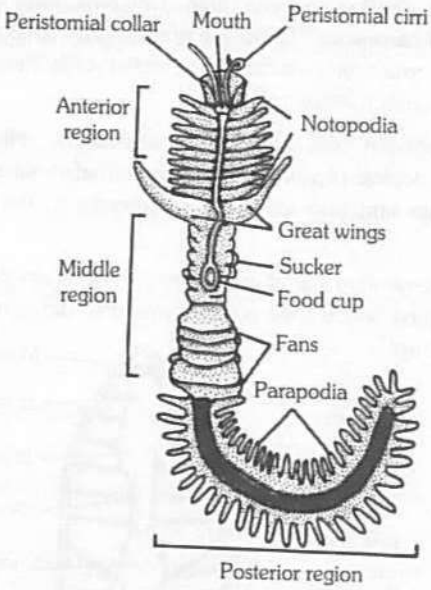


Fig : 1.7-23 *Chaetopterus*

Class 2. Oligochaeta (Gr. oligi, few)

(1) They are mostly terrestrial or some fresh water forms.

(2) Body has conspicuous external and internal segmentation.

(3) Distinct head, eyes and tentacles are absent.

(4) Parapodia are absent.

(5) Locomotory organs are setae.

(6) Setae are usually arranged segmentally.

(7) Clitellum is usually present.

(8) Pharynx is not eversible and without jaws.

(9) They are hermaphrodites.

(10) Development is direct and takes place within cocoons secreted by clitellum.

(11) No free larval stage

Examples : *Tubifex, Dero, Pheretima,* (Indian earthworms), *Lumbricus* (European earthworm).

❑ *Tubifex* and *Dero* are fresh water forms. *Tubifex* can live in polluted water where oxygen availability is poor because its has a large amount of haemoglobin in blood.

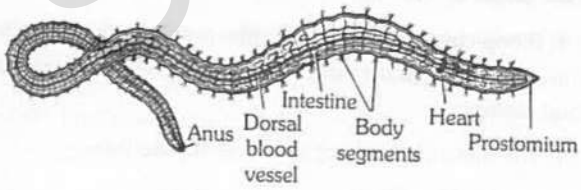


Fig : 1.7-24 *Tubifex*

Class 3. Hirudinea (L. hirudo, a leech)

(1) This class includes mostly ectoparasitic and fresh water forms, while few are marine, feeding upon fishes and other animals.

(2) Body is elongated usually flattened dorso–ventrally or cylindrical.

(3) Body consists or definite number of segments, each segments breaks up into 2 to 4 rings or annuli.

(4) Parapodia and setae are absent.

(5) Body is provided with an anterior and a posterior sucker, both situated ventrally.

(6) Coelom is reduced by botryoidal tissue.

(7) Mouth opens on the ventral surface in the anterior sucker, while anus opens dorsal to the posterior sucker.

(8) Locomotory organs are suckers.

(9) Hermaphrodite *i.e.,* sexes united.

(10) Reproduction sexual. Asexual reproduction is unknown.

(11) Eggs are usually laid in cocoons.

(12) Development is direct without free swimming larval stage.

Examples : *Acantobdella, Glossiphonia* (Fresh water leeches), *pontobdella, Haemodipsa,* etc.

❑ *Haemodipsa* is terrestrial leech.

❑ *Pontobdella* is a ectoparasite on elasmobranchi fishes.

❑ *Acanthobdella* is a ectoparasite of salmon fish.

Class 4. Archiannelida (Gr. archi, primitive)

(1) They are exclusively marine forms.

(2) Body elongated and worm-like.

(3) Setae and parapodia are usually absent.

(4) External segmentation is slightly marked by faint while internal segmentation is marked by coelomic septa.

(5) Prostomium bears two or three tentacles.

(6) Unisexual or hermaphrodite.

(7) Larva is typical trochophore.

Examples : *Polygordius, Protodrillus, Nerilla, Saccocirrus,* etc.

❑ *Polygordius* is a primitive Archiannelid or living fossil.

Some representative animals

Pheretima posthuma

(1) The common Indian earthworm, *Pheretima posthuma* belong to the class oligochaeta of the phylum Annelida. It is found in every part of the world. It lives in damp soil and burrow in lawns, fields, garden etc. rich in humus. Earthworm is nocturnal i.e., active during night.

(2) The generic name *Pheretima* was first used by Kinberg in 1867. Our knowledge of *Pheretima* is mainly due to the work of Karm Narayan Bahl (1926).

(3) Body is cylindrical, bilaterally symmetrical, elongated with metameric segmentation. Earthworm shows both external and internal segmentation. The number of segments is about 100-120, the length is about 150 mm.

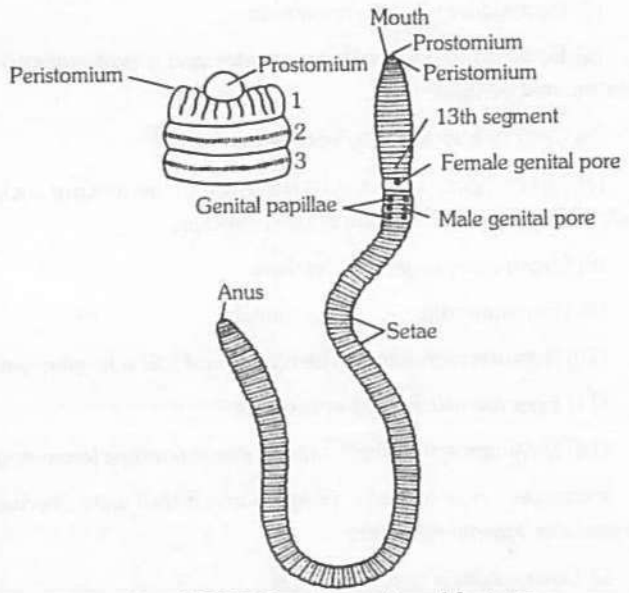


Fig : 1.7-25 *Pheretima* external features

(4) Earthworm is brown or clay-coloured. This is because of the pigment porphyrin. Numerous granules of porphyrin pigment are found scattered in the circular muscle layer of body wall. Porphyrin protects the body from the injurious effects of bright light.

(5) The first segment is peristomium or buccal segment which bears mouth. Anus is located on the last segment.

(6) Three regions in body of earthworm are – Preclitellar region (1 – 13), Clitellar region (14, 15, 16) and Postclitellar region (17 – last).

(7) Nephridiopores of integumentary nephridia 200-250 per segment are found in all segments except the first six. Clitellar segment contains 2000 nephridiopores per segment, so called 'forest of nephridia'.

(8) In the body wall 11 pores are concerned with reproduction. They are – Spermathecal pores in the intersegmental grooves of 5/6, 6/7, 7/8 and 8/9 (4 pairs). Female genital pore midventral on segment 14th. Male genital pores ventrolaterally (1 pair) on segment 18th.

(9) Male genital papillae are present on segments 17 and 19 (2 pairs).

(10) Body wall is dermomuscular, consisting of cuticle, epidermis, muscular layers and coelomic epithelium. Epidermis consists of tall, columnar cells of four types – Supporting cells (major part), Glandular cells (Goblet and albumin), Basal cells and Sensory cells.

(11) All segments except the first, last and clitellar segment contain setae (perichaetine arrangement). Setae are 'S'–shaped, yellowish and chitinous, 80-120 segment. Setae and contraction of muscles help in locomotion.

(12) The body cavity of earthworm is true coelom (schizocoel) as it is formed by the division of mesoderm. The coelom is filled with milky white alkaline coelomic fluid. Coelomic fluid contains different types of carpuscles. These are granulocytes (phagocytes), most numerous mucocytes, circular nucleated cells (leucocytes) and chloragogen cells (yellow cells).

(13) Chloragogen cells are small, star-shaped, yellow cells concerned with storage of reserve food, deamination of proteins, formation of urea and also excretory (analogous to the liver of vertebrates).

(14) The alimentary canal of earthworm is a straight tube, representing a 'tube within tube plan, Location of different part of alimentary canal are –

Buccal chamber : $1-2\frac{1}{2}$

Pharynx : $2\frac{1}{2}-4$

Oesophagus : 5-7

Gizzard : 8

Stomach : 9-14

Intestine : 15 onwards

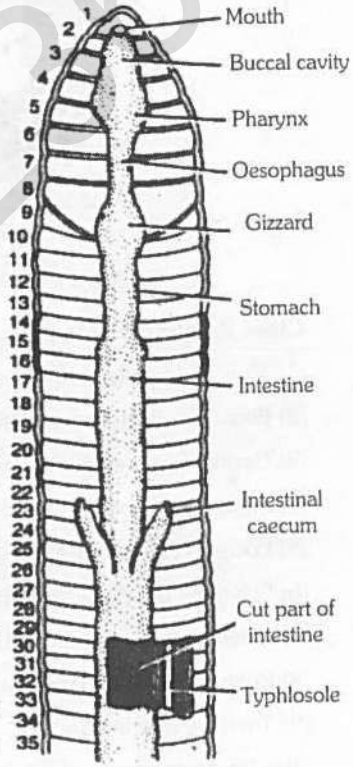


Fig : 1.7-26 Alimentary canal - *Pheretima*

Roof of pharynx contains pharyngeal glands containing chromophil cells secreting mucus and proteases. Gizzard is a thick muscular organ, cavity lined by tough cuticle for grinding. Wall of stomach contains 'calciferous glands' the secretion of which neutralizes the acidity of soil.

(15) Due to presence of typhlosole the intestine is divided into three region – Pretyphlosolar region, typhlosolar region, post typhlosolar region. Intestinal caeca arise from segment 26 and extend forward upto segments 22 or 23.

(16) Typhlosole is a highly glandular, vascular longitudinal ridge increasing the area for absorption of digested food.

(17) Earthworms are omnivorous. Undigested particles as faeces are called as 'casting'.

(18) Blood vascular system of earthworm is closed type. Blood is red in colour, respiratory pigment haemoglobin is dissolved in the blood plasma .

(19) The main longitudinal blood vessels are three –

(i) The dorsal blood vessel

(ii) The ventral blood vessel

(iii) The subneural blood vessel

(20) Important transverse vessels in first 13 segments are –

Lateral hearts (segments 7 and 9), Anterior loops (segments 10 and 11) and, Lateral oesophageal hearts (segments 12 and 13).

(21) Dorsal blood vessel is distributive in segments 1 to 13. Flow of blood in dorsal vessel is from posterior to anterior direction.

(22) Ventral vessel is found below alimentary canal, single, blood flows anterior to posterior direction.

(23) Blood glands are three in number and present on 4th, 5th and 6th segments. These produce blood cells and haemoglobin.

(24) Lymph glands are present on both sides of dorsal blood vessel from segment 26th and those behind it (one pair per segment, small and whitish). Lymph glands are supposed to produce certain phagocytic cells.

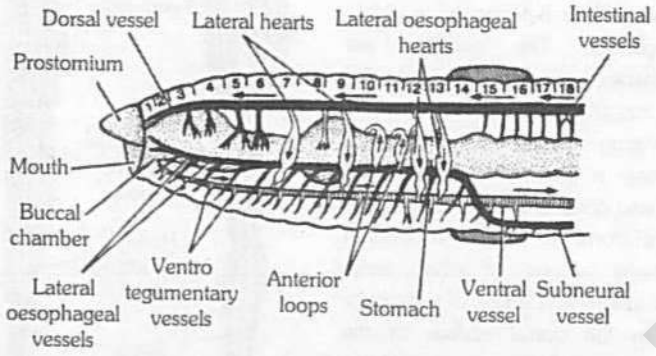


Fig : 1.7-27 Blood vascular system - *Pheretima* (After 13th segments)

(25) Earthworm respires, but has no respiratory organs, exchange of gases takes place through moist skin. The absorptive area of earthworm is more than its volume, so earthworm does not require any respiratory organ. If the skin of the earthworm dries, it cannot respire. it dies due to asphyxia.

(26) Excretory organs of earthworm are segmental nephridia ectodermal in origin, analogous to vertebrate kidney.

(i) Pharyngeal nephridia are situated in the segments 4, 5 and 6. They open in the anterior part of alimentary canal, i.e. buccal cavity and pharynx. They are without nephrostome and are enteronephric type.

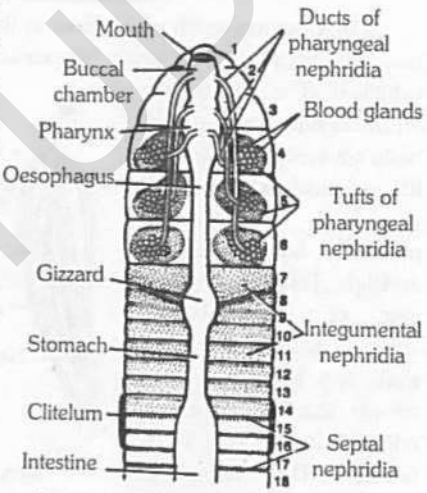


Fig : 1.7-28 Pharyngeal nephridia - *Pheretima*

(ii) Integumentary nephridia are scattered in the body wall. They are smallest, V-shaped without nephrostome and are exonephric type.

(iii) Septal nephridia are the largest, attached to both facees of each intersegment septum behind 15th segment.

(27) Septal nephridia are the only nephridia with nephrostome or funnel. The terminal duct opens into septal excretory canal. Septal nephridia are enteronephric finally excretory products are poured into intestine. Earthworms are mainly ureotelic.

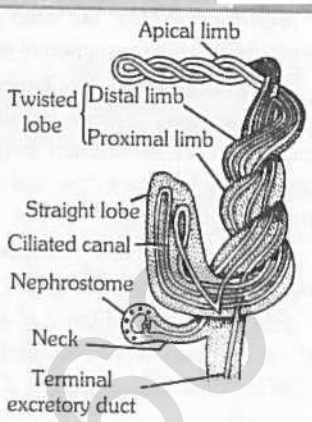


Fig : 1.7-29 Septal nephridium - *Pheretima*

(28) Earthworm has a well developed nervous system; it has a brain but no head. Brain lies above pharynx, made up of a pair of suprapharyngeal (cerebral) ganglia.

(29) Earthworm has no eyes, photoreceptors are used to judge intensity and duration of light, do not have the capacity of vision.

(30) Earthworm are hermaphrodite (monoecious) but fertilization is cross type due to protandrous condition.

(31) In earthworm reproductive system consist of the following organs –

Male organs –	Testes two pairs	(segments 10 and 11)
	Seminal vesicles	(segments 11 and 12)
	Accessory gland	(segments 17 and 19)
	Genital papillae	(segments 17 and 19)
	Male genital apertures	(segments 18)
	Prostate gland	(segments 17-20)
Female organs –	Ovary one pair	(segment 13)
	Female genital pore	(segment 14)
	Spermatheca 4 pairs	(segments 6, 7, 8, 9)

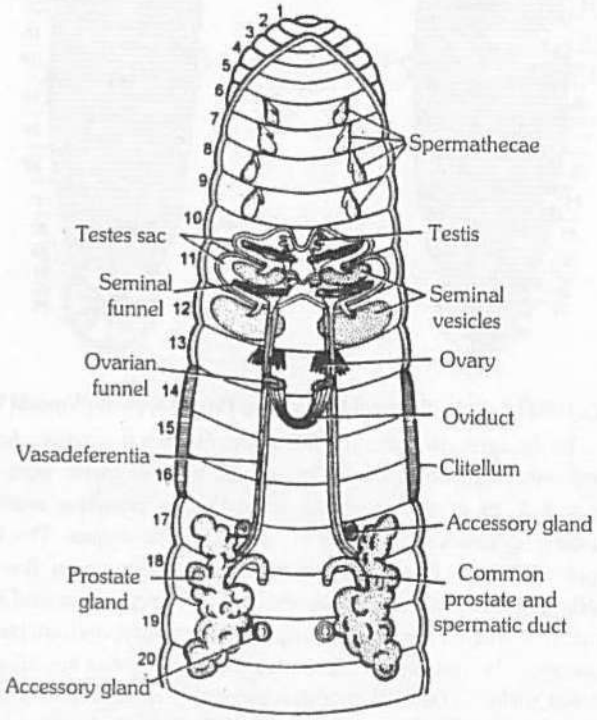


Fig : 1.7-30 Reproductive organs - *Pheretima*

(32) Spermatheca are used to store sperms after copulation (open outside on intersegmental groove 5/6, 6/7, 7/8, 8/9).

(33) Copulation occurs between two earthworms generally at night during rainy season. Fertilization is external and occurs in cocoon. Cocoons are formed by glandular clitellum. A cocoon may contain many fertilized eggs, but only one embryo develops, other eggs serve as nurse cells.

(34) Cleavage is holoblastic and unequal, development is direct without any larval stage.

(35) One of the oldest use of earthworm; it is used as bait for catching fish. Earthworms are friends of farmers because they enrich the soil by nephridial excretion, it increases the fertility of soil.

Hirudinaria granulosa

It is commonly known as Indian cattle leech. It is sanguivorous (feed on blood) segmented animal that live in ponds, streams, rice fields etc. It is ectoparasite on cattle and human. The body is soft, flattened and slimy. The dorsal side is yellowish green while the ventral side is orange. Botryoidal tissue is present in coelomic space.

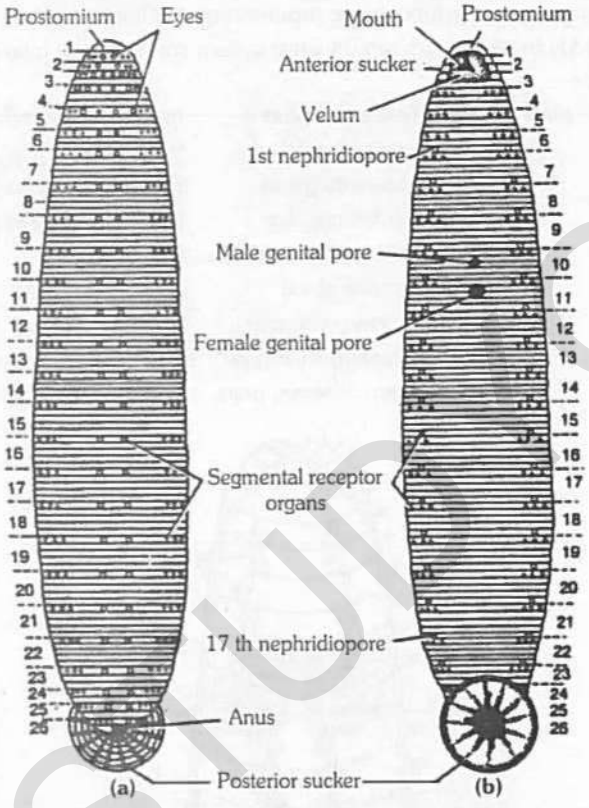


Fig : 1.7-31 *Leech* - External features (a) Dorsal View (b) Ventral View

The body is divisible into 33 segments. Each segment further appear subdivided superficially by annuli. Each segment from 6-22 bear a pair of ventral nephridiopore. During breeding season a temporary clitellum develps on 9, 10 and 11 segments. The leech bears two suckers. The anterior sucker encloses the mouth. It acts as a feeding locomotory and prehensile organ. The posterior end bears a large disc-shaped sucker that helps in locomotion and anchorage. It comprises the last seven uniannulate segments. Anus lies ahead of posterior sucker. Triradiate mouth is present at its bottom. The saliva of the leech contains an anti-coagulant, called hirudin which prevents clotting of blood during blood meal. There are present five pairs of eyes on the dorsal surface. It is hermaphrodite but cross-fertilisation occurs. Development is direct. Prof. M.L. Bhatia has given a detailed morphology of *H. granulosa*.

Nereis

It is commonly called clam worm or sand worm or rag worm which is found on the sea shore in the tubular burrow. *Nereis* is unisexual and its reproductive phase is called *Heteronereis*. Heteroneresis have two regions – epitoke or posterior sexual region and atoke or anterior region without masses of developing gametes. The phenomenon of transformation of nereis into heteronereis is called epitocky. The gametes are liberated through mixonephridia. Fertilization occurs in sea water. During development trochophore larva is present. The prominent head consists of prostomium and peristomium. The prostomium bears a pair of small tactile tentacles and a pair of stout palp. On the dorsal surface of the peristomium there are present two pair of black eyes. Peristomium has four pairs of long tentacles (cirri). Pharynx is everted for ingestion of food. Each segment bears laterally one pair of fleshy projection, the parapodia, used in swimming. The last segment has an anus. The anal segment is devoid of parapodia but bears a pair of elongated anal cirri.

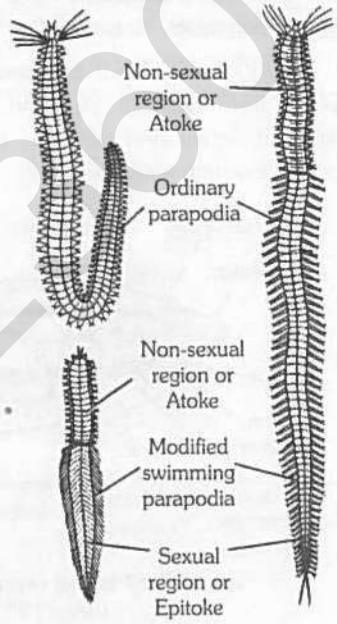


Fig : 1.7-32 *Heteronereis*

Bonellia

It is a marine worm which lives in the crevices of the rocks. It has only traces of segmentation but sexual dimorphism is extremely exhibited. The female has an ovoid and unsegmented body covered with papillae. It is provided with a prostomial bifurcated proboscis homologous to annelids. There is only one pair of large ventral chitinous setae. The male is small and is reduced to a minute size of *Turbellaria* and lives in the body of the female. The larva of *Bonellia* has the potentialities of both male and female. If they develop independently they become females, but if they come in contact with female, they develop into males.

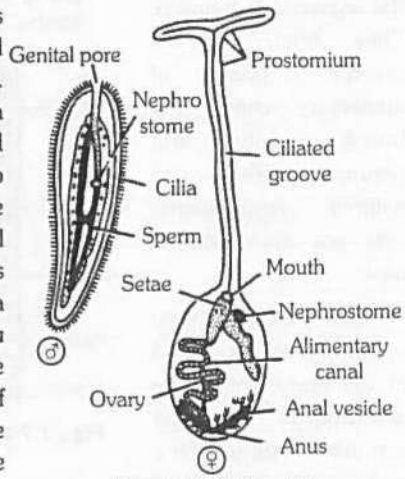


Fig : 1.7-33 *Bonellia*

Aphrodite

The *Aphrodite* is a marine polychaete which is commonly called the 'sea mouse'. It is found burried in the mud or sand or crawling on the sea bed. The body is oval, broad and dorso-ventrally flat and consists of 30-35 metameres. The body is covered with scales or elytra which are modifications of dorsal cirri of parapodia and are respiratory in function. The head is small and consists of a peristomium and a prostomium. The prostomium bears a pair of eyes, a short tentacle and a pair of long palps. During movement the animal changes colour from golden to peacock blue. The animal is commonly found in Atlantic and Mediterranean seas.

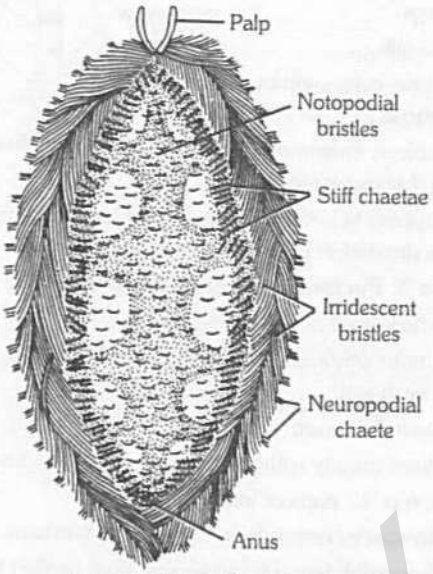


Fig : 1.7-34 *Aphrodite*

Table : 1.7-6 Common Names

Nereis	–	Ragworm
Aphrodite	–	Sea mouse
Polynoe	–	Scale worm
Chaetopterus	–	Paddle worm
Arenicola	–	Lugworm
Glycera	–	Smooth blood worm
Eunice	–	Palolo-worm
Sabella	–	Peacock-worm
Serpula	–	Fan-worm
Pheretima	–	Earthworm
Pontobdella	–	Skate-sucker
Hirudo	–	Medicinal leech
Hirudinaria	–	Cattle leech
Sipunculus	–	Pea-nut worm
Tubifex	–	Blood worm

Phylum Arthropoda – The animals with jointed feet

(Gk. *Arthron* = joint; *Podos* = foot)

Brief History : Aristotle described a few crabs and other arthropods. Linnaeus included all such animals in his group "Insecta". Lamarck divided this group into three classes – Crustacea, Hexapoda and Arachnida. Finally, Von seibold (1845) established the phylum Arthropoda for these animals.

General characters

(1) Occur widely on land, in air, and in all sorts of water, from snowy tops of high mountains to the depths of ocean. Many are parasites of other animals and plants. Hence, the phylum is of great economic importance.

(2) Bilateral, triploblastic, body segmented and also divided into head, thorax and abdomen. Segmentation marked only externally; number of segments or somites fixed and each has its separate exoskeleton of thick and hard, chitinous cuticle secreted by epidermis of body wall. Head somites always fused.

(3) Each segment basically bears a pair of lateral jointed appendages adapted for food ingestion, locomotion, respiration, copulation, etc.

(4) Muscular system well-developed; muscle fibres always striated.

(5) Digestive tract is complete. Most head appendages forms mouth parts with lateral jaws for chewing or sucking. Anus is terminal.

(6) Coelom is reduced to small cavities in excretory and reproductive organs; replaced elsewhere by blood sinuses which merge together to form a large perivisceral cavity – the haemocoel– around viscera. Sinuses form an "open blood vascular system" filled with haemolymph which may contain haemocyanin. Haemocoel communicates with a long tubular and pulsatile, mid–dorsal heart.

(7) Respiration by gills (aquatic forms), or trachea or book lungs (terrestrial forms); by diffusion through body surface in some.

(8) Excretion by coelomoducts or specialized green or coxal glands, or by malpighian tubules. Excretory product is uric acid.

(9) Nervous system is basically similar to the typical annelid plan; head with a brain-ring which is connected to a double ventral nerve cord, having paired segmental ganglia which represent true metamerism. Well–developed sensory organs of various types.

(10) Cilia completely absent. Muscles mostly striated and capable of rapid contraction.

(11) Sexes mostly separate with sexual dimorphism. Paired reproductive organs and ducts.

(12) Fertilization typically internal, in female's body. Eggs megalecithal. Oviparous or viviparous

(13) Life–cycle includes one or more larval stages that metamorphose into adults.

Classification of Arthropoda : On the basis of body shape, degree of segmentation and regionation, and presence or absence of certain appendages (antennae, mandibles and chelicerae), phylum Arthropod is divided into four subphyla; Biggest phylum in regard to the number of species is Arthropoda.

Subphylum (I) Onychophora (Gr. Oychos = claw, phoros = bearing)

(1) Terrestrial walking worms.

(2) Body cylindrical with indistinct external segmentation.

(3) Unjointed 14-43 pairs of legs.

(4) Head not distinct, Oviparous/Viviparous

(5) A pair of eyes, short antennae and blunt oral papillae.

(6) Excretory organs are metanephridia which are segmentally arranged.

(7) A living connecting link forming a transitional link between Annelida and Arthropoda.

Example : *Peripatus, Ophisthopatus, Ooperipatus,* etc.

Subphylum (II) Trilobitomorpha (Gr. TRIA = Three; LOBOS = lobe; MORPHE = form)

(1) Most primitive, extinct, marine arthropods of Cambrian to Permian rocks.

(2) 10 to 675 mm. Long body covered by a hard segmented shell; distinct head of four fused somites bearing a pair of antennae, four pairs of appendages and often a pair of eyes.

(3) Trunk divided, by two longitudinal furrows, into 3 lobes.

(4) Abdominal region of 2 to 29 somites and a fused caudal plate or pygidium.

(5) Each segment, except the last one, bears a pair of biramous jointed appendages.

Example – *Triarthrus, Dalmenites.*

Subphylum (III) Chelicerata (Gr. CHELA = Claw; CEROS = Horn; ATA = Group)

(1) Mostly terrestrial, free–living and small–sized.

(2) Body distinguished into head, thorax and abdomen (= opisthosoma). Head and thorax fused to form a cephalothorax or prosoma.

(3) Cephalothorax with eyes and six pairs of appendages – One pair of clawed and jointed chelicerae in place of mandibles, one pair of pedipalps, and four pairs of walking legs. Antennae absent. Abdomen with or without appendages, but distinguished into a large and broader mesosoma, a small metasoma and a long and narrow, tail–like telson.

(4) Respiration by gills book–lungs or tracheae.

(5) Excretion by malpighian tubules or coxal glands, or both.

(6) Sexes mostly separate; females oviparous; development direct or through a larval stage. Divided into three classes on the basis of respiratory organs

Class 1. Merostoma

(1) They are Marine.

(2) Respiration by gills.

(3) Cephalothorax with lateral compound eyes median simple eyes and six pairs of usual appendages.

(4) Abdomen with 5 to 6 pairs of gill–bearing appendages.

(5) Hind end forms a long bayonet–like telson.

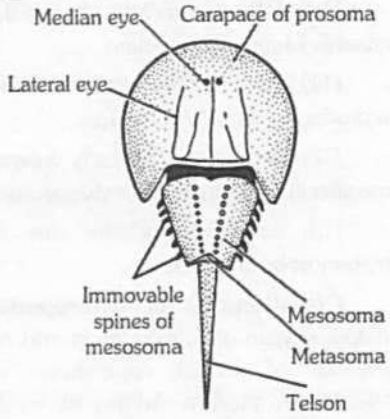


Fig : 1.7-35 *Limulus*

Example– *Limulus* (The king-crab).

❑ Limulus is a living fossil.

Class 2. Arachnida

(1) Mostly terrestrial; spiders, scorpions, mites, ticks, etc.

(2) Respiration by book–lungs or trachea.

(3) Eyes simple.

(4) Abdomen without appendages.

(5) Many with poison glands and poison fangs, jaws of stings.

(6) No gills.

(7) Life–cyle without metamorphosis.

Examples– *Palamnaeus* (scorpion), *Lycosa*, mites, ticks.

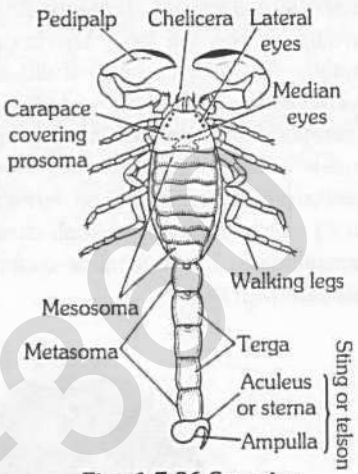


Fig : 1.7-36 Scorpion

❑ *Lycosa* is a common web–spinning spider; web–spinning glands are situated in posterior part of abdomen.

Class 3. Pycnogonida or Pentapoda

(1) Small–sized marine sea–spiders.

(2) Cephalothorax 3–segmented; forms major part of body; abdomen vestigeal.

(3) Suctorial mouth on top of a long proboscis.

(4) Head usually with 4 pairs of appendages and 4 eyes.

(5) 5, 6 or 12 pairs of long walking legs.

(6) No special respiratory and excretory organs.

(7) Unisexual; females oviparous. Eggs carried by males.

Example – *Nymphon.*

Subphylum (IV) Mandibulata or Antennata (L.MANDIBULA = Mandible; ATA =group)

(1) Body divided into head and trunk, or head, thorax and abdomen.

(2) Segmentation distinct.

(3) 1 or 2 pairs of antennae, 1 pair of mandible in place of chelicerae, one or more pairs of maxillae and 3 or more pairs of walking legs.

(4) Eyes mostly compound.

(5) Respiration by gills or trachea.

(6) Excretion by malpighian tubules or antennal glands.

(7) Unisexual; life cycle usually with larval forms. Divided into six classes.

Class 1. Crustacea

(1) Mostly aquatic.

(2) Body divided into cephalothroax and abdomen.

(3) Dorsally, cephalothorax covered by a thick exoskeletal carapace.

(4) Head of 5 segments, with 2 pairs of antennae, one pair of mandibles and 2 pairs of maxillae; thorax of 2 to 60 distinct or variously fused somites; abdominal somites usually distinct with a posterior telson.

(5) Appendages mostly biramous.

(6) Respiration through body surface or by gills.

(7) Excretion by special coxal glands in antennae or maxillae.

(8) Mostly unisexual; genital ducts and pores paired; females oviparous.

(9) Life-cycle usually with larval forms.

Examples – *Palaemon, Cancer, Cyclops, Astacus, Sacculina, Cypris, Daphnia,* etc.

❑ Tiny crustaceans such as Daphnia and cyclops act as zooplankton which form important link in the food chain in water.

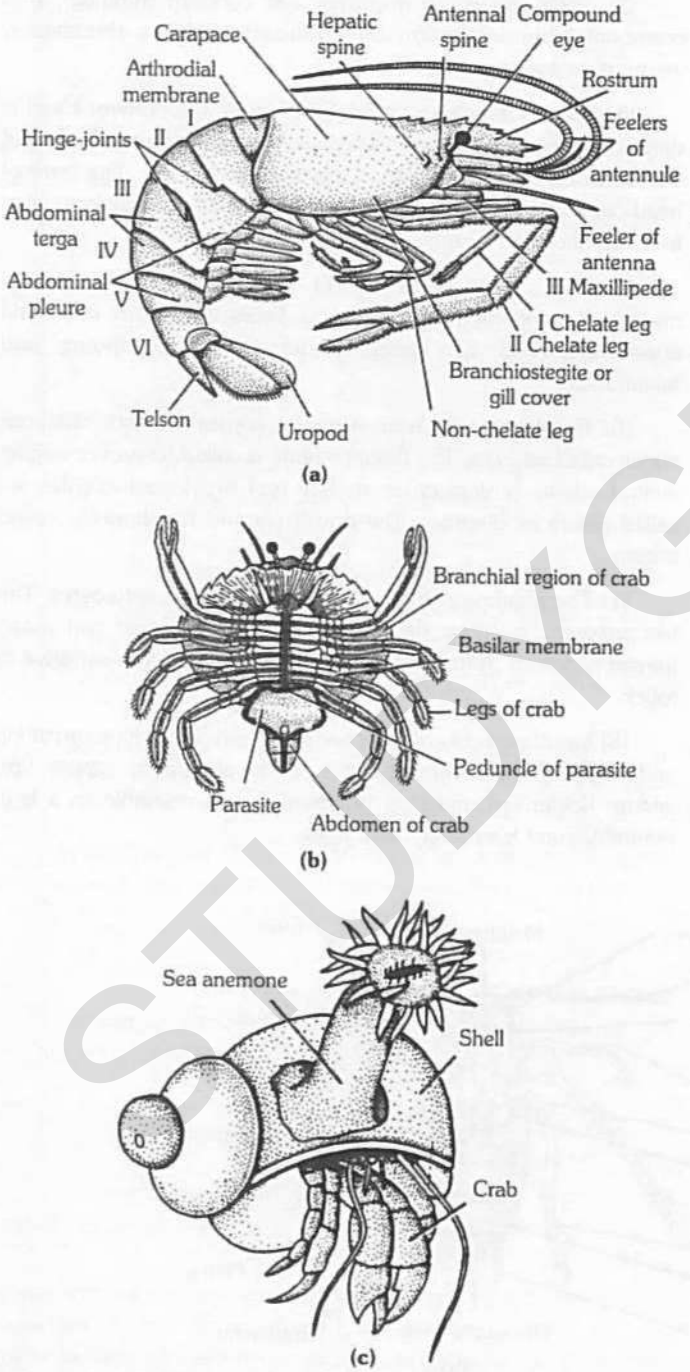


Fig : 1.7-37 (a) Prawn-External features (b) Sacculina (on host body) (c) Hermit crab (*Commensalism*)

Class 2. Insecta

(1) Aquatic, terrestrial or aerial.

(2) Body divided into head, thorax and abdomen.

(3) Segments 6 in head, 3 in thorax and 11 or less in abdomen.

(4) Legs typically 3 pairs (Hexapoda); aerial forms with one or two pairs of wings.

(5) Head with 1 pair of large, compound eyes, 1 pair of antennae and variously modified mouth-parts.

(6) Respiration by branched tracheae.

(7) Excretion by specialized malpighian tubules.

(8) Unisexual; females oviparous.

(9) Life-cycle simple or complicated.

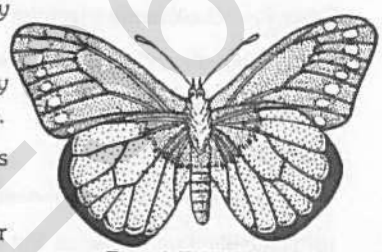


Fig : 1.7-38 *Butterfly*

Examples – *Periplaneta, Musca,* Mosquitoes, locusts, butterflies, bees, wasps, termites, silverfish, beetles, etc.

❑ Insects are of great economic importance to mankind.

❑ Silverfish is not a fish.

Class 3. Diplopoda

(1) Terrestrial.

(2) Body long, cylindrical, worm-like.

(3) 5-segmented head with 1 pair each of short antennae, mandibles and maxillae; 2 groups of simple eyes.

(4) Thorax of 4 segments, each except the first with a pair of joined legs.

(5) Abdomen of 9 to 100 or more segments, but each apparent segment is formed by fusion of two and, hence, bears 2 pairs of legs, spiracles, ostia and nerve ganglia.

(6) Respiration by tracheae.

(7) Excretion by malpighian tubules.

(8) Unisexual; gonad single; females oviparous.

Example – *Thyroglutus* (millipede)

❑ *Thyroglutus* damages the root of crop plants.

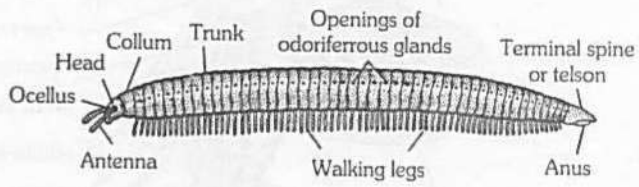


Fig : 1.7-39 *Julus* (millipede)

Class 4. Chilopods

(1) Terrestrial.

(2) Body long, worm-like, somewhat dorso-ventrally flattened and divided into head and trunk.

(3) Segments 15 to 181; not fused in pairs; each with a single pair of legs; first pair of legs claw like and each contains a poison gland.

(4) Head with a pair each of long antennae and mandibles, and 2 pairs of maxillae.

(5) Respiration by tracheae.

(6) Unisexual; females oviparous or viviparous. Genital openings mid ventral on last but one segment.

(7) Excretion by malpighian tubules.

Example – *Scolopendra* (centipede).

❑ Diplopoda and chilopoda are together kept in myriapoda.

Class 5. Symphyla

(1) Terrestrial.

(2) Body upto 6 mm. Long; divided into head and trunk.

(3) Head like that of insects, but without eyes.

(4) Trunk of 15 to 22 somites; bears 10 to 12 pairs of legs.

(5) Genital pores mid ventral between legs of 4th pair.

Example – *Scutigerella* (the garden centipede).

Class 6. Pauropoda

(1) Terrestrial.

(2) Minute, soft and cylindrical, worm like body divisible into head and trunk.

(3) Head with one pair each of branched antennae and unbranched mandibles and maxillae; no eyes.

(4) Trunk of 11 or 12 somites which are dorsally fused in pairs.

(5) Legs 9 to 10 pairs.

(6) Genital pores ventral on 3rd trunk segment.

Example – *Pauropus*.

Some representative animals

Cockroach (*Periplaneta Americana*)

(1) Cockroach belong to the class insecta of the phylum Arthropoda.

(2) Two species of cockroaches commonly found in India are– *Periplaneta americana* and *Blatta orientalis*. *Periplaneta americana* is the largest and most common species. The generic name periplaneta was given by Burmeister in 1838.

(3) Cockroaches are nocturnal and cursorial (running). It is cosmopolitan in distribution, but cockroach are more abundant in warm, humid areas.

(4) Body is divided into head, thorax and abdomen. Head is derived by the fusion of six embryonic segments. The part of head between and behind the eyes is epicranium (vertex). The front of head capsule is made up of three unpaired flattened sclerites called frons, clypeus and labrum.

(5) The thorax consist of three segments–prothorax, mesothorax and metathorax. Thorax bears three pairs of jointed appendages and two pairs of wings on mesothorax and metathorax.

(6) Exoskeleton of each segment consists of four chitinous plates called sclerites. The dorsal sclerite is called tergum or tergite, ventral sclerite is sternum or sternite and two lateral sclerites are called pleura or pleurites. The dorsal plate of the thorax is called notum

(7) The antenna is made of many segments, podomeres. The first segment is scape (largest), second pedicel and rest many jointed flagellum. Antenna is a thigmoreceptor which is sensitive to touch.

(8) Mouthparts of cockroaches are mandibulate type or cutting and chewing type. Mouthparts consists of labrum (upper lip), labium (lower lip), maxillae (segmented and resemble to a leg), mandibles and hypopharynx (tongue).

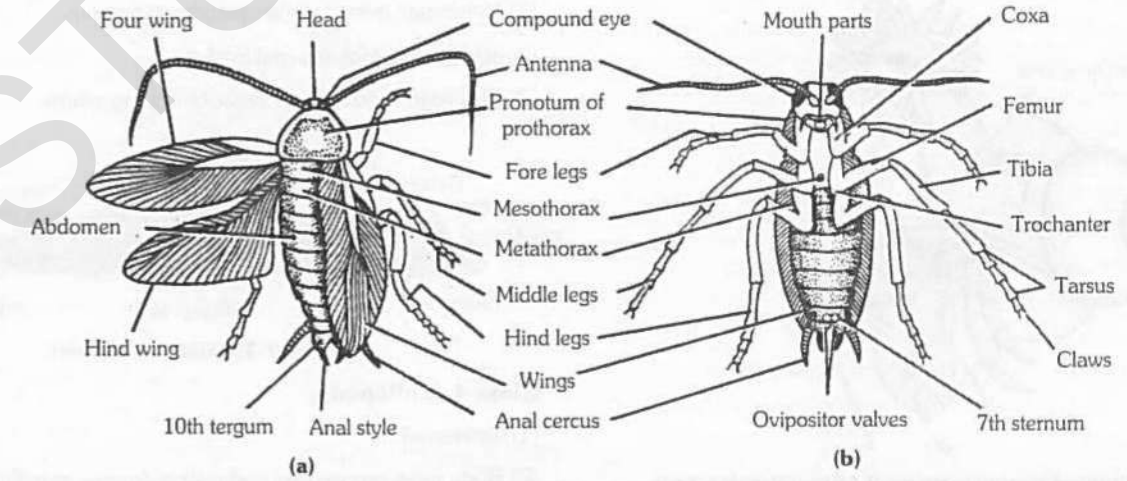


Fig : 1.7-40 *Periplaneta* - External features (a) Dorsal view (b) Ventral view

(9) The main structures of mastication (chewing) are mandibles which are short with teeth.

(10) Maxilla consists of cardo, stipes, galea, lacinia and 5-segmented maxillary palp.

(11) Labium (= second maxilla) consists of submentum, mentum, prementum, palpiger, paraglossa, glossa and three jointed labial palp.

(12) Glossa and paraglossa are together called lingula. They push the masticated food into buccal cavity.

(13) A common salivary duct opens at the base of the hypopharynx.

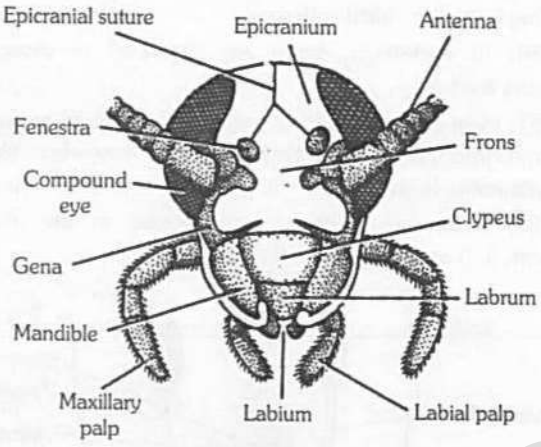


Fig : 1.7-41 *Periplaneta* - head

(14) Each leg is formed by five segments, viz, coxa, trochanter, femur, tibia and tarsus (tarsus is made by five tarsomeres). Attached to the last tarsomere called pretarsus and it bears, a soft lobe called arolium or pulvilus and a pair of claws is present. They are helpful in moving on smooth surfaces. Plantulae are present on tarsus and act as thermoreceptors.

(15) The most swollen segment in the leg of cockroach is coxa. The longest segment in the leg of cockroach is tibia.

(16) In adult cockroach abdomen is made up of ten segments. But in embryonic stage eleven segments are present. The 11^{th} segment of embryo is represented in adult by podical plates.

(17) In male cockroach, eighth and ninth terga are overlapped by seventh tergum. In female seventh, eighth and ninth sterna are fused to form a brood pouch. Seventh sternum of brood pouch forms a pair of gynavalvular plates.

(18) Anal cerci bear minute sensory hairs which are sensitive to sound and other vibrations.

(19) Anal cerci, a pair of many jointed structures are present on the tergite of 10^{th} segment in both sexes.

(20) Anal styles, a pair of small, spine-like unjointed structures are present on sternite of 9^{th} segment in males only.

(21) Cockroach has two pairs of wings. The first pair (mesothoracic) are thick, hard and leathery, protective in function called tegmina (= elytra). Second pair (metathoracic) are thin, soft and membranous.

(22) Cockroach does not fly, but the wings help in escaping from danger.

(23) Body wall of cockroach is made up of two layers, outer cuticle and inner hypodermis.

(24) Cuticle is invaginated forming endoskeletal elements like tentorium in head and apodemes in thorax. They provide sites for attachment of muscles. The cuticle has three distinct layers, outer primary cuticle or epicuticle, middle thick exocuticle and inner thick endocuticle.

(25) Hypodermis is a single layered epithelium. Some of its cells are modified into large oval trichogen cells concerned with secretion of movable bristles on the body of cockroach.

(26) The body cavity of cockroach is a haemocoel, filled with blood.

(27) The alimentary canal of cockroach is divisible into three parts, viz, foregut, midgut and hindgut.

(28) Foregut (stomodaeum) is differentiated into five parts – buccal chamber, pharynx, oesophagus, crop and gizzard. Gizzard is muscular and internally provided with six cuticular teeth which crush the food.

(29) Midgut (mesenteron or ventriculus) is short, tubular, lined with glandular endoderm. At anterior end of mesenteron there are eight blind glandular hepatic caecae which secrete digestive enzymes. Internally mesenteron is not lined by cuticle but it is covered by a very thin and transparent peritrophic membrane formed of chitin and proteins.

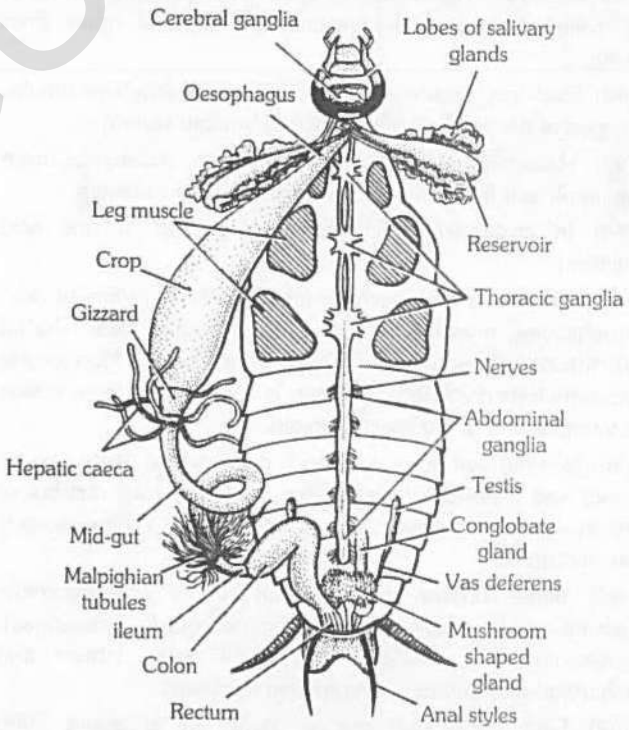


Fig : 1.7-42 *Periplaneta* - Alimentary canal

(30) A stomodaeal valve is present between gizzard and mesenteron.

(31) Hindgut (proctodaeum) comprises ileum, colon and rectum. The wall of rectum is provided with six rectal papillae, which help in the absorption of water and salts.

(32) At the junction of foregut and midgut seven or eight finger like structure are present called hepatic caecae.

(33) Cockroach is omnivorous, feeds on all sorts of organic debris. The digestive enzymes of saliva are mainly zymase and amylase. Most of the nutrients of food are digested in the crop Digested food is absorbed in the mesenteron and hepatic caecae.

(34) Circulatory system in cockroach is of open type or lacunar type. In this type blood is always in direct contact with tissues. The blood flow through haemocoelic system.

(35) The heart is situated in pericardial sinus over the dorsal diaphragm.

(36) Heart of cockroach is neurogenic and longitudinaly beaded with 13 chambers perforated by ostia having valves.

(37) The blood circulation is maintained by 13 pairs of wing-shaped involuntary alary muscles.

(38) Blood (or haemolymph) is colourless due to the absence of respiratory pigment. Hence it does not take part in respiration. Blood is composed of plasma and colourless blood cells called haemocytes.

(39) In cockroach oxygen is carried to individual cell without participation of blood. All body tissue receive oxygen directly.

(40) Respiratory system of cockroach consists of tracheal system. The tracheal system opens outside by ten pairs of spiracles (two pairs thoracic and eight pairs of abdominal). The spiracles are with valves.

(41) The first thoracic and first abdominal spiracles remain open all the times. The trachea is lined with spiral thickening of cuticle called intima which prevents the tracheal tubes from collapsing.

(42) Excretory organs of cockroach are Malpighian tubules which open at the junction of midgut and hindgut (ileum).

(43) Malpighian tubules absorb excretory substances from haemolymph and fat bodies and pass into the proctodaeum.

(44) In cockroach chief excretory product is uric acid (uricotelism).

(45) Fat body of cockroach contains mainly four types of cells. viz., trophocytes, mycetocytes, oenocytes and urate cells. The fat body is functionally analogous to liver of vertebrates. Mycetocytes contain symbiotic bacteria which help in synthesis of some amino acids, vitamins and of glycogen from glucose.

(46) Nervous system of cockroach consists of a nerve ring (in the head) and a double ventral nerve cord. The total number of ganglia in ventral nerve cord of cockroach is nine (Three thoracic and six abdominal).

(47) Sense organs in cockroach are – Photoreceptors (compound and simple eyes), thigmoreceptors (antennae), chemoreceptors (on maxillary and labial palps, labium and hypopharynx) and auditory receptors on anal cerci.

(48) Each compound eye is made up of about 2000 functional units called ommatidia.

(49) Each ommatidium is composed of a cuticular lens, two corneagen cells, a crystalline cone surrounded by four cone cells, a rhabdome surrounded by seven retinular cells and a basement membrane.

(50) There are two types of vision in insects, mosaic vision or apposition image during day time and superposition or dull image in dim light.

(51) The vision in cockroach is called mosaic vision because in cockroach, pigment sheath of ommatidia is non-contractile so capable of only mosaic vision even during night.

(52) Simple eye of cockroach is mainly concerned with light collecting rather than image forming.

(53) In cockroach the endocrine organs are cardiac, corpora allata and prothoracic glands.

(54) Corpora cardica and corpora allata are attached to the brain. Corpora allata is neurosecretory and secretes juvenile hormone or neotinin.

(55) Intercerebral glands in brain secrete the brain hormone. Brain hormone stimulates the prothoracic glands to secrete a moulting hormone called ecdysone.

(56) In cockroach, sexes are separate, so dioecious or unisexual animal.

(57) Male organs consist of testes, vasa deferentia, ejaculatory duct, mushroom or utricular gland, phallic or conglobate gland and male gonaphophysis.

(58) Testes of cockroach are located in the abdominal segments 4, 5 and 6. They produce sperms.

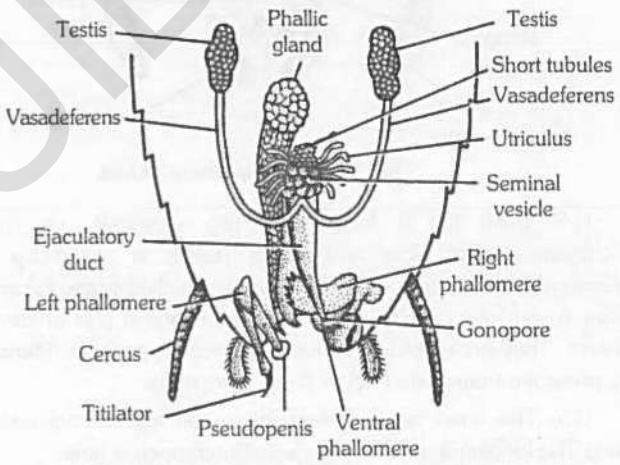


Fig : 1.7-43 *Periplaneta* - Male reproductive organs

(59) All sperms of a seminal vesicle are glued together into a large bundle called spermatophore. Spermatophore has three-layered wall. Inner layer secreted by utriculi majores; middle layer secreted by ejaculatory duct and outer layer secreted by phallic gland.

(60) There are three asymmetrical chitinous structures called male gonapophyses or phallomeres. Right phallomere has serrated edges and a hook; left phallomere has an asperate lobe, pseudopenis and a hooked titillator and ventral phallomere is simple.

(61) Female organs consist of ovaries, oviducts, vagina, genital chamber, spermathecae, colleterial glands and female gonapophysis (ovipositor processes). Ovaries of cockroach are located in the abdominal segments 2 to 6. Each ovary is made up of eight ovarioles.

(62) Oviducts fuse to form a common oviduct or vagina. It opens into gynatrium. Gynatrium opens out through female gonopore.

(63) Collaterial glands opens into gynatrium through a common pore. Left collaterial gland secrete HCl and scleroprotein and right gland secrete hydroxy phenol. Ootheca of cockroach is formed of a protein secreted by collaterial glands.

(64) A pair of spermathecae (left larger pyriform sac) are present near female genital pore. They store spermatophores received during copulation.

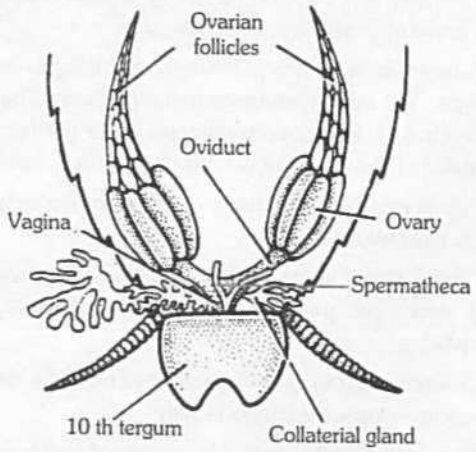


Fig : 1.7-44 Cockroach -Female reproductive organs

(65) Near the female gonopore three pairs of gonapophyses are present. They are helpful in copulation and in oviposition.

(66) Ootheca of cockroach contains 16 fertilized eggs in two rows (8 + 8). The egg of cockroach is centrolecithal type.

(67) Nymph of cockroach emerges out from ootheca.

(68) Metamorphosis in cockroach is incomplete or paurometabolous type. Metamorphosis is regulated by two hormones, ecdysone secreted by prothoracic glands and juvenile hormone secreted by corpora allata.

Mosquito (*Anopheles*)

(1) Mosquito are inhabitants of damp and marshy places.

(2) The common genera of mosquito are –

Culex (body held parallel to surface while sitting),

Aedes (= *Stegomyia*) (body held parallel to surface while sitting, with black and white striped body),

Anopheles (Body held at an angle to the surface, dark spotted wing).

(3) The body of mosquito is divided into head, thorax and abdomen. Head bears a pair of antennae, compound eyes and mouth parts.

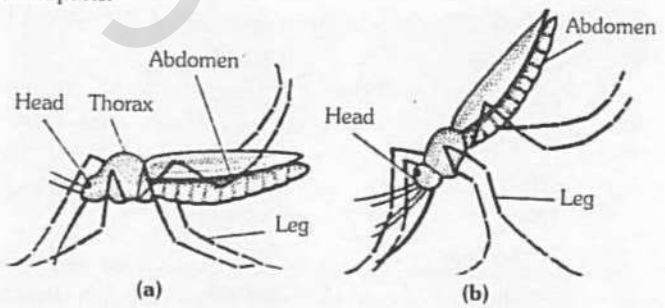


Fig : 1.7-45 Mosquitoes (a) *Culex* (b) *Anopheles*

(4) In adult mosquito, ocelli (simple eyes) are totally absent (in cockroach and housefly, ocelli are present).

(5) Thorax is three-segmented with only one pair of wings (mesothoracic). Metathoracic wings are modified into halteres which are balancing and sound producing structures.

(6) Mosquito shows sexual dimorphism. Sex differentiation can be done on the basis of antennae and maxillary palps. Antenna of a male mosquito is plumose (more hairy or brushy) and female is pilose (with few short hairs).

(7) Female mosquitoes are blood suckers. They have piercing and sucking mouthparts. Males feed on nectar and have only sucking mouthparts.

(8) Mouthparts found in both sexes are – Labrum, epipharynx forming upper lip and labium and proboscis.

(9) The puncturing elements in the mouthparts of female mosquito are maxillae and mandibles.

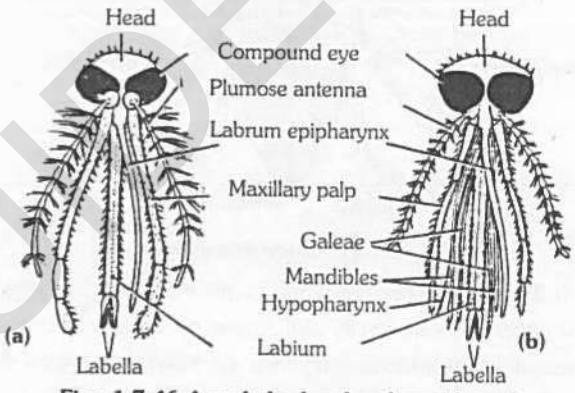


Fig : 1.7-46 *Anopheles* head and mouth parts
(a) Male (b) Female

(10) Mandible are totally absent in male mosquito.

(11) Male and female mosquito copulate while in flight. The eggs are laid by the female in clusters on stagnant water of ponds, ditches, tanks, pools marshy places etc. The eggs develops and from each egg a small transparent larva called wriggler comes out into the water.

(12) Wriggler is a free swimming, active and aquatic larva performing wriggling movements. The body has head, thorax (without legs) and abdomen (9-segmented). Head bears a pair of compound eyes, a pair of simple eyes (absent in adult mosquito), a pair of small antennae.

(13) Wriggler has a lifespan of 3-4 days. During this period it undergoes four moults to give rise to five instar larva.

(14) 5th instar larva changes into a pupa (nonfeeding), it is comma-shaped. The pupa of mosquito is known as tumbler. It has a pair of respiratory trumpets.

(15) After completion of metamorphosis (complete metamorphosis), it will transform into an adult called 'Imago'.

(16) Johnston's organ lies in the second segment of antennae. In male mosquito, it helps to locate females by flight tone.

(17) Spraying of oil on stagnant water controls malaria because mosquito larvae cannot breath and die.

(18) Fish which can be used in biological control of mosquitoes is *Gambusia*.

Housefly (*Musca domestica*)

(1) Housefly belong to the class insecta of the phylum Arthropoda. *Musca domestica* is the most common housefly in Europe and America. The common Indian species in *musca nebulo*.

(2) The body of housefly is divided into head, thorax and adbomen.

(3) Head is large with a pair of compound eyes, each made up about 4000 ommatidia, three ocelli and two antennae.

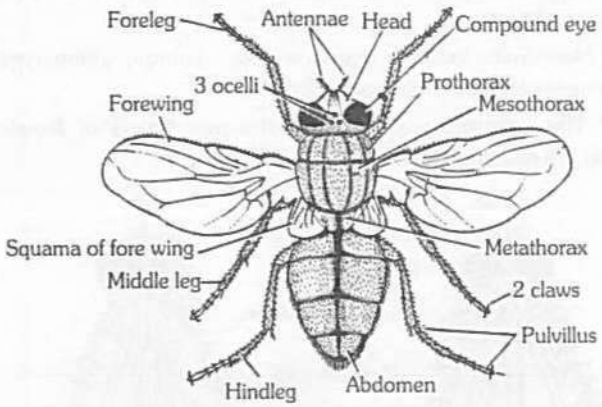


Fig : 1.7-47 *Musca domestica*

(4) Thorax is three segmented with three pairs of legs, one pair of wings (mesothoracic) and a pair of halteres. The halteres are present on metathorax and they are balancing organs during flight and also receive sound stimuli.

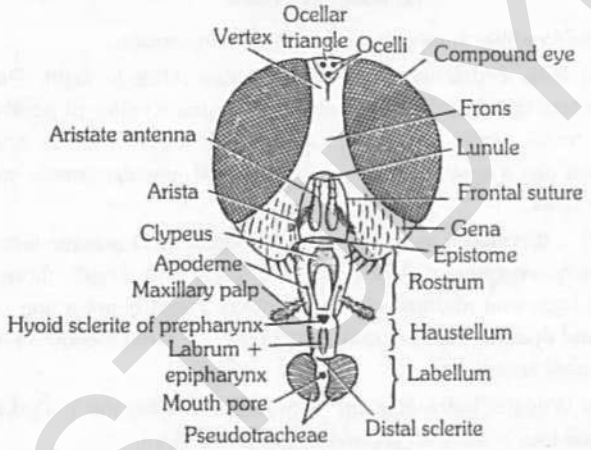


Fig : 1.7-48 Housefly-Head and mouth parts in frontal view

(5) Housefly differs from mosquito in having hindlegs resting on surface while sitting.

(6) The mouth parts of the common housefly are sponging type which are adapted for sucking liquid or semiliquid.

(7) Labium is the most developed part of mouthparts forming the proboscis. The proboscis consists of three region – Rostrum, Haustellum, Labellum.

(8) Oral groove is found on haustellum cantaining blade-like hypopharynx and flattened labrum and epipharynx.

(9) Pseudotracheae are found in labellum.

(10) In the mouth parts of housefly, mandibles are totally absent.

(11) House flies are saprophagus, feed upon all sorts of dead organic matter.

(12) The breeding season of housefly lasts from march to october (summer and rainy season).

(13) Housefly lays eggs on decaying organic matter such as cow dung, horse manure, human faeces etc.

(14) A larval stage occurs in housefly that lives in dung and is called maggot. This larva undergoes moulting twice. The period in between two moults is known as stadium while the form of larva are called instar. Thus there are two moult and three instars.

(15) The first instar has only one pair of posterior abdominal spiracles. So it is metapneustic.

(16) The second instar larva of housefly has one pair of abdominal and one pair of prothoracic spiracles. So it is amphipneustic.

(17) Different stages in the life history of housefly are – Egg → Larva (maggot) → pupa → Imago (adult).

(18) Larva of housefly respires by means of tracheae.

(19) An imago (young one of housefly) will come out after 4-5 days.

(20) Housefly shows a complete metamorphosis (holometabolous type).

Table : 1.7-7 Common Names

Limulus	–	King carb
Palamnaeus	–	Scorpion
Lycosa	–	Spider
Astacus	–	Crayfish
Daphnia	–	Waterflea
Palaemon	–	Freshwater prawn
Palinurus	–	Lobster
Lucifer	–	Shrimp
Carcinus	–	Crab
Eupagurus	–	Hermit crab
Balanus	–	Rock barnacle
Julus	–	Millipede
Scolopendra	–	Centipede
Lepisma	–	Silverfish
Carasius	–	Stick insect
Phyllium	–	Leaf insect
Pediculus	–	Louse
Cimex	–	Bedbug
Xenopsylla	–	Rat flea
Drosophila	–	Fruitfly
Musca	–	Housefly
Phlebotomus	–	Sandfly
Glossina	–	Testse fly
Bombyx	–	Silkmoth

Phylum Mollusca – The soft bodied animals

(L., *Mollis* or *Molluscus* = Soft bodied)

Brief History : Aristotle described a number of molluscs. Johnston (1650) proposed the name of the phylum.

General characters

(1) Molluscs are multicellular organisms.

(2) They are mostly marine.

(3) They have a bilateral symmetry, but snails are asymmetrical.

(4) They are triploblastic animals.

(5) They are coelomate animals. True coelom is reduced and haemocoel is well developed in them.

(6) They have organ system grade of organization.

(7) The body is soft and unsegmented.

(8) The soft body is covered by a fleshy fold of the body wall. It is called mantle.

(9) The molluscs are provided with one or two calcareous shells. The shells may be external or internal, univalve or bivalve.

(10) Respiration is carried out by the gills or pulmonary chambers.

(11) The digestive system is well developed. It contains a radula and a hepatopancreas.

(12) The circulatory system is of an open type. Blood with amoebocytes, respiratory pigment is copper containing haemocyanin dissolved in plasma.

(13) The excretory organ is the kidney (organ of Bojanus).

(14) The nervous system is well developed with paired ganglia, commissures and connectives.

(15) The sensory organs are eyes, statocysts and osphradia (a chemoreceptor to test chemical nature of water).

(16) Reproduction is sexual. Sexes are separate in them, or they are hermaphrodites.

(17) The development in their case is either direct or indirect with free larval forms like trochophore, veliger, glochidium, etc.

Classification of Mollusca : On the basis of body shape and symmetry and characteristics of foot mantle, respiratory organs, nervous system, etc. phylum mollusca are divided into seven classes :

Class 1. Monoplacophora

(1) The body is bilaterally symmetrical and segmented.

(2) The shell is formed of a single valve.

(3) The head is without eyes and tentacles.

(4) The gills are external and serially arranged.

(5) The nephridia are five pairs.

Example : *Neopilina galathea*

❑ Neopilina is a living fossil and connecting link between Annelida and Mollusca.

Class 2. Aplacophora or Solenogasters

(1) The body is worm–like, bilaterally symmetrical and cylindrical.

(2) The head, mantle, foot, shell and nephridia are absent.

(3) The body is covered with spicule–bearing cuticle.

(4) The digestive tract is straight with radula.

(5) A mid dorsal longitudinal keel or crest is often present .

Example : *Neomenia, Chaetoderma*, etc.,

Class 3. Polyplacophora

(1) These molluscs are bilaterally symmetrical, and dorsoventrally flattened.

(2) Head small, without eyes and tentacles.

(3) The shell is composed of a longitudinal series of 8 plates.

(4) The foot is flat and ventral.

(5) The radula is well developed.

(6) Respiration by 8 to 60 pairs of gills.

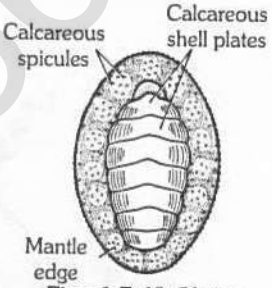


Fig : 1.7-49 *Chiton*

(7) Unisexual; only one gonad; trochophore larval stage.

Example : *Chiton, Cryptochiton*, etc.

❑ On the dorsal surface of chiton is a convex shell composed of 8 transversely elongated calcareous plates arranged in a longitudinal manner.

Class 4. Gastropoda

(1) It is the largest class of Mollusca.

(2) It seems that these animals are moving on their stomach, hence the name gastropoda.

(3) Gastropods are marine, fresh water or terrestrial animals. A few are parasitic.

(4) The body is unsegmented and asymmetrical.

(5) The shell is univalve and spirally coiled due to torsion.

(6) The head is distinct. It bears tentacles, eyes and a mouth.

(7) The foot is ventral and muscular.

(8) The buccal cavity is provided with a radula.

(9) The circulatory system is open.

(10) Respiratory organs are gills (ctinidia), or pulmonary sac or both.

(11) Nervous system usually with four pairs of ganglia.

(12) The sexes are mostly separate, while some forms are hermaphrodite.

(13) The development includes veliger and trochophore larvae.

Examples : *Haliotis, Cypraea, Pila, Murex, Aplysea, Doris, Limax, Patella*, etc.

❑ *Limax* is a terrestrial gastropod. It creeps on a self-secreted tract.

❑ *Doris* is a marine gastropod, commonly called true limpet. It has an aspidobranch gill.

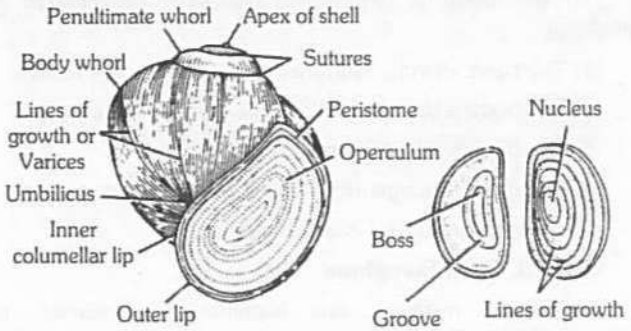


Fig : 1.7-50 (a) *Pila globosa* (b) *Aplysia*

Class 5. Scaphopoda

(1) It is the small group of marine molluscs.

(2) The foot is boat–shaped.

(3) The eyes, the tentacles and ctenidia are absent.

(4) Marine, bilaterally symmetrical molluscs.

Examples : *Siphonodentalium Dentalium*, and *Pulsellum*

❑ Dentalium is commonly called tusk shells.

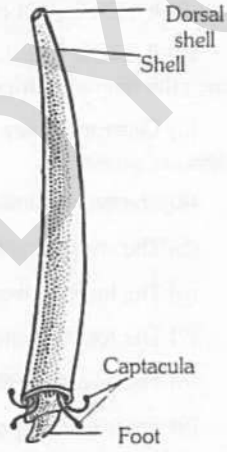


Fig : 1.7-51 *Dentalium*

Class 6. Pelecypoda or Bivalvia or Lamellibranchiata

(1) Pelecypoda are aquatic in habit.

(2) The body is bilaterally symmetrical and laterally compressed.

(3) The shell is formed of two distinctive shell plates.

(4) The head is not distinct.

(5) The alimentary canal shows a crystalline style.

(6) The gills, excretory organs and the other structures are paired.

(7) The sexes are separate or united.

(8) The development is indirect having a glochidium larva.

Example : *Mytilus, Unio, Teredo, Lamellidens, Solen, Pecten, Punctada*, etc.

❑ *Teredo* bores through wood of ship but is without segmentation.

❑ Pearl oysters belongs to the class pelecypoda.

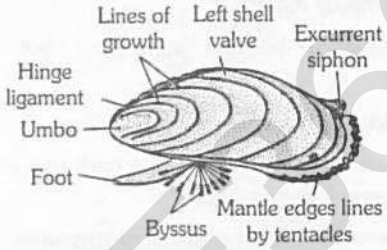


Fig : 1.7-52 *Mytilus*

Class 7. Cephalopoda or Siphonopoda

(1) Most developed, marine and actively swimming by ejecting jets of water through exhalent siphon of mantle.

(2) The body is bilaterally symmetrical.

(3) The foot is modified into arms and funnel.

(4) The shell may be either absent or rudimentary; it may be internal or external.

(5) Nervous system is highly developed.

(6) The odonotophore with a radula is present.

(7) The ink–gland is present.

(8) The sexes are separate.

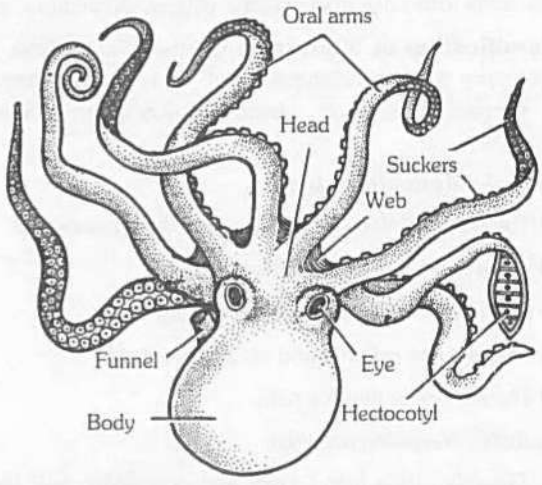
(9) The development is direct hence no metamorphosis and larval stage.

Example : *Nautilus, Loligo Sepia, Octopus*, etc.

❑ *Nautilus* has an external coiled and chambered shell.

❑ *Octopus* has good learning power and can be trained.

❑ Members of genus Architeuth are known as giant squid and are largest living invertebrates.



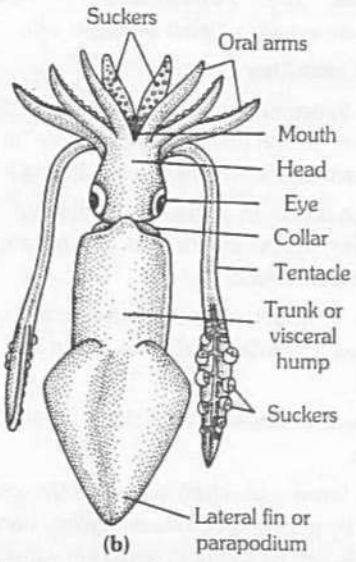


Fig : 1.7-53 (a) *Octopus* (b) *Sepia*

Table : 1.7-8 Common Names

Chiton	–	Sea mica (Mail shell)
Dentalium	–	Tusk shell
Patella	–	Limpet
Fissurella	–	Key-hole limpet
Trochus	–	Top shell
Pila	–	Apple snail
Crepidula	–	Slipper shell
Cypraea	–	Cowrie
Natica	–	Star shell
Buccinum	–	Whelk
Doris	–	Sea lemon
Aplysia	–	Sea hare
Turbo	–	Cat's eyes
Vermetes	–	Worm shell
Nassa	–	Mud shell
Conus	–	Cone shell
Bulla	–	Bubble shell
Helix	–	Land snail
Limax	–	Slug
Pteropod	–	Sea butterfly
Unio	–	Freshwater mussel
Mytilus	–	Sea mussel
Spondylus	–	Edible oyster
Pinctada	–	Pearl oyster
Pecten	–	Scallop
Teredo	–	Shipworm
Solen	–	Razor clam
Sepia	–	Cuttlefish
Loligo	–	Squid (sea arrow)
Octopus	–	Devilfish
Spirula	–	Spiral shell
Architeuthis	–	Giant squid

Phylum Echinodermata – The spiny skinned animals

(Gk. *echinos* = spines; *derma* = skin/covering)

Brief History : Although Jacob Klein (1738) had earlier coined the name "Echinodermata", yet Linnaeus included these animals under "Mollusca", and Lamarck under his class "Radiata" as "Echinodermes". Finally, Leuckart (1847) raised the group to the status of a separate phylum.

General characters

(1) Echinoderms are exclusively marine beings.

(2) They are triplobalstic and coelomate (enterocoetomate) animals.

(3) They have radially symmetrical body. The radial symmetry is due to sedentary or sessile mode of life and it is a secondary character in echinoderms.

(4) They have organ system grade of organization.

(5) They have well developed endoskeleton formed of calcareous ossicles and spines.

(6) They have a water–vascular system (Ambulacral system) with tube–feet for locomotion, feeding and respiration.

(7) Circulatory system is of the open–type.

(8) Respiratory organs include dermal branchiae, tube feet, respiratory tree and bursae.

(9) Nervous system is complex and contains both central and peripheral components, but no brain.

(10) The sensory organs are poorly developed.

(11) The excretory organs are absent.

(12) They have pedicellariae.

(13) Development is indirect.

(14) The larval forms are bilaterally symmetrical.

(15) Regeneration power is well developed in Echinoderms.

Classification of Echinodermata : On the basis of body shape, position of madreporite and kind of larval form, echinoderms are classified into two subphylum.

Subphylum (I) Eleutherozoa : Free-living echinoderms with ventral mouth.

Class 1. Asteroidea

(1) Starfishes or sea stars.

(2) Arms 5 or more and not sharply marked off from the central disc.

(3) Tube feet in orally placed ambulacral grooves; with suckers.

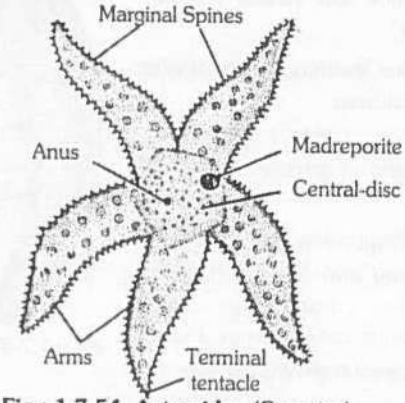


Fig : 1.7-54 Asteroidea (Sea star)

(4) Anus and madreporite aboral.

(5) Pedicellariae present.

(6) Free-living, slow-creeping, predaceous and scavengerous.

Examples : *Astropecten, Luidia, Goniaster, Oreaster* (= *Pentaceros*), *Asterina, Solaster, Pteraster, Echinaster, Asterias, Heliaster*, etc.

Class 2. Ophiuroidea

(1) Brittle-stars and allies.

(2) Body star-like with arms sharply marked off from the central disc.

(3) Pedicellariae absent.

(4) Stomach sac-like; no anus.

(5) Ambulacral grooves absent or covered by ossicles; tube feet without suckers.

(6) Madreporite oral.

Examples : *Ophiura, Ophiothrix, Ophioderma, Ophiopholis, Gorgonocephalus, Asteronyx.*

Class 3. Echinoidea

(1) Body not divided into arms; globular (sea urchins), or flattened disc-like (sea-cakes).

(2) Mouth at lower pole, covered by 5 strong and sharp teeth, forming a biting and chewing apparatus called "Aristotle's Lantern".

(3) Tube-feet slender with suckers.

(4) Skin ossicles fused to form a rigid globular, disc like, or heart-shaped shell or test with movable spines.

(5) 3–jawed pedicellariae present in skin.

(6) Gut long, cylindrical and coiled. Anus present.

(7) Larval forms pluteus and Echinopluteus.

Examples : *Echinus, Clypeaster, Echinarachinus, Echinocardium*, etc.

❑ Members of Echinoidea are also known as Floating stone.

Class 4. Holothuroidea

(1) Body massive, long and cylindrical like a cucumber; elongated in oral–aboral axis; no arms.

(2) Mouth at anterior and anus at posterior ends.

(3) Mouth surrounded by many hollow retractile tentacles.

(4) Tube feet usually present; sucker-like.

(5) Skin leathery, but relatively soft, without spines or pedicellariae; may have an endoskeleton of minute calcareous ossicles.

(6) Respiration and excretion by two long and highly branched tubes (= respiratory tree) extending into coelom from cloaca.

(7) Larval form Auricularia.

Examples – *Holothuria, Cucumaria etc.*

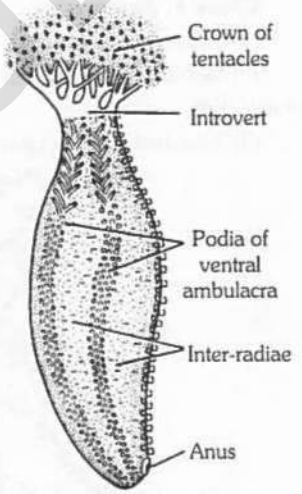


Fig : 1.7-55 *Holothuria*

Subphylum (II) Pelmatozoa : Stalked, sedentary echinoderms, with mouth situated on upper side.

Class 1. Crinoidea

(1) Body flattened and pentamerous; distinguished into a small and circular central disc and five or more (in multiples of five) long, then, branched and flexible arms radiating from the disc.

(2) Disc enclosed in a hard, cup–shaped calyx formed of calcareous plates; calyx attached to a substratum by a stalk or simply by its aboral surface.

(3) Mouth in middle and anus excentral upon a cone, both upon oral surface. 5 ambulacral grooves run from mouth upto the tips of the arms.

(4) Tube feet sucker–like; restricted to central disc; can help in food–collection.

(5) Some forms (sea–lilies) permanently sessile and attached to sea–bottom by a long stalk; others (feather stars) free-swimming, but have flexible cirri for gripping objects in water.

(6) Spines and pedicellariae absent in skin.

Examples : *Antedon, Neometra*, etc.

Table : 1.7-9 Common Names

Asterias	–	Starfish
Astropecten	–	Starfish
Pentaceros	–	Sea pentagon
Ophiothrix	–	Brittle star
Gorgonocephalus	–	Basket star
Echinus	–	Sea urchin
Echinocardium	–	Heart urchin
Clypeaster	–	Sand dollar
Cucumaria	–	Sea cucumber
Antedon	–	Feather star

Phylum Chordata

General Characters

(1) Aquatic, aerial or terrestrial. All free-living with no fully parasitic forms.

(2) Body small to large, bilaterally symmetrical and metamerically segmented.

(3) A post anal tail usually projects beyond the anus at some stage and may or may not persist in the adult.

(4) Exoskeleton often present; well developed in most vertebrates.

(5) Body wall triploblastic with 3 germinal layers : ectoderm, mesoderm and endoderm.

(6) Coelomate animals having a true coelom, enterocoelic or schizocoelic in origin.

(7) A skeletal rod, the notochord, present at some stage in life cycle.

(8) A cartilaginous or bony, living and jointed endoskeleton present in the majority of members (vertebrates).

(9) Pharyngeal gill slits present at some stage; may or may not be functional.

(10) Digestive system complete with digestive glands.

(11) Blood vascular system closed. Heart ventral with dorsal and ventral blood vessels. Hepatic portal system well developed.

(12) Excretory system comprising proto-or meso- or meta-nephric kidneys.

(13) Nerve cord dorsal and tubular. Anterior end usually enlarged to form brain.

(14) Sexes separate with rare exceptions.

Classification of chordata : Phylum chordata can be divided into two groups: Acrania (Protochordata) and Craniata (Euchordata) having contrasting characters.

Group A. Acrania (Protochordata) : (Gk. *a* = absent; *kranion* = head,) or, (Gk. *protos* = first; *chorde* = cord). All marine, small, Primitive or lower chordates. Lacking a head, a skull or cranium, a vertebral column, jaws and brain. About 2,000 species. The Acrania is divided into three subphyla: *Hemichordata, Urochordata* and *Cephalochordata,* chiefly on the character of notochord present.

Subphylum I. Hemichordata : (Gk. *hemi* = half; *chorde* =cord). Body divided into 3 regions: Proboscis, collar and trunk. Notochord doubtful, short, confined to proboscis and non-homologous with that of chordates.

Class 1. Enteropneusta : (Gk. *enteron* = gut; *pneustos* = breathed). Body large and worm-like. Gill slits numerous. Intestine straight. Acorn or tongue worms. 70 species. *e.g. Balanoglossus, Saccoglossus.*

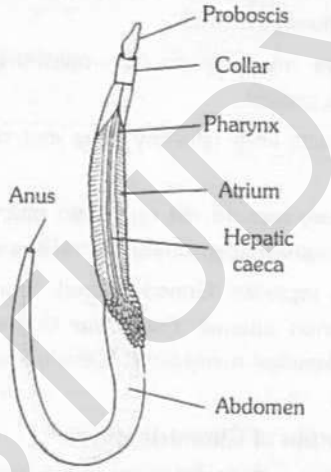


Fig : 1.7-56 Balanoglossus

Class 2. Pterobranchia : (Gk. *pteron* = feather; *branchion* = gill). Body small and compact. Gill-slits one pair or none. Intestine U-shaped. Pterobranchs. 20 species. *e.g. Cephalodiscus, Rhabdopleura.*

Subphylum II. Urochordata or Tunicata : (Gk. *oura* = a tail;) (L. *chorda* = cord). Notochord and nerve cord only in tadpole-like larva. Adult sac-like, often sessile and encased in a protective tunic. Tunicates.

Class 1. Ascidiacea : Sessile tunicates with scattered muscles in tunic. Solitary, colonial or compound. Gill-clefts numerous. Ascidians or sea squirts. 1,200 species. *e.g. Herdmania, Ciona, Molgula.*

❑ Retrogressive metamorphosis present in Herdmania.

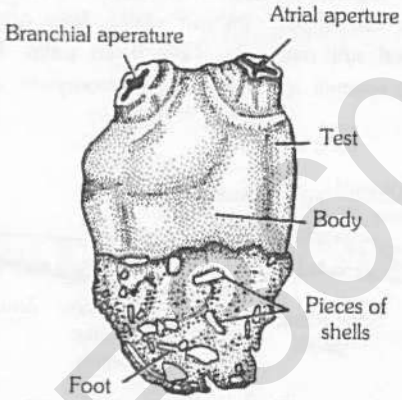


Fig : 1.7-57 Herdmania (Sea-squirt)

Class 2. Thaliacea : Free-swimming or pelagic tunicates with circular muscles in tunic. Sometimes colonial. Salps or chain tunicates. 30 species. *Salpa, Doliolum, Pyrosoma.*

Subphylum III. Cephalochordata : (Gk. *kephale* = head;) or (L. *chorda* = cord). Notochord and nerve cord present throughout life along entire length of body.

Class Leptocardii : Body fish-like, segmented with distinct myotomes and numerous gill-slits. Free swimming and burrowing. Lancelets. 30 species. *e.g. Branchiostoma* (= *Amphioxus*), *Asymmetron.*

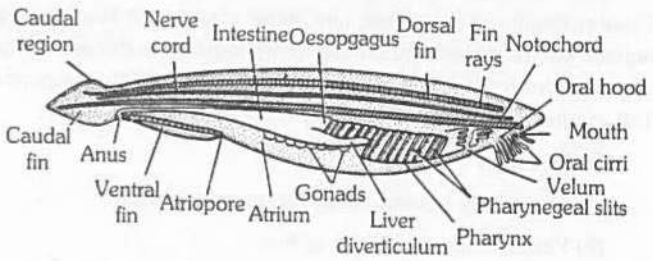


Fig : 1.7-58 *Amphioxus*

Group B. Craniata (Euchordata) : Aquatic or terrestrial, usually large-sized, higher chordates or vertebrates with distinct head. Notochord is embryonic, in adult replaced by vertebral column. Jaws and brain protected by a skull or cranium. The Craniata includes a single subphylum, the vertebrata.

Subphylum IV. Vertebrata : (L. *vertebratus* = backbone). Notochord supplemented or replaced by a vertebral column or backbone composed of overlapping vertebrae. Body divisible into head, neck, trunk and tail. Usually dioecious. Vertebrates, largest chordate subphylum including about 46,500 species. The subphylum Vertebrata is divided into two divisions: Agnatha and Gnathostomata, with contrasting characters as follows;

Division I. Agnatha : (Gk. *a*, not; gnathos, jaw). Jaw less primitive fish-like vertebrates without true jaws and paired limbs.

Class 1. Ostracodermi. (Gk. *ostrakon* = shell; *derma* = skin). Several extinct orders of ancient primitive heavily armoured, Palaeozoic, world's first vertebrates, collectively called the ostracoderms. *e.g. Caphalaspis, Drepanaspis.*

Class 2. Cyclostomata. (Gk. *cyklos* = circular; *stoma* = mouth). Body eel-shaped, without scales, jaws and lateral fins. Mouth rounded and suctorial. Gills 5–16 pairs. Parasites and scavengers. 45 species. *e.g.* Lampreys (*Petromyzon*) and hagfishes (*Myxine*).

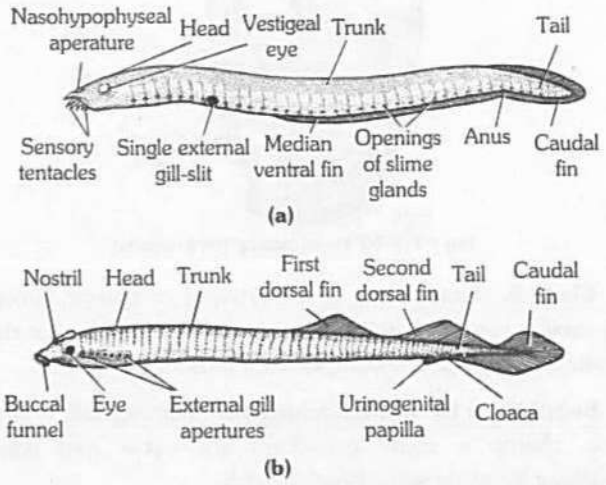


Fig : 1.7-59 (a) *Myxine* (b) *Petromyzon*

Division II. Gnathostomata : (Gk. *gnathos* = jaw; *stoma* = mouth). Jawed vertebrates having true jaws and paired limbs.

For convenience, some taxonomists further divide Gnathostomata division into two super classes. All the fishes like aquatic gnathostomes are placed in the superclass Pisces, whereas all the four-footed terrestrial gnathostomes in the superclass Tetrapoda. Their contrasting features are as follows:

Superclass 1. Pisces

(1) Exclusively aquatic gnathostome vertebrates.

(2) Paired limbs, if present, as fins.

(3) Median fins present

(4) Skin usually moist and scaly

(5) Respiration aquatic, by gills

(6) Sense organs functional in water

(7) It consist of fishes only.

Superclass 2. Tetrapoda

(1) Aquatic or terrestrial. Some arboreal and aerial

(2) Paired pentadactyle limbs present

(3) Median fins absent

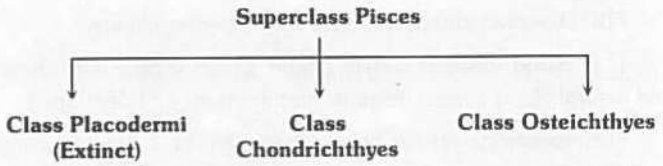
(4) Skin usually dry and cornified

(5) Respiration aerial, by lungs

(6) Sense organs functional in air.

(7) It consist of classes Amphibia, Reptilia, Aves and Mammals.

Superclass Pisces



Class 1. Chondrichthyes (The Cartilaginous Fishes)

(Gk. *chondros* = cartilage; *ichthys* = fish)

General characters.

(1) Mostly marine and predaceous.

(2) Body fusiform or spindle shaped.

(3) Fins both median and paired, all supported by fin rays. Pelvic fins bear claspers in male. Tail heterocercal.

(4) Skin tough containing minute placoid scales and mucus glands.

(5) Endoskeleton entirely cartilaginous, without true bones. Notochord persistent. Vertebrae complete and separate. Pectoral and pelvic girdles present.

(6) Mouth ventral. Jaws present. Teeth are modified placoid scales. Stomach J-shaped. Intestine with spiral valve.

(7) Respiration by 5 to 7 pairs of gills. Gill-slits separate and uncovered (except, *chimaeras*). Operculum absent. No air bladder and lungs.

(8) Heart 2–chambered (1 auricle and 1 ventricle). Sinus venosus and conus arteriosus present. Both renal and portal systems present. Temperature variable (poikilothermous or cold blooded or ectothermal animal.

(9) Kidneys mesonephric or opisthonephric. Excretion ureotelic. Cloaca present.

(10) Brain with large olfactory lobes and cerebellum. Cranial nerves 10 pairs.

(11) Olfactory sacs do not open into pharynx. Membranous labyrinth with 3 semicircular canals. Lateral line system present.

(12) Sexes separate. Gonads paired. Gonoducts open into cloaca. Fertilization internal. Oviparous or ovoviviparous. Eggs large, yolky. Cleavage meroblastic. Development direct, without metamorphosis.

Classification of Chondrichthyes

(a) Subclass I. Selachii : (Gk., selachos, a shark)

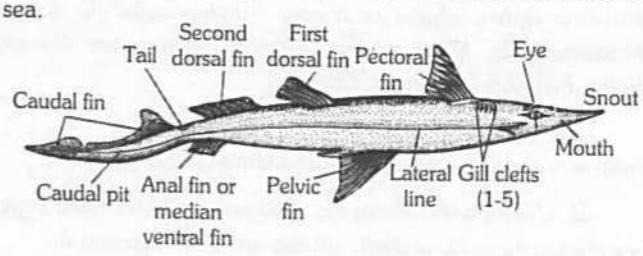
(1) Multiple gill slits on either side protected by individual skin flaps.

(2) A spiracle behind each eye.

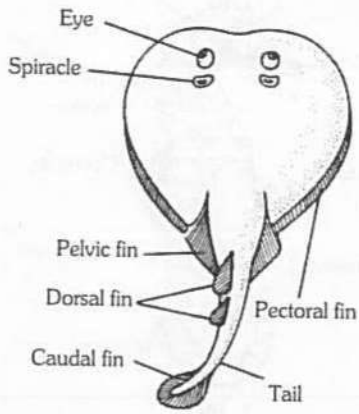
(3) Cloaca present.

Examples : True sharks. Dogfishes (*Scoliodon, Chiloscyllium, Mustelus, Carcharinus*), spiny dogfish (*Squalus*) seven gilled shark (Heptanchus), *Stegostoma, Sphyrna, Rhineodon*. Skates and rays. Skate (*Raja*) *Trygon, Torpedo, Myliobatis, Rhinobatus, Pristis.*

❑ Zebra shark (*Stegostoma*) is the most beautiful fish in the sea.



(a)



(b)

Fig : 1.7-60 (a) *Scoliodon* (b) *Torpedo*

(b) Subclass II. Holocephali : (Gk., holos, entire + kephale, head)

(1) Single gill opening on either side covered by a fleshy operculum.

(2) No spiracles, cloaca and scales.

(3) Jaws with tooth plates.

(4) Single nasal opening.

(5) Lateral line system with open groove. It serves to detect waves in water current.

Examples : *Hydrolagus* (= *Chimaera*).

Class 2. Osteichthyes–(The Bony fishes)

(Gk. osteon = bone; *ichtyes* = fish)

General Characters

(1) Inhabit all sorts of water-fresh, brackish or salt; warm or cold.

(2) Body spindle-shaped and streamlined.

(3) Fins both median and paired, supported by fin rays of cartilage or bone. Tail usually homocercal.

(4) Skin with may mucus glands, usually with embedded dermal scales of 3 types; ganoid, cycloid or ctenoid. Some without scales. No placoid scales.

(5) Endoskeleton chiefly of bone. Cartilage in sturgeons and some other. Notochord replaced by distinct vertebrae Pelvic girdle usually small and simple or absent. Claspers absent.

(6) Mouth terminal or sub terminal. Jaws usually with teeth. Cloaca lacking, anus present.

(7) Respiration by 4 pairs of gill on body gill arches, covered by a common operculum on either side.

(8) An air (swim) bladder often present with or without duct connected to pharynx. Lung-like in some (Dipnoi).

(9) Ventral heart 2-chambered (1 auricle + 1 ventricle). Sinus venosus and conus arteriosus present. Aortic arches 4 pairs. Erythrocytes oval, nucleated. Temperature variable (poikilothermous).

(10) Adult kidneys mesonephric. Excretion ureotelic.

(11) Brain with very small olfactory lobes, small cerebrum and well developed optic lobes and cerebellum. Cranial nerves 10 pairs.

(12) Well developed lateral line system. Internal ear with 3 semicircular canals.

(13) Sexes separate. Gonads paired. Fertilization usually external. Mostly oviparous, rarely ovoviviparous or viviparous. Eggs minute to 12 mm. Cleavage meroblastic. Development direct, rarely with metamorphosis.

Classification of Osteichthyes

(a) **Subclass I. Sarcopterygii :** (Gk., sarcos = fleshy; pterygium = fin)

(1) Paired fins leg-like or lobed. With a fleshy, bony central axis covered by scales.

(2) Dorsal fins 2. Caudal fin heterocercal with an epichordal lobe.

(3) Olfactory sacs usually connected to mouth cavity by internal nostrils or choanae, hence the previous name of subclass, choanichthyes (Gk. *choana* = funnel; *ichthyes* = fish).

(4) Popularly called fleshy or lobe-finned, or air breathing fish. Divided into 2 superorders or orders: Crossopterygii and Dipnoi.

Order 1. **Crossopterygii :** (Gk. crossoi = a fringe ; *pteryx* = fin)

(1) Paired fins lobate. Caudal fin 3–lobed.

(2) Premaxillae and maxillae present.

(3) Internal nares present or absent. Spiracles present.

(4) Air bladder vestigeal.

Example : Primitive fleshy-finned extinct fishes. Single living genus *Latimeria*.

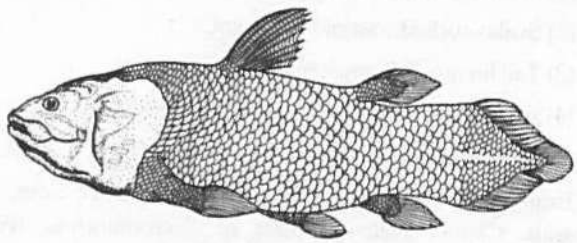


Fig : 1.7-61 *Latimeria*

Order 2. **Dipnoi** : (Gk. *di* = double ; *pnoe* = breathing)

(1) Median fins continuous to form diphycercal tail.

(2) Premaxillae and maxillae absent.

(3) Internal nares present and spiracles absent.

(4) Air bladder single or paired, lung-like

Examples : Lung fishes. Only 3 living genera : *Epiceratodus* (*Neoceratodus*), *Protopterus* and *Lepidosiren*

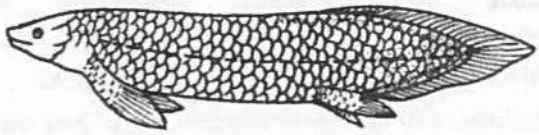


Fig : 1.7-62 *Neoceratodus*

(b) **Subclass II. Actinopterygii** : (Gr. actis = ray; pteryx = fin)

(1) Paired fins thin, broad, without fleshy basal lobes, and supported by dermal fin rays.

(2) One dorsal fin, may be divided.

(3) Caudal fin without epichordal lobe.

(4) Olfactory sacs not connected to mouth cavity.

(5) Popularly called ray-finned fishes. Divided into 3 infraclasses or superorders: Chondrostei, Holostei and Teleostei.

Superorder A. **Chondrostei** : (Gk. chondros = cartilage ; osteon = bone)

(1) Mouth opening large.

(2) Scales usually ganoid.

(3) Tail fin heterocercal.

(4) Primitive ray-finned fish or cartilaginous ganoids.

Examples : *Acepenser* (Sturgeon), *Polyodon* (paddlefish)

Superorder B. **Holostei** : (Gk. holos = entire ; *osteon* = bone)

(1) Mouth opening small.

(2) Ganoid or cycloid scales.

(3) Tail fin heterocercal.

(4) Intermediate ray-finned fish, transitional between Chondrostei and Teleostei

Examples : *Lepisosteus* (garpike)

Superorder C. **Teleostei** – (Gk. *teleos* = complete; *osteon* = bone)

(1) Mouth opening terminal, small.

(2) Scales cycloid, ctenoid or absent.

(3) Tail fin mostly homocercal.

(4) A hydrostatic swim bladder usually present.

(5) Advanced or modern ray-finned fishes

Examples – *Harpodon*, *Cyprinus*, *Labeo rohita*, *Catla*, *Botia*, *Carassius*, *Clarius*, *Heteropneustes* or *Saccobranchus*, *Wallago*, *Mystus*, *Electrophorus*, *Anguilla*, *Muraena* (moray) *Hemirhamphus* (half beak), *Belone* (garfish), Hippocampus (sea horse), *Syngnathus*, *Fistularia Ophiocephalus* or *channa Amphipbnous*, *Symbranchus*. *Mastacembelus*, *Macrognathus*, *Pterois*, *Pleuronectes*, *Synaptura*, *Solea*, *Echeneis* or *Remora*, *Tetrodon*

❑ *Hippocampus* (Sea horse) shows parental care. On the belly of male is a brood pauch for incubating eggs.

❑ *Remora* (*Echeneis*) has modified dorsal fin into a sucker. It attaches to the body of shark, whales, etc. (commensalism).

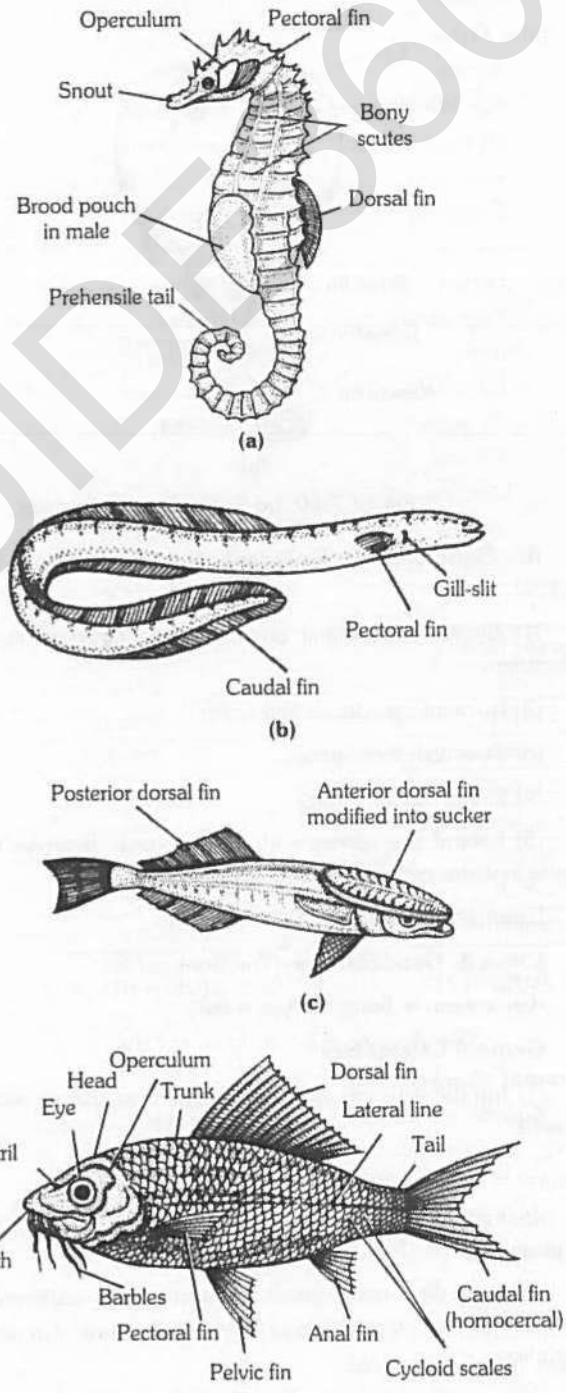


Fig. 1.7-63 : (a) *Hippocampus* (b) *Anguilla* (c) *Echeneis* (d) *Labeo*

Table : 1.7-10 Common Names

Cartilaginous Fishes		
Scoliodon	–	Dogfish (Shark)
Stegostoma	–	Zebra shark (Tigerfish)
Trygon	–	Sting ray
Torpedo	–	Electric ray
Rhinobatus	–	Guitar fish
Pristis	–	Sawfish
Chimaera	–	Rat fish
Bony Fishes		
Clarius	–	Catfish
Echeneis	–	Sucker fish
Hippocampus	–	Sea horse
Gambusia	–	Mosquito fish
Exocoetus	–	Flying fish
Tetradon	–	Globe fish
Diodon	–	Porcupine fish
Cyanoglossus	–	Flatfish
Anabas	–	Climbing fish
Labeo rohita	–	Indian carp
Syngnathus	–	Pipe fish
Fistularia	–	Flute fish
Carassius	–	Goldfish
Anguilla	–	Freshwater eel
Oncorhynchus	–	Pacific salmon

Table : 1.7-11 False Fishes

Common Names	Genus	Phylum
1. Jellyfish	*Aurelia*	Coelenterata
2. Silverfish	*Lepisma*	Arthropoda
3. Crayfish	*Astacus*	Arthropoda
4. Razorfish	*Solen*	Mollusca
5. Cuttlefish	*Sepia*	Mollusca
6. Devilfish	*Octopus*	Mollusca
7. Starfish	*Asterias*	Echinodermata
8. Hagfish	*Myxine*	Chordata

Class Amphibia – The vertebrates with Dual life

(Gk. *Amphi* = both; *bios* = Life)

General characters

(1) Aquatic or semi aquatic (freshwater), air and water breathing, carnivorous, cold–blooded, oviparous, tetrapod vertebrates.

(2) Head distinct, trunk elongated. Neck and tail may be present or absent.

(3) Limbs usually 2 pairs (tetrapod), some limb less toes 4-5 (pentadactyle) or less. Paired fins absent. Median fins, if present, without fin rays.

(4) Skin soft, moist and glandular. Pigment cells (chromatophores) present.

(5) Exoskeleton absent. Digits claw less. Some with concealed dermal scales.

(6) Endoskeleton mostly bony. Notochord does not persist. Skull with 2 occipital condyles. *i.e.* Dicondylic skull.

(7) Mouth large. Upper or both jaws with small homodont teeth. Tongue often protrusible. Alimentary canal terminates into cloaca.

(8) Respiration by lungs, skin and mouth lining. Larvae with external gills which may persist in some aquatic adults.

(9) Heart 3–chambered (2 auricles + 1 ventricle). Sinus venosus present. Aortic arches 1-3 pairs. Renal and hepatic portal systems well developed Erythrocytes large, oval and nucleated. Body temperature variable (poil:ilothermous).

(10) Kidneys mesonephric. Urinary bladder large. Urinary ducts open into cloaca. Excretion ureotelic.

(11) Brain poorly developed. Cranial nerves 10 pairs.

(12) Nostrils connected to buccal cavity. Middle ear with a single rod-like ossicle, columella. Larval forms and some aquatic adults with lateral line system.

(13) Sexes separate. Male without copulatory organ Gonoducts open into cloaca. Fertilization mostly external. Females mostly oviparous.

(14) Development indirect. Cleavage holoblastic but unequal. No extra–embryonic membranes. Larva a tadpole which metamorphoses into adult.

Classification of Amphibia : The living amphibians belong to only 2,500 species, a very much smaller number than that of other principal classes of vertebrates. Ranging from mid-Palaeozoic (Devonian) to early Mesozoic (Triassic). They dominated the World during Carboniferous, but most of them have become extinct since long. The classification most generally followed nowadays was provided by G. Kingsley Noble (1924).

(a) **Subclass I. Stegocephalia (Extinct)** : Limbs pentadactyle. Skin with scales and bony plates. Skull with a solid bony roof leaving openings for eyes and nostrils. Permian to Triassic.

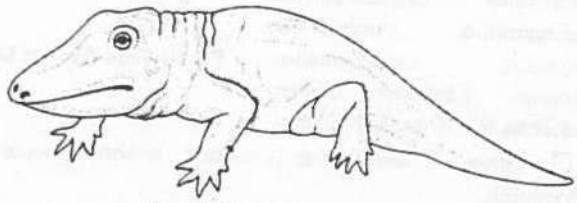


Fig : 1.7-64 Stegocephalia

Order 1. **Labyrinthodontia** : Oldest known tetrapods called stem Amphibia. Carboniferous to Triassic.

Example : *Eryops.*

Order 2. **Phyllospondyli** : Small salamander-like. Carboniferous to permian.

Example : *Branchiosaurs (Ichthyostega).*

Order 3. **Lepospondyli** : Small salamander or eel-like.Carboniferous to Permian.

Examples – *Diplocaulus, Lysorophus.*

(b) **Subclass II. Lissamphibia (living)** : Modern Amphibia lacking dermal bony skeleton. Teeth small, simple.

Order 1. **Gymnophiona or Apoda** : (Gk. gymnos = naked ; ophioneos = serpet-like).

(1) Limb less, blind, elongated worm like, burrowing tropical forms known as caecilians or blind worms.

(2) Tail short or absent, cloaca terminal.

(3) In some dermal scales embedded in skin which is transversely wrinkled.

(4) Skull compact, roofed with bone.

(5) Limb girdle absent.

(6) Males have protrusible copulatory organs,

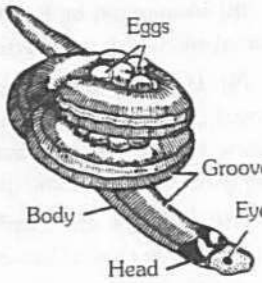


Fig : 1.7-65 *Ichthyophis*

Examples : *Ichthyophis*, *Uroaeoryphlus*, *Rhinatremam*, *Typhlonectes*.

❑ Ichthyophis is a Limb less amphibian showing parental care. It has no tongue.

Order 2. **Urodela or Caudata** : (Gk. Ura = tail ; *delos* = visible) or (L. = cauda = tail).

(1) Lizard-like amphibians with a distinct tail.

(2) Limbs 2 pairs, usually weak, almost equal.

(3) Skin devoid of scales and tympanum.

(4) Gills permanent or lost in adult.

(5) Males without copulatory organs.

(6) Larvae aquatic, adult-like, with teeth.

(7) It mainly includes Newts and Salamanders.

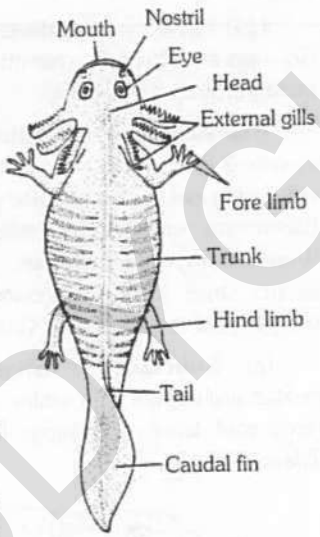


Fig : 1.7-66 *Axolotl* Larva

Examples : *Cryptobranchus*, *Megalobatrachus*, *Ambystoma*, *Salamandra*, *Desmognathus*, *Amphiuma*, *Plethodon*. *Siren*, *Pseudobranchus*, *Triturus*, Necturus.

❑ Larva of *Ambystoma* is axolotl. It shows neoteny or paedogenesis.

❑ The main difference between gymnophiona and urodela is that urodela have smooth moist skin.

Order 3. **Salientia or Anura** : (L., saliens = leaping) or (Gk., an = without ; *nura* = tail)

(1) Specialized amphibia without tail in adults.

(2) Hind limbs usually adapted for leaping and swimming.

(3) Adults without gills or gill openings.

(4) Eyelids well-formed. Tympanum present.

(5) Skin loosely-fitting, scale less; mandible toothless.

(6) Pectoral girdle bony. Ribs absent or reduced. Vertebral column very small of 5–9 pre sacral vertebrae and a slender urostyle.

(7) Fertilization always external.

(8) Fully metamorphosed without neotenic forms.

(9) It mainly includes frogs and toads.

Examples : *Alytes*, *Bombinator*, *Discoglossus*, *Pipa*, *Xenopus*, *Pelobates*, *Scaphiopus*, *Bufo*, *Rhinoderma*, *Dendrobates*, *Hyla*, *Gastrotheca*, *Rana*, *Polypedates* or *Rhacophorus*.

❑ *Bufo* is a poisonous amphibian.

❑ *Bombinator* is famous for warning colouration.

❑ Xenopus is used as a test in diagnosis of human pregnancy.

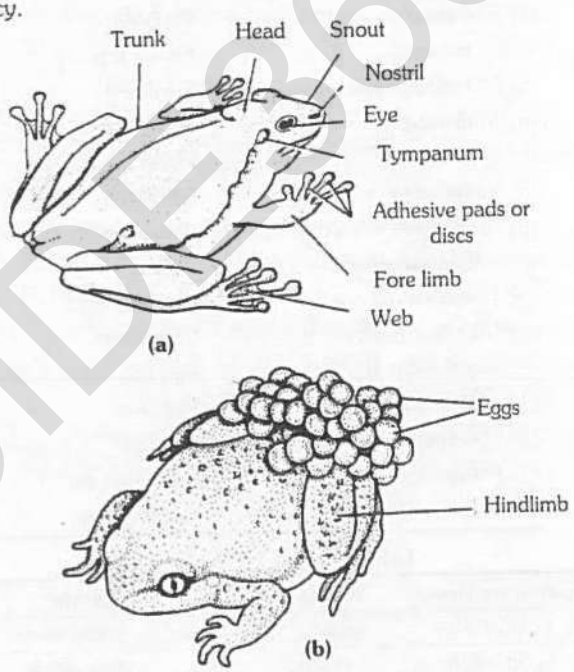


Fig : 1.7-67 (a) *Hyla* (b) *Alytes*

Table : 1.7-12 Common Names

Uraeotyphlus	–	Blindworm
Ichthyophis	–	Caecilian
Ambystoma	–	Tiger salamander
Amphiuma	–	Congo eel
Cryptobranchus	–	Hellbender
Necturus	–	Mud puppy
Proteus	–	Cave salamander
Siren	–	Mud eel
Triton	–	Newt
Salamandra	–	Salamander
Rana tigrina	–	Indian bull frog
Alytes	–	Midwife toad
Bufo melanostictus	–	Indian toad
Pipa	–	Surinam toad
Hyla	–	Tree frog
Rhacophorus	–	Flying frog
Bombinator	–	Fire bellied toad
Xenopus laevis	–	African clawed toad
Ascaphus	–	Bell toad
Astylosternus	–	Hairy frog
Nototrema (Gastrotheca)	–	Marsupial frog

Class Reptilia –The creeping vertebrates

(L. reptare = to creep)

General Characters

(1) Predominantly terrestrial, creeping or burrowing, mostly carnivorous, air–breathing, cold–blooded, oviparous and tetrapodal vertebrates.

(2) Body bilaterally symmetrical and divisible into 4 regions-head, neck, trunk and tail.

(3) Limbs 2 pairs, pentadactyle. Digits provided with horny claws. However, limbs absent in a few lizards and all snakes.

(4) Exoskeleton of horny epidermal scales, shields, plates and scutes.

(5) Skin dry, cornified and devoid of glands.

(6) Mouth terminal. Jaws bear simple conical teeth. In turtles teeth replaced by horny beaks.

(7) Alimentary canal terminates into a cloacal aperture.

(8) Endoskeleton bony. Skull with one occipital condyle (monocondylar). A characteristic T–shaped inter clavicle present.

(9) Heart usually 3–chambered, 4–chambered in crocodiles. Sinus venosus reduced. 2 systemic arches present. Red blood corpuscles oval and nucleated. Cold–blooded.

(10) Respiration by lungs throughout life.

(11) Kidney metanephric. Excretion uricotelic.

(12) Brain with better development of cerebrum than in Amphibia. Cranial nerves 12 pairs.

(13) Lateral line system absent. Jacobson's organs present in the roof of mouth.

(14) Sexes separate. Male usually with a muscular copulatory organ.

(15) Fertilization internal. Mostly oviparous. Large yolky meroblastic eggs covered with leathery shells, always laid on land. Embryonic membranes (amnion, chorion, yolk sac and allantois) appear during development. No metamorphosis. Young resemble adults.

(16) Parental care usually absent

Classification of Reptilia : According to Bogert, there are more than 7,000 living and several extinct species of reptiles, grouped into approximately 16 orders of which only 4 are living.

(a) **Subclass I Anapsida** – Primitive reptiles with a solid skull roof. No temporal openings.

Order 1. **Chelonia or Testudinata** : (Gk. *chelone* = turtle) or (L. *testudo* = turtle)

(1) Body short, broad and oval.

(2) Limbs clawed and/or webbed, paddle-like.

(3) Body encased in a firm shell of dorsal carapace and ventral plastron, made of dermal bony plates. Thoracic vertebrae and ribs usually fused to carapace.

(4) Skull anapsid, with a single nasal opening and without a parietal Foramen. Quadrate is immovable.

(5) No sternum is found.

(6) Teeth absent. Jaws with horny sheaths.

(7) Cloacal aperture a longitudinal slit.

(8) Heart incompletely 4–chambered with a partly divided ventricle.

(9) Copulatory organ single and simple.

(10) About 400 species of marine turtles, freshwater terrapins and terrestrial tortoises.

Examples : *Chelone*, *Chrysemys*, *Testudo*, *Trionyx*, *Dermochelys*.

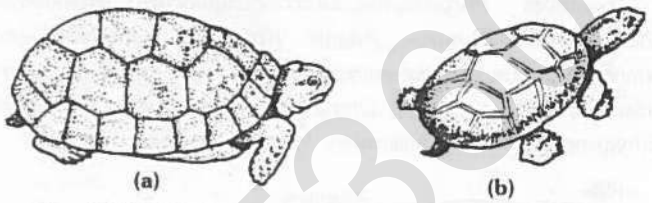


Fig : 1.7-68 (a) Giant tortoise, (b) Snake necked turtle

(b) **Subclass II Euryapsida (extinct)** : Skull with a single dorso–lateral temporal opening on either side bounded below by postorbital and squamosal bones.

(c) **Subclass III Parapsida (extinct)** : Skull with a single dorso–lateral temporal opening on either side bounded below by the supra temporal and post frontal bones.

(d) **Subclass IV Synapsida (extinct)** : Skull with a single lateral temporal opening on either side bounded above by the postorbital and squamosal bones.

(e) **Subclass V Diapsida (Living)** : Skull with two temporal openings on either side separated by the bar of postorbital and squamosal bones.

Order 2. **Rhynchocephalia** : (L. *rhynchos* = snout ; Gk. *kephale* = head)

(1) Body small, elongated, lizard-like.

(2) Skull diapsid. Parietal foramen with vestigeal pineal eye present. Quadrate is fixed.

(3) Vertebrae amphicoelous or biconcave. Numerous abdominal ribs present.

(4) Teeth acrodont. Cloacal aperture transverse.

(5) Heart incompletely 4–chambered.

(6) No copulatory organ is male.

Example : Represented by a single living species, the "Tuatara" or *Sphenodon punctatum* of New Zealand.

❑ Sphenodon is referred to a "living fossil" because it has retained many primitive characteristics of fossil or stem reptiles.

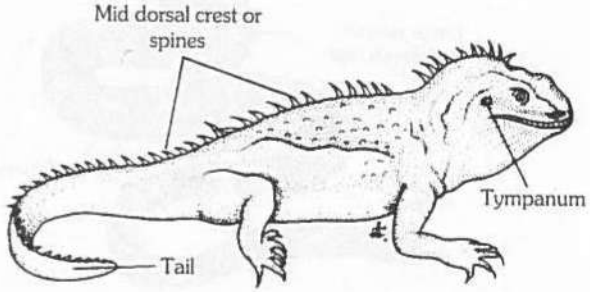


Fig : 1.7-69 Tuatara

Order 3. **Squamata** : (L. *squama* = scale or squamatus = scaly)

(1) Advanced, small to medium, elongated.

(2) Skull diapsid. Quadrate movable.

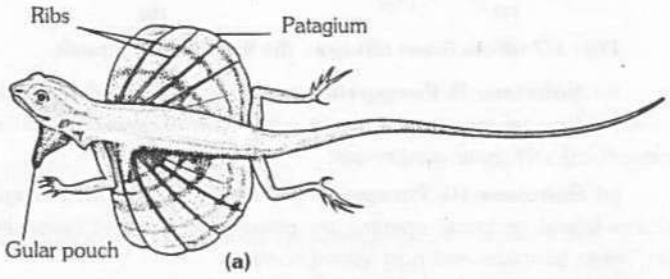
(3) Vertebrae procoelous. Ribs single – headed.

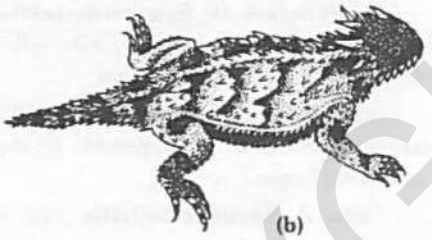
(4) Heart incompletely 4–chambered.

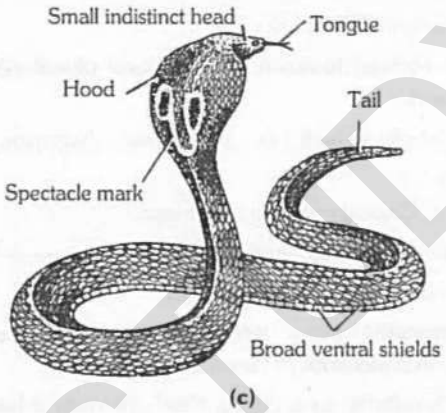
(5) Cloacal aperture is transverse.

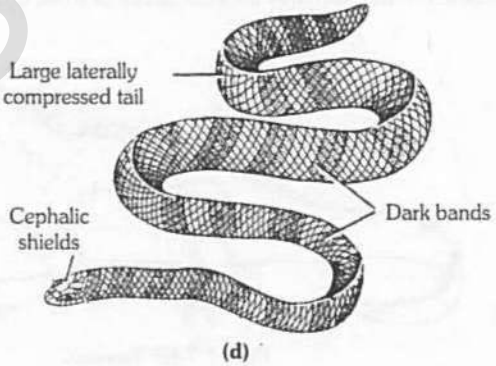
(6) It includes snakes and lizards.

Examples : *Phrynosoma, Draco Hemidactylus, Heloderma, Chameleon, Ophisaurus, Anguis, Rhineura, Barkudia Geko, Iguana, Varanus komodoeusis, Python, Typhlops, Eryx johuii, Naja, Bungarus caeruleus, Dryophis, Vipera russelli. Hydrophis, Enhydrina, Crolatus, Ancistrodon, Micrurus, Lachesis,* etc.









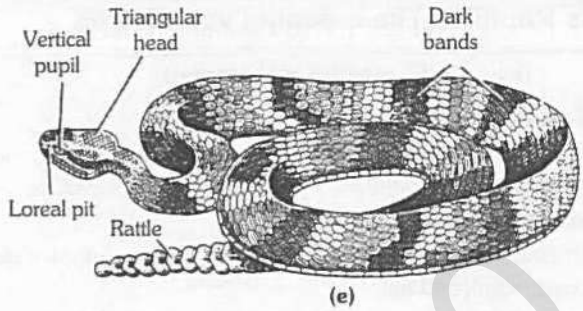


Fig : 1.7-70 (a) *Draco* (b) *Phrynosoma* (c) Indian cobra-*Naja naja* (d) Sea snake-*Hydrophis* (e) Rattle snake *Crotalus horridus*

Order 4. **Crocodilia** : (Gk. *krokodeilos* = Crocodile)

(1) Skin thick with scales bony plates and scutes.

(2) Skull diapsid. Quadrate immovable. No parietal foramen. A pseudopalate present. Pineal gland absent.

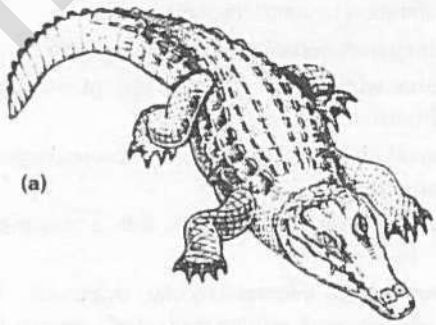
(3) Ribs bicephalous. Abdominal ribs present.

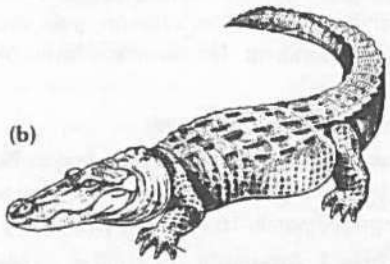
(4) Heart completely 4–chambered.

(5) Cloacal aperture is a longitudinal slit.

Examples : *Crocodylus, Gavialis, Alligator*

❑ The lung cavity of crocodile is separated from rest of body cavity by a muscular diaphragm, analogous to that of mammals.





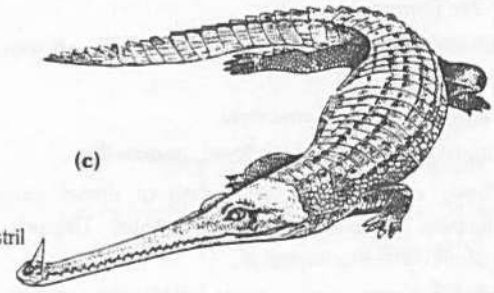


Fig : 1.7-71 (a) *Crocodylus palustris* (Indian freshwater crocodile) (b) *Alligator missisiplensis* (American alligat) (c) *Gavialis gangeticus* (Gavial or gharial)

Table : 1.7-13 Common Names

Testudo	–	Tortoise
Dermochelys	–	Leather back turtle
Trionyx	–	Soft shelled turtle
Chelonia mydas	–	Green turtle
Kachuga	–	Terrapin
Sphenodon	–	Tuatara
Crocodylus	–	Maggar
Alligator	–	Alligator
Gavialis	–	Gharial
Lizards		
Hemidactylus	–	Wall/house lizard
Uromastix	–	Spiny tailed lizard
Calotes	–	Garden lizard
Draco	–	Flying dragon
Phrynosoma	–	"Horned toad"
Mabouia	–	Skink
Varanus	–	Monitor lizard
Heloderma	–	Gila monster
		Beaded lizard
Ophisaurus	–	Glass snake
Anguis	–	Slow worm
		Blindworm
Rhineura	–	Worm lizard
Iguana	–	Collared lizard
Snakes (Nonpoisonous)		
Typhlops	–	Blind snake
Ptyas (Zamenis)	–	Rat snake
Tropidonotus	–	Grass snake
		Pond snake
Lycodon	–	Wolf snake
Dendrophis	–	Tree snake
Dryophis	–	Whip snake
Eryx johnii	–	Sand Boa
Snakes (Poisonous)		
Naja naja	–	Cobra
Naja hannah	–	King cobra
Bungarus	–	Krait
Viper russelli	–	Pitless viper
Ancistrodon	–	Pit viper
Crotalus	–	Rattle snake
Hydrophis	–	Sea snake
Enhydrina	–	Sea snake
Micrurus	–	Coral snake

Class Aves – The Birds

(L. *avis* = bird) or (Gk. ornis = bird)

General Characters

(1) Feather-clad, air-breathing, warm-blooded, oviparous, bipedal flying vertebrates.

(2) Limbs are two pairs. Forelimbs are modified as wings for flying. Hind limbs or legs are large, and variously adapted for walking, running scratching, perching, food capturing, swimming or wading, etc.

(3) Exoskeleton is epidermal and horny.

(4) Skin is dry and devoid of glands except the oil or preen gland at the root of tail.

(5) Pectoral muscles of flight are well developed.

(6) Skull smooth and monocondylic, bearing a single occipital condyle. Cranium large and dome-like. Sutures indistinct.

(7) Vertebral column short. Centra of vertebrae heterocoelous (saddle-shaped).

(8) Sternum large, usually with a vertical, mid ventral keel for attachment of large flight muscles.

(9) Ribs double-headed (bicephalous) and bear posteriorly directed uncinate processes.

(10) Both clavicles and single inter clavicle fused to form a V–shaped bone, called furcula or wishbone or merry-thought bone.

(11) Heart completely 4–chambered. There are neither sinus venosus or truncus arteriosus. Only right aortic (systemic) arch persists in adult. Renal portal system vestigeal. Blood corpuscles nucleated.

(12) Birds are the first vertebrates to have warm blood. Body temperature is regulated (homoiothermous).

(13) Respiration by compact, spongy, nondistensible lungs continuous with thin air-sacs.

(14) Larynx without vocal cords. A sound box or syrinx, producing voice, lies at or near the junction of trachea and bronchi.

(15) Kidneys metanephric and 3–lobed. Ureters open into cloaca. Urinary bladder absent. Birds are urecotelic. Excretory substance of urates eliminated with faeces.

(16) Sexes separate. Sexual dimorphism is well marked in some birds like peacock and parrot.

(17) Fertilization internal, preceded by copulation and courtship. Females oviparous.

(18) Eggs develop by external incubation. Cleavage discoidal, meroblastic. Development direct, Extra-embryonic membranes (amnion, chorion, allantois and yolk-sac) present (Amniota).

(19) Parental care is well marked.

Classification of Aves : Birds show less diversification than any other group of vertebrate animals. 25 to 30 avian orders are recognized depending on the taxonomist. Class Aves is first divided into two subclasses.

(a) **Sub-Class I. Archaeornithes** : (Gk. *archios* = ancient ; *ornithos* = bird)

(1) Extinct, archaic, Jurassic birds of Mesozoic Age, about 155 million years ago.

(2) Wings primitive, with little power of flight.

(3) Vertebrae amphicoelous.

(4) Sternum without a keel.

(5) Thoracic ribs slender, without uncinate processes. In Archacopteryx beak in toothed.

This sub-classes includes a single order

Order **Archaeopterygiformes** : Example : *Archaeopteryx lithographica*, from Jurassic or Bavaria, Germany; one specimen lying in the British museum, London, the other lying in the Berlin.

(b) **Sub-class II. Neornithes** : (Gk. *neos* = modern ; *ornithos* = Birds)

(1) Modern as well as extinct post-Jurassic birds.

(2) Wings usually well-developed and adapted for flight, with few exceptions.

(3) Teeth absent except in some fossil birds.

(4) Vertebrae heterocoelous in living forms.

(5) Sternum usually with a keel.

(6) Thoracic ribs usually with uncinate processes.

(7) Abdominal ribs absent

This sub-class is divisible into 4 super-orders:

Super-order 1. Odontognathae : (Gk. *odontos* = teeth)

(1) Extinct, Upper Cretaceous birds.

(2) Jaws bear teeth, "so advantageous for catching fish".

Order 1. **Hesperornithiformes**

Example – *Hesperornis, Enaliornis, Baptornis,* etc.,

Order 2. **Ichthyornithiformes**

Examples – *Ichthyornis, Apatornis.*

Super-order 2. Palaeognathae or Ratitae : (Gk. *palaios* = *old*; gnathos = jaw) or (L. *ratis* = raft).

(1) Modern big-sized, flightless, running birds, without teeth.

(2) Wings vestigeal or rudimentary; feathers devoid of interlocking mechanism.

(3) Rectrices absent or irregularly arranged.

(4) Oil gland is absent, except in Tinamus and Kiwi.

(5) Skull is dromaeognathous or palaeognathous that is, vomer is large and broad and interpolated between palatines.

(6) Sternal keel vestigeal, absent or flat, raft-like.

(7) Uncinate processes are vestigeal or absent.

(8) Clavicles are small or absent.

(9) Pectoral muscles poorly developed.

(10) Syrinx is absent

The flightless birds or ratites are not represented in India. They are grouped in 7 orders as follows;

Order 1. **Struthioniformes** : (Gk. *struthio* = ostrich + form)

(1) Legs strongly developed, each with two toes (3rd and 4th) with stunted nails.

(2) Pubes form a ventral symphysis.

Examples : True ostriches (Struthio camelus) of Africa and western Asia (Arabia).

Order 2. **Rheiformes** : (Gk. *Rhea* = mother of Zeus + form)

Examples : American ostriches or common rhea (*Rhea americana*) represented by two species in South American pampas; Darwin's rhea (*Pteroncemia pennata*).

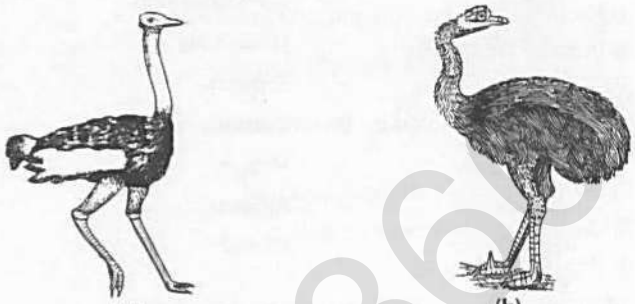


Fig : 1.7-72 (a) Ostrich (b) Rhea

Order 3. **Casuariformes**

Examples : Cassowaries (*Casuarius*) of australia, and New Guinea and Emus (*Dromaius novaehollandiae*) of New Zealand.

Order 4. **Apterygiformes**

Examples : Kiwis (*Apteryx*) of New Zealand.

Order 5. **Dinornithiformes**

Examples : Moas (*Dinornis maximus*) of New Zealand

Order 6. **Aepyornithiformes**

Examples : Giant Elephant-birds (*Aepyornis titan*) *Mulleornis* of Africa and Madagascar.

Order 7. **Tinamiformes**

Examples : Tinamou (*Tinamus*), *Eudromia*

Super-order 3. Impennae

Order 1. **Sphenisciformes**

Examples : Penguins (*Aptenodytes*) Southern Hemisphere.

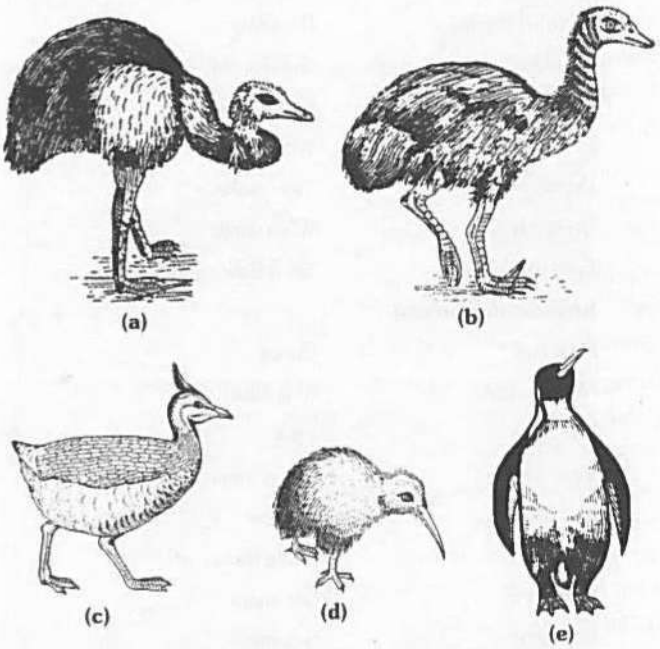


Fig : 1.7-73 (a) Cassowary (b) Emus (c) Tinamou (d) Kiwi (e) Penguin

Super order 4. Neognathae

(1) Most modern, usually small-sized. Flying birds.

(2) Wings well-developed; feathers with interlocking mechanism.

(3) Rectrices present and arranged regularly.

(4) Pterylae are regular.

(5) Oil gland is present.

(6) Skull is neognathous, that is, vomer is short allowing palatines to meet.

(7) Sternum with a well-developed keel.

(8) Uncinate processes are present.

(9) Pygostyle is present

The super-order Neognathae includes several orders. For the sake of study they may be grouped into at least 6 homogenous ecological groups, as follows :

Group A. Arboreal Birds : Under this group may be placed the majority of birds spending most of their lives in and around shrubs and trees.

Order 1. **Passeriformes** : (L. *passer* = sparrow + form)

This is the largest of all the bird orders including half of the known species. Feet are adapted for perching, while beaks are adapted for cutting.

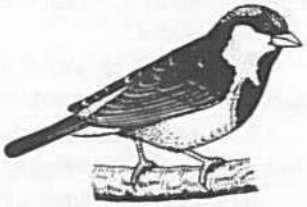


Fig : 1.7-74 House sparrow

Examples : *Passer domesticus*, *Corvus splendens*, common myna (*Acridotheres tristis*).

Order 2. **Piciformes** : (L. *picus* = wood pecker + form) It includes woodpeckers, toucans, sap-suckers and their allies.

Examples : Yellow fronted pied woodpecker (*Dendrocopos mahrattensis*).

Order 3. **Columbiformes** : (L. = *columba* = dove + form) It includes doves and pigeons.

Examples : Blue rock pigeon (*Columba livia*). Green pigeon (*Crocopus*), extinct dodo (*Raphus*).

Order 4. **Psittaciformes** : (L. = *psitacus* = parrot + form)

It includes parrots, parakeets, cockatoos, macaws, love-birds, etc., denizens of the equatorial jungles.

Fig : 1.7-75 Parrot

Examples : Large Indian parakeet (*Psittacula eupatria*), green parrot (*psittacula krameri*).

Group B. Terrestrial Birds : These birds are perfectly able to fly but spend most of their time walking or running on ground.

Order 5. **Galliformes** : (L. *gallus* = a cock + form) It includes gamebirds notable for their palatability, massive scratching feet, short and powerful flight and largely graminivorous diet.

Fig : 1.7-76 Peacock

Examples : Red jungle fowl (*Gallus*), peafowl (*Pavo cristatus*).

Order 6. **Cuculiformes** : (L. = *cuculus* = cuckoo + form) It includes cuckoos and their allies.

Examples : Cuckoo (*Cuculus canorus*), Koel (*Eudynamis scolopaeous*), Crow-pheasant (*Centropus sinensis*).

Group C. Swimming and Diving Birds

Order 7. **Anseriformes** : (L. *anser* = goose + form) Aquatic birds such as geese, swans and ducks belong to this order.

Examples : Wild duck or mallard (Anas), common teal (Nettion crecca), bar-headed goose (*Anser indica*)

Order 8. **Coraciiformes :** (Gk. *korax* = crow or raven + form) It includes kingfishers and their allies.

Fig : 1.7-77 Hoopoe

Examples : White breasted kingfisher (*Halcyon smyrnensis*), *pied kingfisher* (Ceryle rudis), bee eater (*Hoopoe*).

Order 9. **Gaviformes** : (L. *gavia* = sea mew + form) It includes marine birds, called loons (gavia) represented by only four species.

Order 10. **Podicipediformes or Colymbiformes** (Gk. *kolymbos* = diving bird).

It includes grebes (Podicipes), often called divers because of their habits.

Order 11. **Procellariformes** : (L. *Procella* = a tempest + form).

Fig : 1.7-78 Albatross

It includes tube-nosed, long and oily winged seabirds such as albatrosses (Diomedea), Petrels (Procellaria), shearwaters.

Order 12. **Pelecaniformes** : (L. *pelicanus* = pelican + form) It includes pelicans, darters, gannets and cormorants.

Examples : Pelicans (Pelecanus), little cormorant (Phalacrocorax niger)

Group D. Shore Birds and Wading Birds

These aquatic birds seldom swim or dive beneath the water to any great extent.

Order 13. **Charadriiformes** : (NL. *charadrius* = genus of plovers + form) This order includes a rather diverse group of water frequenting shore birds characterized by long wading legs, webbed toes and mudprobing beaks.

Examples : Red wattled lapwing (*Lobivanellus indicus*)

Order 14. **Ciconiiformes** : (L. *ciconia* = a stork + form)

It includes long–legged, marshy wading birds with long snake-like neck and javelin or pincer-like beak for piercing their aquatic prey.

Examples : Cattle egret (*Bubulcus ibis*), heron (*Ardea herodias*), spoonbil (*Platalea leucorodia*), strok (*Ciconia*), flamingo (*Phonicopterus*).

Order 15. **Gruiformes** : (L. grus = crane + form) It includes crane-like wading birds with long legs and partially webbed feet.

Examples : Common coot (*Fulica atra*),

Group E. Birds of Prey

Order 16. **Falconiformes** : (L. falco = falcon + form)

The diurnal birds of prey with sharp hooked beaks and strong curved claws.

Table : 1.7-14 Flightless Birds

Common Names	Genus	Distribution
1. **African ostrich**	*Struthio*	Africa and Arabia
2. **South American**	*Rhea*	South America
3. **Cassowary**	*Casuarius*	Australia and New Guinea
4. **Emu**	*Dromaius*	Australia
5. **Tinamou**	*Tinamus*	South America
6. **Kiwi**	*Apteryx*	New Zealand

Table : 1.7-15 Types of Beaks in Birds

	Type	Example
1.	Seed eating	Sparrow
2.	Cutting	Crow
3.	Fruit eating	Parrot
4.	Insect eating	Hoopoe
5.	Fish eating	Kingfisher
6.	Flower probing	Humming bird
7.	Spatulate	Spoonbill
8.	Water and mud straining	Duck
9.	Tearing and piercing	Eagle and owl

Table : 1.7-16 Types of Feet in Birds

	Type	Example
1.	Perching	Sparrow
2.	Raptorial	Owl
3.	Scratching	Fowl
4.	Swimming	Duck
5.	Running or cursorial	Ostrich
6.	Climbing and clinging	Woodpecker
7.	Wading	Jacana and Heron

Table : 1.7-17 Common Names

Passer domesticus	–	House sparrow
Corvus splendens	–	House crow
Eudynamis scolopaceus	–	Koel
Upupa epops	–	Hoopoe
Pseudogyps bengalensis	–	Bengal vulture
Psittacula eupatria	–	Indian parrot
Psittacula krameri	–	Rose ringed parakeet
Phoenicopterus roseus	–	Flamingo
Pavo cristatus	–	Peacock or Mor
Milvus migrans	–	Kite
Bubo bubo	–	Great horned owl
Dinopium benghalensis	–	Woodpecker
Columba livia	–	Common rock pigeon

Class-Mammalia

(L. *mamma = breast*)

General characters

(1) Hair-clad, mostly terrestrial, air-breathing, warm blooded, viviparous, tetrapod vertebrates.

(2) Limbs 2 pairs, pentadactyle, each with 5 or fewer digits. Hind limbs absent in cetaceans and sirenians.

(3) Exoskeleton includes lifeless, horny, epidermal hairs, spines, scales, claws, nails, hoofs, horns, bony dermal plates, etc.

(4) Skin richly glandular containing sweat, sebaceous (oil) and sometimes scent glands in both the sexes. Females also have mammary glands with teats producing milk for suckling the young.

(5) Endoskeleton thoroughly ossified. Skull dicondylic having 2 occipital condyles. Cranium large. A single zygomatic arch present. Pterygoids small, scale-like. Otic bones fused into periotic which forms tympanic bulla with tympanic. Each half of lower jaw made of a single bone, the dentary, articulating with squamosal of skull Vertebrae with terminal epiphyses and flat centra (acoelous). Cervical vertebrae usually 7. Ribs bicephalous. Coracoid vestigial.

(6) Teeth are of several types (heterodont), borne is sockets (thecodont) and represented by two sets (diphyodont).

(7) Respiration always by lungs (pulmonary). Glottis protected by a fleshy and cartilaginous epiglottis. Larynx contains vocal cords.

(8) Heart 4-chambered with double circulation.

(9) Kidneys metanephric.

(10) Brain highly evolved. Both cerebrum and cerebellum large and convoluted. Optic lobes small and 4 in number called corpora quadrigemina. Corpus callosum present connecting both cerebral hemispheres. Cranial nerves 12 pairs.

(11) Senses well developed. Eyes protected by lids, the upper of which is movable. External ear opening protected by a large fleshy and cartilaginous flap called pinna. Middle ear cavity with 3 ear ossicles–malleus, incus and stapes. Cochlea of internal ear spirally coiled.

(12) Sexes separate.

(13) Fertilization internal preceded by copulation.

(14) Except egg-laying monotremes, mammals are viviparous, giving birth to living young ones.

(15) Development uterine.

Classification of Mammalia : Mammals have been thoroughly described and adequately classified. The main characters forming the basis of their classification into orders include :

(1) Mode of caring of their young,

(2) Nature of dentition

(3) Foot posture,

(4) Nails, claws and hoofs,

(5) Complexity of nervous system and

(6) Systematics.

(a) **Subclass I prototheria** : (Gk. protos = first ; therios = beast).

(1) Primitive, reptile-like, oviparous or egg-laying mammals.

(2) Mammary gland without nipples.

(3) External pinna absent.

(4) Corpus callosum not found.

(5) Adult without teeth, they bear horny beak.

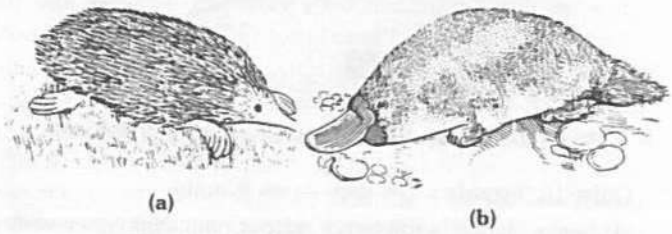
(6) Testes abdominal.

(7) Female without uterus and vagina.

It has only one order :

Order **Monotremata** : (Gk. monos = single ; trema = opening), Cloacal opening present Confined to Australian Tasmania and New Guinea region.

Examples : *Monotremes*. Platypus or duckbill (*ornith orhynchus*) spiny anteater (*Tachyglossus* = Echidna).



(a) (b)

Fig : 1.7-79 (a) *Echidna*, (b) *Ornithorhynchus*

(b) **Sub class II. Theria** : (Gk. *ther*, = animal)

Subclass Theria is divided into two infraclasses : Metatheria and Eutheria.

Infraclass 1. Metatheria : (Gk. meta = between or after)

(1) Metatherians are pouched mammals; young born in very immature state.

(2) Corpus collosum absent.

(3) Ovoviviparous.

(4) Epipublic bone present.

(5) Vagina and uterus are double.

Order 2. **Marsupialia** : (Gk. *marsypion* = pouch).

(1) Born in a very immature state, and complete their development attached to teats or nipples in the abdominal pouch or marsupium. (2) Usually 3 premolars and 4 molars in each jaw on either side. (3) Vagina double

Examples : Opossum (*Didelphis*). Kangaroo (*Macropus*), koala (*Phascolarctos*)

❑ Kangaroo is the native of Australia.

Fig : 1.7-80 Kangaroo

Infraclass 2. Eutheria : (Gk. eu = true ; *therios* ; *beast*)

(1) Higher viviparous placental mammals without marsupium.

(2) Corpus callosum present in brain.

(3) Nipples are present in mammary gland.

(4) Young born in a relatively advanced stage.

(5) Cloaca absent but anus present.

(6) Dentition never exceeds $\frac{3.1 4.3}{3.1 4.3} = 44$. On the basis of characteristics like skull, teeth and limbs, eutheria is arranged into 16 orders.

Order 1. **Insectivora** : (L. insectum = insect ; *vorare* = to eat)

(1) Small mammals with long pointed snout.

(2) Feet plantigrade, usually 5–toed, with claws.

(3) Molars with pointed, peg-like cusps for insect feeding.

Examples : *Talpa*, *Sorex*, *Solenodon*, *Erinaceus*, *Paraechinus*

Order 2. **Dermaptera** : (Gk. derm = skin ; *pteron* = wing).

(1) Nocturnal in trees.

(2) A gliding mammal called flying lemur, resembling a flying squirrel. Membranous skin fold is present which help the animals in gliding from one tree to another.

Examples : One living genus *Cynocephalos* (= *Galaeoithecus*) with 2 species from South eastern Asia.

Order 3. **Chiroptera** : (Gk. Cheiros = hand ; *pteron* = wing)

(1) Flying mammals or bats in which forelimbs are modified into wings.

(2) Hind legs short and included in wing membrane.

(3) Second and third digits greatly longated supporting the skin fold forming the flight membrane.

(4) Eyes are small and vision weak.

(5) Ears have large pinnae.

(6) Radar system present.

(7) Nocturnal

(8) These may be food eating, insect eating or blood sucking in feeding habit.

Examples : *Pteropus*, *Rhinolophus*, *Desmodus*

Order 4. **Edentata** : (L. edentatus = toothless) Teeth absent or reduced to molars. Without enamel. These are nocturnal and herbivorous. Testes are abdominal.

Examples : *Myrmecophaga*, *Dasypus*, *Bradypus*.

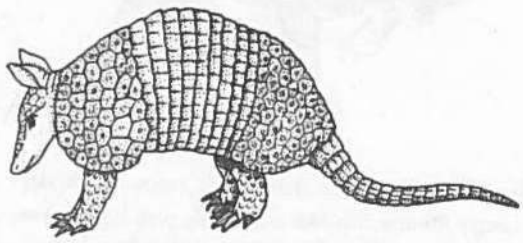


Fig : 1.7-81 Armadillo

Order 5. **Pholidota** : (Gk. pholis = a scale)

(1) Body covered with large overlapping scales with sparse hair in between. No teeth.

(2) Tongue long and protrusible, used to capture insects.

Examples : Single genus of scaly anteaters pangolins (*Manis*)

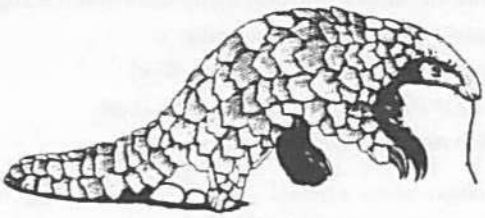


Fig : 1.7-82 Pangolin

Order 6. **Rodentia** : (L. rodo = gnaw).

(1) Largest order including usually small gnawing mammals.

(2) Each jaw with one pair of long, rootless, chisel-like incisors growing throughout life.

(3) Canine absent.

Examples : *Rattus* (House rat), *Mus, Funambulus* (Squirrel).

Order 7. **Lagomorpha** : (Gk. logos = hare ; *morphe* = form)

With a second pair of small upper incisors behind first pair of large chisel like incisors. No canines.

Examples : *Oryctolagus* (Hare), *Lepus* (Rabbit), *Ochotona*.

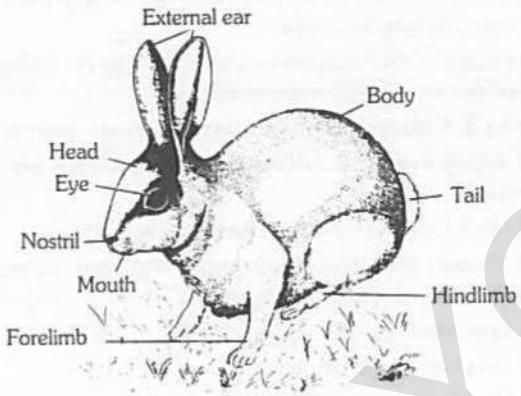


Fig : 1.7-83 Rabbit

Order 8. **Carnivora** : (L. caro = flesh ; *vorare* = to eat) Small to large predatory, flesh-eating mammals.

Examples : *Canis familiaris, C. lupus, C. aureus, Odobenus, Phoca, Panthera tigeris.*

Fig : 1.7-84 Tiger

Order 9. **Cetacea** : (Gk. ketos or L. cetus =a whale)

(1) Large marine fish-like mammals well adapted for aquatic life pectoral limbs modified into broad paddle-like flippers.

(2) Tail divided in two broad horizontal fleshy flukes with a notch, used in propulsion.

(3) No claws, no hind limbs and no external ears.

(4) Mostly gregarious and carnivorous. The living Cetacea are divided into two suborders Odontoceti (toothed whales) and Mysticeti or Mystacoceti (whalebone whales).

Examples : *Phocaena, Orcinus* (Killer whale), *Delphinus* (Dolphins), *Platanista Physeter, Balenoptera* (Blue whale).

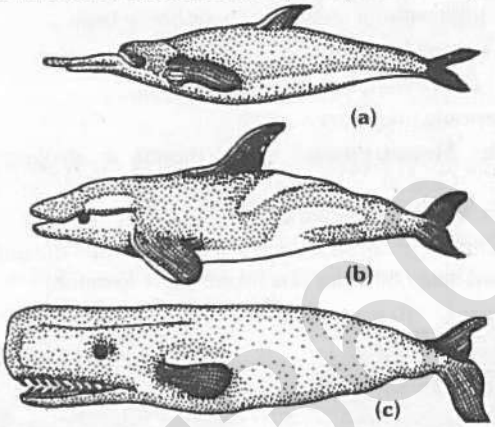


Fig : 1.7-85 (a) Dolphin, (b) Whale, (c) Sperm Whale

Order 10. **Sirenia** : (Gk. siren = sea nymph).

(1) Large, clumsy herbivorous, aquatic mammals with paddle-like forelimbs, no hindlimbs and a flattened tail with horizontal lateral fleshy flukes with or without a notch.

(2) No external ears.

(3) Muzzle blunt. Hairs few.

(4) Stomach complex.

(5) Inhabit estuaries and coastal sea.

Examples : *Trichechus* (Manatees), *Dugong* (*Halicore*), recently extinct Steller's sea-cow (Rhytina).

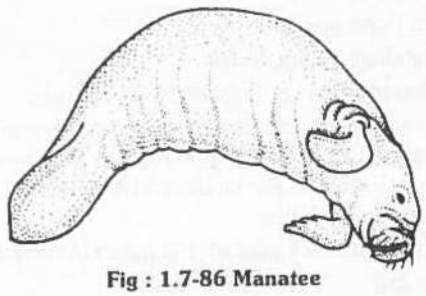


Fig : 1.7-86 Manatee

Order 11. **Tubulidentata** : (L. tubulus Tube like ; dens = tooth) With tubular mouth tongue protrusible, no incisor or conines, limbs clawed and adapted for digging ant and termites nests.

Examples : Single genus of pig-like aardvark or Cape anteater (Orycteropus) of South Africa.

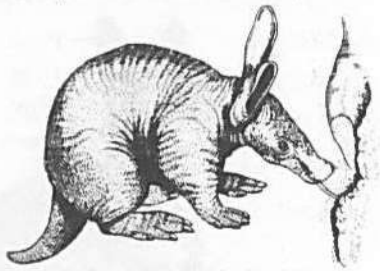


Fig : 1.7-87 Aardvark

Order 12. **Proboscidea :** (Gk. pro = in front ; *boskein* = to eat)

(1) Largest living land animals having large heads, massive ears, thick practically hairless skins (pachyderm).

(2) Bulky straight legs and 3 to 5 toes with small, nail like hoofs.

(3) Conspicuous feature is the nose and upper lip modified as an elongated flexible proboscis or trunk. 2 upper incisors elongated as ivory tusks.

(4) Cheek teeth lophodont.

Examples : *Elephas maximus* (Indian elephant), *Loxodonta africana* (African elephant), Elephas cyclotis.

Order 13. **Hyracoidea** : (Gk. hyrax = shrew ; *eidos* = form)

Small, guinea-pig like mammals distantly related to elephants. No canines. Cheek teeth lophodont.

Example : *Hyrax* (*Procavia*) from S. Africa, Syria and Arabia.

Order 14. **Perissodactyla** : (Gk. perissos = odd ; *dactylos* = toes)

The odd-toed hoofed mammals or ungulates have an odd number of toes (1 or 3) incisors present in both jaws.

Examples : *Equus cabalus* (Horse), *Equus asinus* (Ass), *Equus zebra* (Zebra)

Order 15. **Artiodactyla** : (Gk. artios = even ; *dactylos* = digit)

(1) The even-toed hoofed mammals having an even number of toes (2 or 4)

(2) Incisors and canines in upper jaw usually lacking.

(3) Stomach 4 – chambered.

(4) Many with antlers or horns.

Examples : *Sus*, *Hippopotamus amphibius*, *Camelus*, *Cervus*, *Moschus*, *Ovis*.

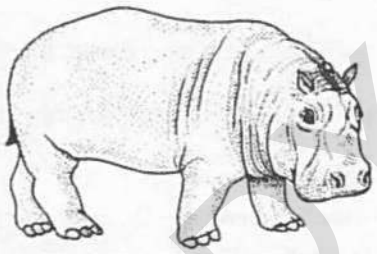


Fig : 1.7-88 *Hippopotamus*

Order 16. **Primates** : (L. primus = of the first rank)

(1) Generalized or primitive mammals except for the great development of brain.

(2) Mostly arboreal.

(3) First digit usually opposable, an adaptation for grasping.

(4) Eyes typically large and turned farward.

Example – *Gibbon*, *Mandrillus*, *Chimpanzee*, *Ateles*, etc.

(a) (b)

Fig : 1.7-89 (a) Gibbon, (b) Chimpanzee

Table : 1.7-18 Common Names

Canis familiaris	–	Dog
Felis domestica	–	Cat
Panthera leo	–	Lion
Panthera tigris	–	Tiger
Acinonyx jubatus	–	Cheetah
Lutra	–	Otter
Herpestes	–	Mongoose
Trichechus	–	Manatee
Halicore	–	Dugong
Equus caballus	–	Horse
Equus asinus	–	Ass
Rhinoceros unicornis	–	Indian rhinoceros
Diceros bicornis	–	African rhinoceros
Tapirus Indicus	–	Malayan Tapir
Hippopotamus amphibius	–	Hippopotamus
Camelus dromedarius	–	Arabian camel
Cervus	–	Red deer
Giraffa camelopardalis	–	Giraffe
Sus scrofa	–	Wild boar
Bubalus bubalis	–	Water buffalow
Ateles paniscus	–	Spider monkey
Macaca mulatta	–	Rhesus monkey
Macaca silenus	–	Lion-tailed macaque
Hylobates lar	–	Gibbon
Papio	–	Baboon
Presbytis	–	Langur
Pongo	–	Orang-utan
Pan	–	Chimpanzee

Tips & Tricks

- Pelagic animals : Animals living in open water and include both zooplanktons and nektons.
- Nektons are those animals which actively swim in open water while neustons are those animals which float or swim in surface water. Neritic are the animals found in coastal water.
- Archaeocyte cells of sponges are totipotent cells.
- Dermal ostia of sponges are analogous to mouth, while osculum is analogous to anus.
- Olynthus stage : It is a stage present during the development of all syconoid sponges. It is a hypothetical ancesters of sponges.
- Hilsa is the only Indian fish that migrates from the seas to the river for breeding.

- Stone fish is the most poisonous fish.
- Bombay duck is a bony fish.
- Seabass (Diploprion) is hermaphrodite fish.
- Ampullae of Lorenzini are peculiar sense organs on their snout to note the thermal change in water.
- Lateral line is with neuromast organs which have rheoreceptors and note changes in water currents.
- Electric organs of Torpedo are modified muscles. These produce an electric current of 50-60 volts.
- All the cartilaginous fishes are marine, while bony fishes are either marine or fresh-water.
- Pectoral fins of fishes act as balancers, pelvic fins as brakes and caudal fin as steering organ in locomotion.
- Echeneis (Sucker fish or Remora) : Dorsal fin is modified into sucker. It shows commensalism with sharks, whale, etc. as is attached on their ventral side by its sucker for dispersal.
- Latimeria (Coelacanth) : A lobe-finned bony fish and is about 70 million years old. First reported by Miss Latimer. Called living fossil.
- The Arrow poison frogs secrete a powerful poison from their skin which can cause instant death.
- Golden dart poison frog from South America is the most poisonous frog. One adult frog contains enough poison to kill 2200 people.
- Largest amphibians. Japanese Giant Salamander which grows to a length of 1.6 m. Smallest amphibian. One of the South American arrow poison frogs, which measures upto 1.3 cm.
- Amphiuma (Congo-eel) – Has largest sized RBCs (75 μm). It has gill slits but no gills, called derotremetons condition.
- Rhacophorus (Flying frog) – Glides on the support of webs. Also has adhesive discs on digits.
- Hyla (Tree frog) – Climbs up the tree with adhesive discs on the tips of digits. Skin is with hygroscopic glands.
- Salamandra (Spotted Salamander) – Viviparous amphibian.
- The king cobra of India is the only snake in the world that builds a nest.
- Most poisonous snake-king cobra.
- Fangs of poisonous snake are maxillary teeth.
- Largest snake-python/Anaconda, may grow upto 10 meter in length.
- Smallest snakes. Thread snake, less than 2 cm. in length.
- Seymouria It was one such ancestral reptile which probably started laying eggs on land in the permian period. It was a lizard like sluggish creature. It was a "connecting link" between amphibian and reptiles.
- Anguis (European glass snake-limbless-lizzard), chameleon pumilus, russelli (the Russell's viper), Hydrophis (sea snake)-All are viviparous.
- T.H. Huxley said "birds are glorified reptiles". The feathers are highly modified reptilian scales. Birds have scales on their legs. Their eggs resemble reptilian eggs in general but have a calcareous shell.
- Humming bird is the only bird which can fly backward as well as forward.
- Kiwi lays the largest egg in proportion to its own size.
- Vision and hearing are the most highly developed senses in a bird.
- Famous Indian Ornithologist – Dr. Salim ali. He was known as "Bird man of India".
- Keoladeo Ghana National Park, Bharatpur, Rajasthan and Chilka lake Bird sanctuary Balagaon, Orissa are famous of birds.
- The Indian one horned Rhinoceros is the second largest land animal in India.
- Walrus – Marine carnivore. Its tusks are upper canines and are used for digging to locate molluscs.
- Koala Bear lives without water on Eucalyptus leaves. The water in the leaves meets its requirement of water.
- Kangaroo rat never drinks water in its entire life.
- Giant panda is one of the rarest animals in the world. Pandas rarely breed in captivity. Giant pandas live only in high mountains of China.

Ordinary Thinking

Objective Questions

Important terms and classification of animals

1. Larva is found in [Odisha JEE 2008]
(a) Vertebrates (b) Invertebrates
(c) Both (a) and (b) (d) None of these

2. Poikilotherms are also known as [Odisha JEE 2008]
(a) Isotherm (b) Ectotherm
(c) Endotherm (d) Heterotherm

3. Animals/organisms floating on the surface of water are [CBSE PMT 1998; BHU 1998, 2001]
(a) Plankton (b) Pelagic
(c) Benthon (d) Neritic

4. The body of the animal can be divided into identical halves in only one plane is [J & K CET 2010]
(a) Asymmetry (b) Bilateral symmetry
(c) Radial symmetry (d) Biradial symmetry

5. Radial symmetry occurs in [HPMT 1995; Chd. CET 2003; MP PMT 2006]
(a) Fishes (b) Molluscs
(c) Star Fishes (d) Sponges

6. The space between body wall and alementary canal lined by mesoderm is called [J & K CET 2010]
(a) Acoelom (b) Pseudocoelom
(c) Coelom (d) None of these

7. In coelomates, the problem of diffusion of food from gut to tissues is solved by [EAMCET 2009]
(a) The presence of coelomic fluid
(b) Churning the food within the body cavity
(c) Developing a circulatory system
(d) Developing gut associated glands

8. Trochophore larva occurs in [BHU 1995; Odisha JEE 2005]
(a) Annelida and Porifera
(b) Coelenterata and Annelida
(c) Mollusca and Coelenterata
(d) Annelida and Mollusca

9. An animal which comes out at night and hides during day time is [CPMT 1998]
(a) Diurnal (b) Nocturnal
(c) Cursorial (d) Arboreal

10. Parasites capable of living without a host are called [Odisha JEE 2005]
(a) Facultative (b) Permanent
(c) Obligate (d) None of these

11. Enterocoelous coelom is found in [Odisha JEE 2005]
(a) Deuterostomia (b) Astomia
(c) Protostomia (d) Blastostomia

12. Non-chordates have [BCECE 2005]
(a) Notocord
(b) Dorsal tubular nerve chord
(c) Pharyngeal gills cleft
(d) Absence of hepatic portal system

13. Cell aggregate plan is found in [AFMC 1997]
(a) Cnidarians (b) Sponges
(c) Roundworms (d) Flatworms

14. Which of the following statements is false [Kerala CET 2005]
(a) Male roundworm is smaller than female
(b) Earthworms are hermaphrodite
(c) Echinoderms are protostomous coelomates
(d) Human teeth are anatomically comparable to scales of shark
(e) Hair is derivative of skin

15. Which of the following phylum are included in enterozoa [RPMT 2001]
(a) Annelida, Mollusca, Porifera
(b) Echinodermata, Hemichordata, Porifera
(c) Mollusca, Arthropoda, Hemichordata
(d) Porifera, Mollusca, Arthropoda

16. Tube-within-a-Tube body plan is shown by
(a) Coelenterates
(b) Platyhelminthes
(c) Aschelminthes (Nemethelminthes)
(d) Porifers

17. Cold-blooded animals fall under the category of [DUMET 2010]
(a) Ectotherms (b) Psychrotherms
(c) Endotherms (d) Thermophiles

18. Blind sac body plan is shown by
(a) Roundworms (b) Annelids
(c) Coelenterates (d) Arthropods

19. What is characteristic of deuterostomes [DPMT 2001]
(a) Spiral cleavage, blastopore becoming mouth
(b) Radial cleavage, blastopore becoming anus
(c) Spiral cleavage, blastopore becoming anus
(d) Radial cleavage, blastopore becoming mouth

20. Mouth develops first in the embryo and anus is formed later in [BHU 2012]
(a) Deuterostomes (b) Protostomes
(c) Echinoderms (d) Chordates

21. Which of these statements are incorrect
(i) Parapodia are lateral appendages in arthropods used for swimming
(ii) Radula in molluscs are structures involved in excretion
(iii) Aschelminthes are dioecious
(iv) Enchinoderm adults show radial symmetry
(v) Ctenophorans are diploblastic [Kerala PMT 2011]
(a) (i) and (ii) (b) (i) and (iii)
(c) (i), (iv) and (v) (d) (iii) and (v)
(e) (ii), (iii) and (iv)

22. In which triploblastic animal coelom is absent [WB JEE 2008, 11]
(a) Platyhelminthes (b) Aschelminthes
(c) Annelida (d) Arthropoda

23. On the basis of organisation, animals are grouped into [MP PMT 1997]
(a) Metazoa and Eumetazoa (b) Protozoa and Metazoa
(c) Protozoa and Parazoa (d) Parazoa and Metazoa

24. Radial symmetry occurs in **[Chd. CET 1997; AFMC 2000; Kerala CET 2007]**
(a) Porifera and Coelenterata
(b) Coelenterata and Echinodermata
(c) Coelenterata and Platyhelminthes
(d) Arthropoda and Mollusca

25. Coelom produced by splitting of mesoderm is **[CPMT 1997]**
(a) Hydrocoel (b) Enterocoel
(c) Schizocoel (d) None of the above

26. Which one of the following does not have larvae in its life cycle **[Pb. PMT 1997]**
(a) Prawn (b) Earthworm
(c) Crab (d) Cockroach

27. Coelom is cavity between alimentary canal and body wall enclosed by **[CBSE PMT 1996; JIPMER 1997; JKCMEE 2002; J & K CET 2005]**
(a) Ectoderm and endoderm (b) Mesoderm and ectoderm
(c) Ectoderm on both sides (d) Mesoderm on both sides

28. Tiny free living animals on the surface of water constitute **[KCET 1999]**
(a) Zooplankton (b) Phytoplankton
(c) Benthon (d) Symbionts

29. From the following statements select the wrong one **[CBSE PMT 2005]**
(a) Millipedes have two pairs of appendages in each segment of the body
(b) Prawn has two paris of antennae
(c) Animals belonging to phylum porifera are exclusively marine
(d) Nematocysts are characteristic of the phylum cnidaria

30. An enterocoelomate invertebrate group is **[APMEE 1999]**
(a) Annelida (b) Echinodermata
(c) Arthropoda (d) Mollusca

31. Schizocoelomates and enterocoelomates are **[AFMC 2006]**
(a) Acoelomates (b) True coelomates
(c) Invertebrates (d) Echinoderms only

32. Metameric segmentation is the characteristic of **[NCERT; [HPMT 1993; CBSE PMT 2006]**
(a) Annelida and Arthropoda
(b) Mollusca and chordata
(c) Platyhelminthes and Arthropoda
(d) Echinodermata and Annelida

33. A radially symmetrical diploblastic animal is **[AFMC 1993]**
(a) Roundworm (b) Earthworm
(c) *Hydra* (d) Liver Fluke

34. Radial symmetry is often exhibited by animals having **[CBSE PMT 1994, 96, 97]**
(a) One opening of alimentary canal
(b) Aquatic mode of living
(c) Benthos/sedentary nature
(d) Ciliary mode of feeding

35. Arboreal mammals have **[Pb. PMT 1999]**
(a) Jumping character (b) Burrowing character
(c) Climbing character (d) Flying character

36. In contrast to annelids the Platyhelminthes show **[NCERT; CBSE PMT 2005]**
(a) Radial symmetry (b) Presence of pseudocoel
(c) Bilateral symmetry (d) Absence of body cavity

37. Animal with pseudocoelom is **[RPMT 2000; DPMT 2001; Kerala PMT 2006]**
(a) *Amia*/Leech (b) *Lepisma*/Liver Fluke
(c) Dragon Fly/Jelly Fish (d) *Wuchereria*/Hookworm

38. Pseudocoelom develops from **[CBSE PMT 1994; CPMT 2002; RPMT 2005]**
(a) Blastopore lip (b) Archenteron
(c) Embryonic mesoderm (d) Blastocoel

39. A true coelom is absent in phylum
Or
Which of the following is pseudocoelomate **[Odisha JEE 2009]**
(a) Nematoda (b) Annelida
(c) Echinodermata (d) Mollusca

40. True coelom or body cavity occurs in **[NCERT]**
(a) *Hydra* (b) *Taenia*
(c) *Pheretima* (d) *Sycon*

41. Veliger larva occurs in phylum **[DPMT 2001]**
(a) Mollusca (b) Echinodermata
(c) Arthropoda (d) Cnidaria

42. Cell-tissue organisation occurs in **[CBSE PMT 2000]**
(a) Liver fluke (b) Sponge
(c) *Hydra* (d) Starfish

43. A list of animals is given below. Identify the animals with open circulatory system and choose the correct answer.
(A) *Ascidia* (B) Cockroach
(C) Earthworm (D) Prawn
(E) Silverfish (F) Snail
(G) Squid
[Kerala CET 2002, 05; AMU (Med.) 2005]
(a) B, D, F (b) A, B, D, F
(c) C, D, E, G (d) B, D, E, F
(e) A, B, D, F, G

44. Besides Annelida and Arthropoda metamerism is found in **[NCERT; CBSE PMT 1995]**
(a) Cestoda (b) Acanthocephala
(c) Chordata (d) Mollusca

45. Organisms attached to substratum generally possesses **[CBSE PMT 1995; AIIMS 1999]**
(a) Asymmetrical body
(b) Radial symmetry
(c) One single opening of digestive canal
(d) Cilia on the surface to create water current

Phylum-Porifera

1. Which one of the following categories of animals, is correctly described with no single exception in it **[NCERT; CBSE PMT (Mains) 2012]**
(a) All reptiles possess scales, have a three chambered heart and are cold blooded (poikilothermal)
(b) All bony fishes have four pairs of gills and an operculum on each side
(c) All sponges are marine and have collared cells
(d) All mammals are viviparous and possess diaphragm for breathing

2. Tissues are absent in the body of **[CPMT 2009]**
(a) Sponge (b) Annelida
(c) Platyhelminthes (d) Arthropoda

3. Which is not correct for sponges **[Odisha JEE 2009]**
(a) Internal fertilization
(b) External fertilization
(c) Gemmule formation
(d) Gametes are formed from epidermal cells

4. Ostia is present in **[Odisha JEE 2011]**
(a) Poriferans (b) Coelenterates
(c) Annelids (d) Molluscs

5. In porifera, skeleton forming cells are **[MP PMT 2000; Odisha JEE 2012]**
(a) Sclerocytes (b) Archaeocytes
(c) Thesocytes (d) Amoebocytes

6. Glass Rope sponge is **[BVP 2000]**
(a) *Hyalonema* (b) *Euplectella*
(c) *Scypha* (d) *Spongilla*

7. Sponges structure corresponding to mouth of other animals is **[BHU 1999]**
(a) Incurrent canal (b) Ostium
(c) Osculum (d) Excurrent canal

8. The most distinctive character of sponge is **[EAMCET 1998]**
(a) Presence of choanocytes (b) Unicellular
(c) Marine (d) Asexual reproduction

9. Canal system is a characteristic of **[CPMT 1996; CBSE PMT 1999; RPMT 1999; BHU 2000, 02; Odisha JEE 2011]**
(a) *Hydra* (b) Sponge
(c) Sea anemone (d) Sea urchin

10. Common bath sponge is **[CBSE PMT 1995; MP PMT 2002]**
(a) Spongilla (b) Euspongia
(c) Leucosolenia (d) Sycon

11. Body having meshwork of cell, internal cavities lined with food filtering flagellated cells and indirect development are the characteristics of phylum
(a) Porifera (b) Mollusca
(c) Protozoa (d) Coelenterate

12. In *Leucosolenia*, digestion takes place in the
(a) Paragastric cavity (b) Stomach
(c) Osculum (d) Food vacuole

13. *Parenchymula* (sponges free swimming larva) is the larva of **[EAMCET 1998; CPMT 2000]**
(a) *Hydra* (b) *Ascaris*
(c) *Pheretima* (d) *Leucosolenia*

14. Sponges are **[BVP 2003]**
(a) Sessile (b) Planktonic
(c) Free-swimming (d) Pelagic

15. Which sponge is given as a gift in Japan **[CPMT 1998]**
(a) *Hyalonema* (b) *Euplectella*
(c) *Tethya* (d) *Leucosolenia*

16. Water currents in *Leucosolenia* are produced by **[AIIMS 1999; BHU 1999; DPMT 1999; HPMT 2002]**
(a) Choanocytes (b) Pinacocytes
(c) Archaeocytes (d) Thesocytes

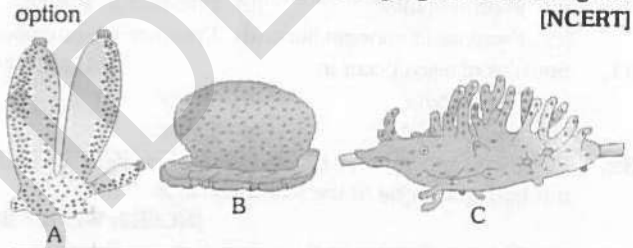
17. Members of phylum porifera are **[CBSE PMT 2000; AFMC 2000; MH CET 2003]**
(a) Exclusively marine animals
(b) Exclusively fresh water animal
(c) Mostly fresh water animals but few are marine animals
(d) Mostly marine animals but few are fresh water animals

18. Which sponge is found in the river **[NCERT; RPMT 1999]**
(a) *Cliona* (b) *Spongilla*
(c) *Sycon* (d) *Hyalonema*

19. What is found in a sponge **[RPMT 1995; CPMT 1996, 2002, 10]**
(a) Choanocytes (b) Nematocysts
(c) Amoebocytes (d) Both (a) and (c)

20. Which of the following is boring sponge **[CPMT 1999]**
Or
A sponge harmful to oyster industry is **[AFMC 1997]**
(a) *Cliona* (b) *Chalina*
(c) *Euplectella* (d) *Hyalonema*

21. Identify the names of the following figure from the given option **[NCERT]**



	A	B	C
(a)	*Euspongia*	*Sycon*	*Spongilla*
(b)	*Spongilla*	*Sycon*	*Eusporangia*
(c)	*Euspongia*	*Spongilla*	*Sycon*
(d)	*Sycon*	*Euspongia*	*Spongilla*

22. Classification of Phylum Porifera is based on **[CBSE PMT 1991; WB JEE 2012]**
(a) Nutrition (b) Spicules
(c) Locomotion (d) Reproduction

23. *Amphiblastula* is the larva of **[AFMC 2001; CPMT 2002; RPMT 2005]**
(a) *Hydra* (b) Sycon
(c) *Planaria* (d) *Leucosolenia*

24. What is left, when bathsponges dries up **[AIIMS 2002]**
(a) Spicules (b) Holdfast
(c) Tentacles (d) Spongin fibres

25. What will happen if a sponge is cut into maximum possible pieces **[RPMT 2001]**
(a) These will die
(b) These will differentiate
(c) Every piece will form a sponge
(d) Some pieces will develop in organs

26. Which of the following cell type is capable giving rise to other cell type in sponges **[CPMT 1993; MH CET 2002; Pb. PMT 2004]**
Or
Reproductive cells of sponges are formed from **[CBSE PMT 1991]**
(a) Archaeocytes (b) Collenocytes
(c) Thesocytes (d) Pinacocytes

27. Spongin fibres are secreted by **[BVP 2000]**
(a) Choanocytes (b) Pinacocytes
(c) Amoebocytes (d) Spongioblasts

28. The middle layer in body wall of porifera is **[AIIMS 1999]**

Or

The non-cellular layer present between pinacoderm and choanoderm in body wall of poriferans is known as **[Odisha JEE 2012]**
(a) Mesoderm (b) Mesenchyme
(c) Mesogloea (d) Mesentery

29. Sponges capture food particles with the help up **[BVP 2001; MHCET 2002; RPMT 2005]**

Or

Feeding in sponges takes place through **[BHU 1999; CPMT 1999, 2005]**
(a) Choanocytes (b) Pinacocytes
(c) Thesocytes (d) Trophocytes

30. Which of the following features is universally present in all sponges **[MP PMT 2013]**
(a) Marine habitat (b) Presence of spicules
(c) Presence of spongin fibres (d) Presence of spongiocoel

31. Spicules of silica occur in **[APMEE 2001]**
(a) *Hyalonema* (b) *Sycon*
(c) *Leucosolenia* (d) *Grantia*

32. In most simple type of canal system of porifera, water flows through which one of the following ways **[NCERT; WB JEE 2012]**
(a) Ostia → Spongocoel → Osculum → Exterior
(b) Spongocoel → Ostia → Osculum → Exterior
(c) Osculum → Spongocoel → Ostia → Exterior
(d) Osculum → Ostia → Spongocoel → Exterior

33. One of the following is not a characteristic feature of sponges **[NCERT; Kerala PMT 2010]**
(a) Cellular level of organization
(b) Presence of ostia
(c) Intracellular digestion
(d) Body supported by chitin
(e) Indirect development

34. Internal asexual propagule of some fresh water sponges is **[Kerala PMT 2006]**

Or

Internal bud for overcoming unfavourable conditions in *Leucosolenia* is **[CPMT 1996]**
(a) *Gemmule* (b) *Planula*
(c) *Stereoblastula* (d) *Amphiblastula*

35. Skeleton made of spongin fibres occurs in **[CPMT 2001; RPMT 2001]**
(a) Calcarea (b) Demospongiae
(c) Hexactinellida (d) Both (a) and (b)

36. Digestion of food occurs in sponges *Leucosolenia* in
(a) Spongocoel
(b) Choanocytes followed by amoebocytes
(c) Amoebocytes
(d) Choanocytes

37. Venus Flower Basket belongs to Phylum
(a) Porifera (b) Coelenterata
(c) Echinodermata (d) Mollusca

38. Spicules are found in **[J & K CET 2010]**
(a) *Hydra* (b) *Planaria*
(c) *Sycon* (d) *Obelia*

39. Sponges are porifers because their bodies have **[CPMT 1994; RPMT 2002]**
(a) Spicules in skeleton (b) Several pores
(c) Canal system (d) All the above

40. Nerve cells do not occur in **[NCERT; AMU (Med.) 2012]**
(a) Nematodes (b) Mosquitoes
(c) Sponges (d) Coelenterates

41. Bath sponges is generally found in **[CPMT 1992]**
(a) Red Sea (b) Gulf Mexico
(c) Pacific Islands (d) Mediterranean sea

42. The simplest type of canal system in Porifera **[CBSE PMT 1992]**

Or

Type of spongocoel found in Leucosolenia is **[CPMT 2001]**
(a) Ascon type (b) Leucon type
(c) Sycon type (d) Radial type

43. Thesocytes serve as **[CPMT 1992]**
(a) Sex cells (b) Slime secreting cells
(c) Food reserve (d) Embryonic cells

44. Animals devoid of respiratory, excretory and circulatory organs are **[HPMT 1993; DPMT 2002, 04]**
(a) Tapeworms (b) Sponges(Porifera)
(c) Thread worms (d) Liver Fluke

45. Collar cells occur in **[CPMT 1992, 93]**
(a) Sponges (b) *Hydra*
(c) Sandworm (d) Star fish

46. Nutrition in sponges is
(a) Extracellular
(b) Intracellular
(c) First extracellular and then intracellular
(d) First intracellular and then extracellular

47. Carmine particle put above osculum of a sponge would be **[CPMT 1993]**
(a) Left there
(b) Ingested and digested
(c) Thrown away
(d) Ingested and thrown away by ostia

48. Canal system in porifera is not concerned with **[AFMC 2005]**
(a) Respiration (b) Nutrition
(c) Sexual reproduction (d) None of these

49. Which of the following are 'multicellular grade' organisms **[AFMC 1997; BVP 2004]**
(a) Sponges (b) Coelenterates
(c) Prokaryotes (d) Vertebrates

50. Sponges have evolved from **[RPMT 1996]**
(a) Ciliates (b) Flagellates
(c) Protozoans (d) Choanoflagellates

51. Which is universal for sponges **[CBSE PMT 1996]**
(a) Marine (b) Calcareous spicules
(c) Radial symmetry (d) High regenerative power

52. In sponges, canal system develops due to **[CBSE PMT 1996]**
(a) Gastrovascular system (b) Folding of inner walls
(c) Porous walls (d) Reproduction

53. Osculum occurs in **[BHU 1997]**
(a) Star Fish (b) Ray Fish
(c) *Hydra* (d) Sponge

54. Incurrent canals are lined by **[CPMT 1998]**
(a) Choanocytes (b) Pinacocytes
(c) Porocytes (d) None of the above

55. Choanocytes in Ascon-type of canal system form lining of **[NCERT; CPMT 1998]**
(a) Spongocoel (b) Porocyte
(c) Apopyle (d) Incurrent canal

56. In case of poriferans, the spongocoel is lined with flagellated cells called **[NEET 2017]**
(a) Ostia (b) Oscula
(c) Choanocytes (d) Mesenchymal cells

Phylum-Coelenterata

1. Larva of jelly fish (*Aurelia*) **[Odisha JEE 2008]**
(a) Planula (b) Polyp
(c) Medusa (d) Blastula

2. Highest degree of polymorphism is found in **[J & K CET 2008]**
(a) Protozoa (b) Cnidaria
(c) Platyhelminthes (d) Arthropoda

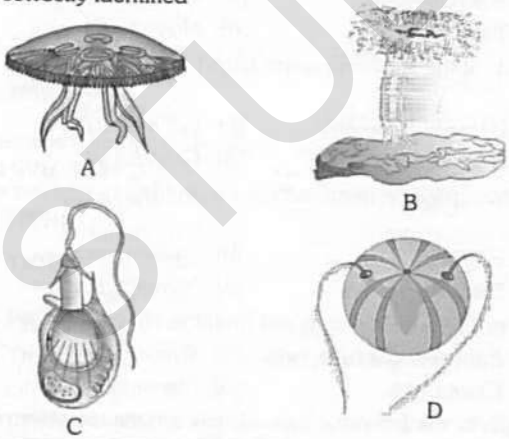
3. The dioecious animal is **[J & K CET 2008]**
(a) Liverfluke (b) Aurelia
(c) Tapeworm (d) Earthworm

4. Metagenesis referes to **[AIPMT 2015]**
(a) Alternation of generation between asexual and sexual phases of an organisms
(b) Occurrence of a drastic change in form during post embryonic development
(c) Presence of a segmented body and parthenogenetic mode of reproduction
(d) Presence of different morphic forms

5. Which of the following do not have polyp form **[RPMT 1995]**
(a) Hydrozoa (b) Scyphozoa
(c) Anthozoa (d) All the above

6. Which shows polymorphism **[CPMT 1998; MP PMT 2009; BHU 2012]**
(a) Physalia (b) Trypanosoma
(c) Termite (d) All of the above

7. Select the right option in which all the following figures are correctly identified **[NCERT]**



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

8. Most appropriate term to designate the life cycle of *Obelia* is **[NCERT; BHU 2002]**
(a) Neoteny (b) Metagenesis
(c) Metamorphosis (d) None of these

9. Which of the following does not belong to phylum Coelenterata **[MP PMT 2002]**
(a) Sea pen (b) Sea feather
(c) Sea cucumber (d) Sea fan

10. Sea anemone belongs to class **[CPMT 1998]**
(a) Hydrozoa (b) Anthozoa
(c) Scyphozoa (d) None of these

11. Primitive nervous system is formed in **[CPMT 2009]**
(a) Sponge (b) Cnidaria (Coelenterata)
(c) Echinodermata (d) Annelida

12. Corals belong to the phylum **[MP PMT 1994]**
(a) Protozoa (b) Porifera
(c) Cnideria (d) Mollusca

13. The phylum of comb jelly is **[NCERT; RPMT 1999]**

Or

Which one of the following groups of animals reproduces only by sexual means **[NEET (Karnataka) 2013]**
(a) Mollusca (b) Echinodermata
(c) Coelenterata (d) Ctenophora

14. *Hydra* is **[RPMT 1999, 2002]**
(a) Herbivorous (b) More developed
(c) Carnivorous (d) Omnivorous

15. Polyp phase is absent in **[BHU 2006]**
(a) *Hydra* (b) *Aurelia*
(c) *Physalia* (d) *Obelia*

16. Jelly fish is placed in which class of coelenterata **[RPMT 1995]**
(a) Anthozoa (b) Scyphozoa
(c) Hydrozoa (d) None of the above

17. One of the special characters of coelenterata only is the occurrence of **[CBSE PMT 1994; CPMT 1999; BHU 1999; MP PMT 2002, 06]**
(a) Hermaphroditism (b) Flame cells
(c) Polymorphism (d) Nematocysts

18. Organ pipe coral is
(a) *Astrea* (b) *Tubipora*
(c) *Fungia* (d) *Meandrina*

19. Nematoblast of *Hydra* are **[RPMT 2006]**
(a) Sensory
(b) Complicated
(c) With nematocyst apparatus
(d) All of the above

20. The nitrogeneous metabolic waste in *Hydra* mostly **[AFMC 2006]**
(a) Ammonia and is removed from whole surface of body
(b) Urea and is removed mainly by tentacles
(c) Urea and is removed from whole surface of body
(d) Uric acid and is removed from whole surface of body

21. A mature *Hydra* usually bears **[CPMT 2002; RPMT 2005]**
(a) One testis and several ovaries
(b) One testis and one ovary
(c) Several testes and one ovary
(d) Several testes and several ovaries

22. Main cavity in the body of *Hydra* is called **[CPMT 1998]**
(a) Gastrovascular cavity (b) Schizocoel
(c) Haemocoel (d) Pseudocoelom

23. Pneumatophore helps in **[RPMT 1999]**
(a) Feeding (b) Reproduction
(c) Protection (d) Floating

24. Which of the following statements is incorrect **[CPMT 2010]**
(a) Cnidocil is for defence in *Hydra*
(b) Nerve cells are absent in *Hydra*
(c) *Hydra is a coelentrate*
(d) *Hydra* shows budding

25. A coral island with a central shallow lake is known as **[BHU 2001]**
(a) Coral reef (b) Atoll
(c) Corallite (d) Diatomaceous sheath

26. Why does the Ctenophora is a minor phylum **[RPMT 2001]**
(a) It includes small sized animals
(b) It includes only few genera
(c) It does not include animals of economic importance
(d) It was included earlier in cnidaria

27. The larva of *hydra* is **[RPMT 1999]**
(a) Planula (b) Rhabditoid
(c) Trochophore (d) None of these

28. The true statement regarding corals is **[AIIMS 1999]**
(a) They form branched colonies
(b) Are solitary or colonial polypoid
(c) They grow as massive bodies
(d) All of these

29. *Hydra* is **[CPMT 1993; RPMT 1999, 2000; Pb. PMT 2000; Odisha JEE 2012]**

Or

Coelenterates generally include animals which are **[CMC Vellore 1993]**
(a) Triploblastic, radial symmetry and acoelomate
(b) Triploblastic, radial symmetry and coelomate
(c) Diploblastic, radial symmetry and acoelomate
(d) Diploblastic, radial symmetry and coelomate

30. Symmetry in Cnidaria is **[CBSE PMT 2005]**
(a) Radial (b) Bilateral
(c) Pentamerous (d) Spherical

31. How many ova are formed in the ovary of *hydra* **[RPMT 1999]**
(a) 2 (b) 4
(c) 1 (d) 3

32. Which one of the following animals is a coelenterate **[MP PMT 2003; CPMT 2005]**
(a) Sea cow (b) Sea horse
(c) Sea cucumber (d) Sea pen

33. *Hydra* receives impulses and stimuli through **[CBSE PMT 2000; AIIMS 2002]**
(a) Nerve net (b) Sensory cells
(c) Nematocytes (d) All of these

34. In which class of coelenterata the polyp and medusa both are found in one animal **[RPMT 2001]**
(a) Hydrozoa (b) Scyphozoa
(c) Anthozoa (d) None of them

35. Which of the following belongs to anthozoa **[CPMT 1999]**
(a) *Aurelia* (b) *Fungia*
(c) *Stercularia* (d) *Dugesia*

36. Match the following and choose the correct option

i. Physalia	A. Sea anemone
ii. Meandrina	B. Brain coral
iii. Gorgonia	C. Sea fan
iv. Adamsia	D. Portuguese man of war

[Bihar MDAT 1995; Kerala PMT 2002,12]
(a) i-C; ii-B; iii-A; iv-D (b) i-D; ii-C; iii-B; iv-A
(c) i-D; ii-B; iii-C; iv-A (d) i-B; ii-C; iii-A; iv-D
(e) i-A; ii-B; iii-C; iv-D

37. Statocysts are sense organs of **[CPMT 1999]**
(a) *Ascaris* (b) *Paramecium*
(c) *Taenia solium* (d) *Obelia medusa*

38. 'Ephyra' is the stage in the life cycle of **[AFMC 2000, 09]**
(a) Frog (b) *Obelia*
(c) *Aurelia* (d) Sea anemone

39. Choose the correct pair **[MP PMT 2010; Kerala PMT 2012]**
(a) Radial symmetry – Coelenterates
(b) Coelomates – Aschelminthes
(c) Metamerism – Molluscs
(d) Triploblastic – Sponges
(e) Metagenesis – Echinoderms

40. The characteristic larva of phylum 'Coelentrata' is **[CPMT 2000; BHU 2006]**
(a) Planula (b) Cysticercus
(c) Rhabdiform (d) Wriggler

41. Among the following organisms point out a completely non-parasitic form **[CBSE PMT 1994]**
(a) Sea anemone (b) Leech
(c) Tape worm (d) Mosquito

42. Which of the following is not found in vertebrates **[MP PMT 1998]**
(a) Bilateral symmetry (b) Gill opening
(c) Body scales (d) Cnidoblasts

43. In which phylum nerve cells are found but nerves are absent **[RPMT 2001]**
(a) Porifera (b) Coelenterata
(c) Platyhelminthes (d) Nemathelminthes

44. Which of the following is not found in *Hydra* **[DPMT 2004]**
(a) Epithelio-muscular cells (b) Cnidocyte
(c) Choanocyte (d) Nerve cells

45. Which of the following animals has a nervous system but no brain **[CBSE PMT 1993, 2002; BVP 2002]**
(a) *Pheretima* (b) *Hydra*
(c) *Amoeba* (d) *Periplaneta*

46. Penetrant, valvent and glutinant are types of
(a) Nematocysts of *Hydra* (b) Tentacles of *Hydra*
(c) Zooids of *Obelia* (d) Tentacles of *Obelia*

47. Tentacles of ***Hydra*** appear to be **[Odisha JEE 2012]**
(a) 2 (b) 15
(c) 8 (d) 14

48. The gastrovascular cavity of *Hydra* provides for
(a) Digestion and storage (b) Storage and circulation
(c) Excretion and storage (d) Digestion and circulation

49. Testes are located in *Hydra* at
(a) Proximal half (b) Distal half
(c) Middle (d) Tentacles

50. Zoochlorellae and zooxanthallae present in *Hydra* are **[CPMT 1994; RPMT 1996]**
(a) Symbionts in nutritive cells
(b) Symbionts in the gut
(c) Symbionts in cnidoblasts
(d) Organisms that provide hypnotoxin

51. Body cavity of *Hydra* is called **[JIPMER 1998; Odisha JEE 2012]**
(a) Enterocoel (b) Coelenteron
(c) Gastrovascular cavity (d) Both (b) and (c)

52. Precious Red Coral is/Coral used in ornaments is **[MP PMT 1993]**
(a) *Astraea* (b) *Fungia*
(c) *Corallium* (d) *Tubipora*

53. Gonads of *Obelia occur*
(a) In hydrula stage and indefinite in number
(b) Bases of tentacles of medusa and 8 in number
(c) On blastostyles and 8 in number
(d) On radial canals, oral surface of medusa and four in number

54. Gastrodermis of *Hydra* takes part in digestion of
(a) Carbohydrates and fats
(b) Proteins and fats
(c) Proteins, fats and some carbohydrates
(d) Proteins and carbohydrates

55. The cells absent in gastrodermis of *Hydra* are
(a) Nutritive cells (b) Stinging cells
(c) Gland cells (d) Nerve cells

56. Muscles of *Hydra* are
(a) Smooth (b) Skeletal
(c) Both (a) and (b) (d) None of the above

57. Budding is a normal mode of asexual reproduction in **[CBSE PMT 1993; CPMT 1996; HP PMT 2005; Kerala PMT 2009; Odisha JEE 2009, 10]**
(a) Starfish and Hydra (b) Hydra and sponges
(c) Tapeworm and Hydra (d) Sponges and starfish

58. Which of the following is not present in the body wall of *Hydra* **[CPMT 2010]**
(a) Sensory cell (b) Glial cell
(c) Cnidoblasts (d) Nerve cell

59. Nematocysts take part in **[MP PMT 1993]**
(a) Locomotion (b) Offence and defence
(c) Food capture (d) All the above

60. Which is wrongly matched **[Odisha JEE 2004]**
(a) Euglinoidae → Myonemes (b) Ciliophora → Axonemes
(c) Annelida → Notopodia (d) Cnidaria → Parapodia

61. Nematocysts are activated by **[Bihar MDAT 1994]**
(a) Water (b) Touch
(c) Brain (d) None of the above

62. Which one of the following living organisms completely *lacks* a cell wall **[CBSE PMT 2014]**
(a) *Saccharomyces* (b) Blue – green algae
(c) Cyanobacteria (d) Sea – fan (*Gorgonia*)

63. Which pair of cells is present in epidermis of *Hydra* but not in its endoderm **[Bihar MDAT 1995]**
(a) Stinging cells and interstitial cells
(b) Gland cells and germ cells
(c) Stinging cells and germ cells
(d) Stinging cells and gland cells

64. If *Hydra* is broken into pieces **[RPMT 1995, 96; CPMT 1996]**
(a) *Hydra* will die
(b) Every fragment will grow into complete *Hydra*
(c) Some fragments will form complete
(d) *Hydra* will undergo sexual reproduction

65. Testes/gonads are formed in *Hydra* from **[RPMT 1995; Bihar MDAT 2001]**
(a) Interstitial cells (b) Epithelio-muscular cells
(c) Nerve cells (d) All the above

66. Food of *Hydra* is **[RPMT 1995]**
(a) Aquatic plants
(b) Aquatic animals
(c) Algae and aquatic animals
(d) Some crustaceans

67. A number of buds have developed on *Hydra* **[APMEE 1996; Pb. PMT 1999]**
(a) Oldest bud is towards oral region
(b) Oldest bud is towards aboral region
(c) Both (a) and (b)
(d) There is no order

68. Mesogloea of *Hydra* is made of **[RPMT 1996]**
(a) Mucopolysaccharides (b) Protein
(c) Protein and fat (d) Reticulate tissue

69. Characteristic feature of coelenterata is **[CPMT 1996]**
(a) All are marine
(b) Presence of tentacles around mouth
(c) Polyp
(d) Gastrovascular cavity

70. Which of the following during respiration obtain water dissolved oxygen by diffusion through their body surface **[HP PMT 2005]**
(a) Cnidarians (b) Fishes
(c) Amphibians (d) Reptiles

71. *Hydra* recognises its prey by **[BVP 2001; MHCET 2003]**
(a) Nematocyst (b) Chemical stimulus
(c) Smell (d) Sensitivity

72. Common name of *Fungia* is **[Bihar MDAT 1996]**
(a) Mushroom Coral (b) Red Coral
(c) Brain Coral (d) Organ Pipe Coral

73. In *Hydra* new nematocysts develop from **[BHU 1996]**
(a) Cnidocils (b) Glandular cells
(c) Germ cells (d) Interstitial cells

74. Polymorphism occurs in **[BHU 1997]**
(a) Anthozoa (b) Scyphozoa
(c) Rhizopoda (d) Hydrozoa

75. Medusa of *Obelia* is **[AIIMS 1999]**
(a) Carnivorous (b) Herbivorous
(c) Detritus feeder (d) Omnivorous

76. Sense organs of *Aurelia* are **[AIIMS 1999]**
(a) Tentilla (b) Tentaculocyst
(c) Nematocyst (d) Otolith

77. Germ cells of *Hydra* are derived from **[BHU 2000]**
(a) Ectoderm (b) Endoderm
(c) Mesoderm (d) Mesogloea

78. Looping and somersaulting types of locomotion are seen in **[Odisha JEE 2011]**
(a) Leech (b) *Amoeba*
(c) Snail (d) *Hydra*

79. The figure shows four animals (A), (B), (C) and (D). Select the correct answer with respect to a common characteristics of two of these animals

(A)  (B) 

(C)  (D) 

[CBSE PMT (Mains) 2011]
(a) (A) and (B) have cnidoblasts for self- defence
(b) (C) and (D) have a true coelom
(c) (A) and (D) respire mainly through body wall
(d) (B) and (C) show radial symmetry

80. In *Hydra*, cnidoblasts employed during looping are **[APMEE 2000]**
(a) Volvents (b) Stenoteles
(c) Atrichous isorhizas (d) Desmonemes

81. Animal showing thigmotaxis is **[CPMT 2000]**
(a) *Ascaris* (b) *Taenia*
(c) *Fungia* (d) *Hydra*

82. Which of the following symmetry is found in adult sea-anemone **[CPMT 2004; Odisha JEE 2009]**
(a) Biradial (b) Spherical
(c) Bilateral (d) None of these

83. Which is correct about nematocyst in *Hydra* **[AFMC 2001]**
(a) It is re-used
(b) Ejection is conditioned reflex
(c) Ejection occurs in response to contact and pierces the prey
(d) Prevents coming in contact with other *Hydra*

84. *Hydra* will regenerate from a fragment, if it contain **[AFMC 2001]**
(a) Tentacles
(b) Epidermis and gastrodermis
(c) Tentacles, epidermis and gastrodermis
(d) Epidermis, hypodermis and gastrodermis

85. Bilateral symmetry does not occur in **[Pb. PMT 2001]**
(a) Frog (b) *Octopus*
(c) Mammal (d) *Obelia*

86. Ctenophores have similarities with members **[RPMT 2002]**
(a) Porifera (b) Coelenterata
(c) Arthropoda (d) Annelida

87. Larva like stage of *Hydra* is **[RPMT 2002]**
(a) Hydrula (b) Hydratuba
(c) Scyphula (d) Planula

Phylum-Platyhelminthes

1. Solenocytes and nephridia are respectively found in **[RPMT 2002]**
(a) Platyhelminthes and Annelids
(b) Annelids and Nematoda
(c) Cnidaria and Mollusca
(d) Mollusca and Echinodermata

2. Which of the following is a free living flat worm **[NCERT; RPMT 2001; AMU (Med.) 2005]**
(a) *Planaria* (b) *Taenia*
(c) *Fasciola* (d) *Pheretima*

3. In which of the following organisms, self fertilization is seen **[KCET 2007; AFMC 2012]**
(a) Fish (b) Roundworm
(c) Earthworm (d) Liver fluke

4. Which one of the following kinds of animals are triploblastic **[AIIMS 2010; CBSE PMT (Pre.) 2010]**
(a) Corals (b) Flat worms
(c) Sponges (d) Ctenophores

5. Cestodes are distinguished from other flatworms by the absence of **[CPMT 2001]**
(a) Nervous System (b) Digestive system
(c) Excretory system (d) Reproductive system

6. Which one of the following is an example of platyhelminthes **[CBSE PMT 1994; AIIMS 1999]**
(a) *Trypanosoma* (b) *Schistosoma*
(c) *Plasmodium* (d) *Wuchereria*

7. *Fasciola hepatica* is **[AFMC 2008]**
(a) Hermaphrodite, self fertilising
(b) Hermaphrodite, cross fertilising
(c) Unisexual
(d) Both (a) and (b)

8. Which of the following animals does not have a body composed of many segments **[Odisha JEE 2009]**
(a) Flatworm (b) Grass hopper
(c) Earthworm (d) Lobster

9. Cysticercus is the larva of **[AFMC 2001; WB JEE 2010]**
(a) Liver fluke (b) Tapeworm (*Taenia*)
(c) Ascaris (d) Mollusca

10. Planaria, liver fluke and taenia solium are **[NCERT; CBSE PMT 1993]**
(a) All segmented (b) All found in the gut
(c) All have coelom (d) All are flatworms

11. All flatworms differ from all roundworms in having **[DUMET 2009]**
(a) Triploblastic body
(b) Solid mesoderm
(c) Bilateral symmetry
(d) Matamorphosis in the life history

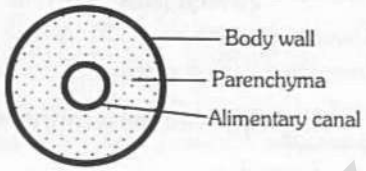
12. Which stage in the life cycle of *Taenia solium*, insects the intermediate host **[EAMCET 2009]**
(a) Hexacanth larva (b) Oncosphere
(c) Cysticercus larva (d) Miracidium

13. Flame cells are excretory organ of **[JIPMER (Med.) 2002; J & K CET 2005; Manipal 2005; BHU 2005, 08; Odisha JEE 2012]**
(a) Planaria (b) *Flatworms*
(c) *Taenia* (d) All of the above

14. Laurer's canal is found in **[CPMT 1998; BHU 2012]**
(a) Amoeba (b) Paramecium
(c) Fasciola (d) Hydra

15. Turbellarians are free living **[CPMT 2000; BHU 2006]**
(a) Nematodes (b) Annelids
(c) Trematodes (d) Flatworm

16. The cross-section of the body of an invertebrate is given below. Identify the animal which has this body plan **[NCERT; KCET 2009]**

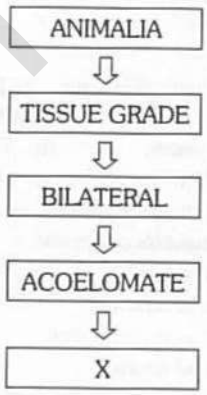


(a) Cockroach (b) Round worm
(c) *Planaria* (d) Earthworm

17. Locomotory organs in *Taenia* are called **[AIIMS 2001; MH CET 2002]**
(a) Setae (b) Parapodia
(c) Flagella (d) None of these

18. To which of the following Phylum class Trematoda belongs **[MP PMT 2001]**
(a) Platyhelminthes (b) Arthropoda
(c) Mollusca (d) Annelida

19. Identify the phylum X **[KCET 2015]**



(a) Hemichordata (b) Aschelminthes
(c) Platyhelminthes (d) Ctenophora

20. Flatworms are **[EAMCET 1998]**
(a) Acoelomates (b) Pseudocoelomates
(c) Haemocoelomates (d) Coelomates

21. Rhabdites occur in **[AIIMS 1999; RPMT 2000]**
(a) *Planaria/Dugesia* (b) *Fasciola*
(c) *Taenia* (d) *Echinococcus*

22. "Triploblastic, unsegmented, acoelomate exhibiting bilateral symmetry and reproducing both asexually and sexually with parasitic forms." The above description is characteristic of phylum **[Kerala CET 2005; MP PMT 2011]**
(a) Platyhelminthes (b) Annelida
(c) Ctenophora (d) Cnidaria
(e) Porifera

23. The contrast to Annelids the Platyhelminthes show **[CBSE PMT 2005]**
(a) Absence of body cavity (b) Bilateral symmetry
(c) Radial symmetry (d) Presence of pseduocoel

24. The greatest ability of regeneration amongst the animals is found in **[HP PMT 2005; Kerala PMT 2010; CBSE PMT 2014]**
(a) *Ascaris* (b) *Pheretima*
(c) *Hirudinia* (d) *Planaria* (Dugesia)

25. A metozoan covered by cilia is **[APMEE 2000]**
(a) *Paramecium* (b) *Dugesia*
(c) *Fasciola* (d) *Ascaris*

26. Chloragogen cells resemble the following in function **[Manipal 2005]**
(a) Collared cells (b) Flame cells
(c) Plasma cells (d) Mesophyll cells

27. Pseudocoelom is not found in **[DPMT 2004]**
(a) *Ascaris* (b) *Ancylostoma*
(c) *Fasciola* (d) None of these

28. One example of animals having a single opening to the outside that serves both as mouth as well as anus is **[CBSE PMT (Pre.) 2010]**
(a) Fasciola (b) Octopus
(c) Asterias (d) Ascidia

29. Which of the following show anaerobic respiration **[MP PMT 2006]**
(a) Earthworms (b) Rabbit
(c) Echinoderms (d) Tapeworms

30. Bilaterally symmetrical but acoelomate animal is **[DPMT 2003; BVP 2004]**
(a) Liver fluke (b) Jelly fish
(c) Round worms (d) Crab

31. Sometimes parasites themselves are parasitised by other organism, such parasites known as **[AFMC 2003]**
(a) Symbionts (b) Endoparasites
(c) Ectoparasites (d) Hyperparasites

32. Mehlis's glands of Tapeworm are associated with **[BHU 2002]**
(a) Reproduction (b) Excretion
(c) Respiration (d) Circulation

33. Malpighian tubules are analogous to **[AFMC 2010]**
(a) Trachea of cockroach (b) Gills
(c) Flame cells (d) None of these

34. Tapeworm does not possess digestive system as it **[BHU 1994]**
(a) Does not require solid food
(b) Obtains food through general surface
(c) Does not require food
(d) Lives in intestine

35. Intermediate host of Liver Fluke is
(a) Pig (b) Man
(c) Snail (d) Mosquito

36. The embryo of *Taenia* present in ripe proglottids is
(a) Tetracanth (b) Hexacanth
(c) Miracidium (d) Bladderworm

37. *Schistosoma* is a parasite found in
(a) Blood (b) Liver
(c) Lungs (d) Intestine

38. Onchosphere occurs is **[CBSE PMT 1990]**
(a) *Ascaris* (b) *Fasciola*
(c) *Taenia* (d) *Planaria*

39. *Hymenolepis nana* is **[APMEE 2001]**
(a) Dog Tapeworm (b) Dwarf Tapeworm of Man
(c) Pork Tapeworm (d) Dead Man's Finger

40. *Fasciola hepatica* lives in **[AFMC 2000; BHU 2001]**
(a) Liver of sheep (b) Blood of sheep
(c) Intestine of sheep (d) Spleen of sheep

41. The intermediate host of *Schistosoma* is **[BHU 2006]**
(a) Snail (b) Mosquito
(c) Housefly (d) Sheep

42. Larva of *Schistosoma* is
(a) Cercaria (b) Planula
(c) Cysticercus (d) Muller's larva

43. What is correct about *Taenia* **[CBSE PMT 1992; RPMT 1995, 98]**
(a) The animal has no mouth, alimentary canal and anus
(b) Presence of hooks for adhesion, externally divided body
(c) Mature proglottides contain both male and female organs
(d) All of the above

44. What is true about *Taenia saginata* **[CBSE PMT 1993]**
(a) Life history has pig as intermediate host
(b) There are two large suckers on scolex
(c) Rostellar hooks are absent
(d) Rostellum has double circle of hooks

45. Cysticercus of *Taenia* develop in **[AFMC 2001]**
(a) Man (b) Goat
(c) Sheep (d) Pig

46. Which constitutes the correct pairing **[CPMT 1994]**
(a) Flatworm-Planaria (b) Dogfish-Sea Urchin
(c) Fish-Snail (d) None of the above

47. Anus is absent in **[BHU 1994]**
(a) *Fasciola* (b) *Pheretima*
(c) *Periplaneta* (d) *Unio*

48. Pick up the correctly matched **[BHU 1994]**
(a) Water vascular system-Sponge
(b) Blubber-Kangaroo
(c) Marsupium-Platypus
(d) Flame cell-Flatworm

49. Cysticerci in pig muscles can remain viable upto **[AFMC 1994]**
(a) One year (b) Six months
(c) Six years (d) One month

50. In life history of liver fluke are present (1) Cercaria (2) Metacercaria (3) Sporocyst (4) Redia (5) Miracidium. What is their proper sequence **[AIIMS 1999]**
(a) 21354 (b) 53412
(c) 54213 (d) 54312

51. Both alternation of generations and alternation of hosts are present in **[APMEE 1995; BVP 2001]**
(a) *Wuchereria* (b) *Fasciola*
(c) *Taenia* (d) *Ascaris*

52. Give the correct match in the following

	Column I		Column II
A.	Flame Cells	*p.*	Sponges
B.	Collar Cells	*q.*	*Hydra*
C.	Stinging Cells	*r.*	*Planaria*
–	–	*s.*	*Ascaris*

[KCET 1997]
(a) A = r, B = p, C = q (b) A = r, B = p, C = s
(c) A = r, B = s, C = p (d) A = r, B = q, C = s

53. Solenocytes/flame cells are excretory structures of **[AFMC 1997; CBSE PMT 1998; CPMT 1998; DPMT 2006]**
(a) Echinoderms (b) Annelids
(c) Platyhelminthes (d) Molluscs

54. Lung Fluke is **[APMEE 2002]**
(a) *Hymenolepis nana*
(b) *Paragonimus westermani*
(c) *Schistosoma haematobium*
(d) *Echinococcus granulosus*

55. Alimentary canal is absent in **[RPMT 1998; CPMT 1999; JIPMER (Med.) 2001, 02; J & K CET 2002]**
(a) *Taenia* and *Schistosoma* (b) *Ascaris* and *Fasciola*
(c) *Taenia* and *Echinococcus* (d) *Tricuris* and *Fasciola*

Phylum-Nemathelminthes

1. Pin worm is called as **[EAMCET 1998; BHU 2012; MP PMT 2013]**
(a) *Schistosoma haematobium*
(b) *Wuchereria bancrofti*
(c) *Ancylostoma duodenale*
(d) *Enterobius vermicularis*

2. Pineal setae in male *Ascaris* are found in **[RPMT 1999]**
(a) Cloaca (b) Rectum
(c) Anus (d) Mouth

3. Which one of the following groups of animals is bilaterally symmetrical and triploblastic **[CBSE PMT 2009]**
(a) Coelenterates (Cnidarians)
(b) Aschelminthes (round worms)
(c) Ctenophores
(d) Sponges

4. The parasite which completes its life cycle in a single host (only man) is **[RPMT 1999; WB JEE 2008]**
(a) *Fasciola hepatica* (b) *Plasmodium vivax*
(c) *Taenia solium* (d) *Ascaris lumbricoides*

5. Which of the following groups have one or more animals which are not pseudocoelomate **[AFMC 1993]**
(a) Ascaris, taenia
(b) Enterobius, wuchereria
(c) Ancylostoma, dracunculus
(d) Ascaris, ancylostoma

6. *Ancylostoma* infection spreads through **[AFMC 2001]**
(a) Contaminated food (b) Kissing
(c) Skin (d) Blood

7. In *Ascaris* 3rd moulting takes place in **[CPMT 2002; RPMT 2005]**
(a) Intestine (b) Lung
(c) Liver (d) Egg

8. Excretory pore of *Ascaris* is present **[CPMT 2010]**
(a) Behind the mouth (b) On the posterior end
(c) On the dorsal side (d) In the middle of the body

9. A rhabditiform larva is formed in the life cycle of **[CPMT 1998; RPMT 2001]**
(a) *Ascaris* (b) *Tapeworm*
(c) *Hydra* (d) *Leucosolenia*

10. Choose the correct statement with reference to *Ascaris* **[CPMT 2004]**
(a) Hatching of embryos takes place in the stomach due to lytic enzyme
(b) Adulthood is reached inside the body of the host in ten days time
(c) Development and moulting takes place in the alveoli of lungs
(d) Hatching of embryo takes places within ten hours

11. In nemathelminthes the coelom is not lined by peritoneum is **[AFMC 2004]**
(a) A coelom (b) Pseudocoelom
(c) Enterocoelom (d) Haemocoel

12. Which of the following sense organs present in *Ascaris* are chemoreceptors and are located in ventrolateral lips **[CPMT 1999]**
(a) Amphids (b) Pineal setae
(c) Pineal spicules (d) Copulatory bursa

13. One of the following is pseudocoelomate **[DPMT 2001]**
(a) Leech (b) Liver fluke
(c) Hookworm (d) Jelly fish

14. *Ascaris* performs **[RPMT 1999]**
(a) Aerobic respiration (b) Anaerobic respiration
(c) Both (a) and (b) (d) None of these

15. Filariform is larva of **[AFMC 2001]**
(a) Platyheminthes (b) Aschelminthes
(c) Annelids (d) Arthropods

16. Thigmotaxis is not shown by **[BHU 2006]**
(a) *Paramecium* (b) *Amoeba*
(c) *Ascaris* (d) *Hydra*

17. The adult *Wuchereria bancrofti* lives in or attacks **[EAMCET 1998; AIIMS 2000, 02; CPMT 2009; NEET (Karnataka) 2013]**
(a) Human subdermal spaces
(b) Muscles of culex
(c) Salivary glands of culex
(d) Human lymph glands

18. Musculature of *Ascaris* consists of
(a) Circular muscles only
(b) Outer longitudinal and inner circular
(c) Outer circular and inner longitudinal
(d) Longitudinal muscles only

19. Which is the monogenetic in following **[AFMC 2003]**
(a) *Tapeworm* (b) *Ascaris*
(c) *Fasciola* (d) Hookworm

20. All worms are **[MP PMT 2003]**
(a) Triploblastic (b) Segmented
(c) Endo-parasites (d) Free-living

21. Which of the following is metazoan parasite transmitted through contaminated food or water **[APMEE 1995; DPMT 1999; MH CET 2000]**
(a) *Ascaris* (b) *Entamoeba*
(c) Guinea worm (d) Worm

22. The anterior V – spot in microfilaria of *Wuchereria* represents **[WB JEE 2011]**
(a) Nerve ring (b) Cervical papilla
(c) Excretory system (d) Reproductive system

23. Syncytial epidermis occurs in **[BHU 1994, 2001; DPMT 1999, 2001; Bihar MDAT 2002; CBSE PMT 2002]**
(a) *Ascaris* (b) *Hydra*
(c) *Taenia* (d) *Leucosolenia*

24. Male *Ascaris* is differentiable from female *Ascaris* in
(a) Presence of post-anal papillae
(b) Presence of pre-anal papillae
(c) Presence of penial setae
(d) All the above

25. Female *Ascaris* is differentiable from male in
(a) Presence of cloaca (b) Presence of penial setae
(c) Shorter size (d) Straight posterior end

26. Ascaris is characterized by **[CBSE PMT 2008]**
(a) Presence of true coclom but absence of metamerism
(b) Presence of true coclom and metamerism (metamerisation)
(c) Absence of true coclom but presence of metamerism
(d) Presence of neither true coelom nor metamerism

27. An intermediate host is absent in case of parasite
(a) Liver fluke (b) Tapeworm
(c) *Ascaris* (d) *Plasmodium*

28. *Ascaris* protects itself against digestive enzymes of the host by
(a) Mucus (b) Antienzymes
(c) Antienzymes and cuticle (d) Cuticle

29. Which is true of *Ascaris*
(a) Host (b) Aquatic
(c) Unisexual (d) Bisexual

30. Alcopar is drug useful for
(a) Taeniasis (b) Amoebiasis
(c) Ascariasis (d) Schistosomiasis

31. *Cyclops* is intermediate host of **[HPMT 1993]**
(a) *Planaria/Dugesia* (b) *Echinococcus*
(c) *Dracunculus* (d) *Ancylostoma*

32. Differentiating trait of *Ascaris* is **[RPMT 2002]**
(a) Sexual dimorphism and rhabditiform larva
(b) Unisexual and digenetic parasite
(c) Pseudocoelom and metameric segmentation
(d) Hermaphrodite and pseudocoelom

33. Microfilariae are carried by **[CPMT 1993]**
(a) Sandfly (b) *Culex* mosquito
(c) *Anopheles* mosquito (d) Housefly

34. The first and last moults of *Ascaris* occur in **[CPMT 1993]**

Or

Fourth moulting of *Ascaris* occur in **[Odisha JEE 2012]**

(a) Heart (b) Kindey
(c) Liver (d) Intestine

35. Which one is used in treatment of ascariasis **[CPMT 1994]**

(a) Chenopodium oil (b) Paludrin
(c) Terramycin (d) None of the above

36. A thick layer of cuticle on the surface of *Ascaris* indicates **[CPMT 1994]**

(a) Reproduction (b) Growth
(c) Parasitism (d) Evolution

37. Embryonated egg of *Ascaris* is **[BHU 1994]**

(a) An egg with gastrula (b) An egg with blastula
(c) An egg with juvenile (d) An egg within an egg

38. Sensory structures in *Ascaris* are **[RPMT 1995]**

(a) Phasmids (b) Amphids
(c) Papillae (d) All the above

39. Excretory pores present in *Ascaris* are **[RPMT 1995]**

(a) One (b) Two
(c) One pair (d) Two pairs

40. *Ascaris lumbricoides* is commonly called **[Kerala PMT 2002]**

(a) Roundworm (b) Hookworm
(c) Seat worm (d) Pinworm
(e) Filarial worm

41. Pseudocoelom develop from **[CPMT 2002]**

(a) Blastopore lip (b) Archenteron
(c) Embryonic mesoderm (d) Blastocoel

42. Which is secondary/intermediate host of Hookworm **[Bihar MDAT 1995]**

(a) Bed Bug (b) Sandfly
(c) Mosquito (d) None of the above

43. *Wuchereria* causes a disease in parts of India **[BHU 1996]**

(a) Filariasis-South India (b) Elephantiasis-Bihar
(c) Elephantiasis-Karnataka (d) None of the above

44. Which larval stage of *Ascaris* is infective **[RPMT 1996]**

(a) First and fourth (b) Second and third
(c) First and second (d) Third and fourth

45. Which is not true of *Ascaris* infection **[RPMT 1996]**

(a) More common in childern
(b) Does not produce tonsilitis
(c) Number can be 500-5000
(d) Infection is cured even without medication

46. Life span of *Ascaris* is **[RPMT 1996; AFMC 2010]**

(a) 6-9 months (b) 9-12 months
(c) 4-10 months (d) 10-12 months

47. *Ascaris* has three lips **[APMEE 1996; Odisha JEE 2012]**

(a) One median dorsal and two ventrolateral
(b) All dorsal
(c) Two lateral and one ventral
(d) Two dorso-lateral and one median ventral

48. Number of juvenile stages found during development of *Ascaris* **[RPMT 1998]**

(a) 1 (b) 2
(c) 3 (d) 4

49. *Enterobius* infection occurs through **[Pb. PMT 1999]**

(a) Mosquito (b) Contamination
(c) Inoculation (d) Piercing

50. Microfilaria occurs in peripheral blood of human beings during **[Pb. PMT 1999]**

(a) Morning (b) Evening
(c) Night (d) Day time

51. Animal group with pseudocoelom is **[MP PMT 2001; CPMT 2002; Kerala PMT 2002, 10; DPMT 2002, 06; Odisha JEE 2004; RPMT 2005]**

(a) Echinoderms
(b) Molluscs
(c) Aschelminthes/Nematodes
(d) Annelids

52. Which one of the following statements about certain given animals is correct **[BHU 2006, 12; AMU (Med.) 2006; CBSE PMT (Pre.) 2010]**

(a) Flat worms (Platyhelminthes) are coelomates
(b) Round worms (Aschelminthes) are pseudocoelomates
(c) Molluses are acoelomates
(d) Insects are pseudocoelomates

53. Coenocytic condition is found in **[HP PMT 2005]**

(a) *Ulothrix* (b) *Chlamydomonas*
(c) *Spirogyra* (d) *Wuchereria*

54. Size of female *Ascaris lumbricoides* is **[RPMT 2000]**

(a) 50-80 mm (b) 100-150 mm
(c) 150-250 mm (d) 200-350 mm

55. An ovoviviparous parasite is **[APMEE 2001]**

(a) Taenia (b) Wuchereria
(c) Ascaris (d) Plasmodium

56. Larvae of *Ascaris* hatch out in **[CPMT 2001]**

(a) Soil (b) Intestine
(c) Liver (d) Lungs

Phylum-Annelida

1. Which one of the following correctly describes the location of some body parts in the earthworm *Pheretima* **[CPMT 1994; Odisha JEE 1997; CBSE PMT 2009]**

(a) Two pairs of accessory glands in 16-18 segments
(b) Four pairs of spermathecae in 4 – 7 segments
(c) One pair of ovaries attached at intersegmental septum of 14^{th} and 15^{th} segments
(d) Two pairs of testes in 10^{th} and 11^{th} segments

2. If a live earthworm is pricked with a needle on its outer surface damaging its gut, the fluid that comes out is **[CBSE PMT 2009]**

Or

Earthworms have no skeleton but during burrowing, the anterior end becomes turgid and acts as a hydraulic skeleton. It is due to **[CBSE PMT 2008]**

(a) Excretory fluid (b) Coelomic fluid
(c) Haemolymph (d) Slimy mucus

3. Male genital aperture of earthworms is located in the segment **[NCERT; CPMT 1999]**

(a) 13 (b) 14
(c) 19 (d) 18

4. Annelids are **[CMC Vellore 1993]**
(a) Radially symmetrical (b) Externally segmented
(c) Triploblastic (d) Pseudocoelomate

5. The parasite found in the seminal vesicle of earthworm **[RPMT 1999, 2006]**
(a) *Monocystis* (b) *Nosema*
(c) *Sarcocystis* (d) *Nyctotherus*

6. Which one of the following is *NOT* a characteristic of phylum Annelida **[DPMT 2003; BVP 2004; CBSE PMT 2008]**
(a) Pseudocoelom (b) Ventral nerve cord
(c) Closed circulatory system (d) Segmentation

7. Which one of the following is not hermaphrodite animal **[HP PMT 2005; Odisha JEE 2008]**
(a) Leeches (b) Polychaetes
(c) Flatworms (d) Earthworm

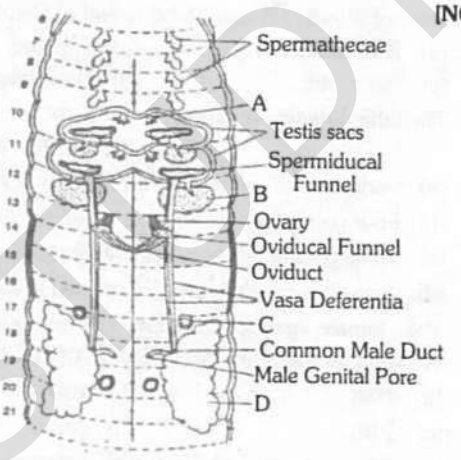
8. *Pheretima posthuma and Periplanata* are similar in which aspect **[CPMT 1995]**
(a) Both have nephredia as excretory organs
(b) Both have ventral nerve cord
(c) Both belong to same taxonomical group
(d) All the above

9. Which of the following belongs to the phylum annelida **[Odisha JEE 1997]**
(a) *Octopus* (b) *Ant*
(c) *Nereis* (d) *Crab*

10. 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

11. Closed blood vascular system, liver cells in the blood and chitinous setae or parapodia are the characteristics of **[AFMC 2009]**
(a) Arthropoda (b) Nematoda
(c) Annelida (d) None of these

12. See the figure given below and identify A to D respectively **[NCERT]**



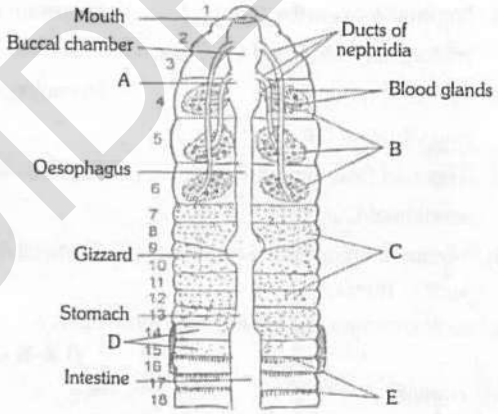
(a) A – Seminal vesicle, B – Testis, C – Prostate gland, D – Accessory gland
(b) A – Testis, B – Seminal vesicle, C – Prostate gland, D – Accessory gland
(c) A – Seminal vesicle, B – Testis, C – Accessory gland, D – Prostate gland
(d) A – Testis, B – Seminal vesicle, C – Accessory gland, D – Prostate gland

13. In which of the following, clitellum is absent **[BHU 2000]**
(a) Polychaeta (b) Oligochaeta
(c) *Hirudinea* (d) All the above

14. One very special feature in the earthworm pheretima is that **[NCERT; AFMC 1999; CBSE PMT (Pre.) 2011]**
(a) It has a long dorsal tubular heart
(b) Fertilisation of eggs occurs inside the body
(c) The typhlosole greatly increases the effective absorption area of the digested food in the intestine
(d) The S-shaped setae embedded in the integument are the defensive weapons used against the nemies

15. Botryoidal tissue is found in **[BHU 2002]**
(a) Rabbit (b) *Ascaris*
(c) *Hirudinaria* (d) Earthworm

16. Identify the following structures labelled A to E in the diagram given below from the list I to V



I. Septal nephridia
II. Pharynx
III. Forest of integumentary nephridia
IV. Integumentary nephridia
V. Tufts of Pharyngeal nephridia **[NCERT]**

	A	B	C	D	E
(a)	II	III	IV	I	V
(b)	II	IV	V	I	III
(c)	II	V	IV	III	I
(d)	II	I	III	IV	V

17. In Pheretima, there are red coloured round bodies in 4th, 5th and 6th segments above the alimentary canal. They are believed to be involved in **[NCERT; BHU 1999]**
(a) Excretion (b) Digestion
(c) Reproduction (d) Leucocyte production

18. Which one of the following exhibits concentric "tube within tube" plan **[MP PMT 1999]**
(a) Arthropoda (b) Oligochaeta
(c) Mollusca (d) Echinodermata

19. The colour of the body in earthworm is brown due to the presence of **[CPMT 2001]**
(a) Porphyrin (b) Haemoglobin
(c) Blood (d) Haemocyanin