

CHAPTER - 02

ANIMAL KINGDOM - NON-CHORDATA

- ◆ In our earth the number of species that are known and described range between 1.7 - 1.8 million.
- ◆ According to Robert May, global species diversity is 7 million
- ◆ Over a million species of them are Animals ie, approximately 1.2 million
- ◆ All these animal species are classified into different categories, based on some criteria
- ◆ The classification also helps in assigning a systematic position to newly described species.

BASIS OF CLASSIFICATION

- ◆ Based on the differences in structure and form of different animals they can be classified into many categories on the basis of some criteria. They are :

1. MODE OF NUTRITION

- 1. Holozoic Nutrition** : Such animals are called Holotrophs.
- 2. Saprozoic Nutrition** : Saprotrophs
- 3. Parasitic Nutrition** : Parasites → (1) Ectoparasites, (2) Endoparasites
- 4. Symbiotic Nutrition** : Symbionts

2. TYPE OF FOOD EATING

A) Herbivores

- i) Folivores → Animals which eat leaves of plants
- ii) Granivores → Grain eating animals
- iii) Seedivores → Seed eating
- iv) Frugivores → Fruit eating animals
- v) Detritivores → Eat dead and decayed fallen leaves and soil organic matter.

B) Carnivores

- i) Insectivores → Insect eating animals
- ii) Larvivores → Organisms eat larva of other animals
- iii) Piscivores → Fish eating animals
- iv) Cannibals → Animals which eating their own species
- v) Sanguivores → Blood sucking animals

C) Omnivores

3. MODE OF HABITAT

A) Terrestrial : Animals which lives on land. It is of different types.

- a) Aerial (air)
- b) Arboreal (in trees)
- c) Fossorial (under the soil)
- d) Scansorial (on the walls)
- e) Cursorial (fast running) etc.

B) Aquatic : (1) Marine (2) Fresh water (3) Brackish water

- i) Pelagic forms : Animals which mostly spending their life on water surface.
- ii) Benthic / Benthic : Animals lives in deep regions of water medium

4. TYPE OF DIGESTION

- 1) Intracellular digestion : Digestion takesplace within the cells of animals. Found in unicellular animals, sponges, cnidarians, ctenophores etc.
- 2) Extracellular / Intercellular digestion : Here digestion takes place outside the cells within the alimentary canal. Eg. Vertebrates and higher invertebrates, cnidaria, ctenophora etc.

5. TYPE OF RESPIRATION

1) ANAEROBIC

2) AEROBIC

A) Type of respiratory organs

- i) Gills - Branchial respiration
- ii) Moist skin - Cutaneous respiration
- iii) Buccal cavity - Buccopharyngeal respiration
- iv) Lungs - Pulmonary respiration
- v) Tracheal tubes - Tracheal respiration

6. TYPE OF EXCRETION

Based on the type of nitrogenous waste removed from the body of animals they can be classified into many types.

- 1. Ammonotelics - Ammonia is the nitrogenous wastes.
- 2. Ureotelics - Urea is the chief nitrogenous wastes
- 3. Uricotelics - Uric acid is the nitrogenous wastes

7. TYPE OF SEX

Based on the nature of sex in animals they classified into two types.

1. MONOECIOUS / HERMAPHRODITES / BISEXUAL

→ These animals do not have separate sexes, both sexes present in a single individual.

2) DIOECIOUS / GONOCHORITES / UNISEXUAL

- Here the organisms have separate sexes
- Such animals exhibit **SEXUAL DIMORPHISM** ie, male and female can be distinguishable on the basis of their external features.

8. TYPE OF REPRODUCTION

- 1) **ASEXUAL REPRODUCTION** : Animals produce their offspring without the fusion of separate gametes. Here young ones are formed from a single individual by fragmentation, budding etc.
- 2) **SEXUAL REPRODUCTION** : Here animals produce their young ones by the fusion of separate gametes to produce a zygote.

9. MODE OF PRODUCTION OF YOUNG ONES

- 1) **Oviparous** : Animals produce their young ones by laying eggs.
- 2) **Viviparous** : Animals which give birth to young ones
- 3) **Ovoviviparous** : Animals producing young ones by means of eggs which are hatched within the body of parent and delivered.

10. TYPE OF FERTILISATION

1. **External fertilization** : It takes place outside the body of organisms, especially within the water medium.
2. **Internal fertilization** : Fertilisation takes place within the body of an organism.

11. MODE OF DEVELOPMENT

1. **Indirect** : Young one are not resemble their parents.
2. **Direct** : Young ones are closely resemble their parents.

12. TYPE OF METAMORPHOSIS

Metamorphosis is the important changes occurs in the body of young ones during their growing period. It is of two types.

1. **Progressive metamorphosis** : Here a poorly developed larva grows into an advanced adult.
Eg. Amphibia
2. **Retrogressive metamorphosis** : In this, an advanced larva changed into a poorly developed adult. Eg. Urochordata

13. NATURE OF REGULATION IN BODY TEMPERATURE

1. **Poikilotherms** [Ectothermic / Cold blooded animals]

These organisms cannot regulate their body temperature, so it always changes in response to the surrounding medium. Eg. Fishes, Amphibians and Reptiles

2. **Homoeotherms** [Endothermic / warm blooded animals]

These can regulate their body temperature, so it remains constant, do not changes according to the surroundings. Eg. Birds and Mammals

14. TYPE OF ENDOSKELETON

1. Bony endoskeleton. eg. Bony fishes
2. Cartilaginous endoskeleton. eg. Cartilaginous fishes

Major criterias for the classification of animals are :-

A) PRESENCE OR ABSENCE OF NOTOCHORD

- ◆ Notochord is a mesodermally derived rod like structure formed on the dorsal side of the body of embryo in some animals.
- ◆ It lying between nerve cord and alimentary canal of embryo ie, ventral to nerve cord but dorsal to alimentary canal.
- ◆ Animals without notochord are called **Non-chordata** and those animals with notochord are called **Chordata**.
- ◆ Non chordates are again classified into 10 different phylums : Such as ;

PHYLUM : PORIFERA, COELENTERATA [CNIDARIA], CTENOPHORA, PLATYHELMINTHES, ASCHELMINTHES, ANNELIDA, ARTHROPODA, MOLLUSCA, ECHINODERMATA AND HEMICHORDATA

B) LEVELS OF ORGANISATION

- ◆ Though all members of Animalia are multicellular Eukaryotic and Heterotrophic animals.
- ◆ All of them do not exhibit the same pattern of organization of cells. So it classified into four types.

1. Cellular Level of Organisation

- ◆ Here body is formed by the organisation of structurally and functionally different types of cells. They do not together formed as tissues.
- ◆ Some division of labour occur among the cells.
Eg. **Sponges** (Poriferans)

2. Tissue Grade of Organisation

- ◆ Here body is formed with structurally and functionally similar type of cells organised to form as **Tissues**. But tissues do not together form as organs.
Eg. **Coelenterata** [Cnidaria] and **Ctenophora**

3. Organ Level

- ◆ In this, similar type of tissues organised to form as an organ.
Eg. **Platyhelminthes**
- ◆ Flame cells / protonephridia are the firstly formed organ in flatworms for excretion and osmoregulation.

- ◆ But some flatworms possess an organ system level of organisation.

4. Organ system Level

- ◆ Here body contains several organs and they are associated to form functional systems, each system concerned with a specific physiological function.

Eg. **Platyhelminthes** → **Chordata**

- ◆ Most animal species exhibit **organ system level of organisation**.

C) TYPE OF SYMMETRY

- ◆ Symmetry is the arrangement / distribution of organs or body parts around the central axis of the body of an organism. It is of mainly two types.

i) **Asymmetry** : Here body of organism does not have a specific pattern of arrangement. So any plane that passes through the central axis of body does not divide them into equal halves.

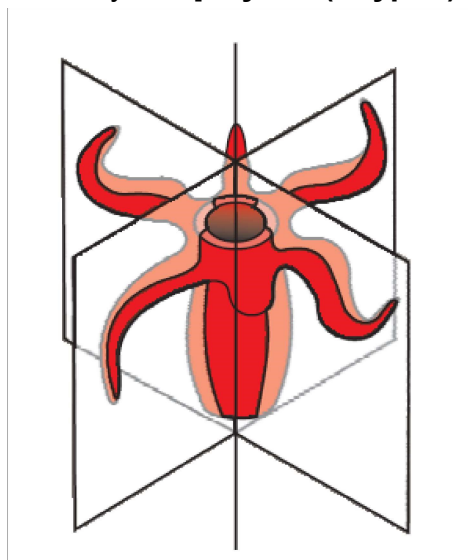
- ◆ It is found in **most Sponges and adult Gastropod Molluscs**.

ii) **Symmetry** : Here body has a specific / regular pattern of arrangement. But it is of different types.

1. Radial Symmetry

- ◆ Here body parts are equally distributed around the central axis. Hence, when any plane passing through the central axis of body of organism it can divide into two identical halves.

- ◆ It is found in **Cnidarians, Ctenophores** [Biradial] and **Adult Echinoderms** [Pentamerous radial system], **Sycon (Scypha)**



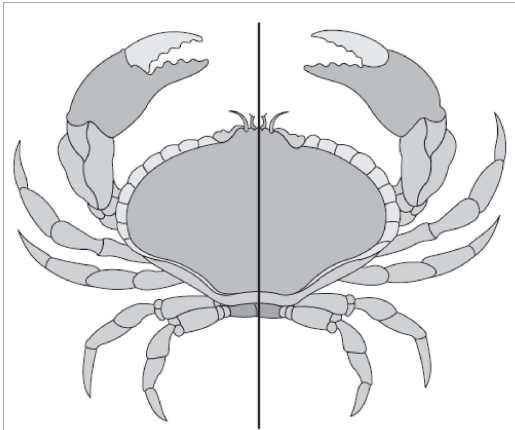
2. Bilateral Symmetry

- ◆ Here body parts are equally distributed on lateral sides of central axis of the body. So body can be divided into two identical halves only through a single longitudinal plane of central axis.

Eg. **Platyhelminthes** → **Chordata**

Larva of Echinoderms

- ◆ Most animal species exhibit Bilateral symmetry

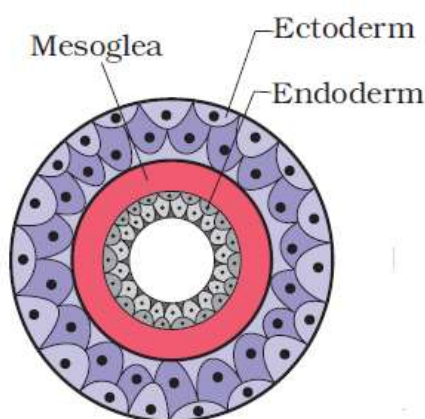


D) NUMBER OF GERM LAYERS

- ◆ Germ layers are the embryonic cell layers formed around the embryonic gut at the '**GASTRULA**' stage of an embryo.
- ◆ Various organs and organ systems are derived from these germ layers. Based on the number of germ layers animals are classified into two types.

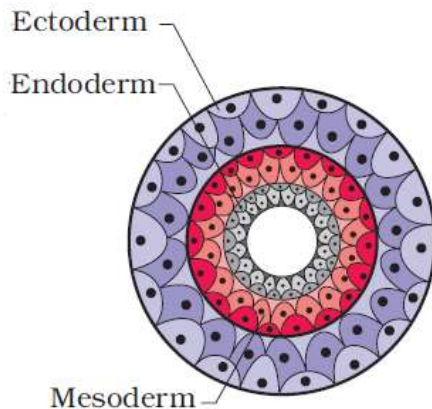
1. Diploblastic Animals

- ◆ Cells are arranged as two embryonic layers such as an outer **Ectoderm** and an inner **Endoderm**.
- ◆ An undifferentiated layer present between these two germ layers are called **MESOGLEA**.
Eg. **Sponges, Cnidaria and Ctenophora**



2. Triploblastic Animals

- ◆ These animals in which the developing embryo has a third germinal layer ie, **MESODERM** formed between ectoderm and endoderm.
Eg. **Platyhelminthes to Chordata**



- ◆ Most animal species are Triploblastic in nature.

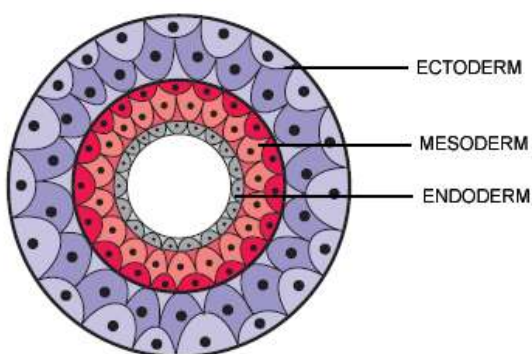
E) NATURE OF COELOM

- ◆ Coelom is body cavity between body wall and gut wall
- ◆ Coelom is a mesodermally lined cavity formed between ectoderm and endoderm in some animals. Most of the internal body organs present in this coelom.

i) Acoelom

- ◆ Here coelom is absent, between body wall and gut wall. Such animals are called **Acoelomates**.

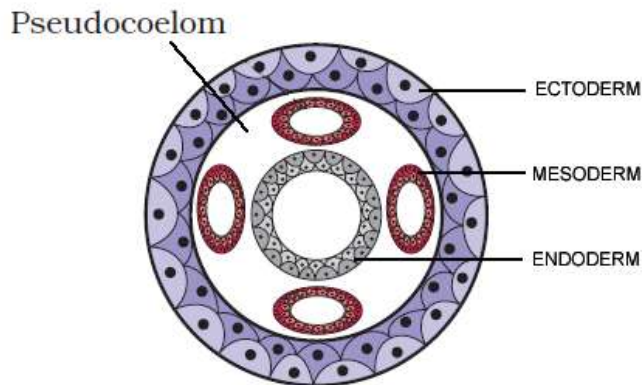
Eg. Platyhelminthes, Sponges, Cnidaria and Ctenophora



ii) **Pseudocoelom** [False coelom]

- ◆ In this type, a body cavity present, but it is not lined with mesoderm, instead, the mesoderm is present as scattered pouches between Ectoderm and Endoderm
- ◆ It appearing like that of coelom but not considered as a true coelom.
- ◆ Such animals are termed as Pseudocoelomates

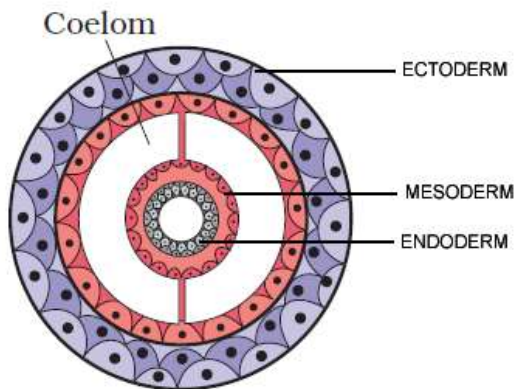
Eg. Aschelminthes (Round worms)



iii) Eucoelom [Coelom]

- ◆ Here a true coelom present between ectoderm and endoderm. Such animals are coelomates.

Eg. **Annelida** → **Chordata**



- ◆ Coelomates are again classified into two types based on the origin of coelom.

1. Schizocoelomates

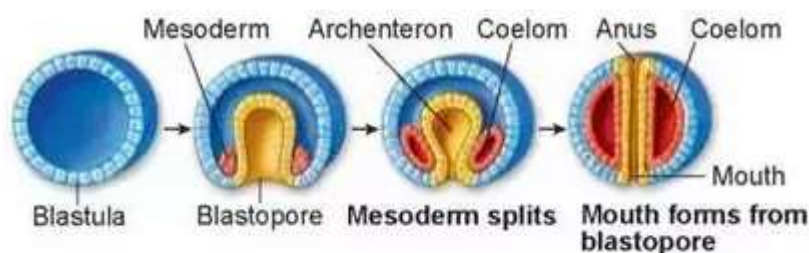
- ◆ Here a true coelom formed by the splitting of mesoderm / coelom formed from mesodermal clefts.

Eg. **Annelida, Arthropoda and Mollusca**

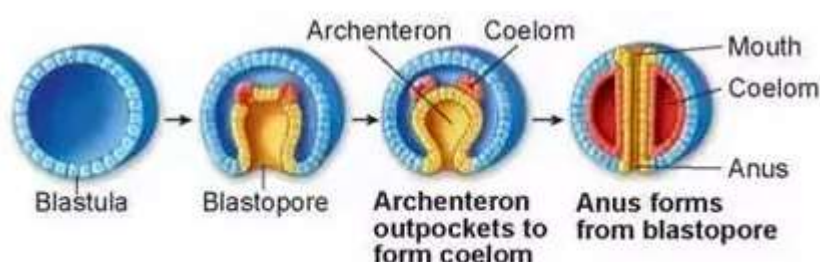
2. Enterocoelomates

- ◆ Here coelom formed from the archenteron of embryonic gut.
- ◆ It found in **Echinodermata, Hemichordates & Chordates**

Schizocoelom and Protostome



Enterocoelom and Deuterostome



- ◆ Most of the triploblastic animals are **Schizocoelomates**.

F) SEGMENTATION

- ◆ It is the serial repetition of body organs in some animals externally or internally.
 - ◆ **Metamerism** is the most common type of segmentation in animals. Such segments are called **Metameres**.
 - ◆ These metamerism are of three types.
- No metamerism** : Here body of animals do not divisible into any segments. Hence such animals have an unsegmented body.
Eg. **Porifera, Cnidaria, Ctenophora, Platyhelminthes, Ashelminthes, Mollusca, Echinodermata and Hemichordata**
 - Pseudometamerism** : In some animals body is formed with metamere like segments. But they are not considered as true metameres. It found in *Taenia solium*
 - True Metamerism** : Here body is formed with repeated structures. It found in :
 1. Annelids → External and internal metamerism
 2. Arthropods → External segmentation
 3. Chordates → Internal segments (somites)

G) TYPE OF BODY PLAN : It is of 3 types.

1. Cell Aggregate Body Plan

- ◆ In this, body of organisms are formed by the loose aggregation of a group of cells only.

- ◆ It found in **Sponges**.

2. **Blind Sac Body Plan**

- ◆ Here body is like that of a sac with only a single opening at one region that considered as both mouth and Anus.

Eg. **Cnidaria, Ctenophora and Platyhelminthes**

3. **Tube within a Tube Body Plan**

- ◆ Body is like that of a tube another tubular alimentary canal present in it with two separate openings such as **Mouth and Anus**.

Eg. **Aschelminthes → Chordata**

H) **TYPE OF DIGESTIVE SYSTEM**

1. **Incomplete Digestive System**

- ◆ Here an alimentary canal formed with a single opening.

Eg. **Some flatworms, Coelenterata & Ctenophora**

2. **Complete Digestive System**

- ◆ Alimentary canal formed with separate mouth and Anus; between these two openings other structures are also present.

- ◆ It found in Aschelminthes → Chordata

- ◆ Based on the origin of mouth and Anus in alimentary canal animals are classified into two types.

1. Protostomes : Here blastopore of embryo is firstly developed into mouth and anus formed finally. Eg. **Aschelminthes, Annelida, Arthropoda, Mollusca**

- ◆ Most of the triploblastic animals are **Protostomes**.

2. Deuterostomes : Blastopore of embryo firstly developed into Anus, but mouth formed finally.

Eg. **Echinodermata, Hemichordata and Chordata**.

I) **TYPES OF CIRCULATION**

1. **Open Type** : A dorsal heart pumps colourless blood directly into the open cavity called sinuses / Lacunae

- ◆ Closed blood vessels are absent or poorly developed in it, only a dorsal / anterior aorta is present.
- ◆ Blood flows slowly with low pressure and low velocity
- ◆ It takes long time to complete their circulation
- ◆ Here blood flow cannot be regulated
- ◆ Internal organs bathed in blood
- ◆ Blood have a direct contact with the cells

- ◆ Respiratory pigments absent in it, so blood do not transport respiratory gases.

Eg. Some Annelids like Leeches [Haemocoelic circulation]

All Arthropods and Hemichordates

Most Molluscs and some Urochordates

2. Closed C.S

- ◆ Here coloured blood flows through closed blood vessels like arteries, veins capillaries etc.
- ◆ Blood flows forcefully with high pressure and high velocity
- ◆ So it takes little time to complete their circulation
- ◆ Blood flow can be regulated
- ◆ Internal organs not bathed in blood, so blood do not have a direct contact with the cells.
- ◆ Respiratory pigment present that transport respiratory gases.

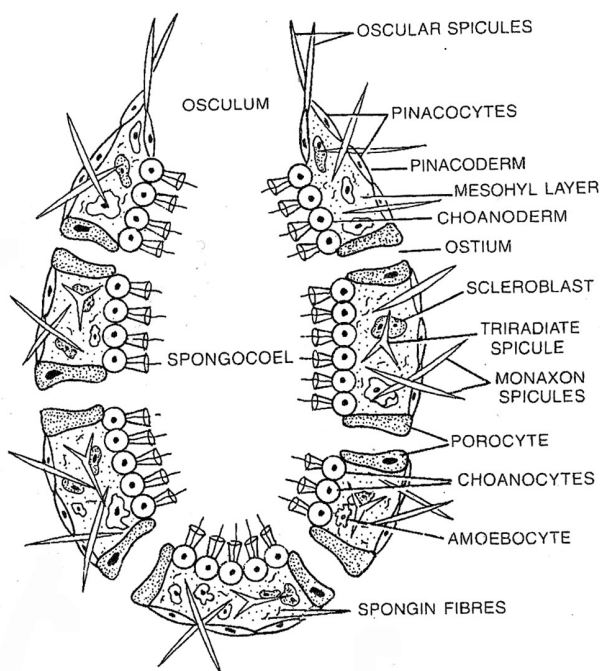
Eg. Most Annelids, Cephalopod Molluscs and Most of the Chordates

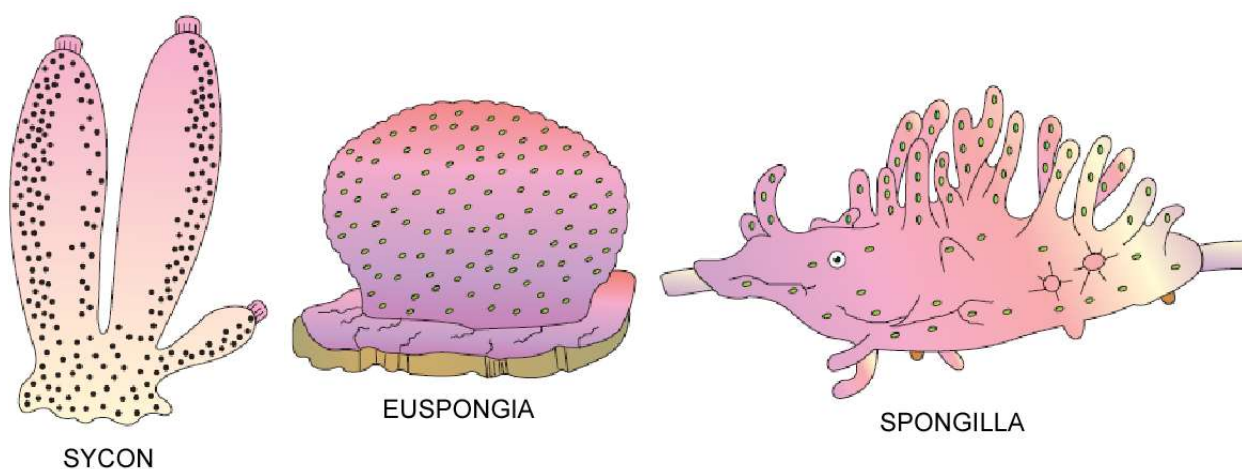
PHYLUM : PORIFERA [Sponges]

- ◆ Study of sponges called '**PARAZOOLOGY**'
- ◆ These are the most primitive multicellular animals evolved from Protozoans.
- ◆ **Proterospongia** is a connecting link between protozoa to sponges.
- ◆ Mostly marine but some are freshwater. eg. **Spongilla**
- ◆ All of them are sessile / sedentary and lead solitary / colonial mode of life.
- ◆ Exhibit cellular level of organisation, Diploblastic condition, Acoelomates, No metamerism and cell aggregate body plan.
- ◆ Mostly Asymmetrical except **Sycon / Scypha**. It has **Radial symmetry**.
- ◆ Body has minute pores called Ostia / Inlets hence they named as pore bearing animals.
- ◆ Ostia opens into a central **paragastric cavity** called **spongocoel**
- ◆ Spongocoel opens to exterior through a single opening called **Osculum (outlet)**
- ◆ Its most diagnostic feature is the presence of **water canal system**.
- ◆ Path of canal system is OSTIA → SPONGOCOEL → OSCULUM → OUTSIDE
- ◆ It helps for **food gathering, Respiratory exchange, Reproduction and Removal of nitrogenous wastes**.
- ◆ Walls of spongocoel and canals are internally lined with specialised flagellated cells called **COLLAR CELLS / Choanocytes**.
- ◆ That layer is called **Choanoderm**.
- ◆ It **creates a water current** for the entry of water into it and helps for **partial digestion** of food.
- ◆ Sponges exhibit **Intracellular digestion** only

- ◆ Body wall is externally lined with **PINACOCYTES** that layer is called **Pinacoderm**.
 - ◆ A gelatinous non-cellular layer present between **Choanoderm** and **Pinacoderm**, **MESENCHYME / Mesohyl**
 - ◆ Mesenchyme / Mesohyl contains specialised cells called **Amoebocytes**. For eg. **Thesocytes** (store food), **Trophocytes** (Nurse cells), **Archaeocytes** (Totipotent), **Collencytes** (Spongin fibres), **Sclerocytes** (spicules), Myocytes, Gland cells (Slimy substance), Phagocytes etc.
 - ◆ Body is supported by a skeleton made up of **SPICULES** and **SPONGIN FIBRES**
 - ◆ Spicules are of two types.
 - i) **Calcareous spicules (CaCO_3)**
 - ii) **Silicious spicules (SiO_2)**
 - ◆ Sponges have great power of regeneration.
 - ◆ These are Hermaphrodites / Monoecious / Bisexual.
 - ◆ Exhibit Asexual and sexual reproduction
 - ◆ Asexually reproduced by Fragmentation and Budding.
 - i) External budding → Gemmation
 - ii) Internal budding → Gemmulation
 - ◆ Fertilization is internal, development is indirect with larval forms → Parenchymula, Amphiblastula
- Eg. **Sycon** (Scypha), **Spongilla** (F W sponge), **Euspongia** (Bath sponge), **Euplectella** (Venus flower basket), **Leucosolenia** (simple / Ascon sponge), **Hyalonema** (Glass rope sponge), **Cliona** (Boring sponge)

LONGITUDINAL SECTION OF A SIMPLE SPONGE (Leucosolenia)



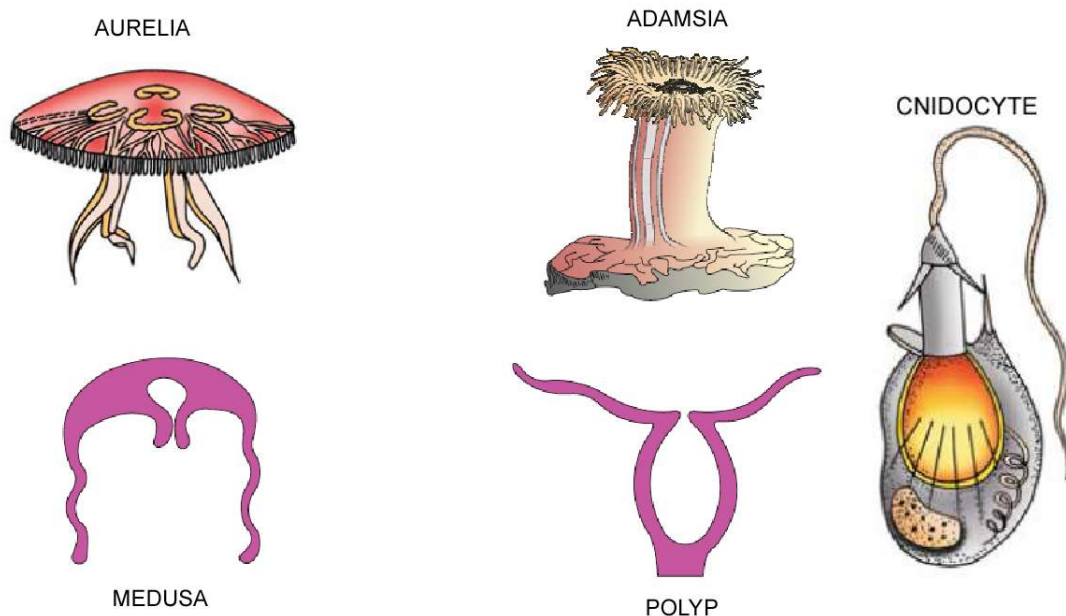


PHYLUM : COELENTERATA [CNIDARIA]

- ◆ Study of Cnidaria is “CNIDOLOGY”
- ◆ Exhibit Tissue level of organisation, Radial symmetry, Acoelom, Diploblastic condition, No metamerism and Blind sac body plan with a single opening **mouth on Hypostome**.
- ◆ Mostly marine but some are Fresh water (Hydra)
- ◆ Mostly **sessile** (Sea anemone) but some are **free swimming** (Aurelia).
- ◆ Exhibit solitary or colonial mode of life.
- ◆ Body has a central gastrovascular cavity or **COELENTERON** opens out through a single opening on **Hypostome**.
- ◆ Most diagnostic feature is the presence of poisonous stinging cells on **Body wall** and **Tentacles** called **Cnidoblasts** or **Cnidocytes**, hence the phylum is named as **Cnidaria**.
- ◆ Cnidocytes contain a poison filled (Hypnotoxin) stinging capsule or **Nematocysts**.
- ◆ Cnidoblasts helps for **Anchorage**, **Defence** and for the **Capture of prey**.
- ◆ Two different body forms are present such as **Polyp** and **Medusa**.
- ◆ Polyps are sessile, cylindrical and with an upwardly directed mouth. Eg. **Adamsia**
- ◆ **Medusa** are umbrella shaped, free swimming and downwardly directed mouth. Eg. **Aurelia**
- ◆ Some are showing **polymorphism**, ie, different body forms living together as a colony.
Eg. **Obelia**, **Physalia**
- ◆ Each individuals in that colony are called **zooids** that exhibit **Division of Labour**.
- ◆ Those cnidarians which exists in both body forms exhibit **Alternation of Generation** [**Metagenesis**] ie, **polyp produce Medusa asexually** while **medusa forms polyp sexually**. Eg. **Obelia**
- ◆ Some cnidarians have a skeleton composed Calcium Carbonate, called **corals**. Eg. **Meandrina**

- ◆ Digestion is both **Intracellular** and **Extracellular**
- ◆ A **primitive nerve network** is present on body wall formed with **apolar / non-polar neurons**.
- ◆ Hermaphrodites / Monoecious.
- ◆ **Asexual reproduction** by **budding** (Hydra) and **sexual reproduction** by **gamete formation**.
- ◆ Fertilization is **external**, development is indirect with **Planula larva**.

Eg. **Physalia** (Portuguese man of war), **Hydra**, **Adamsia** (sea anemone), **Pennatula** (sea pen), **Gorgonia** (sea fan), **Obelia** (sea fur), **Aurelia** (Jelly fish), **Meandrina** (Brain coral), **Fungia** (Mushroom coral), **Madrepora** (stag horn coral)

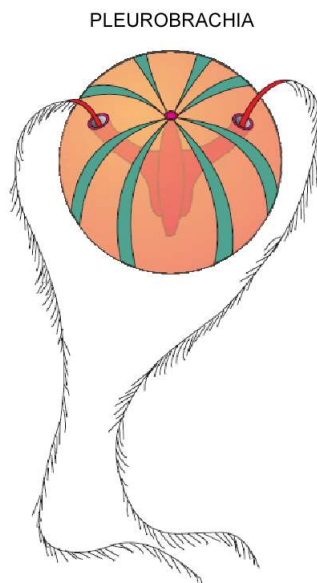


PHYLUM : CTENOPHORA

- ◆ These are commonly known as **Sea Walnuts, or Combjellies / Seagooseberries**.
- ◆ Exhibit Tissue grade, Radial symmetry [Biradial] Diploblastic, Acoelom, No metamerism and Blind sac body plan.
- ◆ Mesoglea contains specialised cells. [Amoebocytes]
- ◆ Both intra and extracellular digestion.
- ◆ Hermaphrodites, External fertilization and Indirect development with **CYDIPPID** larva.
 - Cnidoblasts absent in this phylum [Acnidaria]
 - Exclusively marine
 - **Statocysts** is a balancing organ present on the ventral side of body.

- Ctenophores exhibit Bioluminescence
- Exhibit sexual reproduction only
- Body bears eight external rows of ciliated plates called “**COMBPLATES**” which helps in **Locomotion**.
- ◆ Two tentacles bears specialised adhesive cells called **Lasso cells / Colloblast** for **food capturing**.

Examples : **Pleurobrachia, Ctenoplane, Beroe, Cestum, Hormiphora**, etc.



PHYLUM : PLATYHELMINTHES

- ◆ It commonly called as Flatworms, because their body is dorsoventrally flattened.
- ◆ These are 1st group of animals with Organ or organ system level of organisation, Bilateral symmetry, Triploblastic condition and Acoelom.
- ◆ Exhibit blind sac body plan with incomplete digestive system and no metamerism
- ◆ Most of them are endoparasitic worms in man and other animals, but some are free living. eg. **Planaria**.
- ◆ These are Digenetic endoparasites, because they completed their life cycle within 2 different hosts. ie, primary host and an Intermediate host
- ◆ It cause diseases to primary host.
- ◆ Hooks and suckers are present in parasitic forms.
- ◆ Some of them absorb nutrients from host directly through their body surface. eg. **Tapeworm**
- ◆ Some have high power of regeneration. eg. **Planaria**

- Specialised cells called **Flame cells / Protonephridia / Solenocytes** helps in Osmoregulation and Excretion.

- ◆ It have a Ladder like Nervous system with two nerve cords.
- ◆ Mostly Monoecious but some are **Dioecious**. Eg. **Schistosoma**
- ◆ Male Schistosoma has a **Gynaecophoric canal** female present in it.
- ◆ Asexual reproduction through fragmentation, regeneration, binary fission etc.
- ◆ SR is also present with internal fertilization
- ◆ Development is Indirect through many larval forms.
- ◆ It classified into 3 different classes

Class : TURBELLARIA (Free living flat worm)

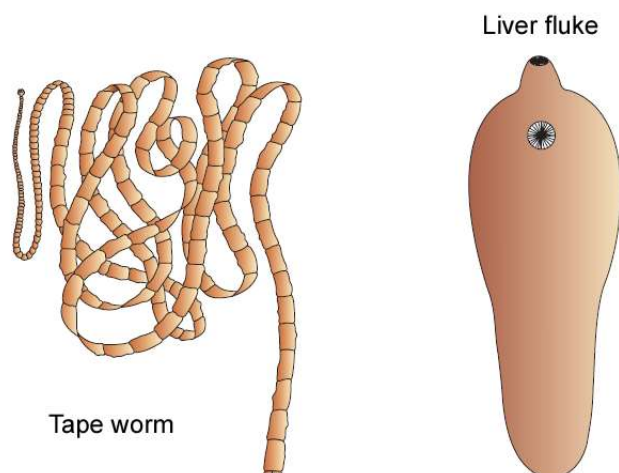
Eg. **Planaria**

Class : TREMATODA (Flukes)

Eg. **Fasciola (Liver fluke)**

Schistosoma (Blood fluke)

- ◆ Schistosoma cause **schistosomiasis** in man
- ◆ Primary host of Fasciola → Sheep / Goat
Intermediate host is → Pond snail (Planorbis, Limnaea)
- ◆ It cause a disease to sheep → **Fascioliasis / Liver rott disease**
- ◆ Larval form of fasciola are ;
Miracidium → Sporocyst → Redia → Cercaria → Metacercaria
- ◆ Fasciola infects its primary host in the form of **METACERCARIA** larva but it enters into the body of snail in the form of **MIRACIDIUM** larva.
- ◆ Class : **CESTODA** [Tapeworms]
eg. Taenia solium [Pork tapeworm]
Taenia saginata [Beef tape worm]
Echinococcus [Dog tapeworm]
- ◆ Tania causes **Taeniasis / Cysticercosis** in man. Its **primary host is man but intermediate host is Pig**.
- ◆ Its larval forms are :
ONCHOSPHERE → HEXACANTH → CYSTICERCUS → BLADDER WORM
- ◆ It infects man through uncooked measley pork in the form of **Cysticercus larva**.
- ◆ Tape worm enters into the body of pig in the form of **onchosphere larva**



PHYLUM : ASCHELMINTHES [Nemathelminthes]

- ◆ These are commonly called as **Round worms / Thread worms / Bag worms / Nematode worms**.
- ◆ Body is circular in cross section hence the name round worms.
- ◆ They may be free living, aquatic and terrestrial or parasites in plants and animals
- ◆ Most of them are Monogenetic endoparasites except **Wuchereria** and **Trichinella**.
- ◆ It exhibit organ system level of organisation, Bilateral symmetry, Triploblastic condition and no metamerism.
- ◆ **Its most Diagnostic feature is Pseudocoelom.**
- ◆ **These are the first group of animals have Tube within a tube body plan and protostomous condition.**
- ◆ **Alimentary canal is complete with well developed muscular pharynx.**
- ◆ **An excretory tube removes body wastes from the body cavity through excretory pore.**
- ◆ Respiratory and circulatory systems absent
- ◆ Epidermis of body wall is **Syncitial** which secrete a resistant **cuticle**, which keeping their body wall in slimy condition.
- ◆ Body wall is supported with **longitudinal** muscles below the epidermis, it helps for their movement.
- ◆ **Rennette cells / H-shaped cells** are also helps for excretion.
- ◆ Mostly Ammonotelics
- ◆ Sensory organs like **Papillae** [Gustatory and Tactile], **Amphids** [Chemoreceptor and Gustation], **Phasmids** [Glandulosensory organ] etc. are present.
- ◆ Sexes are separate [Dioecious / Gonochorites / unisexual]

- ◆ Exhibit sexual dimorphism; **often females are slightly longer than males.**
- ◆ Sexual reproduction only, fertilization is internal and development may be **Direct** or **Indirect**.
- ◆ Mostly oviparous but some are viviparous (**Wuchereria and Trichina worm**)
- ◆ Endoparasitic round worms cause diseases to its host.

Examples :

1. Ascaris [Human Round Worm]

- Present in small intestine of man
- Cause diseases to man - ASCARIASIS
- Larva is Rhabditiform

2. Wuchereria [Filarial worm]

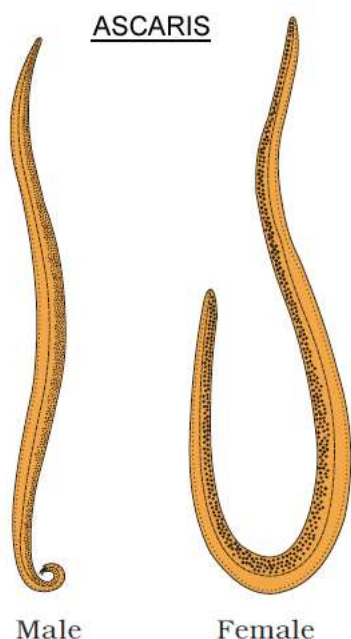
- Digenetic, viviparous endoparasite
- Primary host is Man → It cause a disease to man → **Filariasis / Elephantiasis**
- Intermediate host → Female culex mosquito
- Its larva is Microfilariae

3. Ancylostoma [Hook worm]

- Sanguivorous worm
- Host is Man, it cause **Ancylostomiasis**.
- Filariform larva is present

4. Enterobius [Pinworm / Seat worm]

- Found in Large intestine of man.
- Cause diseases to man - **Enterobiasis / Oxyuriasis**.



PHYLUM : ANNELIDA

- ◆ These are commonly called **Segmented worms or Ringed worms**.
- ◆ Their body is formed with numerous segments or metameres or little rings called **Annulus**. Hence the phylum is named as Annelida.
- ◆ Most of them are free living, Aquatic [Marine and Fresh water], Terrestrial and some are Ectoparasites [Leech]
- ◆ They exhibit Organ system level, Bilateral symmetry, Triploblasty, True metamerism, Tube within a Tube body plan and Protostomous condition.
- ◆ **First group of animals with a True coelom [Schizocoelom] and closed circulation with Red coloured blood due to Haemoglobin in plasma**
- ◆ Body wall is **Dermomuscular** in nature.
- ◆ Body wall is formed with **Epidermis, outer circular and inner longitudinal muscles**, which helps in **Locomotion**.
- ◆ Aquatic annelids like Neries possess lateral appendages called **Parapodia** that helps for **Swimming and Respiration**.
- ◆ Respiration through **moist skin, cuticle, parapodia, gills** etc.
- ◆ **Nephridia / Nephridium helps in Excretion and Osmoregulation.**
- ◆ Locomotory organs are **setae, muscles, parapodia, coelomic fluid** etc.
- ◆ Nervous system formed with ;
 1. Paired Ganglia connected by lateral nerves

2. Double, ventral, solid, ganglionated Nerve cords.

- ◆ Sensory organs are **Tactile receptors, Chemoreceptors, Photoreceptors, Statocysts** etc.
- ◆ Mostly monoecious [Earthworm and Leech] but some are Dioecious. Eg. **Nereis**
- ◆ Exhibit **sexual reproduction only**
- ◆ Fertilization is external, development is direct and Indirect with **Trochophore larva**
- ◆ Annelida is classified into 3 classes.

Class : POLYCHAETA

→ Aquatic Annelids

eg. NEREIS [Sand worm]

→ Trochophore larva present

CHAETOPTERUS [Paddle worm]

APHRODITE [Sea mouse]

ARENICOLA [Hag worm]

Class : HIRUDINEA

HIRUDINARIA [Blood sucking leech]

→ Sanguivorous ectoparasite. Haemocoelic circulation

→ Fertilization is Internal

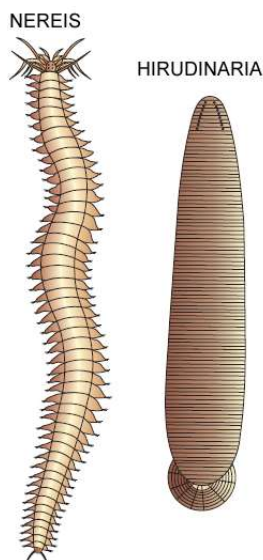
→ Hirudin - Anticoagulant present in Leech

Class : OLIGOCHAETA

1. PHERETIMA [Indian Earthworm]

2. LUMBRICUS

3. TUBIFEX [Blood worm]



PHYLUM : ARTHROPODA

- ◆ It is the **largest phylum** under animal kingdom which includes **Insects**.
- ◆ It contributes over 2/3rd of all named animal species on earth.
- ◆ Mostly terrestrial but some are aquatic (crustacea)
- ◆ Exhibit Organ system level, Bilateral symmetry, Triploblastic condition, Schizocoelom, External segmentation, Tube within a tube body plan and Protostomous condition.
- ◆ Body is covered with **Chitinous** (Chitin → N-acetyl glucosamine) **exoskeleton**.
- ◆ Cephalisation is present
- ◆ During growth they periodically removes their exoskeleton as skin cast. It is called **Moulting / Ecdysis**.
- ◆ Body is divisible into **Head, Thorax** and **Abdomen**. In some arthropods Head fused with thorax to form as **Cephalothorax**. Eg. **Prawn**.
- ◆ Body is formed with many **jointed appendages** hence the phylum is named as **Arthropoda**.
- ◆ Insects have different types of mouth parts based on their feeding adaptation. For eg.
Cockroach - Biting and Chewing type
House fly - Sponging type mouth parts
Mosquito - Piercing and Sucking type
Honey bee - Chewing and Lapping type
Butter fly - Siphoning type
- ◆ Respiratory organs are **Trachea** [Insects], **Gills** [Prawn], **Book lungs** [Spider], **Book Gills** [Limulus] etc.
- ◆ Circulatory system is of open type with an open cavity called **Haemocoel, Haemolymph** (Blood) and a **Dorsal heart**.
- ◆ Excretion takes place through **Malpighian tubules** [Insects, Centipede, Millipede etc.] **Coxal glands** (spider), **Green / Antennal glands** (Prawn).
- ◆ Neural System formed with **paired ganglia and Double, Ventral, solid, ganglionated nerve cord**.
- ◆ Sense organs are ; A pair of **compound eyes** for **mosaic vision**, A pair of **Antennae**, A pair of **simple eyes**, **Statocyst** or **balancing organ** etc.
- ◆ **These are the first group of animals with an Endocrine system**.
- ◆ They are mostly Dioecious / Gonochorites.
- ◆ Exhibit sexual reproduction, usually **internal fertilization**, Development is Direct / Indirect and **Mostly oviparous** except **Scorpion** (Ovoviviparous)
- ◆ Phylum Arthropoda is classified into seven different classes.

Class : INSECTA

Eg. Economically important insects

1. APIS [Honey bee] → Provide Wax and Honey
2. BOMBYX [Silk worm] → Silk
3. LACCIFER [Lac insect] → Shellacc

Vectors :

1. Anopheles female mosquito

It spread Malaria

2. Female Culex Mosquito

It spreading Filariasis / Elephantiasis

3. Aedes

Transmit Yellow fever / Dengue fever and Chikunguinea

4. Locusta (Locust)

It is a polyphagous gregarious pest

5. Lepisma (Silver fish)

Class : ARACHNIDA

Eg. ARANAEUS [Spider]

BUTHUS [Scorpion]

Class : CRUSTACEA

Eg. PENAEUS [Marine prawn], PALAEMON [Fresh water Prawn], EUPARAGUS [Hermit crab], CANCER [Crab]

Class : MEROSTOMATA

LIMULUS [King Crab] : It is a living fossil

Class : DIPLOPODA

Eg. JULUS [Millipede]

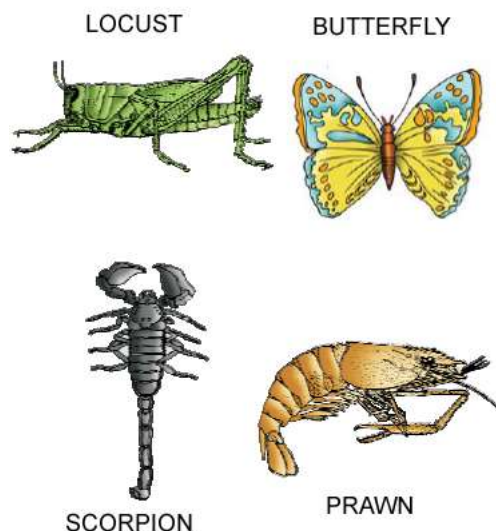
Class : CHILOPODA

Eg. SCOLOPENDRA [Centipede]

Class : ONYCHOPHORA

Eg. PERIPATUS [Walking worm]

- ♦ **PERIPATUS** is a connecting link between Annelida and Arthropoda.



PHYLUM : MOLLUSCA

- ◆ It is the second largest phylum under animal kingdom
- ◆ These are **soft unsegmented bodied animals** hence the phylum is named as Mollusca.
- ◆ Most of them have a **Calcareous shell** covering their body. Hence they named as **shelled organisms**.
- ◆ Study of Molluscs called "**MALACOLOGY**"
- ◆ Study of their shell is called "**CONCHOLOGY**"
- ◆ Mostly Aquatic [Marine and Fresh water] but some are **Terrestrial** [Land snail]
- ◆ Exhibit organ system level, Bilateral symmetry, Triploblasty, Schizocoelom, No metamerism, Tube within a tube body plan and Protostomes
- ◆ Body is divisible into **Head, muscular foot** and **visceral hump**. [Visceral mass]
- ◆ Anterior head bears **stalked eyes** and **sensory tentacles**
- ◆ Muscular foot helps for Locomotion.
- ◆ Mouth bears a file like Rasping organ called "**RADULA**" for **feeding**.
- ◆ A soft, spongy glandular layer of skin covering the **visceral hump** is called **Mantle / Pallium**. It secrete calcareous shell.
- ◆ Space between **Mantle** and **Visceral hump** called **Mantle cavity / Pallial cavity**.
- ◆ Certain **feather like gills** present in mantle cavity called **CTENIDIA**
- ◆ It helps for Respiration and **Excretion**
- ◆ Mostly an open circulation present

- ◆ **Cephalopod molluscs** exhibit **closed circulation**, with a **blue coloured blood** due to the presence of a **copper containing** pigment called **Haemocyanin**.
- ◆ Excretory organs are one or two pairs of sac like kidneys / organs of Bojanus / Keber's organ.
- ◆ Mostly **Ammonotelics** but some are **Uricotelics**. Eg. **Land Snail**
- ◆ Nervous system comprises paired cerebral, pleural, pedal and visceral ganglia joined by the nerve connectives and commissures.
- ◆ Sense organs are **stalked eyes, statocysts, sensory tentacles** and **osphradium** for testing chemical and physical nature of surrounding water.
- ◆ Exhibit SR only, External fertilization, Indirect development with Veliger, Trochophore and Glochidium larva.
- ◆ Mostly Dioecious but some are Monoecious.
- ◆ Mostly oviparous in nature
- ◆ Phylum Mollusca is subdivided into six classes

Class : MONOPLACOPHORA

Eg. **NEOPILINA** - Living fossil and connecting link between Annelida to Mollusca.

Class : AMPHINEURA

Eg. **CHAETOPLEURA** [Chiton]

Class : SCAPHOPODA

Eg. **DENTALIUM** [Tusk shell / Tooth shell]

Class : GASTROPODA

- ◆ Early embryo is symmetrical but during development body twists showing **Torsion**. So that the body becomes **Asymmetrical**.

Eg. **PILA** [Apple snail], **APLYSIA** [sea hare]

Class : PELECYPODA [Bivalvia]

Eg. **UNIO** [Fresh water mussel]. **TEREDO** [Ship worm], **PINCTADA** [Pearl oyster] - Pearl producing layer between shell and Mantle is called **Mother of Pearl / Nacreous layer**.

Class : CEPHALOPODA

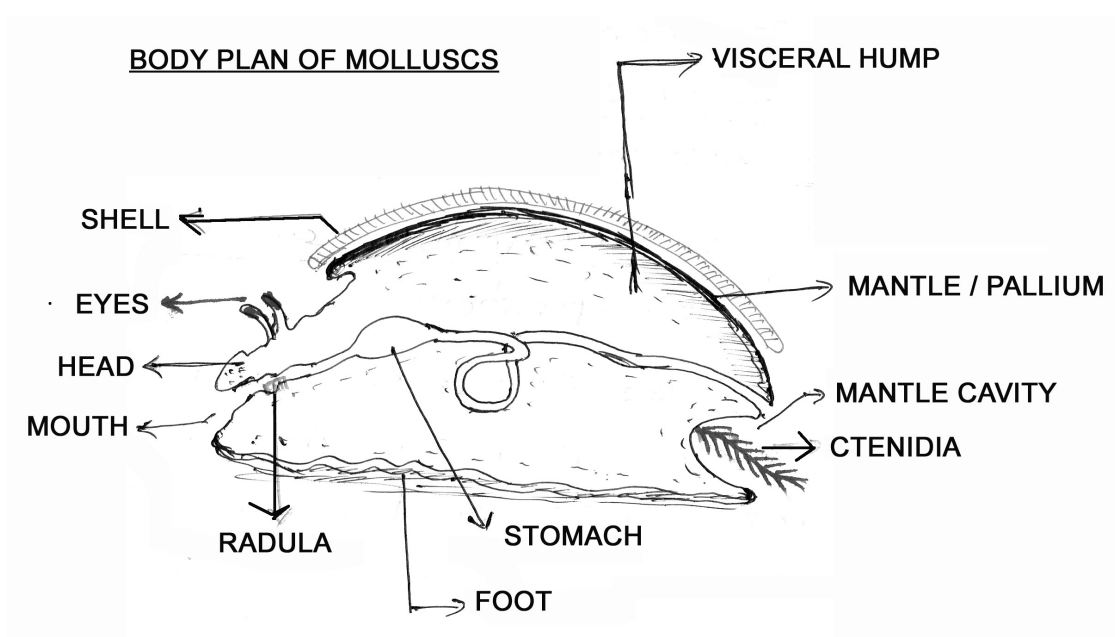
Eg. **SEPIA** [Cuttle fish]. **LOLIGO** [Squid], **OCTOPUS** [Devil fish]



Pila



Octopus



PHYLUM : ECHINODERMATA

- ◆ These are **spiny skinned bodied** animals hence the phylum is named as Echinodermata.
- ◆ Exclusively **Marine** and **Benthic** [Deep sea] in nature
- ◆ Most of them are free swimming except **Antedon**.
- ◆ Exhibit organ system level, Triploblasty, No metamerism and tube within a tube body plan.
- ◆ Larvae exhibit **Bilateral symmetry**, but adults show **Radial symmetry** [Pentamerous radial]
- ◆ These are the first group of animals with **Enterocoelom** and **Deuterostomous** condition.

- ◆ Digestive system is complete with mouth on the ventral / lower side and Anus on the upper / dorsal side.
- ◆ **Its most diagnostic feature is the presence of a Water vascular system / Ambulacral system with terminal projections called Tube feet.**
- ◆ It helps for **Locomotion, Capture and Transport of food and Respiration.**
- ◆ Excretory system is absent
- ◆ Head and Brain are absent
- ◆ They respire through **Tube feet** (star fish) **Dermal Branchiae** (star fish), **Respiratory tree** (sea cucumber).
- ◆ Excretion through general body surface, with the help of **Amoebocytes / Coelomocytes**. Most of them are Ammonotelics.
- ◆ **Calcareous ossicles as endoskeleton**, so the phylum is named as Echinodermata.
- ◆ A perforated plate called **MADREPORITE** is present in Ambulacral system, the pores of the madreporite allow water into the system.
- ◆ Water vascular system is coelomic in origin.
- ◆ Nervous system formed with **Nerve ring** and **Radial nerve cords**, so sense organs are poorly developed. Such as Tactile organs, chemoreceptors, terminal tentacles etc.
- ◆ Sexes are separate, SR, External fertilization and Development is Indirect with free swimming larva.
- ◆ Some showing well marked power of Regeneration.
- ◆ In between the spines certain Pincer like **Pedicellariae** present that helps to clean the body from debris and minute organisms.
- ◆ Echinodermata is further divisible into five classes.

Class : ASTEROIDEA

Eg. **ASTERIAS** [Star fish]

ASTROPECTEN

Its Larval forms are **Brachiolaria** and **Bipinnaria**

Class : ECHINOIDEA

Eg. **ECHINUS** [Sea urchin]

- ◆ Biting and chewing apparatus with teeth called **Aristotle's lantern** is present.
- ◆ Larval forms are Pluteus and Echinopluteus

Class : HOLOTHUROIDEA

- ◆ Oral end has mouth surrounded by tentacles.
- ◆ Larval forms are **Auricularia** and **Doliolaria**.

Eg. **HOLOTHURIA** and **CUCUMARIA** [Sea cucumber]

Class : OPHIUROIDEA

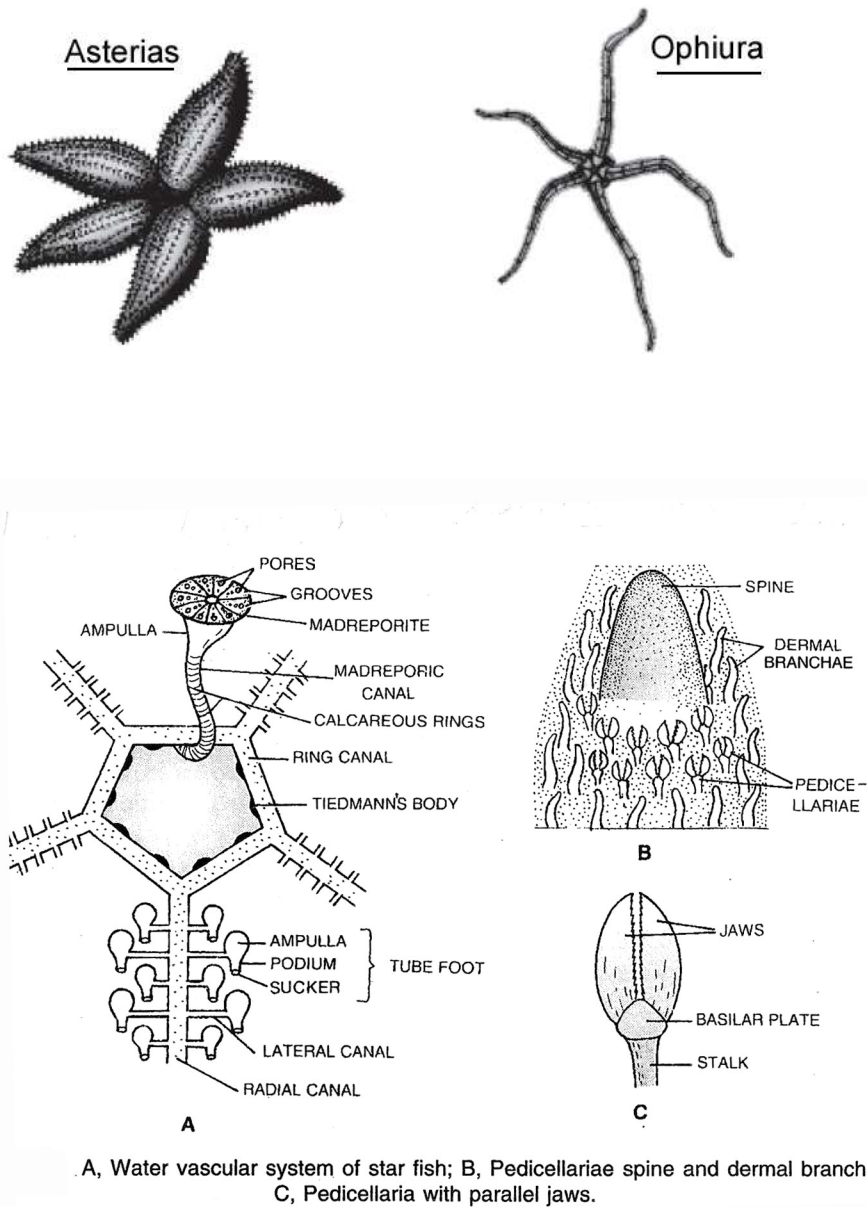
Eg. **OPHIURA** [Brittle star]

Larva is Ophiopluteus

- ◆ They show **EVISCERATION**, is a defence mechanism.

Class : CRINOIDEA

- ◆ Doliolaria is the larva.
- ◆ Body has a central disc which is attached to the substratum.
Eg. **ANTEDON** [Sea lilly / Feather star]



PHYLUM : HEMICHORDATA

- ◆ Previously it considered as a **subphylum under chordata**.
- ◆ It is considered as connecting link between Nonchordata to Chordata.

- ◆ Exclusively Marine and Benthic group of animals
- ◆ Exhibit organ system level, Bilateral symmetry, Triploblastic, Enterocoelom, No metamerism, Tube within a tube body plan and Deuterostomes.
- ◆ Body is soft, elongated worm like and it is divisible into **Anterior Proboscis, Middle Collar and Posterior Trunk.**
- ◆ A hollow outgrowth arises from the roof of buccal cavity called **Buccal diverticulum / Stomochord**. It present in the collar region
- ◆ It is a rudimentary structure similar to Notochord.
- ◆ Dorsally opened **pharyngeal gills** for respiration.
- ◆ A dorsal nerve ganglia is present.
- ◆ Circulatory system is of open type with Dorsal heart.
- ◆ **Proboscis gland / Glomerulus acts as their excretory organs.**
- ◆ Sensory cells of epidermis acts as sensory organs.
- ◆ Sexes are separate, SR only, external fertilization and Indirect development with **TORNARIA** larva.

Eg. **Balanoglossus** [Acorn worm / Tongue worm]

Sacchoglossus

