UNIT III

GENERAL CHARACTERS OF MICROBES AND STAINING

INTRODUCTION :

- Invertebrates are animals that neither possess nor develop a vertebral column, derived from the notochord. These include all animals apart from the subphylum Vertebrata.
- Invertebrates are animals with no backbone. 97% of the animals are invertebrates among the estimated 2.16 million animal species. Invertebrates exist about anywhere.
- These have been found in the driest of deserts, high reaches of the atmosphere and canopies of wettest rainforests. They also exist in the frozen Antarctic or under the deepest oceans.

General characteristics :

- All invertebrates do not have a spinal cord or vertebral column, instead, most of them possess an exoskeleton that encompasses the entire body.
- Normally, these are tiny and don’t grow very large.
- Do not possess lungs since they respire through their skin.
- Since they cannot produce their own food, Invertebrates are heterotrophic.
- Reproduction occurs through fission.

CLASSIFICATION OF INVERTEBRATES

PORIFERA

CNIDARIA

ECHINODERMATA

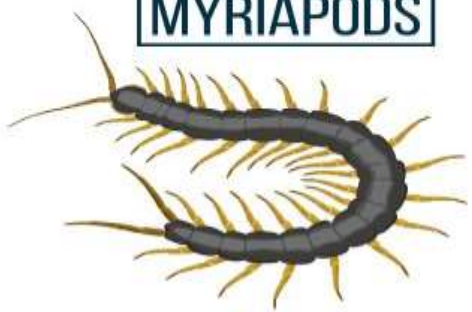
PLATYHELMINTHES

ANNELIDA

MOLLUSCA

ARTHROPODS

MYRIAPODS



CRUSTACEANS

ARACHNIDS

INSECTS

1.PORIFERA:

- Phylum Porifera are the lowest multicellular animals belonging to the kingdom Animalia.
- The word “Porifera” mainly refers to the pore bearers or pore bearing species. Based on the embryological studies, sponges are proved as animals and are classified into a separate Phylum in animals.
- This phylum includes about 5000 species. Poriferans are pore-bearing first multicellular animals. The pores are known as Ostia.
- The poriferans have a spongy appearance and are therefore called sponges. They are attached to the substratum and do not move. They have the ability to absorb and withhold fluids.

Characteristics of Phylum Porifera

1. The cells of Poriferans are loosely organized.
2. They are mostly found in marine water. Only a few are found in freshwater.
3. They are either radially symmetrical or asymmetrical.
4. Their body is usually cylindrical.
5. The scleroblast secretes spicules while spongin fibres are secreted by spongioblasts.
6. They have no organs in their body.
7. They depict cellular grade of organization.
8. The body comprises numerous pores known as Ostia and osculum.
9. The central cavity is called spongocoel or atrium which opens to the outside through the osculum.
10. They reproduce asexually by budding, and fragmentation.
11. The nutrition is holozoic.
12. They have neurosensory cells but are devoid of any specific nervous system.
13. They have the power to regenerate the lost parts.
14. The development is indirect and the cleavage is holoblastic.
15. The exchange of respiratory gases and nitrogenous wastes occurs by the process of diffusion.

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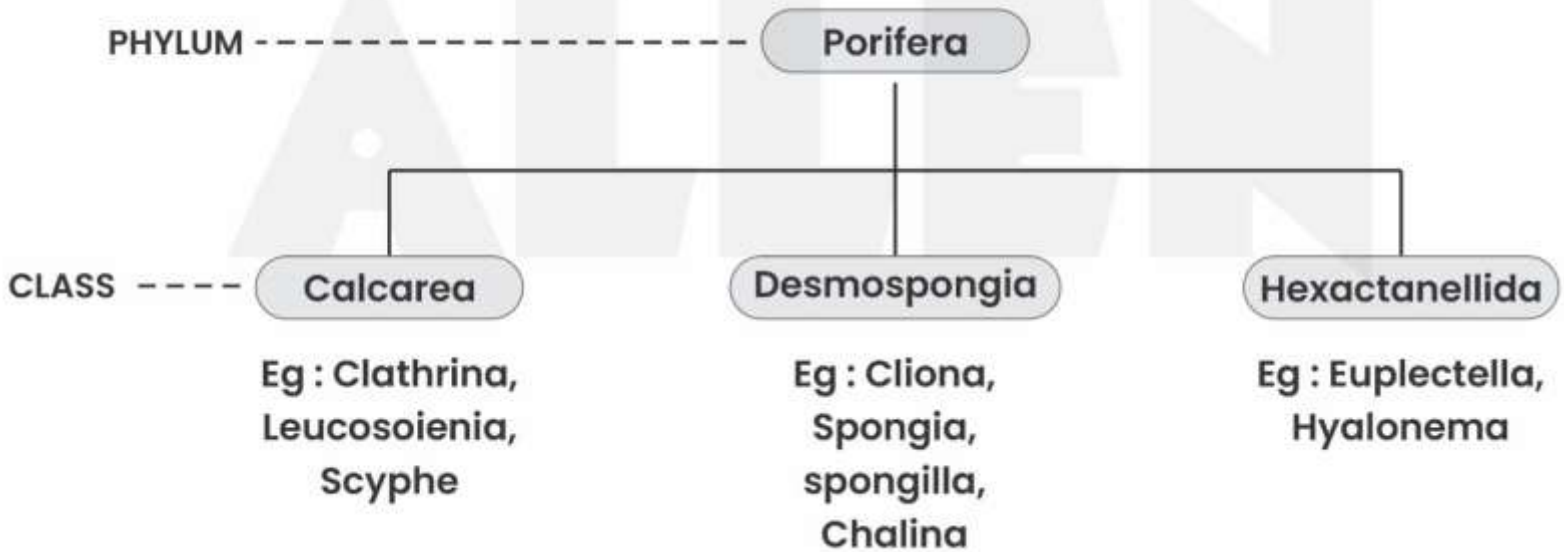
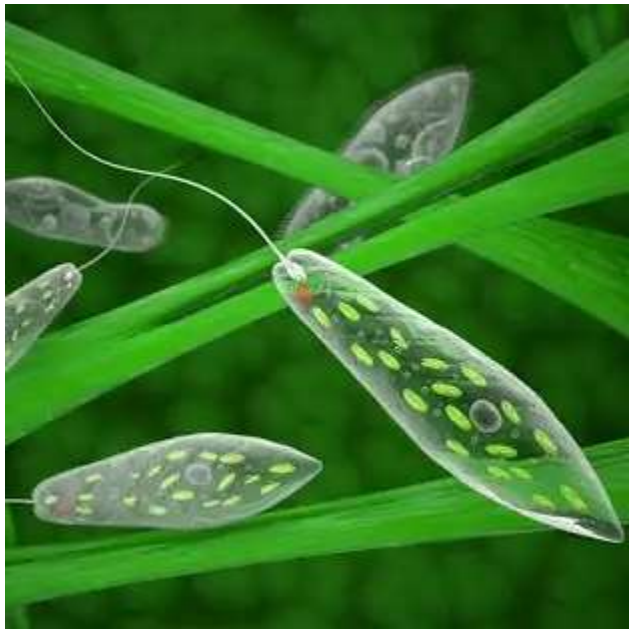
Phylum Porifera Classification



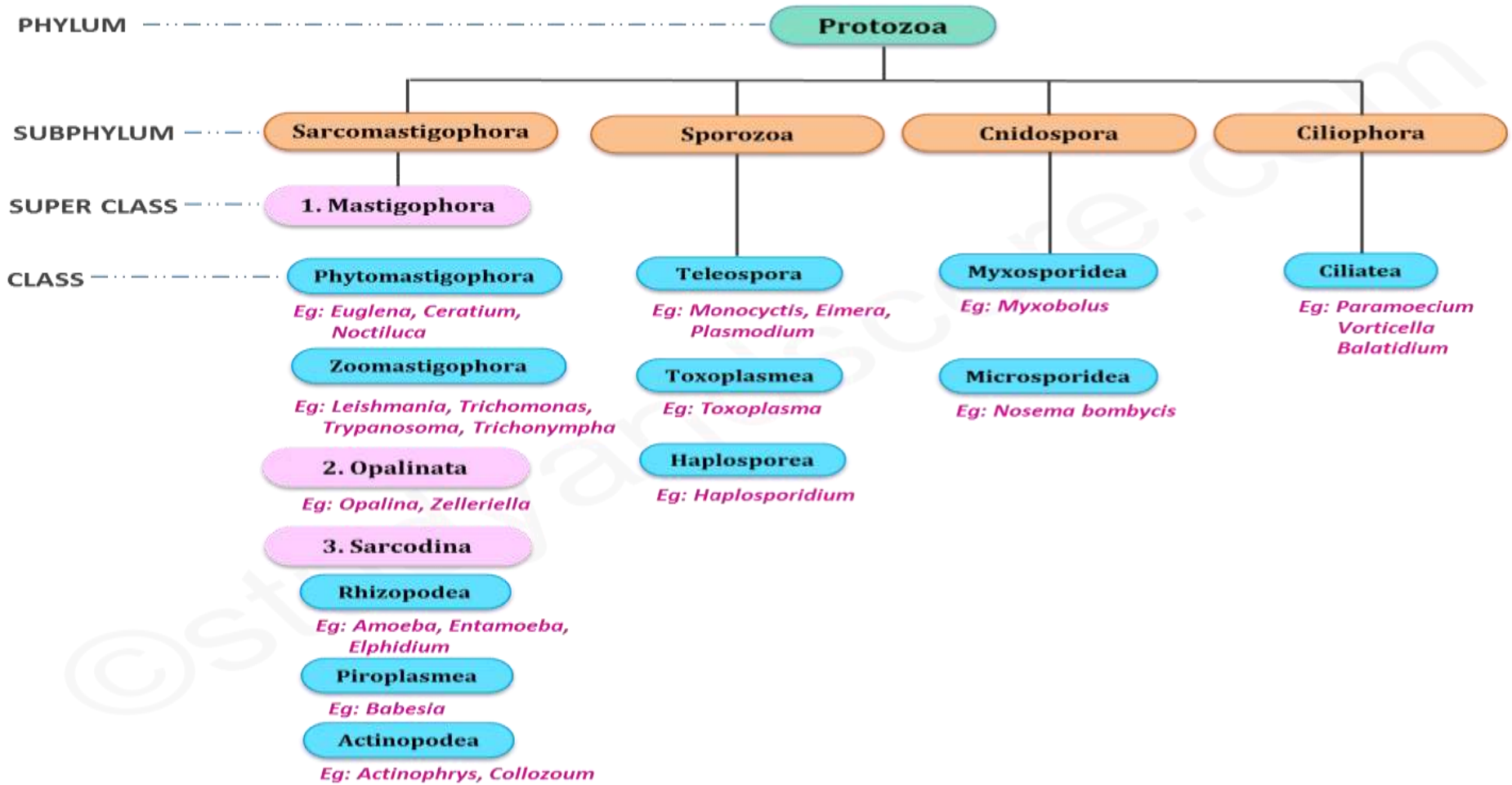
PROTOZOA :

- Protozoa are unicellular, eukaryotic, heterotrophic organisms. They are either free-living or parasites. There are around 65000 species of protozoans categorized in different groups. They lack a cell wall. There are many different cell organelles, that perform various tasks performed by different organs in higher animals, e.g. mouth, anus, intestinal tract, etc.
- There are many protozoa, that cause various diseases in animals and humans, e.g. Plasmodium (malarial parasite), Trypanosoma (sleeping sickness), Trichomonas (trichomoniasis), etc.
- The protozoa have many stages in their life cycle. Some of the stages of the life cycle are infectious.

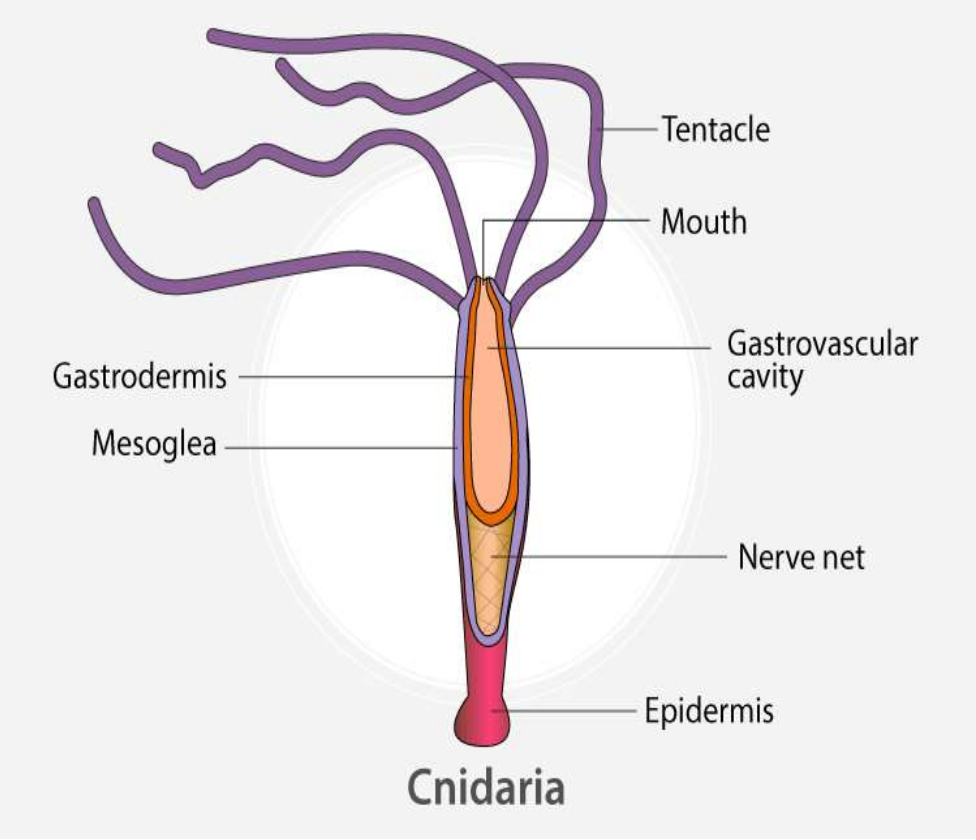


CHARACTERISTICS :

- Protozoa are found in the aquatic environment. They live in freshwater or oceans. Some are free-living and some are parasitic in plants and animals.
- The size and shape of Protozoa vary greatly, from microbial (1µm) to large enough and can be seen by the naked eye. The shell of unicellular foraminifera can have a diameter of 20 cm.
- They lack a rigid cell wall, so they are flexible.
- Protozoa are heterotrophic and have holozoic nutrition.
- protozoa species have flagella, cilia or pseudopodia.
- Mostly they reproduce by asexual means. They multiply by binary fission, longitudinal fission, transverse fission or budding.



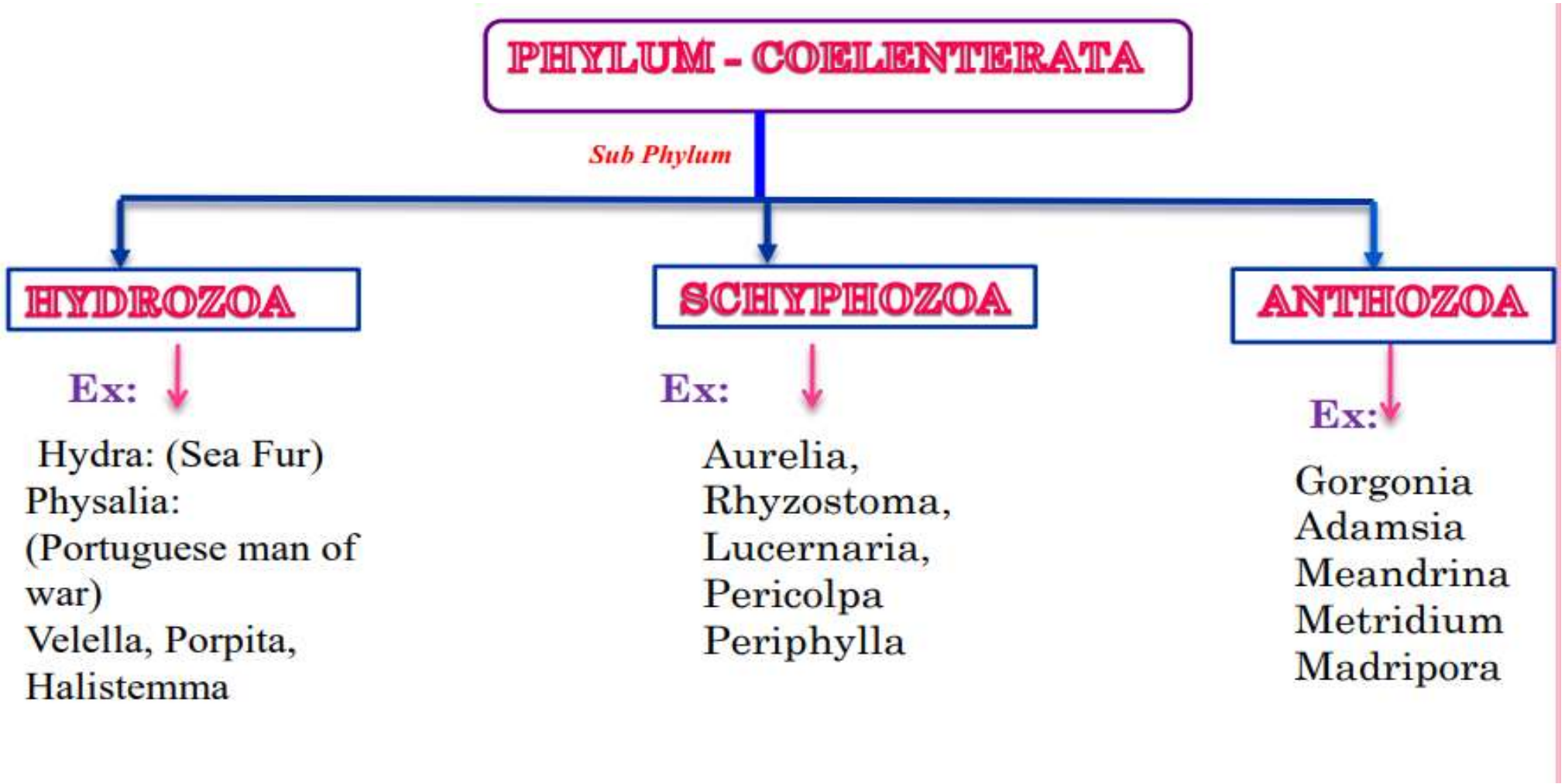
Coelenterata



- Phylum Coelenterata is a group of aquatic, or marine organisms and a member of the Animal kingdom. They are usually found attached to the rocks at the bottom of the sea. These are the multicellular and simplest group of invertebrate animals, found in colonies or solitarily.

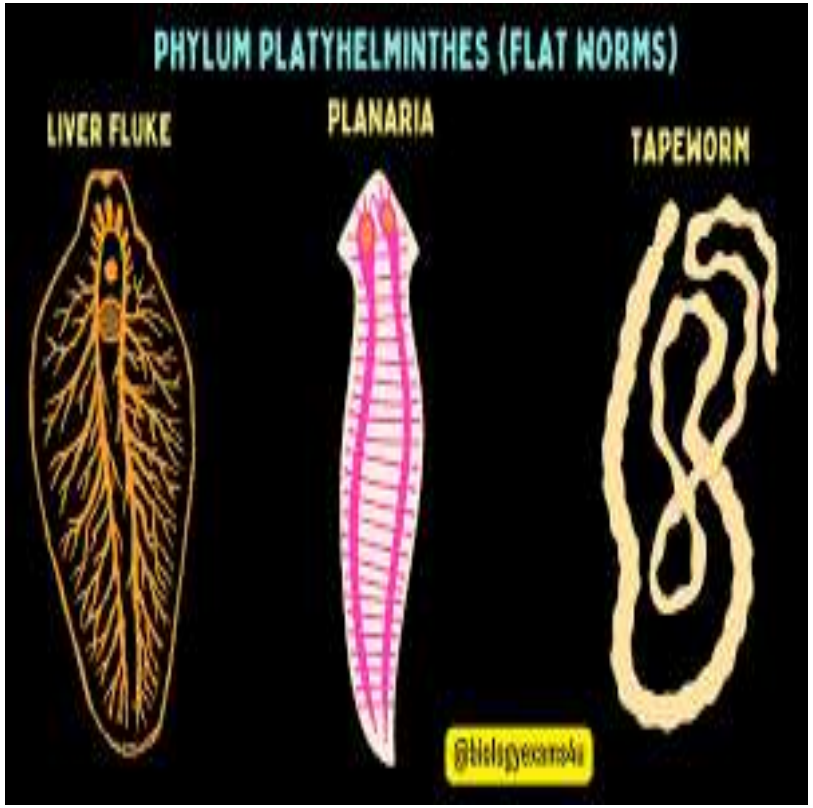
Characteristics of Coelenterata

- These are mostly aquatic or marine habitat animals.
- These species exhibit a tissue-level organization.
- The mouth is enclosed by thin and short tentacles.
- They are diploblastic animals, in which, the body is made up of two layers of cells:
- Ectoderm – One layer makes up the cells outside the body
- Endoderm – the other forms the inner lining of the body.
- They have cavities in their body.
- The body is radially symmetrical.
- The digestion is both intracellular and extracellular.
- The nervous system and the circulatory system is absent.
- They excrete and respire through simple diffusion.
- The mode of reproduction is asexual, which is through budding.
- The sexual mode of reproduction is seen only in a few Coelenterates.
- E.g., Hydra, Rhizostoma, Xenia, etc.


PHYLUM - COELENTERATA
Sub Phylum
HYDROZOA
SCHYPHOZOA
ANTHOZOA
Ex:
Hydra: (Sea Fur)
Physalia:
(Portuguese man of war)
Velella, Porpita,
Halistemma
Ex:
Aurelia,
Rhyzostoma,
Lucernaria,
Pericolpa
Periphylla
Ex:
Gorgonia
Adamsia
Meandrina
Metridium
Madripora

Platyhelminthes

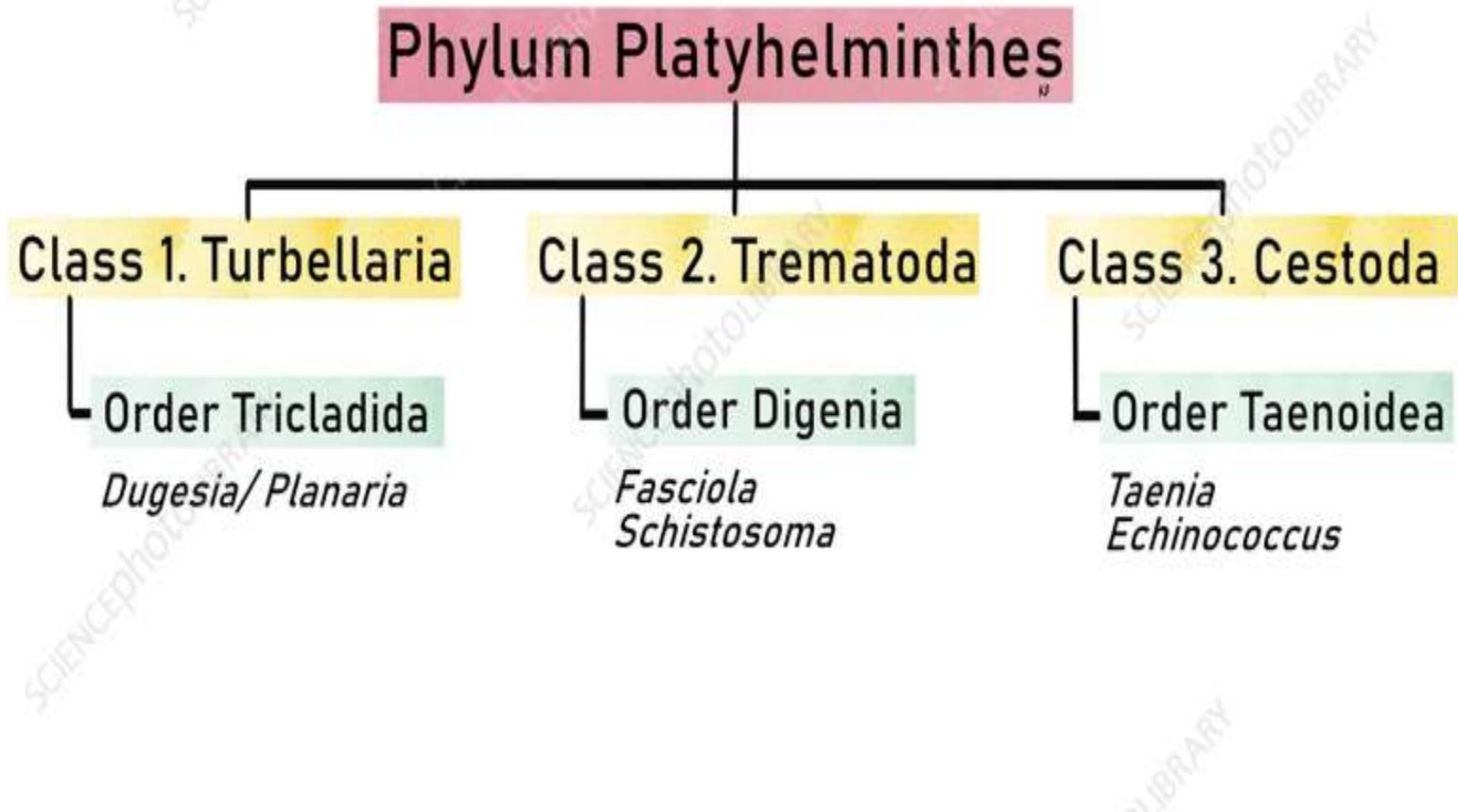
- Phylum Platyhelminthes belongs to kingdom Animalia. This phylum includes 13,000 species. The organisms are also known as flatworms. These are acoelomates and they include many free-living and parasitic life forms.
- Members of this phylum range in size from a single-celled organism to around 2-3 feet long.



Characteristic features of Phylum Platyhelminthes

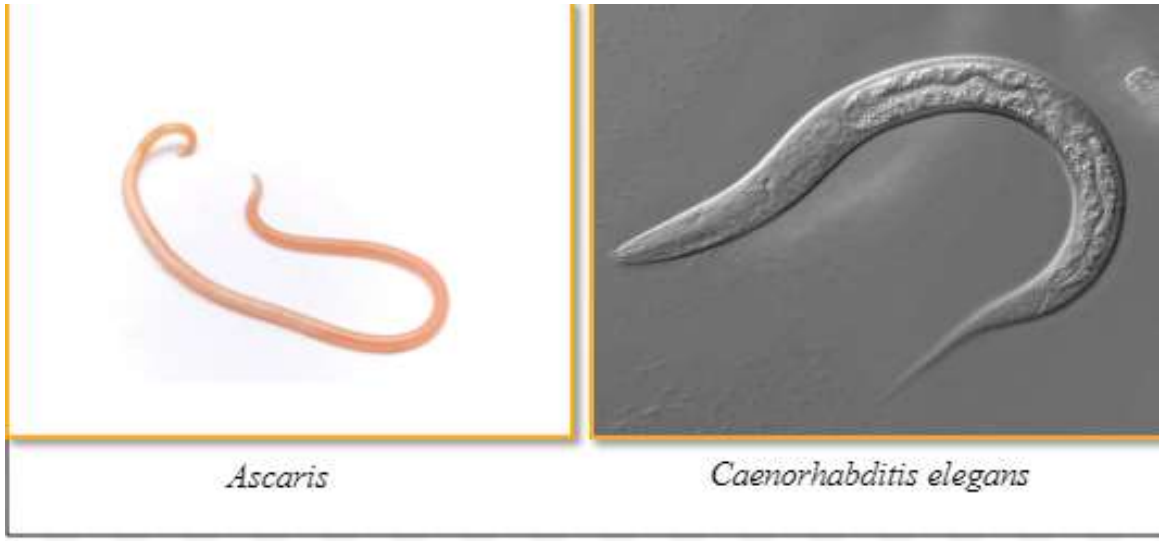
- Their body is dorsoventrally flattened.
- They exhibit bilateral symmetry.
- Also, they are triploblastic, with three germ layers.
- They do not have a body cavity and are acoelomate.
- The body is soft and unsegmented.
- They are mostly parasitic with a few free-living
- They exhibit an organ system grade of organization.
- The digestive system is incomplete or absent.
- Respiratory and circulatory systems are absent.
- Sexual reproduction happens through gametic fusion.
- Asexual reproduction also happens in a few species through regeneration and fission.
- Fertilization is internal.

Classification:



Aschelminthes

- Aschelminthes are commonly known as roundworms. They are characterized by the presence of a pseudocoelom. It is now an obsolete phylum of invertebrates, and the animals grouped under this are now kept in ten different phyla.
- Aschelminths can be free-living or parasitic.
- Many adult roundworms live inside the intestine, causing obstruction to the intestinal passage. This causes abdominal discomfort, colic-like pain, impaired digestion, diarrhea, and vomiting.



Characteristic features of Phylum Aschelminthes

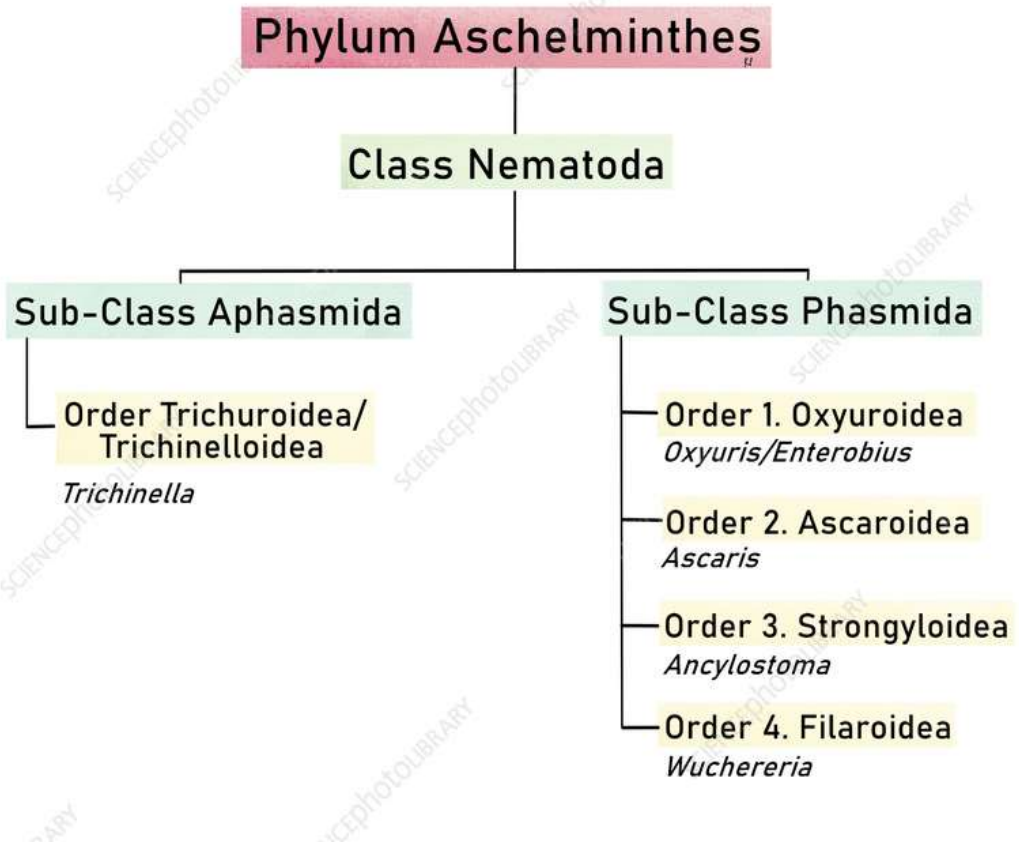
- The body of these organisms is unsegmented and triploblastic.
- They have a pseudocoeloem, where the body cavity is not lined by the mesodermal layer.
- They are bilaterally symmetric.
- The body is cylindrical or thread like with elongated, slender worm-like appearance and tapering at both ends.
- Body wall has epidermis, muscle layer and is covered by cuticle.
- The body size of these organisms varies from microscopic to several centimetres in length.
- These organisms are mostly parasitic, with a few free-living
- They exhibit an organ system level of organization.
- Externally, there is little differentiation between the anterior and posterior regions. But internal cephalization is present.
- There is no distinct head. However, the mouth is present in the anterior

•The digestive system is complete, with a mouth and anus.
•The mouth in these organisms is terminal and is surrounded by lips bearing sense organ.
•Amphids and papillae are the main sensory organs.
•The nervous system consists of a nerve-ring that encircles the oesophagus. From it, nerves extend out anteriorly and posteriorly.
•Respiratory organs are absent. Respiration occurs through the general body surface. It is aerobic in free-living forms and anaerobic in parasitic organisms.
•The excretory system has canals and gland-like
•Sexes are separate and are unisexual, exhibiting sexual dimorphism.
•Fertilization is internal.
•They are ovo-viviparous, oviparous or viviparous.
•The life cycle of these organisms is complicated. It may be with or without an intermediate host.

Examples

- Ascaris lumbricoides – Round Worm
- Enterobius vermicularis – Pinworm
- Ancylostoma duodenale – Hookworm
- Wuchereria bancrofti – Filarial worm
- Loa loa – Eye Worm

Classification of Phylum Aschelminthes



Mollusca

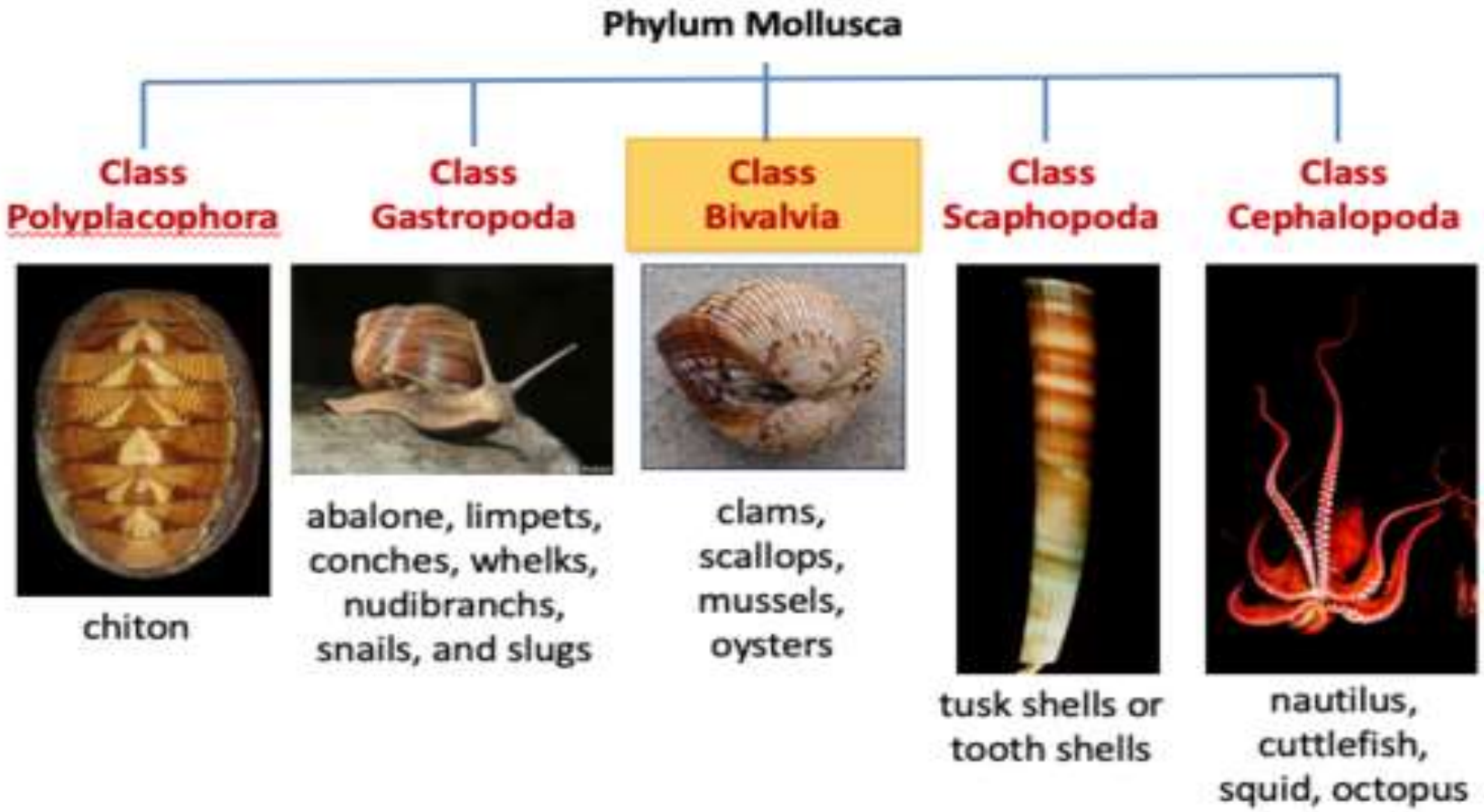
- The animals belonging to the phylum Mollusca have soft-bodies, triploblastic and bilaterally symmetrical and coelomate.
- They are sluggish invertebrates, with a thin fleshy envelope or mantle covering the visceral organs.
- These organisms are found in the terrestrial as well as in deep seas. Their size ranges from microscopic organisms to organisms 20 metres long.
- They play a very important role in the lives of humans. They are a source of jewellery as well as food. Natural pearls are formed within these molluscs.

Mollusca Characteristics

- They are mostly found in marine and freshwater. Very few are terrestrial and found in moist soil.
- They exhibit organ system level of organization.
- Their body has a cavity.
- The body is divided into head, visceral mass, muscular foot and mantle.
- The head comprises of tentacles and compound eyes.
- The body is covered by a calcareous shell.
- The muscular foot helps in locomotion.
- They have a well-developed digestive system, the radula is the rasping organ for feeding.
- Respiration in Mollusca occurs through the general body surface, gills or pulmonary sac.

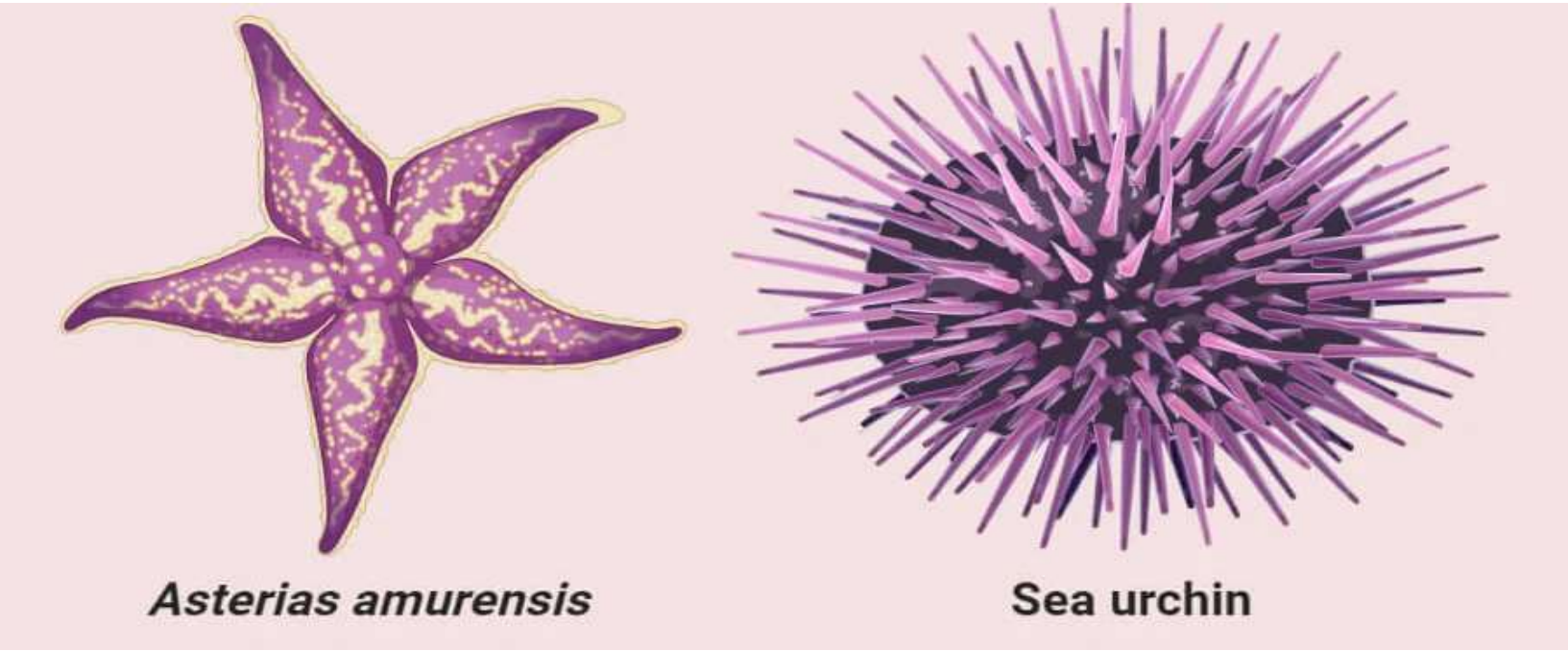
- The blood circulates through the open circulatory system.
- They have a pair of metanephridia that helps in excretion.
- The nervous system in Mollusca consists of number of paired ganglia and nerves.
- The tentacles, eyes, osphradium, and statocysts act as the sensory organs.
- The sexes are separate in most of the molluscs but some species are hermaphrodites. Fertilization may be external or internal.
- They are generally oviparous with indirect development .

CLASSIFICATION OF PHYLUM MOLLUSCA



Phylum Echinodermata

- Echinoderms are enterocoelous coelomates with pentamerous radial symmetry, without distinct head or brain having a calcareous endoskeleton of separate plates or pieces and a peculiar water vascular system of coelomic origin with podia or tube-feet projecting out of the body.

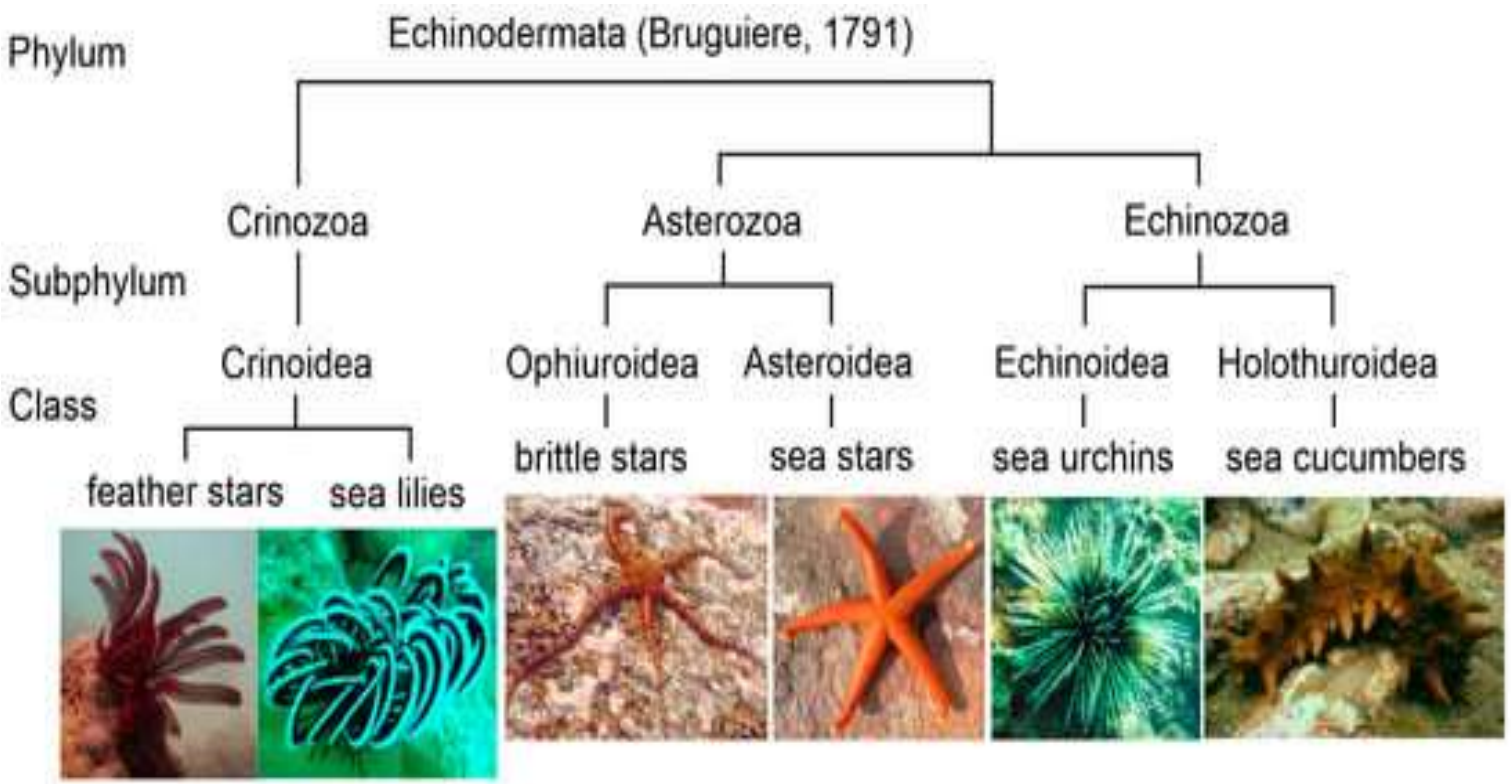


Phylum Echinodermata Characteristics

- ❖They are exclusively marine and are among the most common and widely distributed marine animals.
- ❖They occur in all seas from the intertidal zones to great depths.
- ❖They have an organ grade system of body organization.
- ❖Symmetry usually radial, nearly always pentamerous.
- ❖The body is triploblastic, coelomate with distinct oral and aboral surfaces, and without definite head and segmentation.
- ❖They are moderate to considerable size but none are microscopic.
- ❖Body shape globular, star-like, spherical, discoidal, or elongated.
- ❖The surface of the body is rarely smooth, typically covered by 5 symmetrically radiating grooves called ambulacra with 5 alternating inter-radii or inter-ambulacra.

- The body wall consists of an outer epidermis, a middle dermis, and an inner lining of the peritoneum.
- Endoskeleton consists of closely fitted, plates forming a shell usually called theca or test or may be composed of separate small ossicles.
- The coelom is spacious lined by peritoneum, occupied mainly by the digestive and reproductive system, and develops from embryonic archenteron i.e. enterocoel.
- Coelom of enterocoelous type constitutes the perivascular cavity of water vascular system; coelom fluid with coelomocytes.
- Water -vascular system of coelomic origin, including podia or tube feet for locomotion and usually with a madreporite.
- The alimentary canal is usually a coiled tube extending from the mouth located on the oral surface to the anus on the aboral or oral surface.
- Vascular and haemal or blood lacunar system, enclosed in coelomic peripheral channels.
- Respiratory organs include branchiae, tube-feet, respiratory tree, and bursae.
- A nervous system without a brain and with a circumoral ring and radial nerve.
- The excretory system is wanting.

CLASSIFICATION :



1. Rice (Oryza sativa)

- Rice is a staple crop worldwide, and various insect pests target it at different growth stages.
  Major insect pests of rice:
- **Brown planthopper (Nilaparvata lugens)**: Sucks sap from rice plants, causing "hopper burn" and transmitting rice ragged stunt virus.
- **Rice stem borer (Scirpophaga incertulas)**: Larvae bore into stems, causing "dead hearts" and "whiteheads."
- **Rice leaf folder (Cnaphalocrocis medinalis)**: Larvae fold leaves and feed on chlorophyll, reducing photosynthesis.
- **Rice gall midge (Orseolia oryzae)**: Larvae induce gall formation ("silver shoots"), preventing grain production.

2. Sugarcane (Saccharum officinarum)

- Sugarcane is highly susceptible to damage from both chewing and boring insects. **Major insect pests of sugarcane**:
- **Sugarcane stem borer (Chilo sacchariphagus)**: Larvae tunnel into the stalks, reducing sucrose content.
- **Sugarcane top borer (Scirpophaga excerptalis)**: Affects the upper portion of the cane, stunting growth.
- **White grub (Holotrichia spp.)**: Larvae feed on roots, reducing plant vigor.
- **Pyrilla (Pyrilla perpusilla)**: Sucks sap from leaves, causing yellowing and drying.

3. Coconut (Cocos nucifera)

- Coconut palms are often attacked by pests that weaken trees and reduce nut production.
  Major insect pests of coconut:
- **Coconut rhinoceros beetle (Oryctes rhinoceros)**: Adults bore into crowns, damaging fronds and growing tissues.
- **Red palm weevil (Rhynchophorus ferrugineus)**: Larvae tunnel through stems, potentially killing trees.
- **Coconut hispine beetle (Brontispa longissima)**: Larvae and adults feed on leaf tissues, leading to defoliation.
- **Coconut scale insect (Aspidiotus destructor)**: Sucks sap from leaves and fruits, causing yellowing and fruit drop.

4. Cotton (Gossypium spp.)

- Cotton is a valuable fiber crop targeted by a variety of insect pests.
  Major insect pests of cotton:
- **Cotton bollworm (Helicoverpa armigera)**: Larvae feed on bolls, reducing fiber yield and quality.
- **Pink bollworm (Pectinophora gossypiella)**: Larvae bore into bolls, damaging seeds and lint.
- **Whitefly (Bemisia tabaci)**: Sucks sap and transmits cotton leaf curl virus (CLCuV).
- **Aphids (Aphis gossypii)**: Sucks sap from leaves and excretes honeydew, encouraging sooty mold.

5. Vegetables

- Vegetables are frequently attacked by insect pests, leading to significant losses in yield and quality.
  Major insect pests of vegetables:
- **Fruit fly (Bactrocera cucurbitae)**: Damages cucurbits by laying eggs in fruits, causing them to rot.
- **Diamondback moth (Plutella xylostella)**: Larvae feed on cruciferous vegetables like cabbage and cauliflower.
- **Cutworms (Agrotis spp.)**: Feed on seedlings and cut stems at ground level.
- **Aphids (Aphis spp.)**: Infest a wide range of vegetables, sucking sap and transmitting viral diseases.

6. Fruits

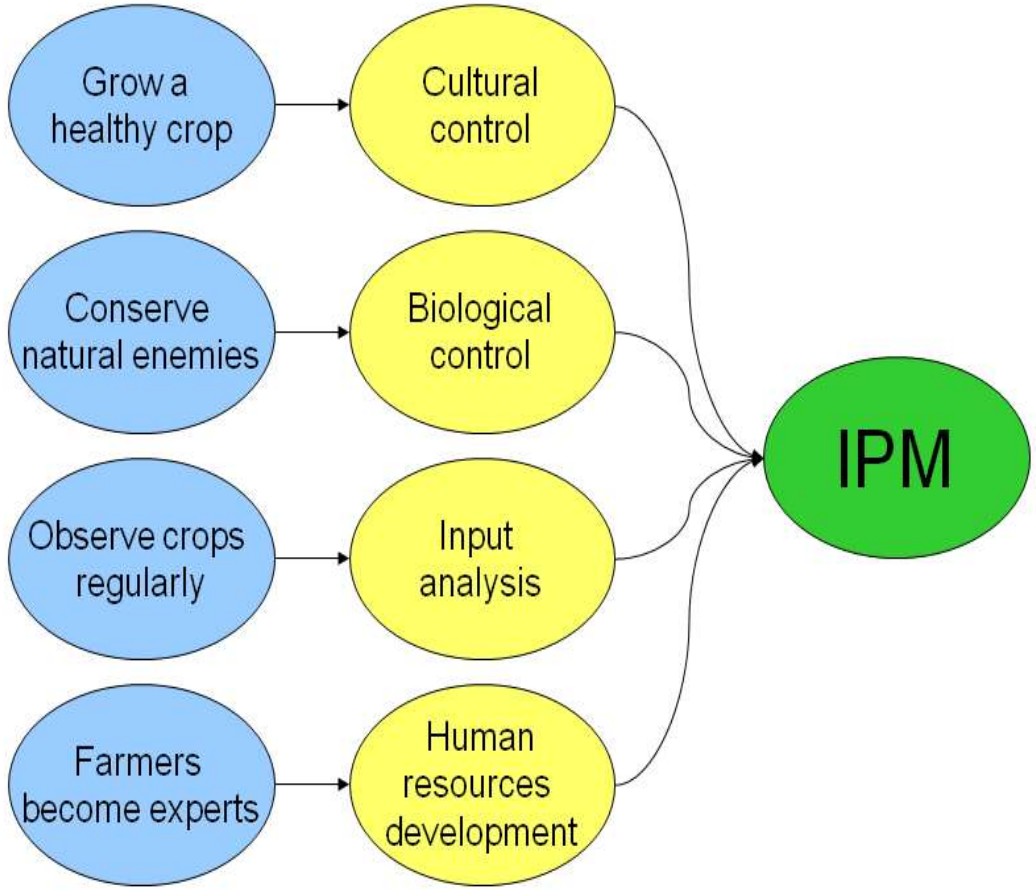
- Fruits are highly susceptible to insect pests, which cause both direct damage and post-harvest losses.
  Major insect pests of fruits:
- **Fruit fly (Bactrocera dorsalis)**: Affects mangoes, guavas, and citrus fruits by laying eggs in fruits, causing decay.
- **Mango hoppers (Idioscopus spp.)**: Suck sap from mango inflorescences, reducing fruit set.
- **Citrus psylla (Diaphorina citri)**: Transmits citrus greening disease (huanglongbing).
- **Mealybugs (Planococcus spp.)**: Infest fruits like papayas and grapes, causing fruit drop and sooty mold.

7. Stored Products

- Stored grains, pulses, and processed products are prone to infestation by insect pests during storage.
  Major insect pests of stored products:
- **Rice weevil (Sitophilus oryzae)**: Infests stored grains like rice and wheat, causing weight loss and contamination.
- **Lesser grain borer (Rhyzopertha dominica)**: Bores into stored grains, reducing quality.
- **Red flour beetle (Tribolium castaneum)**: Damages flour and other processed grains.
- **Indian meal moth (Plodia interpunctella)**: Larvae infest stored nuts, grains, and dried fruits.

Principles of insect control :

- The principles of pest control include identifying pests, monitoring them, and choosing an effective control method. These principles are often applied in the context of Integrated Pest Management (IPM), which aims to minimize environmental impact.



1. Biological Pest Control

- This method uses natural predators, parasites, pathogens, or competitors to control insect populations.
- **Principles**:
- Exploits the natural enemies of pests (e.g., parasitoids, predators, pathogens) to reduce pest numbers.
- Maintains ecological balance with minimal environmental disruption.
- **Examples**:
- **Predators**: Ladybirds and lacewings feed on aphids.
- **Parasitoids**: Trichogramma wasps parasitize the eggs of pests like moths.
- **Pathogens**: Bacillus thuringiensis (Bt) is used as a microbial insecticide against caterpillars.
- **Competitors**: Using sterile insect techniques (e.g., sterile male flies) to reduce pest reproduction.

2. Physical Pest Control

- This method involves manipulating environmental conditions or applying physical barriers to prevent pests from damaging crops or stored products.
- **Principles**:
- Involves direct use of environmental modifications or physical barriers to deter pests.
- Focuses on prevention rather than extermination.
- **Examples**:
- **Temperature control**: Heat treatment of stored grains to kill pests like weevils.
- **Light traps**: Attracting and capturing nocturnal insects.
- **Barriers**: Using nets to protect crops from flying pests (e.g., fruit flies).
- **Radiation**: Gamma radiation to sterilize pests in post-harvest products.

3. Chemical Pest Control

- This is the use of synthetic or natural chemicals (pesticides) to kill or repel pests.
- **Principles**:
- Effective in rapidly reducing pest populations but may cause environmental and health concerns.
- Chemicals should be applied with caution to avoid pest resistance, residues in food, and non-target effects.
- **Types of pesticides**:
- **Insecticides**: For insects (e.g., organophosphates, pyrethroids).
- **Fumigants**: For stored product pests (e.g., methyl bromide).
- **Repellents**: To deter pests (e.g., DEET for mosquitoes).
- **Growth regulators**: Disrupt pest life cycles (e.g., juvenile hormone analogs).
- **Examples**:
- Spraying pyrethroids to control bollworms in cotton.
- Use of neem-based products as botanical insecticides.

4. Mechanical Pest Control

- This involves the direct removal or exclusion of pests using tools, machinery, or manual methods.
- **Principles**:
- Physically disrupt or kill pests or prevent their access to crops.
- Labor-intensive but environmentally friendly.
- **Examples**:
- **Handpicking**: Removing caterpillars or beetles from plants manually.
- **Traps**: Using sticky traps, pheromone traps, or pitfall traps to catch pests.
- **Weeding**: Removing weeds that harbor pests.
- **Tillage**: Plowing fields to expose and kill soil-borne pests (e.g., cutworms).

5. Integrated Pest Management (IPM)

- IPM combines multiple pest control methods in a coordinated approach to manage pests sustainably.
- **Principles**:
- Focuses on long-term pest control by integrating biological, physical, chemical, and cultural methods.
- Prioritizes non-chemical methods and only uses pesticides as a last resort.
- Reduces pest populations to economically acceptable levels rather than eradicating them.

Steps in IPM:

1. **Monitoring**: Regularly inspect crops to assess pest levels.
2. **Thresholds**: Identify economic thresholds to determine when control measures are needed.
3. **Control methods**: Apply the most effective and least harmful strategies.
4. **Evaluation**: Assess the effectiveness of the control measures and make adjustments.

Examples:

- Combining the use of resistant crop varieties, biological controls (e.g., Trichogramma), and pheromone traps to manage rice stem borers.
- Managing aphids in vegetables using cultural practices (crop rotation), physical barriers (nets), and natural enemies (ladybugs).