

1. Details of Module and its structure

Module Detail	
Subject Name	Biology
Course Name	Biology 01 (Class XI, Semester - 1)
Module Name/Title	Animal Kingdom – Part 2
Module Id	kebo_10402
Pre-requisites	Basic knowledge about biodiversity and classification
Objectives	After going through this lesson, the learners will be able to understand the following: <ul style="list-style-type: none">• To study the significant features of different phyla of animal kingdom.• To develop the interest of the learner in classification of animals.
Keywords	Colloblast cells, flame cells, comb plates, metamerism, ctenidia, worm charming, tagmatization, radula, notochord.

2. Development Team

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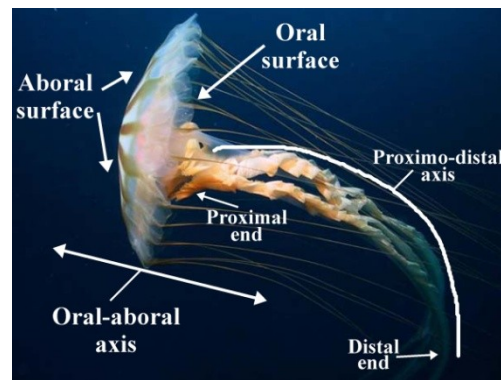
1. Phylum Ctenophora
2. Phylum Platyhelminthes
3. Phylum Aschelminthes
4. Phylum Annelida
5. Phylum Arthropoda
6. Phylum Mollusca
7. Phylum Echinodermata
8. Phylum Hemichordata
9. Summary

1. Phylum Ctenophora

Etymology: Ctenophore is made of two words- “ktene” means comb and “phors” means bearing.



Comb



Jelly

This is a small phylum containing about 90 species of small and delicate animals. Ctenophores, commonly known as comb jellies or sea walnuts, are voracious predators. They lack stinging cells, instead they possess sticky cells called colloblasts in order to capture prey.

Habitat: They are exclusively marine.

Symmetry: These are radially symmetrical animals.

Level of Organization: They have tissue level of organisation.

Germ Layer: They are diploblastic organisms.

Body Cavity: These are acoelomate.

Body Plan: Their body has two layers of cells which are “epidermis” and “gastrodermis”. There is one more poorly defined third layer between them called “mesoglea”.

They also possess a sense organ called “statocyst” at the aboral end (opposite end of mouth) for balance.

Locomotion: Their body bears eight external rows of ciliated comb plates, which help in locomotion. The cilia present on these plates help them in swimming.

Digestion: They have a digestive system with mouth, stomach, complex gastrovascular canals and two aboral anal pores. The digestive tract is complete. Digestion is both extracellular and intracellular.

No Skeletal, Circulatory, Respiratory and Excretory System.

Reproduction: Sexes are not separate. They are monoecious i.e. hermaphrodite. Reproduction takes place only by sexual means. Fertilisation is external with indirect development. Asexual reproduction is absent.

Speciality: Bioluminescence is well-marked in ctenophores. It is the property of a living organism to emit light. They also have the power of regeneration.

What makes them unique?

- Presence of colloblast cells.
- Bioluminescence.
- Power of regeneration.
- sense organ called “statocyst”
- Comb plates for locomotion.

Examples: *Pleurobrachia* and *Ctenoplana*.



Lobates



Pleurobrachia



Venus Girdle

Quick review:

- 1) Radially or biradial Symmetrical.
- 2) Body multicellular, few tissues, some organs and organelles.
- 3) Body contains an internal cavity and a mouth and anal pores.
- 4) Swims by means of plates of cilia (the combs)
- 5) Reproduction mainly sexual as hermaphrodites.
- 6) Lives in marine environments.
- 7) All are carnivorous.

2. Phylum Platyhelminthes

Etymology: *platy* means "flat" and *helminth* means "worm".

Body Form: Platyhelminthes have dorso-ventrally flattened body, hence are called flatworms. They do not possess any segment.

Habitat: These are mostly parasites, specifically endoparasites found in animals including human beings and some are free living.

Symmetry: These are bilaterally symmetrical animals.

Level of Organization: They have organ level of organisation.

Germ Layer: They are triploblastic organisms i.e. having three germ layers- ectoderm, endoderm and mesoderm.

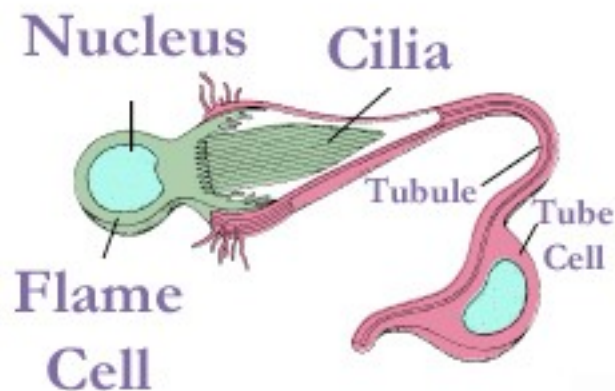
Body Cavity: These are acoelomate. The space between body wall and organs is filled with connective tissue called parenchyma which helps in transporting food.

Body Plan: Hooks and suckers are present in the parasitic forms.

Digestion: Some of them absorb nutrients from the host directly through their body surface. The digestive tract, if present, is incomplete i.e. without anus.

Skeletal, Respiration and Circulatory System are absent.

Excretion: Specialised cells called flame cells help in osmoregulation and excretion.



Nervous System: They have ladder like nervous system which has brain and two main longitudinal nerve cords connected at intervals by transverse commissures.

Reproduction: Sexes are not separate. They are generally hermaphrodite and the reproductive organs are well developed. Fertilisation is internal and development is through many larval stages. Some flatworms reproduce by binary fission.

Some flatworms like Tapeworms show self fertilization

Some members like *Planaria* possess high regeneration capacity.

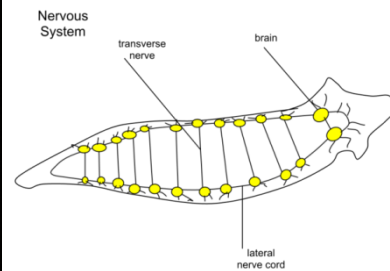
What makes them unique?

- Triploblastic
- Flame cells
- Ladder like nervous system
- Power of regeneration
- Self fertilization in some flatworms

Examples: *Taenia* (Tapeworm), *Fasciola* (Liver fluke).

Quick review:

- 1) Bilaterally symmetrical.
- 2) Triploblastic and organ level of organization.
- 3) No internal cavity.
- 4) Possesses a blind gut (i.e. it has a mouth but no anus) or blind sac body plan.
- 5) Flame cells for excretion.
- 6) Ladder like nervous system.
- 7) Generally dorsoventrally flattened.
- 8) Reproduction mostly sexual as hermaphrodites.
- 9) Feed on animals and other smaller life forms.
- 10) Occur in all major habitats, including many as parasites of other animals.



Planaria



Tapeworm



Fasciola

3. Phylum Aschelminthes

They are also known as “Nematodes”. They are commonly called roundworms.

Etymology: *aschel* means "round" and *helminth* means "worm".

Body Form: The body of the aschelminthes is circular in cross-section, hence, the name roundworms. They have elongated, cylindrical and unsegmented body with tapering ends.

Habitat: They are free living, aquatic and terrestrial or parasitic in plants and animals.

Symmetry: These are bilaterally symmetrical animals.

Level of Organization: They have organ level of organisation.

Germ Layer: They are triploblastic organisms i.e. having three germ layers- ectoderm, endoderm and mesoderm.

Body Cavity: They are pseudocoelomate which is filled with pseudocoelomic fluid.

Body Wall: Body wall is composed of cuticle, epidermis and muscle layer.

Digestion: Alimentary canal is complete with a well developed muscular pharynx.

Skeletal, Respiration and Circulatory System are absent. Pseudocoelomic fluid present in pseudocoelom maintains body shape and forms hydroskeleton. Respiration occurs by simple diffusion through body surface. The pseudocoelomic fluid transports materials.

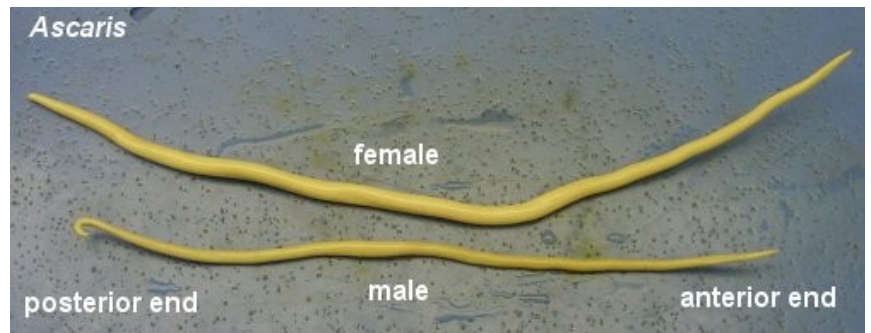
Excretion: An excretory tube removes body wastes from the body cavity through the excretory pore. Ammonia is the main excretory material.

Nervous System: It has circumpharyngeal ring that gives rise to nerves forward and backward. Sense organs are present on the lips, pits and on the lateral sides of posterior end.

Reproduction: They have separate sexes (dioecious), i.e., males and females are distinct (Sexual Dimorphism). Often females are longer than males. Fertilisation is internal and development may be direct in which the young ones resemble the adult or indirect.

What makes them unique?

- Pseudocoelomate
- Internal fertilization
- Sexual dimorphism



Ancylostoma

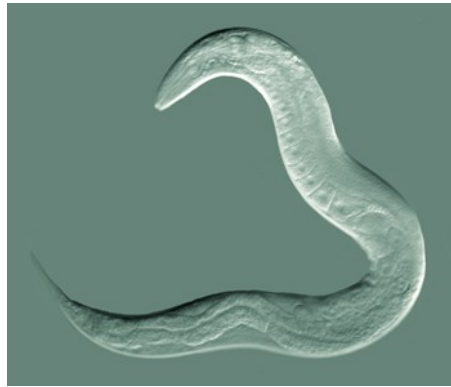
Examples: *Ascaris* (Round Worm), *Wuchereria* (Filaria worm), *Ancylostoma* (Hookworm), *Rhabditis* (free living)

Quick review:

- 1) Bilaterally symmetrical.
- 2) Triploblastic and organ system level of organization.
- 3) Pseudocoelomate.
- 4) Complete digestive system.
- 5) Flame cells for excretion.
- 6) Show sexual dimorphism.
- 7) Round in shape.
- 8) Internal fertilization.



Wuchereria



Rhabditis

4. Phylum Annelida

This phylum consists of over 9000 species.

Etymology: In Latin, *annulus* means “little ring”.

Habitat: Annelids are found throughout the world, from deep ocean bottoms to high mountain glaciers. They live in protected habitats such as mud, sand, and rock crevices. Some are free living, others are burrowing and a few are parasitic.

Annelids are grouped into three classes:

- The [earthworms](#) and freshwater worms called [oligochaetes](#)
- The [leeches](#) called [hirudineans](#).
- The marine worms called [polychaetes](#).



Polychaete

Symmetry: These are bilaterally symmetrical animals.

Level of Organization: They have organ level of organisation.

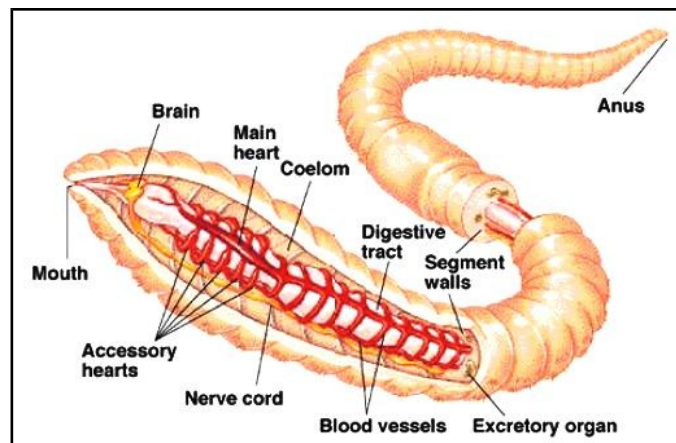
Germ Layer: They are triploblastic organisms i.e. having three germ layers- ectoderm, endoderm and mesoderm.

Body Cavity: They are coelomate animals. The coelom fluid serves as a hydroskeleton.

Body Wall: The body wall has thin, moist non cellular cuticle, layer of epidermis and circular and longitudinal muscles. These muscles are smooth and highly contractile and help in locomotion.

Their body is metamerically segmented i.e. the body surface is distinctly marked out into segments or metameres or ring like grooves called “annuli” and internally by transverse “septa”. The segments are called metamers.

Body Plan: They have a head in front followed by an elongated body having many segments and a tail in the end. The head has a mouth, which is called prostomium and sometimes a peristomium. The tail is not actually a tail and is known as pygidium.



Body plan of Annelida

Locomotion: They possess longitudinal and circular muscles which help in locomotion. All of them, except leeches, possess non-jointed chitinous “setae”. Aquatic annelids like *Nereis* possess lateral appendages, parapodia, which help in swimming.



People enjoying worm charming in Great Britain

Digestion: The digestive tract is complete.

Respiration: Exchange of gases takes place through skin i.e. cutaneous respiration. In some annelids like in *Terebella*, gaseous exchange also occurs through gills which are called brachial respiration.

Circulatory System: A closed circulatory system is present.

Excretion: Nephridia help in osmoregulation and excretion. Ammonia is the chief excretory product.

Nervous System: Neural system consists of a nerve ring and paired ganglia connected by lateral nerves to a double ventral nerve cord.

Reproduction: *Nereis*, an aquatic form, is dioecious, but earthworms and leeches are monoecious. Reproduction is sexual.

What makes them unique?

- Metameric body
- Coelom fluid serves as a hydroskeleton
- Nephridia for osmoregulation and excretion
- Cutaneous and branchial respiration

Examples : *Nereis*, *Pheretima* (Earthworm) and *Hirudinaria* (Blood sucking leech).

Quick Review :

- 1) Bilaterally symmetrical.
- 2) Triploblastic and organ level of organization.
- 3) True coelom, often divided by internal septa.
- 4) Body has a through gut with mouth and anus.
- 5) Body possesses 3 separate sections, a prosomium, a trunk and a pygidium.
- 6) Has a nervous system with an anterior nerve ring, ganglia and a ventral nerve chord.
- 7) Has a true closed circulatory system.
- 8) Has no true respiratory organs.

9) Reproduction normally sexual and gonochoristic (having either of the one sex) or hermaphroditic.

10) Feed a wide range of material.

11) Live in most environments.



Neries



Earthworm



Hirudinaria (Leech)

5. Phylum Arthropoda

This phylum includes largest number of animals having 900,000 species. Over two-thirds of all named species on earth are arthropods. Thus, it is the largest phylum of animal kingdom. Some of the more well-known arthropods include insects, crustaceans, and spiders.

Etymology: “arthros” means joint and “poda” means appendages. So, they are the animals having jointed appendages.

Habitat: Arthropodes are found on land, in soil, in water, on the bodies of organisms as parasites and even on dead organisms.

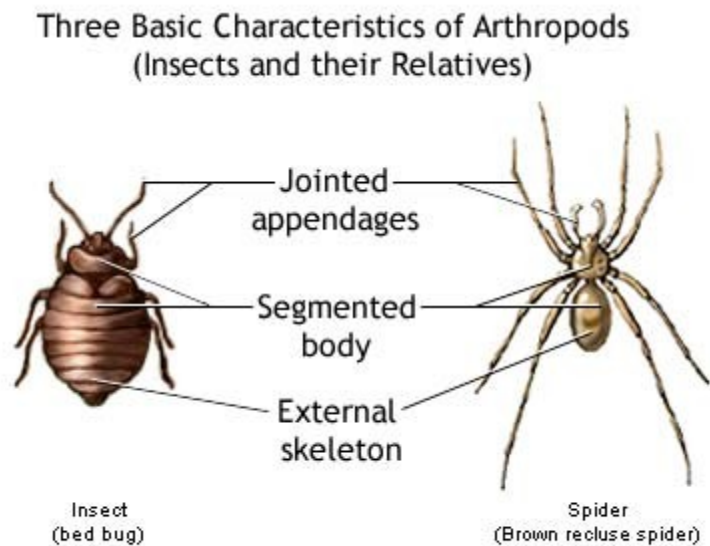
Symmetry: They are bilaterally symmetrical.

Level of Organization: They have organ-system level of organisation.

Germ Layer: These are triploblastic.

Body Cavity: The true coelom is greatly reduced in adults and is only represented by the cavities of reproductive and excretory organs. The body is haemocoel i.e. having filled with blood.

Body Form: The body of arthropods is covered by thick, tough and non-living chitinous exoskeleton (cuticle). The body consists of head, thorax and abdomen. They have jointed appendages. Their body is segmented externally.



ADAM.

The exoskeleton of arthropods is incapable of growth, and is molted or shed repeatedly during the growth of the animal. This process is called **ecdysis**. This process of molting allows for rapid growth until the newly secreted exoskeleton hardens.

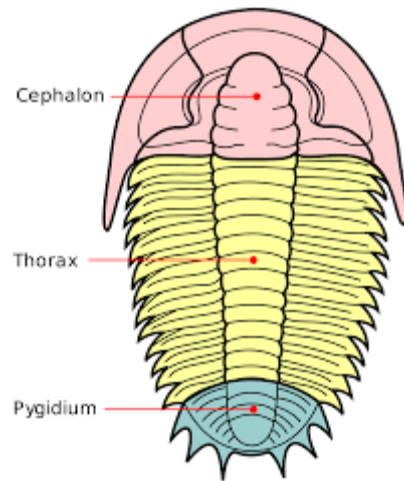
Metameric segmentation is where the body is divided into a series of repeated segments, like in millipede. Here, each segment performs all the functions of the body trunk sections, has legs, nerves, breathing apparatus, a unit of digestive tract and all the same organs and tissues. Each segment is a copy of the one before it and the one behind. This is seen in some arthropods like millipedes but not in others.

Then, what has happened in the other arthropods?

They have **tagmatization**. In this, groups of segments become specialized to perform specific functions for the whole body, these groups of segments are called Tagmata (Tagma).



Metamers seen in Arthropoda



Tagmata of a Trilobite

Locomotion: Many of them have the ability to fly.

Digestion: The digestive tract is complete i.e. having mouth and anus.

Respiration: They have gills or book gills in aquatic forms and trachea or book lungs in terrestrial types.

Circulatory System: Circulatory system is of open type.

Excretion: Excretion takes place through malpighian tubules.

Nervous System: Sensory organs like antennae, eyes (compound and simple), statocysts or balance organs are present. Most species have paired compound eyes which have mosaic vision and many also have a number of simpler eyes called ocelli.



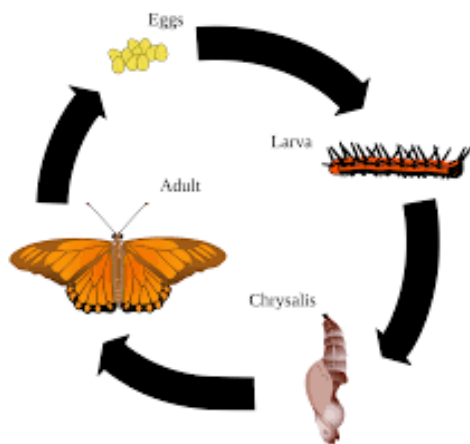
Compound eyes of Hornet



Ocelli of Honeybee

Endocrine Glands: These glands secrete hormones. Insects excrete pheromones which are chemicals to communicate messages. Some pheromones also act as sex attractants.

Reproduction: They are mostly dioecious and many of them exhibit sexual dimorphism. Fertilisation is usually internal. They are mostly oviparous. Development may be direct or indirect. The indirect development shows metamorphosis.



What makes them unique?

- Jointed legs
- Compound eyes
- Antennae, pheromones, haemocoel
- Thick exoskeleton
- Gills or lungs as respiratory organs
- Excrete pheromones
- Some of them show metamorphosis.

Metamorphosis

Examples:

Economically important insects – *Apis* (Honey bee), *Bombyx* (Silkworm), *Laccifer* (Lac insect)

Vectors – *Anopheles*, *Culex* and *Aedes* (Mosquitoes)

Gregarious pest – *Locusta* (Locust)

Living fossil – *Limulus* (King crab).

Quick review:

- 1) Mostly bilaterally symmetrical.
- 2) Triploblastic, organ level of organization.
- 3) Has true coelom.
- 4) Most possesses a through straight gut with an anus (in most cases).
- 5) Pairs of jointed legs.
- 6) External skeleton (in most cases).

-
- 7) Body is divided in 2 or 3 sections.
 - 8) Nervous system includes a brain and ganglia.
 - 9) Possesses a respiratory system in the form of tracheae and spiracles (in most cases).
 - 10) Open circulatory system with a simple heart, one or more arteries, and no veins, (in most cases).
 - 11) Reproduction normally sexual.
 - 12) Feed on almost everything.
 - 13) Live everywhere.



Honey bee (*Apis*)



Bombyx



Laccifera



Anopheles



Culex



Aedes



Locust



Limulus

6. Phylum Mollusca

This is the second largest animal phylum having more than 60,000 species.

Etymology: In Latin “*Molluscus*” means soft of body.

Habitat: Molluscs are aquatic (mostly marine and few fresh water), some also live in damp soil. It is the largest marine phylum. Few are adapted to live in deserts and some are parasitic. They also exhibit an enormous range in size.

Symmetry: These are bilaterally symmetrical. *Pila* is an exception, which also shows asymmetry.



Asymmetry in *Pila*

Level of Organization: They have an organ-system level of organisation.

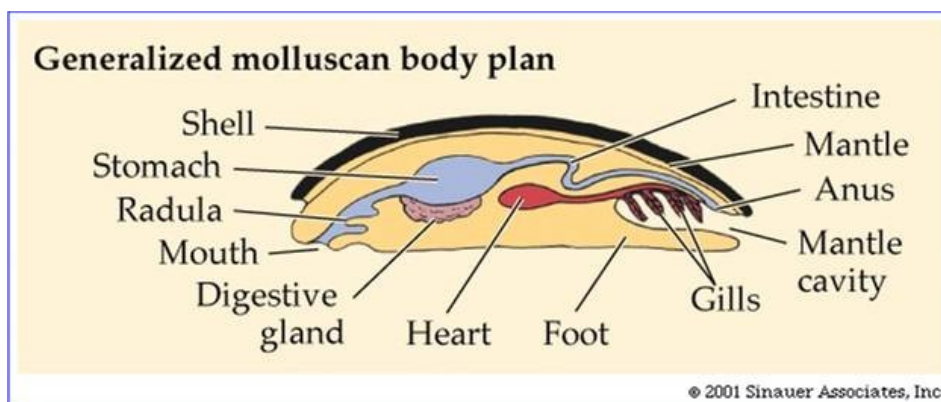
Germ Layer: They are triploblastic.

Body Cavity: Coelom is reduced. The space between internal organs contains blood and forms haemocoel.

Body Wall: They have single layered ciliated epidermis.

Digestion: The mouth contains a file-like rasping organ for feeding, called radula. The digestive tract is complete.

Body Form: The body is covered by a calcareous shell and is unsegmented with a distinct head, muscular foot and visceral hump. A soft and spongy layer of skin forms a mantle over the visceral hump. The space between the hump and the mantle is called the mantle cavity in which feather like gills are present. They have respiratory and excretory functions.



Respiratory System: They perform respiration through gills called ctenidia, mantle and pulmonary sac.

Circulatory System: It is of open type having a heart and an aorta. Blood is usually blue due to the presence of copper containing blue respiratory pigment called haemocyanin.

Excretory System: They possess a pair of kidney.

Nervous System: They have two pairs of main nerve cords. The anterior head region has sensory tentacles.

Reproduction: They are usually dioecious and oviparous with indirect development.

What makes them unique?

- Presence of shell
- Presence of radula
- Presence of hemocyanin
- Ctenidia, mantle or pulmonary sac as respiratory organs.

It is being noticed that in the history molluscs were important to humans as a source of food, jewelry, tools, and even pets.

Examples: *Pila* (Apple snail), *Pinctada* (Pearl oyster), *Sepia* (Cuttlefish), *Loligo* (Squid), *Octopus* (Devil fish), *Aplysia* (Seahare), *Dentalium* (Tusk shell) and *Chaetopleura* (Chiton).

Quick review:

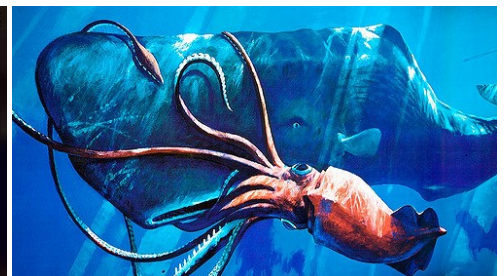
- 1) Bilaterally symmetrical.
- 2) Triploblastic, organ level of organization.
- 3) No or reduced coelom.
- 4) Complete digestive system with mouth and anus.
- 5) Body unsegmented and possess a dorsal or lateral shells and calcareous spicules.
- 6) Has a nervous system with a ganglia and paired nerve chords.
- 7) Open circulatory system
- 8) Has ctenidial gills.
- 9) Has a pair of kidneys.
- 10) Reproduction normally sexual.
- 11) Feed a wide range of material.
- 12) Live in most environments.



Pearl Oyster



Cuttle fish



Squid



Octopus



Sea Hare



Chiton

7. Phylum Echinodermata

Echinoderms have an endoskeleton of calcareous ossicles and, hence, the name Echinodermata (Spiny bodied).

Etymology: “*echinos*” means hedgehog and “*derma*” means skin i.e. they have spiny skin.

Habitat: All are exclusively marine and are found at every ocean depth. They are either filter feeders, substrate eaters or carnivores.

Symmetry: The adult echinoderms are radially symmetrical (pentamerous radial) but larvae are bilaterally symmetrical.

Level of Organization: They have an organ-system level of organisation.

Germ Layer: They are triploblastic.

Body Cavity: They are true enterocoelic animals.

Body Wall: Here too, epidermis is single layered and ciliated. Many echinoderms have endoskeleton of calcareous plates in the dermis.

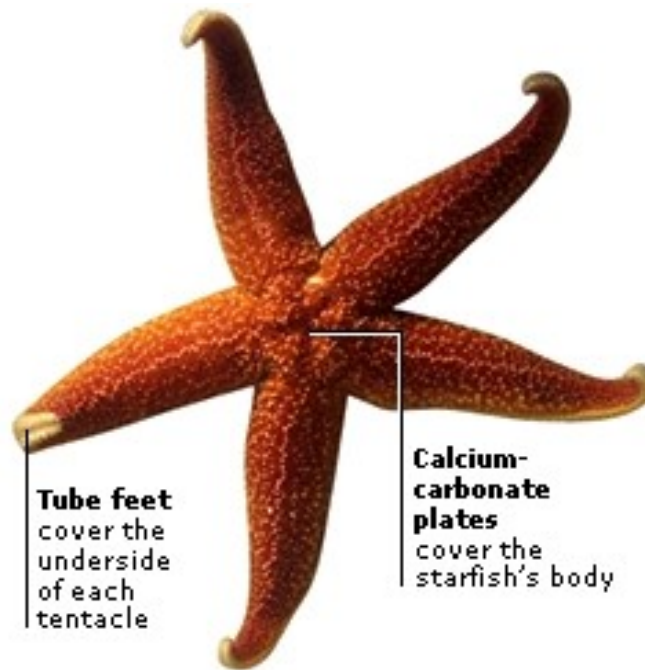
Body Form: The body form varies greatly. It could be star shapes, cylindrical or spherical. The body is unsegmented and lacks head.

Digestion: Digestive system is complete with mouth on the lower (ventral) side and anus on the upper (dorsal) side.

Respiration: Exchange of gases take place through tube feet, dermal brachae, peristominal gills etc.

Circulatory System: The most distinctive feature of echinoderms is the presence of water vascular system. The tube feet of this system helps in locomotion, capture and transport of food and respiration.

Many echinoderms like sea cucumbers and sea urchins were harvested and used for consumption.



Tube feet in *Asteria*

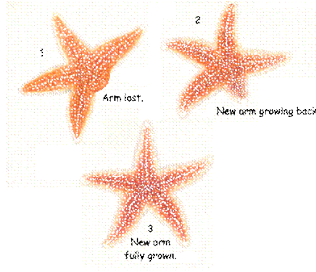
Excretory System: An excretory system is absent.

Nervous System: It has nerve ring and radial nerve cords.

Reproduction: Sexes are separate. There is no sexual dimorphism. Reproduction is sexual. Fertilisation is usually external. Development is indirect with free-swimming larva.

Speciality: They have spines for protection and pincer like pedicellariae for keeping the body surface clear. The power of regeneration and autonomy are the special features of echinoderms.

Due to the power of regeneration they are difficult to kill.



Regeneration in Star fish

What makes them unique?

- Presence of spines
- Power of regeneration
- Water Vascular System
- Endoskeleton of calcareous plates
- Bilateral symmetry in larva and radial symmetry in adult.

Examples: *Asterias* (Star fish), *Echinus* (Sea urchin), *Antedon* (Sea lily), *Cucumaria* (Sea cucumber) and *Ophiura* (Brittle star).

Quick review:

- 1) Has 5-rayed symmetry, mostly radial, sometimes bilateral.
- 2) Triploblastic, organ level of organization.
- 3) Has true coelom.
- 4) Most possesses a through gut with an anus.
- 5) No head.
- 6) Nervous system includes a nerve ring and nerve cords.
- 7) Poorly defined open circulatory system.
- 8) Possesses a water vascular system that operates the tube feet or feeding tentacles.
- 9) No excretory organs.
- 10) Normally possesses a sub-epidermal system of calcareous plates
- 11) Reproduction is sexual.
- 12) Feeds on fine particles in the water, detritus or other animals.
- 13) All live marine environments.



Sea urchin



Sea cucumber



Brittle star

8. Phylum Hemichordata

Hemichordata, also called Acorn Worms, was earlier considered as a sub-phylum under phylum Chordata. But now it has proven that none of the animals of Hemichordata possess a post anal tail or a notochord and so they have been allocated as a separate phylum under non-chordata.

Etymology: In Greek *Hemi* for half and in Latin *Chorda* means a chord or string.

Habitat: This phylum consists of a small group of worm-like marine animals mostly living in burrows. Most of them are benthic i.e. they live on the sea floor in their adult form.

Symmetry: These are bilaterally symmetrical.

Level of Organization: They have an organ-system level of organisation.

Germ Layer: They are triploblastic.

Body Cavity: They are enterocoeleous animals.

Body Form: The body is cylindrical and is composed of an anterior proboscis, a collar and a long trunk.

Body Wall: They have single layered epidermis.

Digestion: They have complete digestive system.

Respiration: Respiration takes place through gills.

Circulatory System: Circulatory system is of open type. Blood is colourless.

Excretory System: Excretory organ is proboscis gland situated in the proboscis.

Nervous System: It is of primitive type.

Reproduction: Sexes are separate. They possess mostly sexual reproduction. Fertilisation is external. Development is indirect.

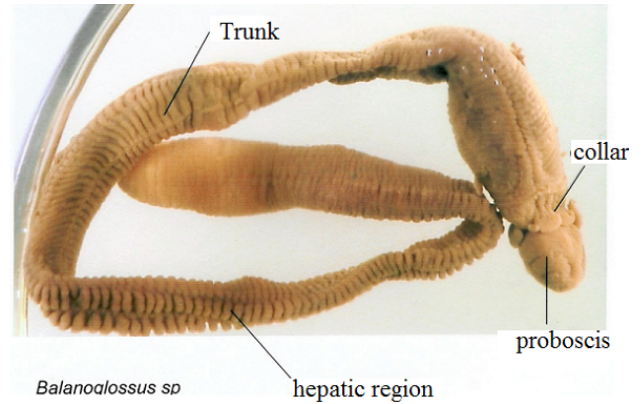
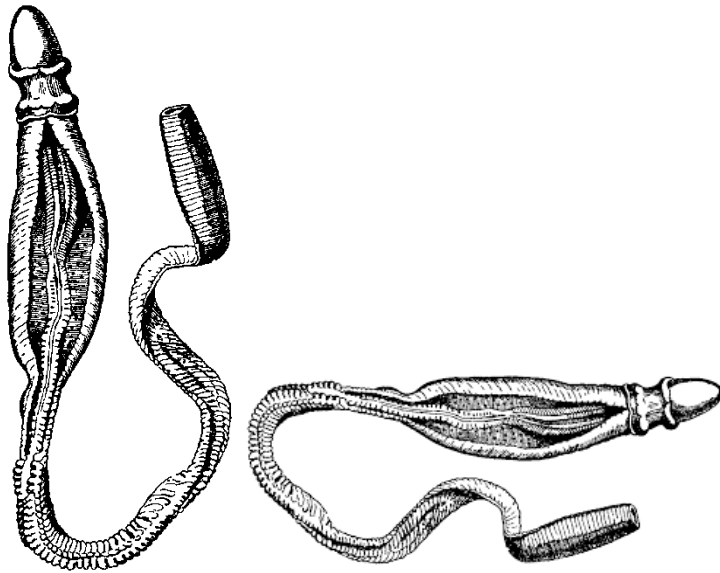
What makes them unique?

- Worm like marine animals
- Do not possess a notochord

Examples: *Balanoglossus* and *Saccoglossus*.

Quick review:

- 1) Bilaterally symmetrical.
- 2) Triploblastic, organ level of organization.
- 3) True coelom.
- 4) Body possesses a through gut, straight or U-shaped, with an anus.
- 5) Body divided into three sections, a proboscis, a collar and a trunk.
- 6) Nervous system normally diffuse, but variable.
- 7) Has a partially open circulatory system.
- 8) Has glomerulus as an excretory organ.
- 9) Reproduction is sexual.
- 10) Feeds on fine particles in the water.
- 11) All live marine environments.



Balanoglossus

9. Summary

In this module, we studied about the characteristics of animals of phyla Ctenophora, Platyhelminthes, Aschelminthes, Annelida, Arthropoda, Mollusca, Echinodermata and Hemichordata.

We also discussed about the different organ systems present in them and with this we have completed all the phyla which fall under non- chordates.

In our next and last module, we will be dealing with chordates.