



YOUR GATEWAY TO EXCELLENCE IN  
IIT-JEE, NEET AND CBSE EXAMS

**XI**  
**NEET**  
**1**  
**ANIMAL KINGDOM**  
**BIOLOGY**

**ANIMAL KINGDOM**

**BIOLOGY**

**IIT-JEE**  
**NEET**  
**CBSE**



**01** BASIS OF CLASSIFICATION AND PHYLUM PORIFERA

**02** PHYLUM COELENTERATA, PHYLUM CTENOPHORA, PHYLUM PLATYHELMINTHES, PHYLUM ASCHELMINTHES

**03** PHYLUM ANNELIDA, PHYLUM ARTHROPODA

CONTACT US:

+91-9939586130  
+91-9955930311



# 01 BASIS OF CLASSIFICATION AND PHYLUM PORIFERA

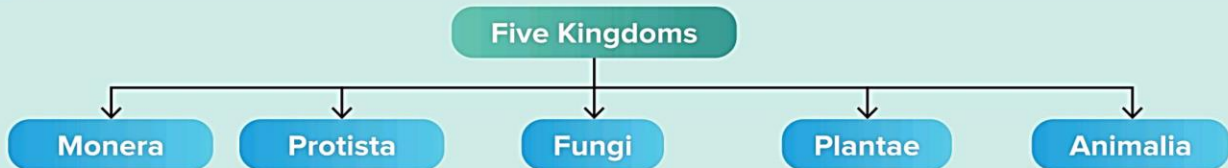


## Key Takeaways

- Characteristics of animals
- History of animal classification
  - Oldest system of classification
  - Early system of classification
  - Aristotle's system of classification
- Basis of classification
  - Level of organisation
  - Symmetry
  - Germ layer
  - Coelom
  - Segmentation
  - Notochord
- Classification of animals
- Characteristic features of phylum Porifera



## Prerequisites

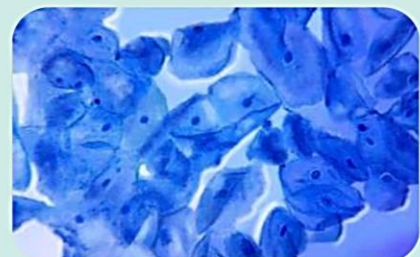


## Characteristics of Animals

- Type of cell - Eukaryotic
  - Animal cells have a well-developed nuclear membrane and membrane-bound organelles.
- Number of cells - Multicellular



Animal Cell



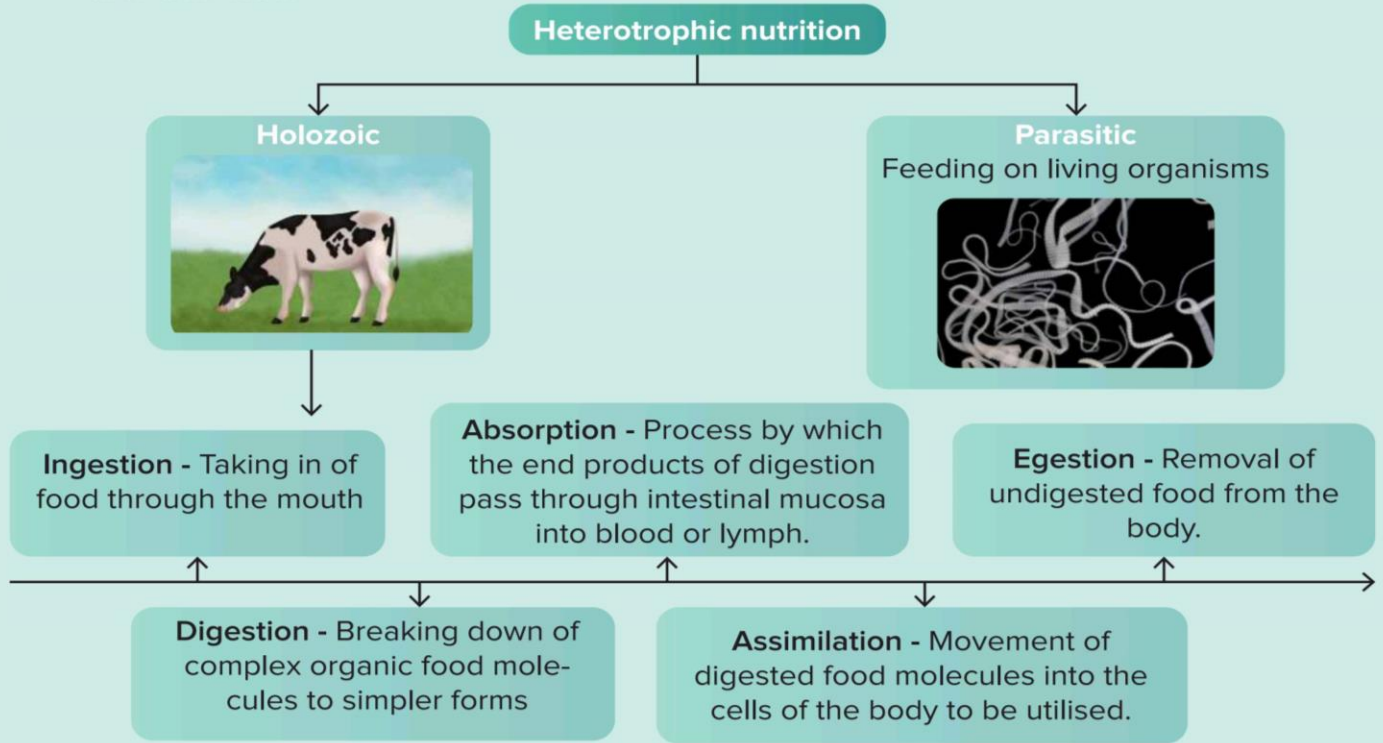
Animal cells under the microscope





**Nutrition - Heterotrophic**

- Animals depend upon other organisms for food. They do not have the ability to prepare their own food.



- **Reproduction - Usually Sexual**
  - Sexual reproduction involves the fusion of gametes to produce the zygote.
  - Some animals reproduce asexually also.



**Did you know?**

There are approximately 8.7 million species of animals across the globe!





## Classification of Animals

### Objectives of Classification

Identification and description of organisms

Arrangement of organisms in various categories

Evolve a phylogenetic system of classification

Classification of organisms based on their evolutionary relationships is known as the **phylogenetic system of classification**.

### History of Animal Classification

- Oldest system of classification
  - Based on **behaviour**.
- Early system of classification:
  - Animals were classified into five types:



Domestic animals



Wild animals



Creeping animals



Flying animals

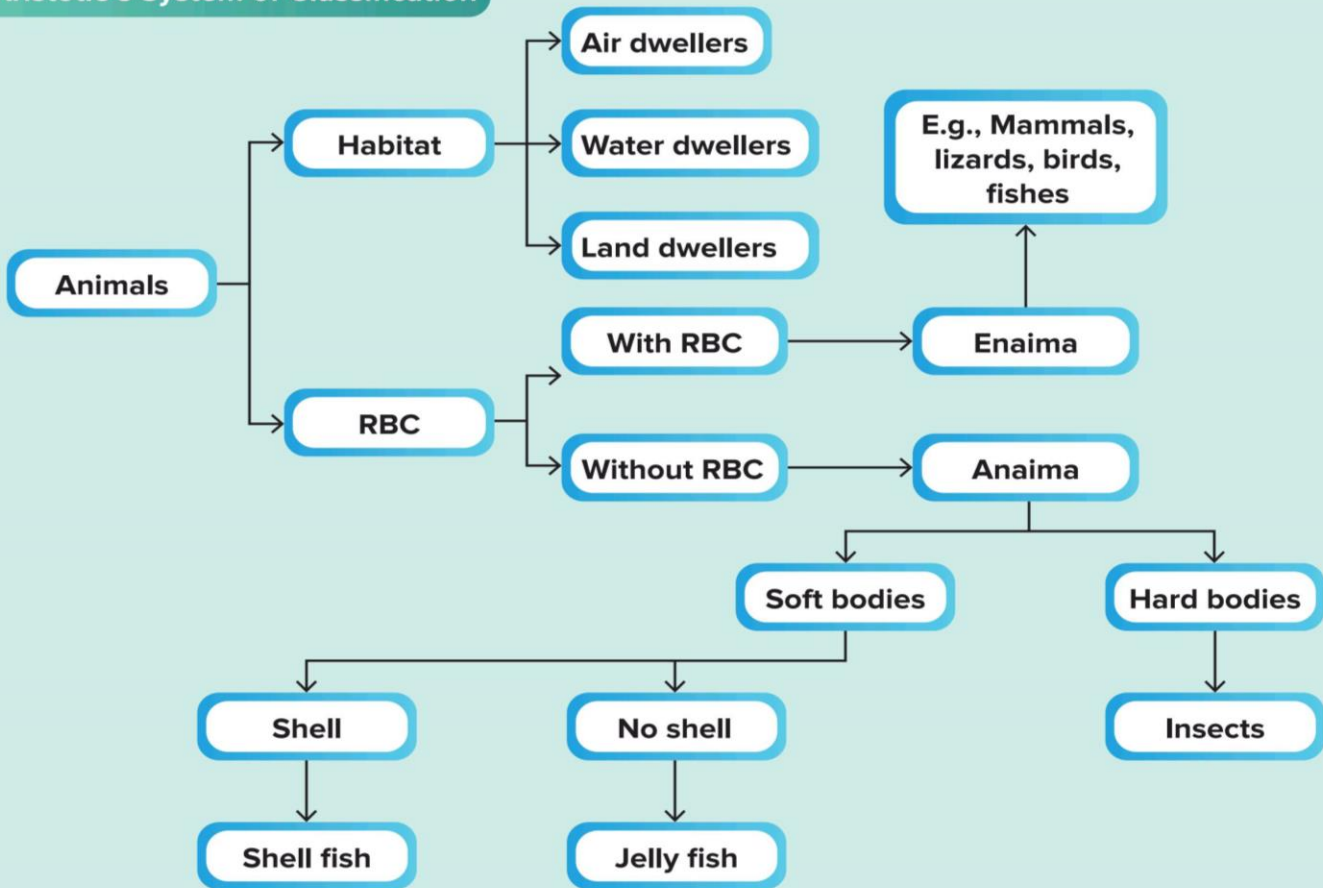


Sea animals



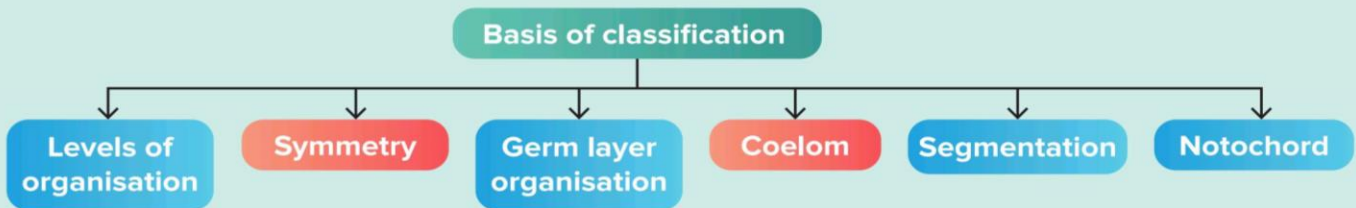


### Aristotle's System of Classification



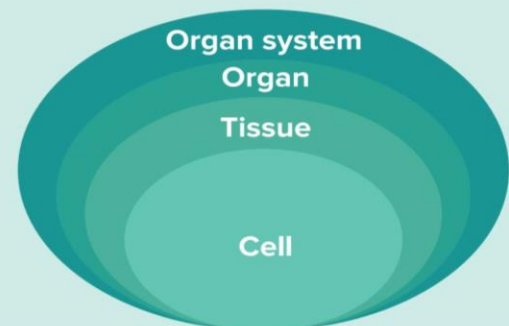
### Basis of Classification

Several characteristics were taken into consideration for the classification of animals.



### Levels of Organisation

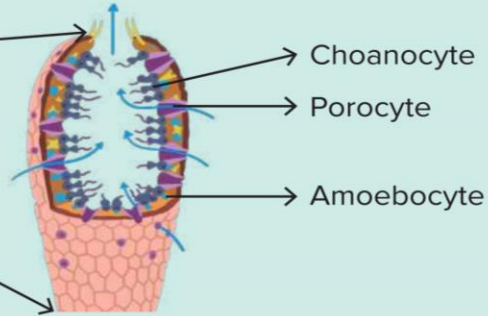
- Even though all animals are multicellular, their cells may not be organised in the same pattern.
- The various types of levels organisation includes the following:





**Cellular level of organisation**

- In lower animals such as sponges, cells aggregate together. This type of organisation is called cellular organisation.



**Sponges**

**Tissue level of organisation**

- Cells that perform similar functions are grouped together to form tissues.
- For example, in *Hydra*, epithelial cells group together to form the epidermal tissue or the epidermis.

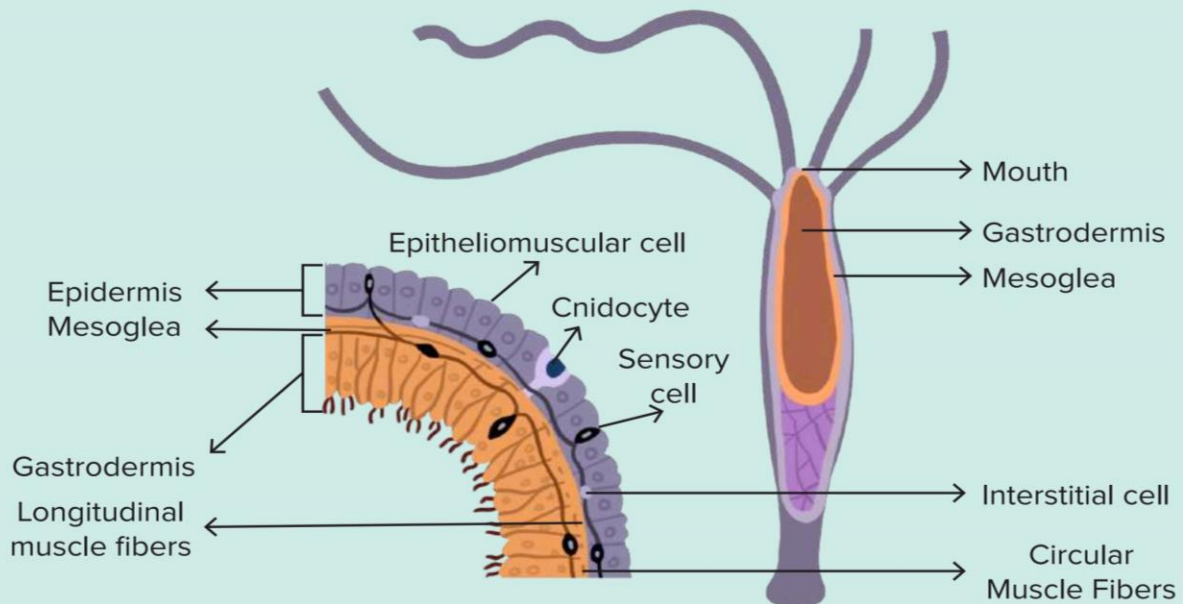


**Hydra**



**Jelly fish**

Tissue level of organisation in *Hydra*



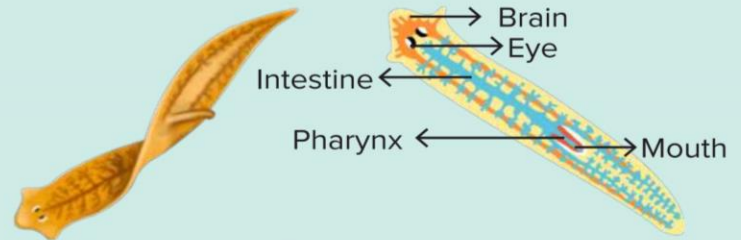
**Cross-section of *Hydra***





### Organ level of organisation

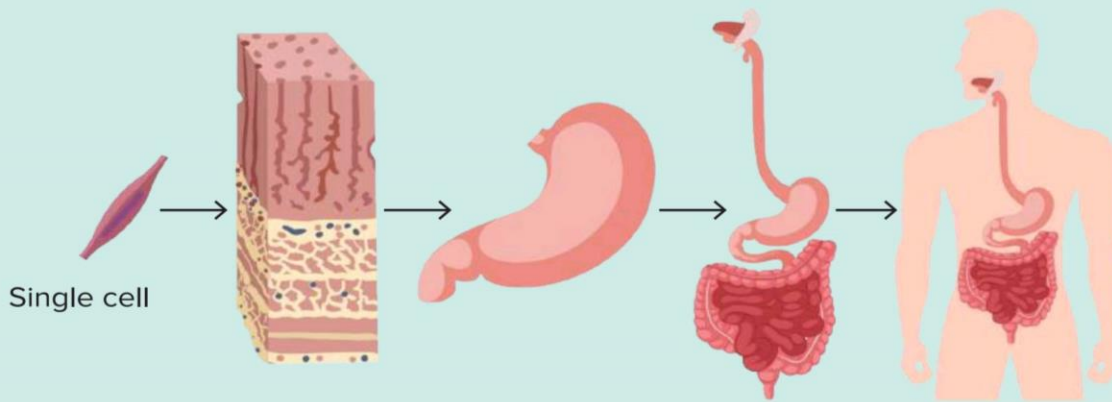
- Several tissues combine to form an organ.



**Flatworm**

### Organ system level of organisation

- Several **organs** combine to form the **organ system**.
- Different **organ systems** combine to form an **organism**.
- Example: Digestive system in human beings, let us consider the digestive system.

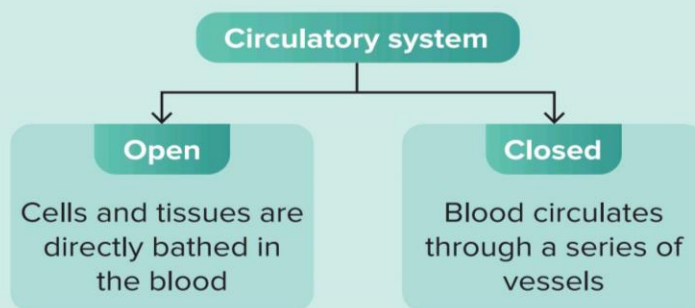


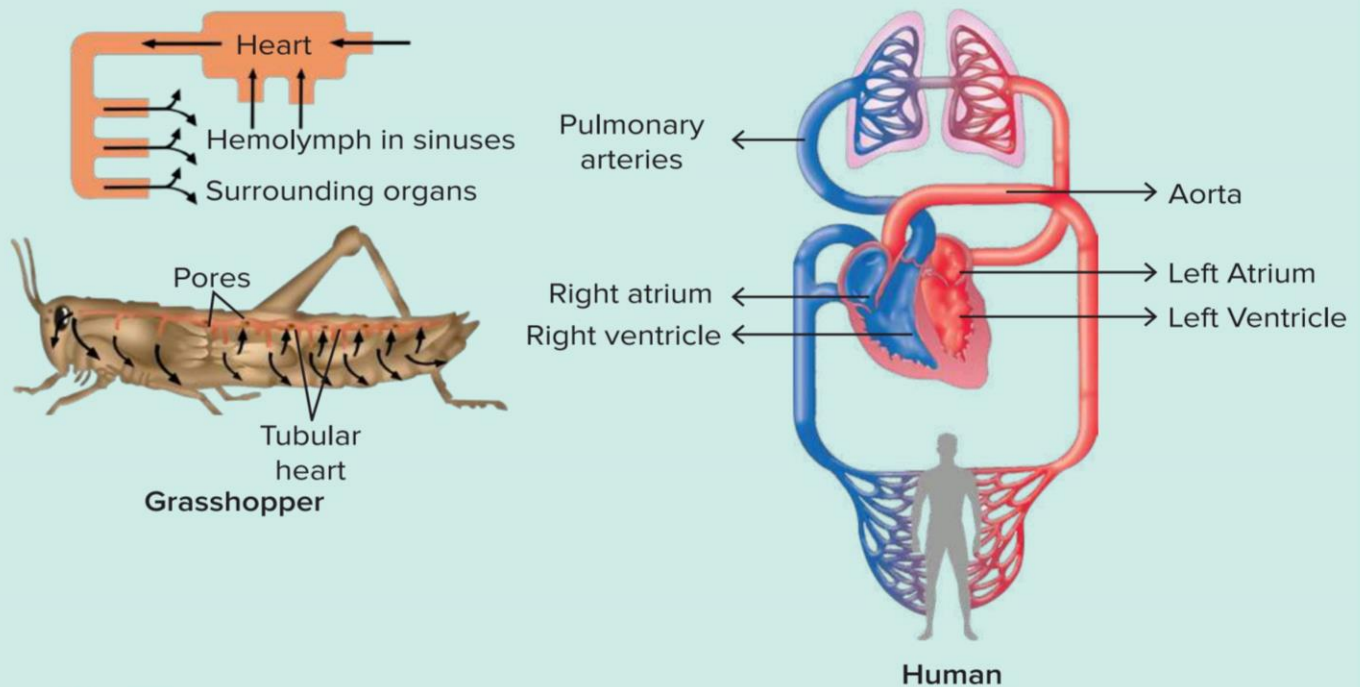
Tissues are made up of several cells.

Each organ is made up of several tissues such as epithelial, connective etc.

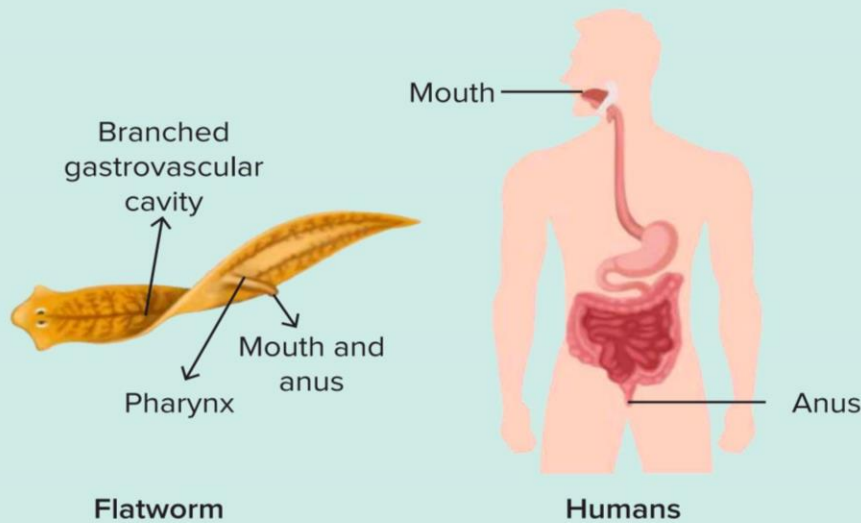
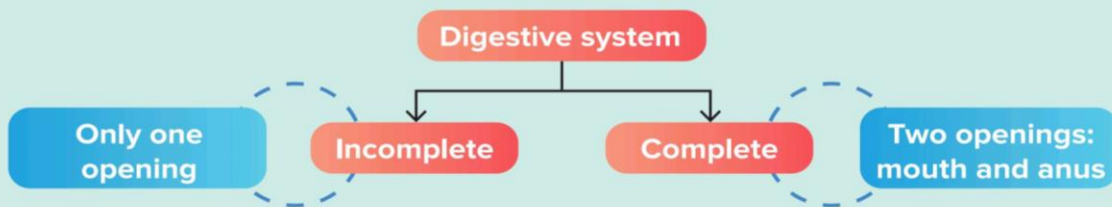
The digestive system is made up of several organs such as stomach, liver and intestine.

- Thus, in human beings, there is an **organ system level of organisation**.
- The organ system varies in different organisms.
  - **Circulatory system**
    - The circulatory system in grasshoppers is not as well-developed as it is in humans.





- **Digestive system**
  - The digestive system is not well-developed in some organisms, like flatworms.



**Symmetry**

- **Symmetry** refers to a **correspondence of body parts**, in size, shape and relative position on opposite sides of a dividing line or distributed around a **central point or axis**.





**Types of symmetry**

**Asymmetric**



**Sponges**

Body **cannot** be divided into identical halves in any plane.

**Radial**



**Starfish**

- There is one main axis around which the various body parts are arranged.  
 - Body can be divided into **two identical halves** in **any plane** passing through the centre.

**Bilateral**

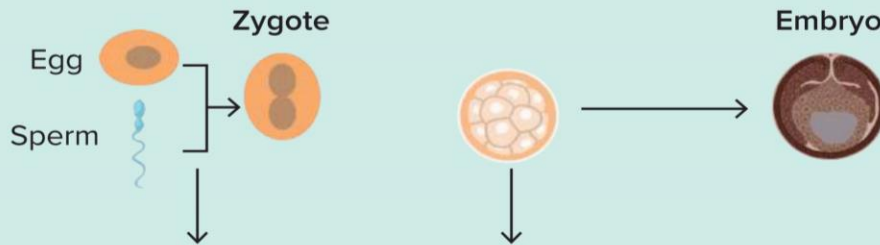


**Goat**

The body can be divided into **identical halves** on either side of a **single plane**.

**Germ Layer Organisation**

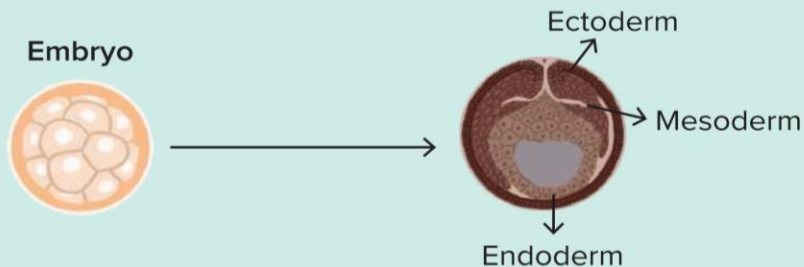
**Fertilisation**



The **male gamete** (sperm) and the **female gamete** (egg) fuse together to form the **zygote**. This process is known as **fertilisation**.

The zygote undergoes multiple cleavages (cell division) to form the **embryo**.

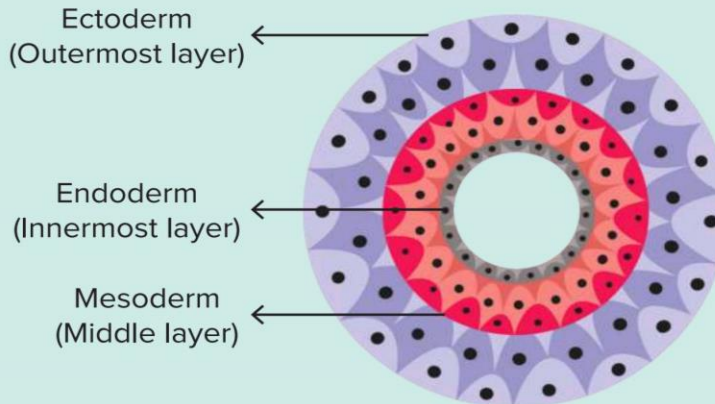
- During the formation of the embryo, the cells arrange themselves into **different layers**.
- Cells of each layer contribute to the formation of **tissues** or **organs**. These layers are known as **germ layers**.



**Formation of germ layers in the embryo**



### Different germ layers

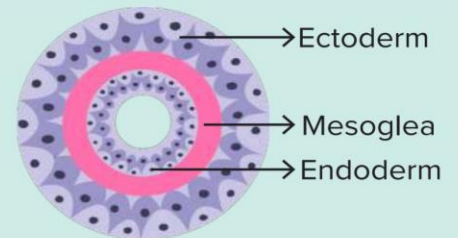


### Germ layer organisation (based on number of germ layers)

#### Germ layer organisation

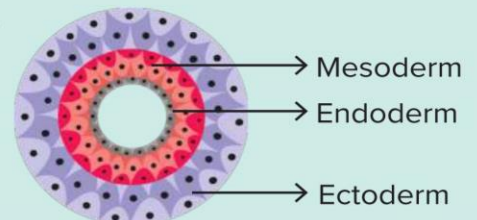
#### Diploblastic

- Organisms that have **two germ layers** (endoderm and ectoderm). E.g. *Hydra*
- **Middle layer** is not differentiated and is known as **mesoglea**.



#### Triploblastic

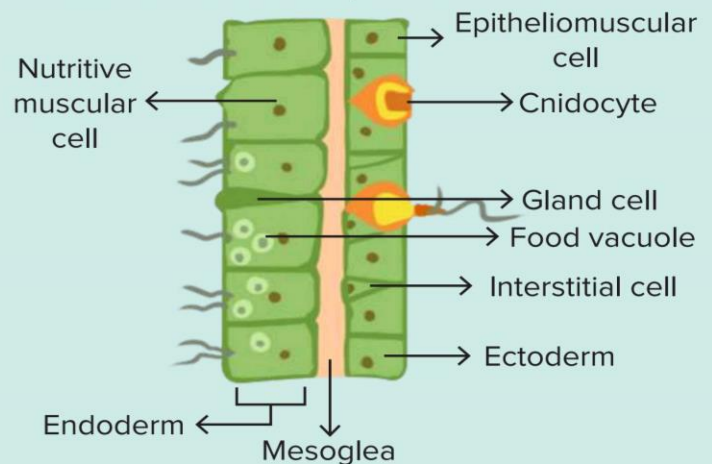
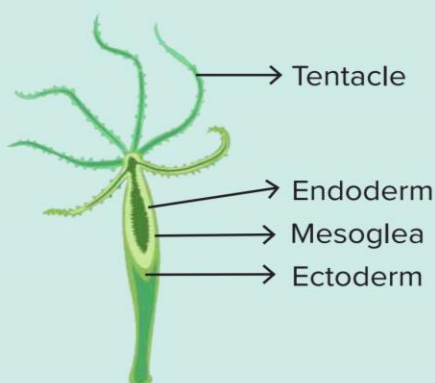
- Organisms that have **three germ layers** (endoderm, mesoderm, and ectoderm). E.g. Human beings



### Fate of the germ layers

In diploblastic organisms like *Hydra*,

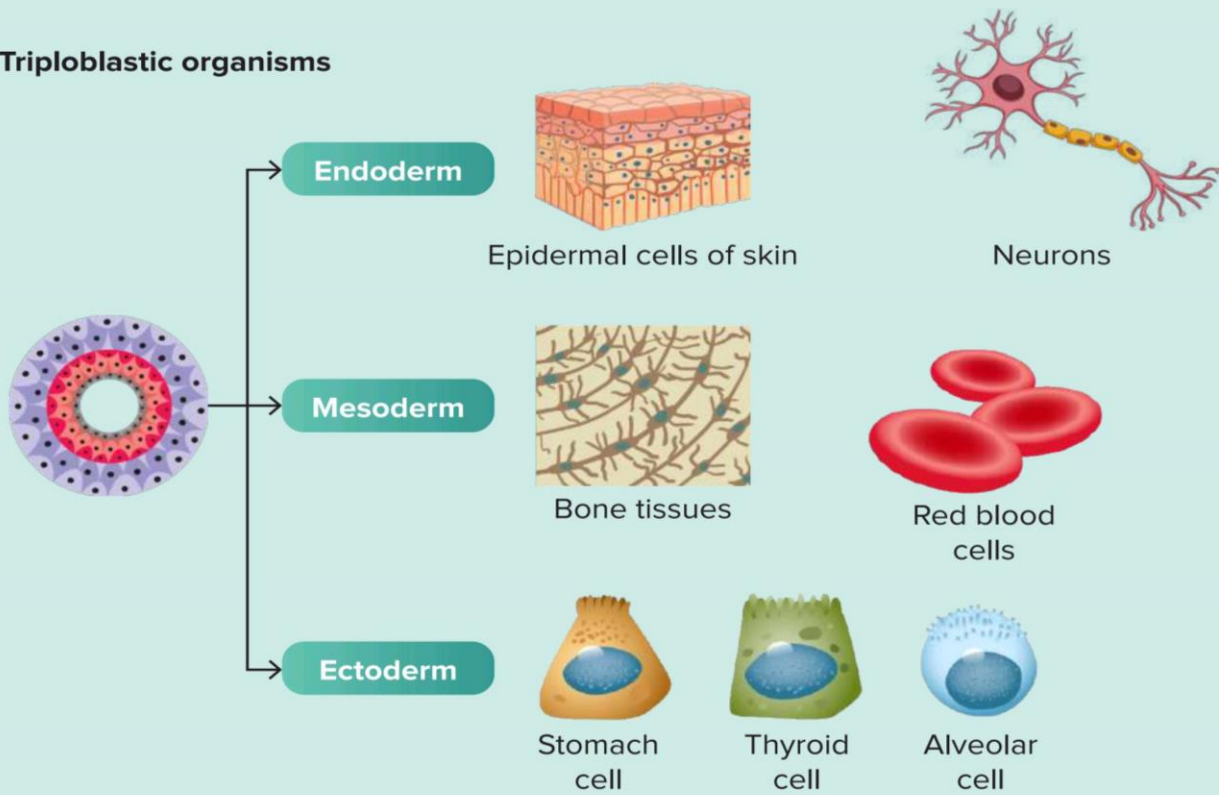
- **Endoderm layer** gives rise to the **gland cell** and the **muscular tissue**.
- **Ectoderm layer** gives rise to the **epitheliomuscular cell** and **cnidocyte cell**.





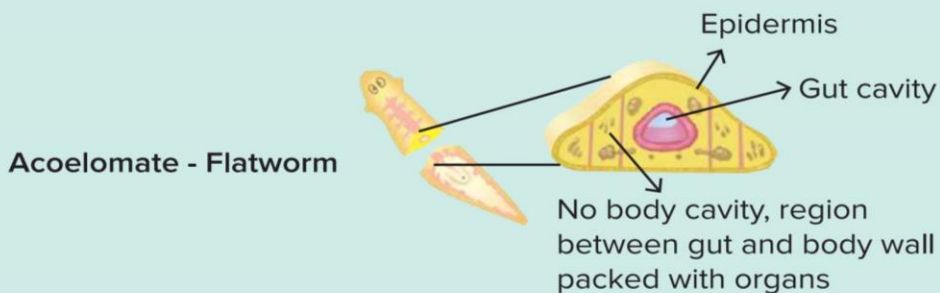
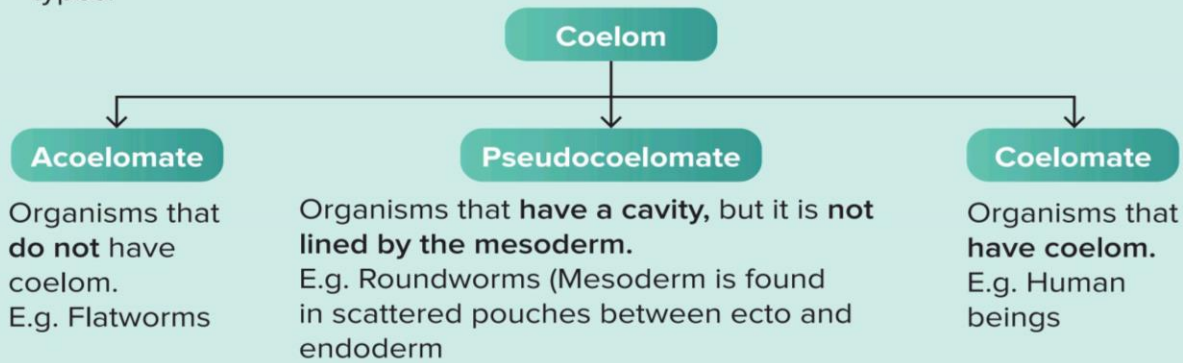


**Triploblastic organisms**



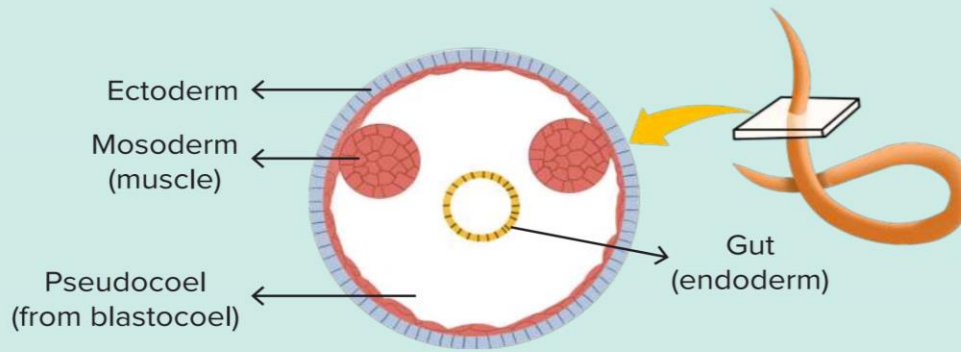
**Coelom**

- Coelom is the **body cavity** present between the alimentary canal and body wall of **triploblastic organisms**.
- It is **lined** externally by **mesoderm** on all sides.
- Based on the presence or absence of coelom, organisms are classified further into three types:

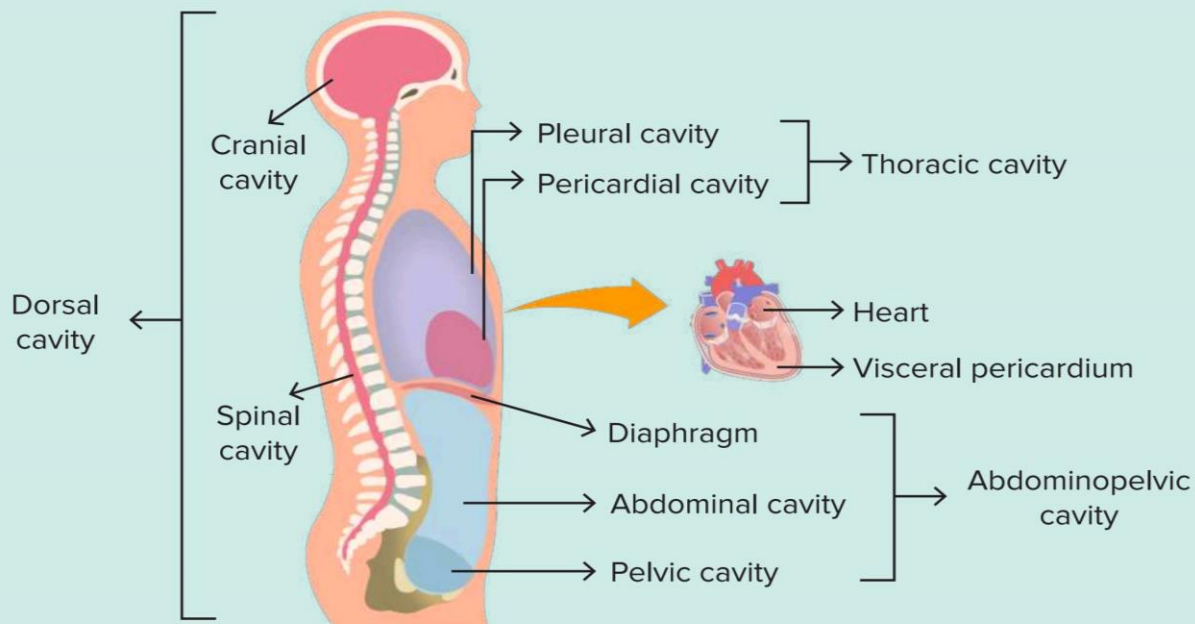




**Pseudocoelomate - Roundworms**



**Coelomate - Human beings**



**Functions of the coelom**

- **Protects organs** from accidental shocks.
- Permits **changes** in the **shape** and **size** of organs. When we breathe our lungs change shape and size. The stomach and the urinary bladder also expand and contract.

**Segmentation**

- Based on the presence or absence of segments in their body, the organisms are classified into the following:
  - Unsegmented
  - Segmented



Segments

**Earthworm**





### Metamerism

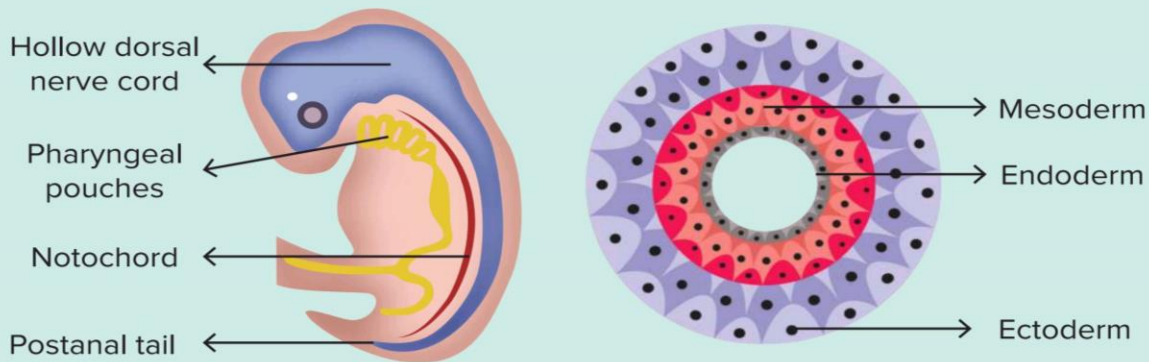
- In organisms like earthworms, the body is **divided into segments** with serial **repetition** of some organs. This type of segmentation is known as **metameric segmentation**.
- For example, excretory organs (nephridia) are repeated serially in the segments.



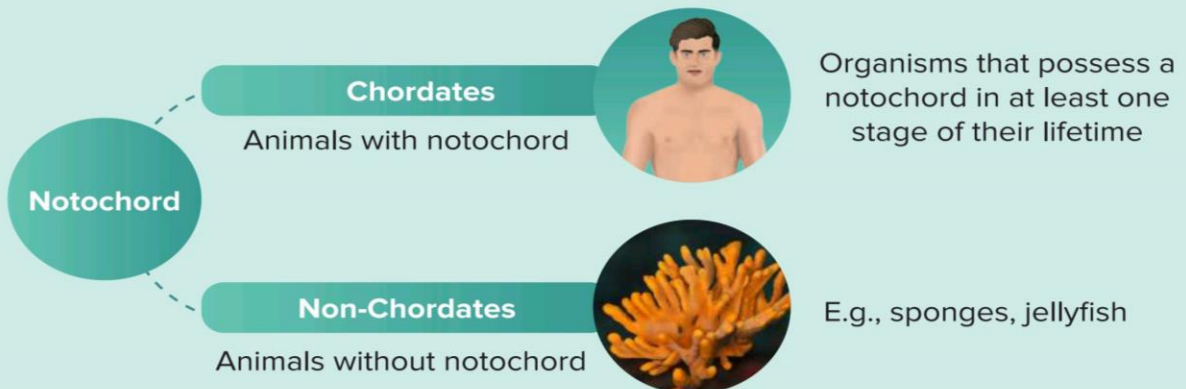
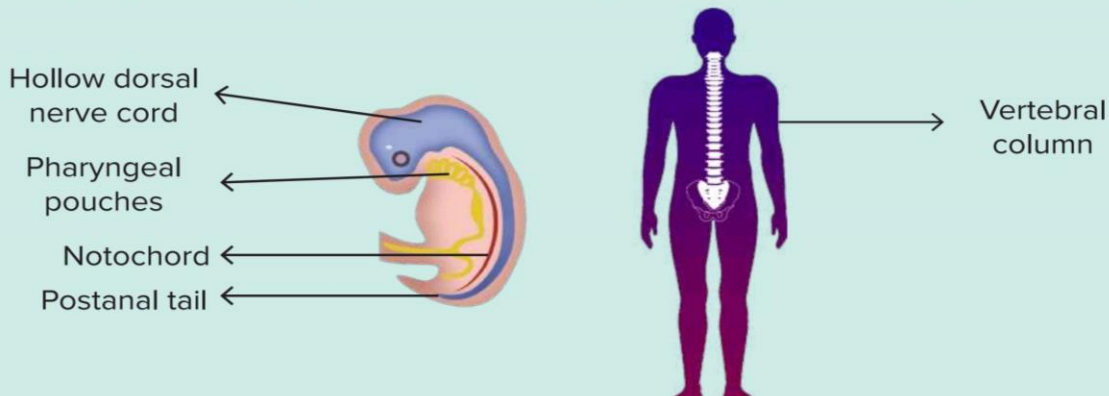
**Excretory organs (nephridia)**

### Notochord

- Notochord** is a **rod-like structure** derived from the **mesoderm**. It is present on the dorsal side of an organism during **embryonic development**.



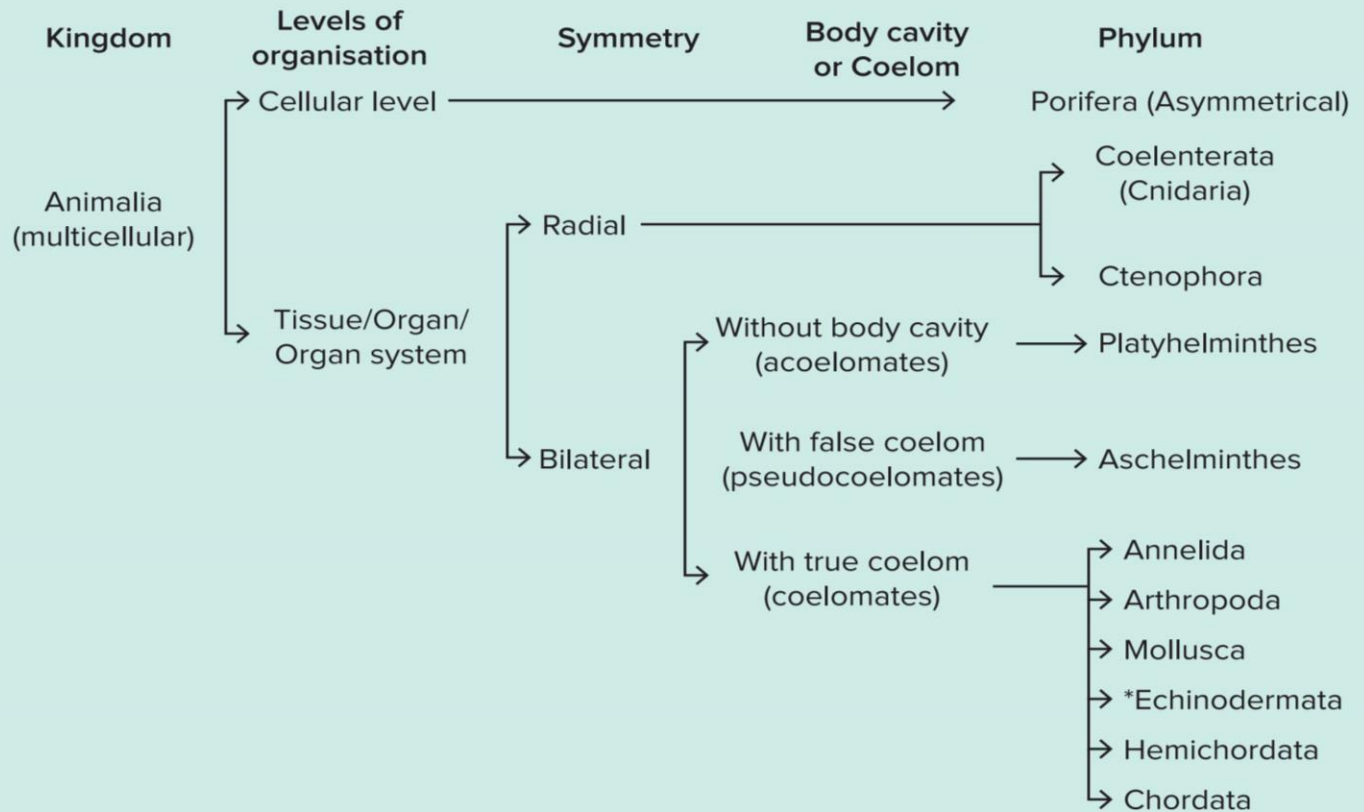
- In **higher vertebrates**, the notochord develops into the **vertebral column**.





### Classification of animals

Based on the above mentioned characteristics, the organisms in kingdom Animalia are classified into **eleven different phyla** as follows:



\*Echinodermata exhibits radial or bilateral symmetry depending on the stage.

#### Broad classification of kingdom Animalia based on common fundamental features

#### Mnemonic to remember the eleven phyla of the Animal Kingdom

Porifera - Prince  
Coelenterata - Charles'  
Ctenophora - Children  
Platyhelminthes - Play  
Aschelminthes - All  
Annelida - Anglo  
Arthropoda - American  
Mollusca - Music  
Echinodermata - Eating  
Hemichordata - Hot  
Chordata - Cakes

Prince Charles's Children Play All Anglo American Music  
Eating Hot Cakes  
PCCPAAAMEHC





### Phylum Porifera

Organisms in phylum Porifera are also known as sponges.



### Characteristic features

- **Habitat**
  - Members of this phylum are generally **marine**.  
Example: *Sycon*.



*Sycon*

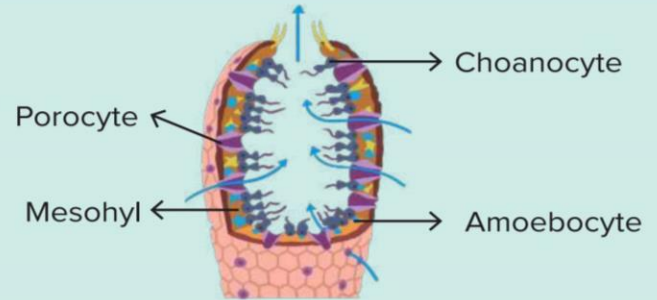
- There are a few members that are found in **freshwater**. Example: *Spongilla*
- Most of the sponges are **sedentary** or fixed to a surface.



*Spongilla*



- **Symmetry** - They are **asymmetrical**.
- **Level of organisation** - Sponges exhibit **cellular level of organisation**.



### Nutrition - The water canal system

Water enters through the pores known as **ostia** (plural) or **ostium** (singular) in the body wall of the sponge.



From the ostia, water enters the central cavity known as **spongocoel**.



The spongocoel is lined by cells known as **choanocytes** that generate water currents and help in capturing the food particles.

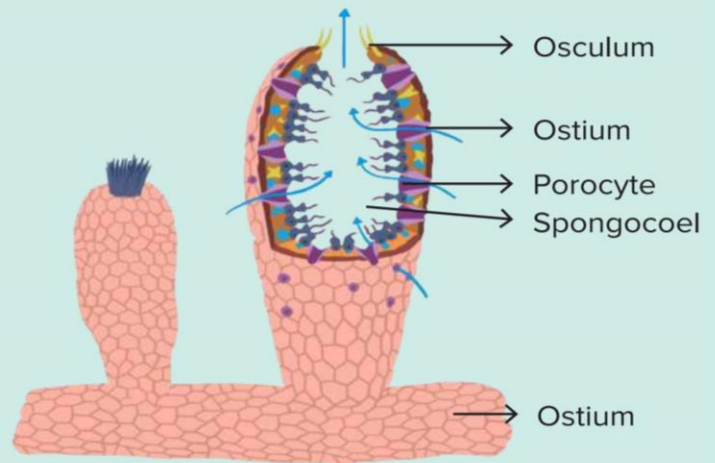


The food particles present in the water are digested by specialised cells known as **amoebocytes**.



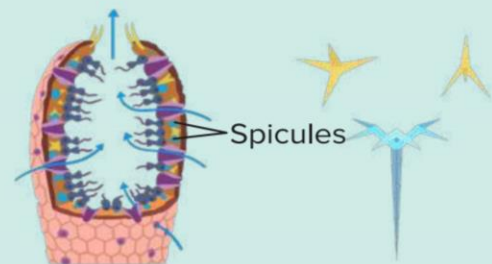
The water leaves the organism through the **osculum**.

- Other functions of the water canal system are:
  - **Ostia** - Exchange of gases
  - **Osculum** - Elimination of waste



### Defence mechanism in Porifera

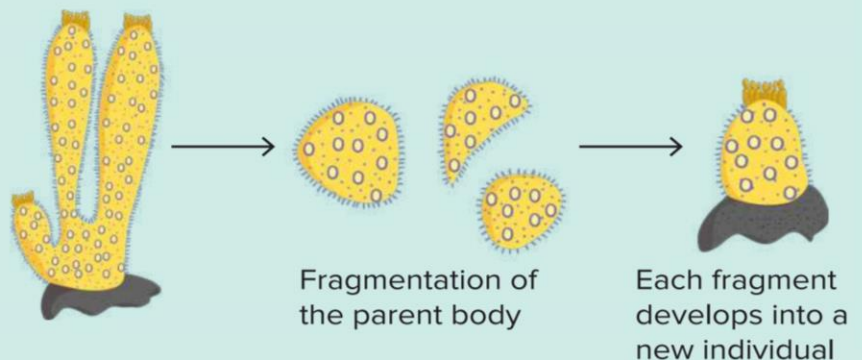
- **Spicules** are elements that provide structural support and help in defence against predators in the sponges.



Spongin fibres and spicules

### Reproduction

- **Asexual** mode of reproduction occurs through **fragmentation**.



Fragmentation of the parent body

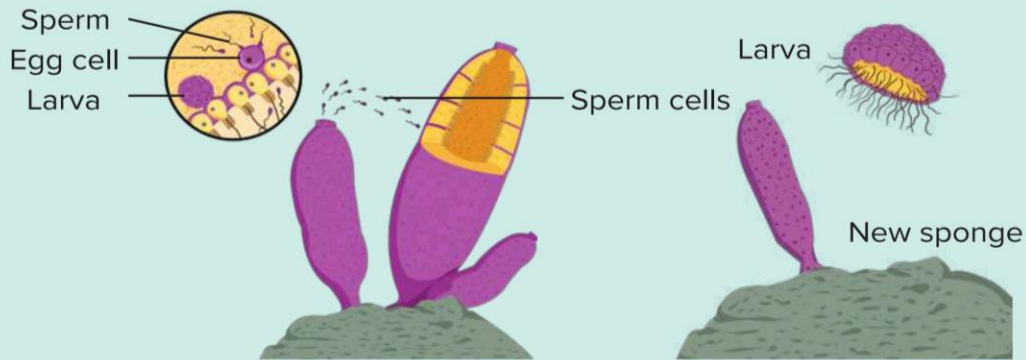
Each fragment develops into a new individual



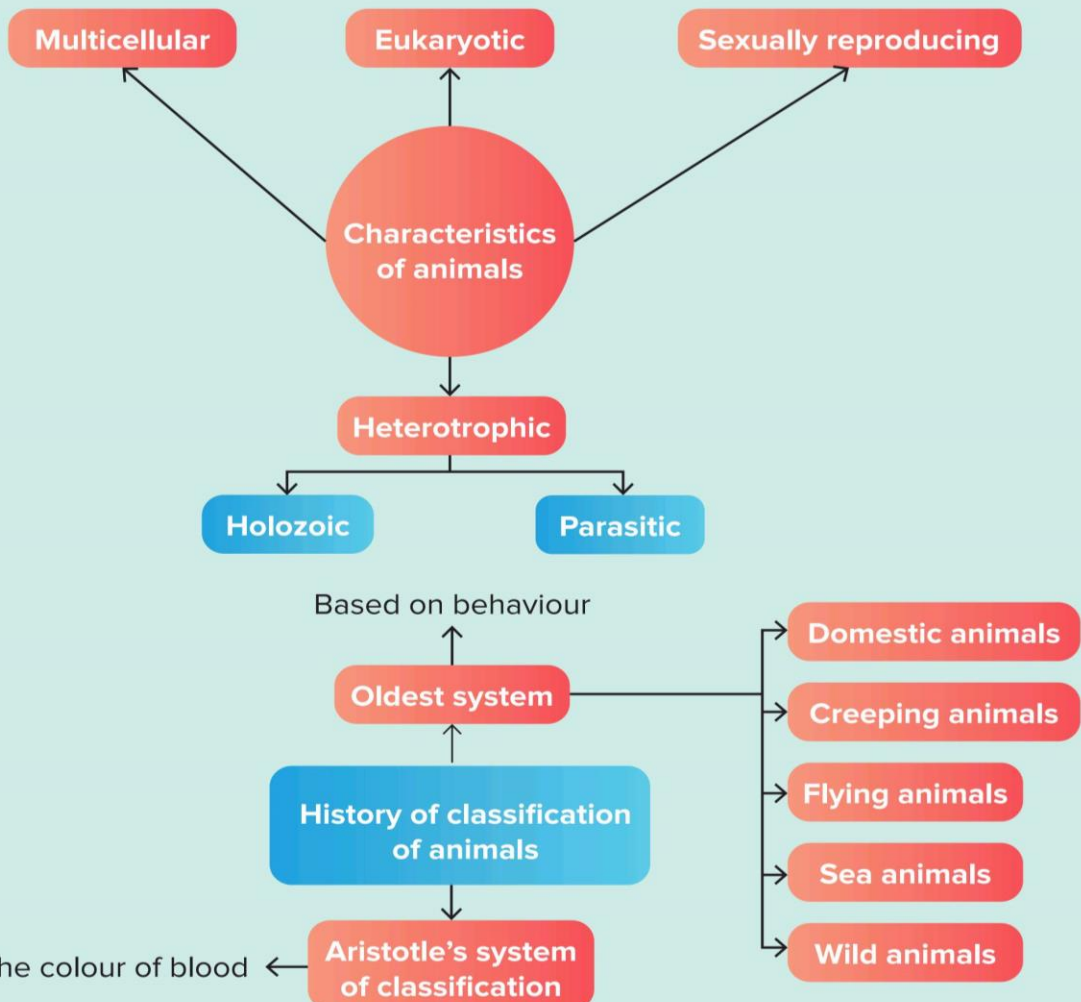


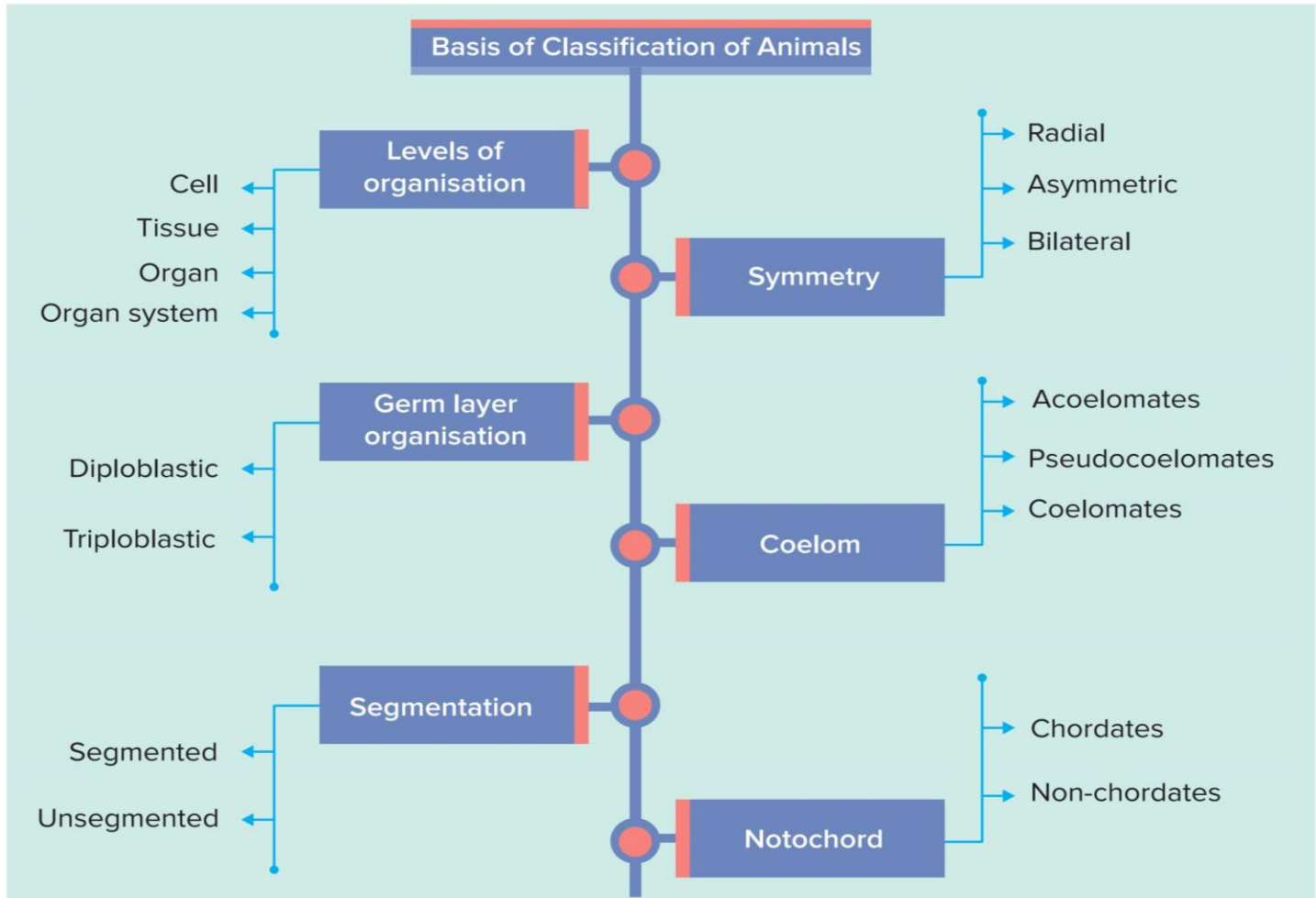
### Sexual reproduction

- Most of the sponges are **hermaphrodites**. Thus, the egg and the sperm are produced by the same individual. However, in some species, the **sexes are separate**.
- **Fertilisation is internal**.
- **Indirect development** - Larval stage is involved that is distinct from the adult.
- Larva is motile



### Summary Sheet





**Phylum Porifera (Sponges)**

Characteristics	
Habitat	Freshwater Mostly marine
Body symmetry	Asymmetric
Level of organisation	Cellular
Nutrition	Water canal system <ul style="list-style-type: none"> <li>• Ostia - Pores in the body of the sponges</li> <li>• Spongocoel - Body cavity of the sponges</li> <li>• Amoebocytes - Specialised cells for digestion</li> <li>• Choanocytes - Capturing of food particles</li> </ul>
Reproduction	<ul style="list-style-type: none"> <li>• Asexual - Fragmentation</li> <li>• Sexual</li> </ul>
Fertilisation	Internal
Development	Indirect





## 02 PHYLUM COELENTERATA, PHYLUM CTENOPHORA, PHYLUM PLATYHELMINTHES, PHYLUM ASCHELMINTHES



### Key Takeaways

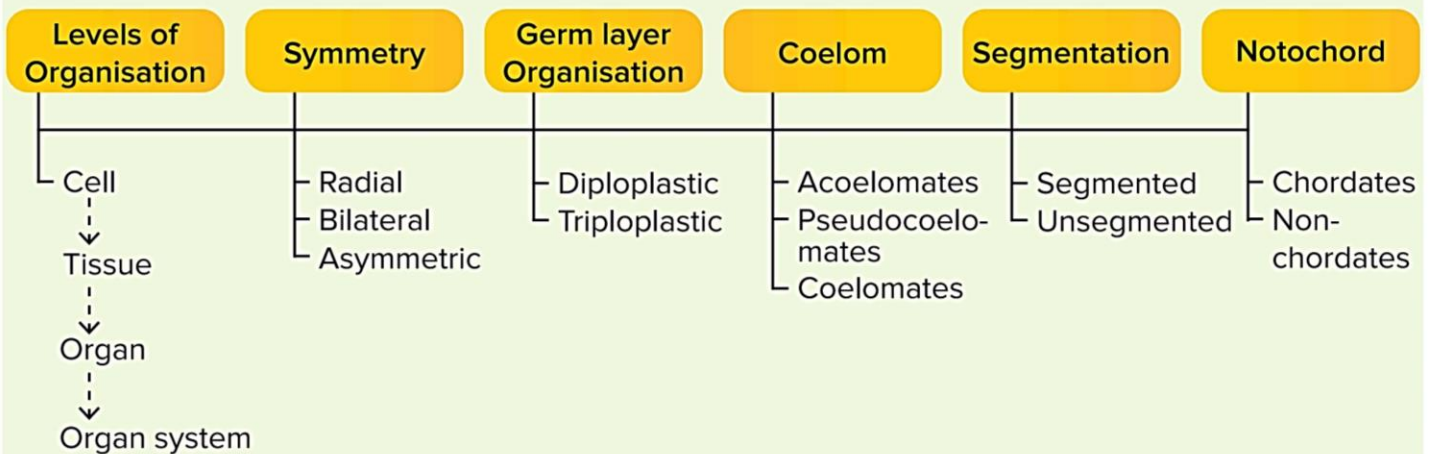
Characteristic features of:

- Phylum Coelenterata
- Phylum Ctenophora
- Phylum Platyhelminthes
- Phylum Aschelminthes

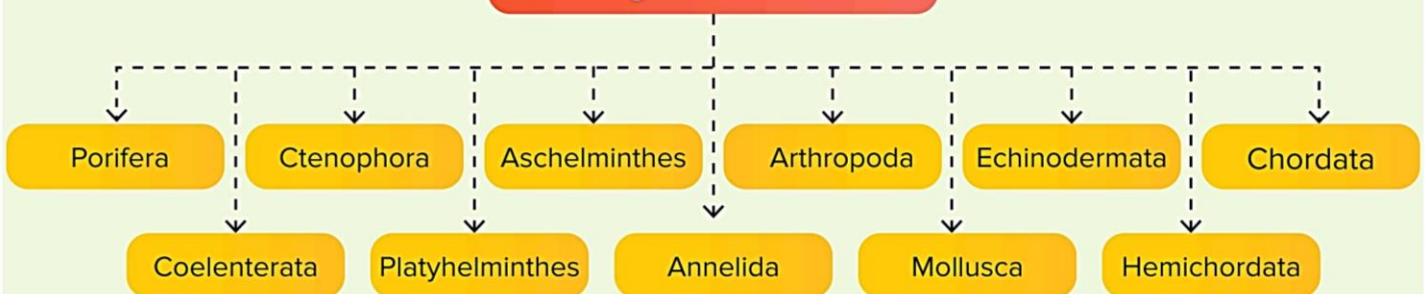


### Prerequisites

#### Current Basis of Classification of Animals



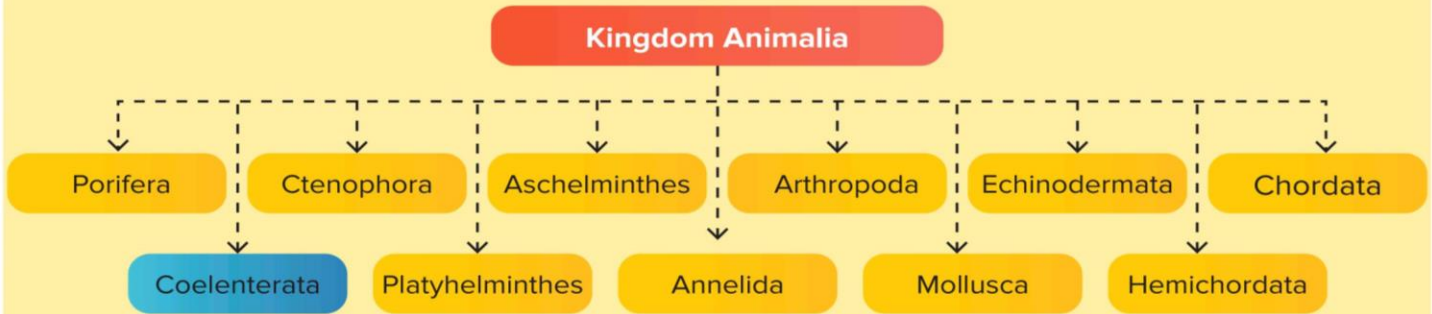
#### Kingdom Animalia





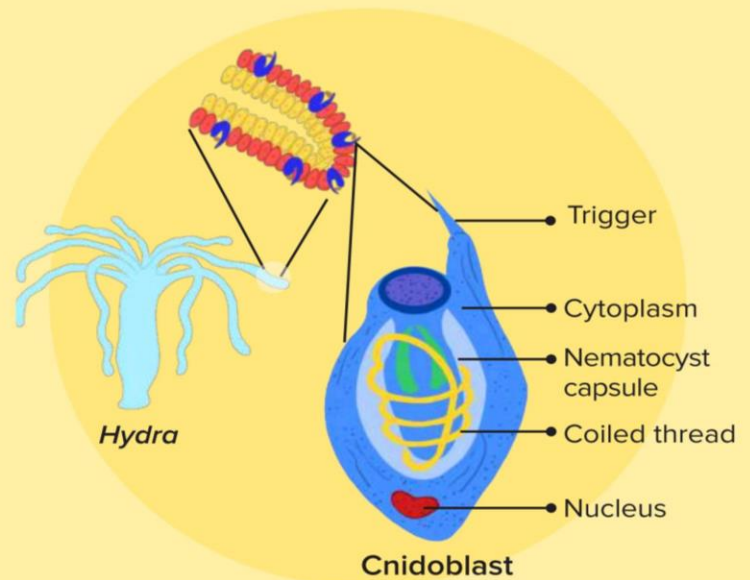
## Phylum Cnidaria or Coelenterata

Phylum Cnidaria includes organisms like *Adamsia* (sea anemone), *Meandrina* (Brain coral), *Physalia* (Portuguese man-of-war), *Hydra*, etc.



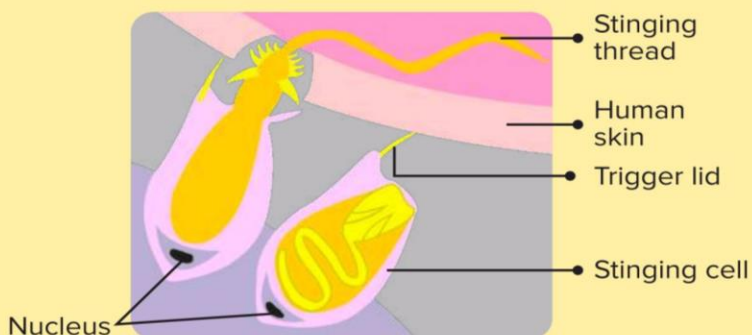
### Characteristics of Phylum Cnidaria

- Presence of **cnidoblasts**
- Cnidarians are **carnivorous**. They contain special **stinging cells** called **cnidocytes** or **cnidoblasts** or **nematocytes** on the tentacles, which they use to capture prey.
- The name 'Cnidaria' is derived from the cnidoblasts or **cnidocytes**.



Structure of the cnidoblast

### Stinging action of cnidoblasts in jellyfish



- Cnidoblasts contain stinging capsules known as **nematocysts** and a paralyzing toxin known as **hypnotoxin**.
- When a prey approaches the cnidarian, the cnidoblasts fire off and inject the hypnotoxin into the prey.
- The paralyzed prey is pulled into the **mouth**.
- Apart from capturing prey, cnidoblasts are also involved in:
  - Defence
  - Anchorage





**Habitat**

- **Aquatic animals**, mostly **marine**
- Either **sessile** or **free-living**



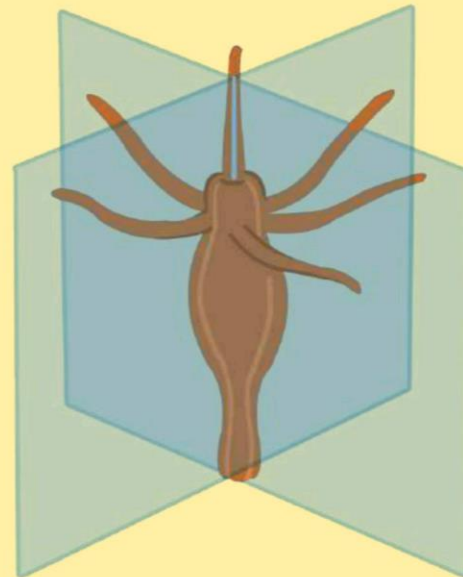
Jellyfish (Free-living)



Sea pen (Sessile)

**Symmetry**

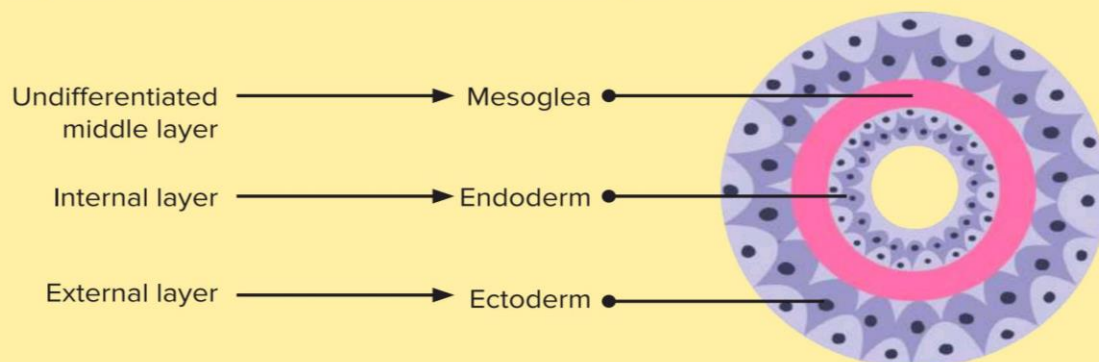
- Exhibit **radial symmetry**: Body can be divided into two identical halves in any plane



Radial symmetry in *Hydra*

**Germ layer organisation**

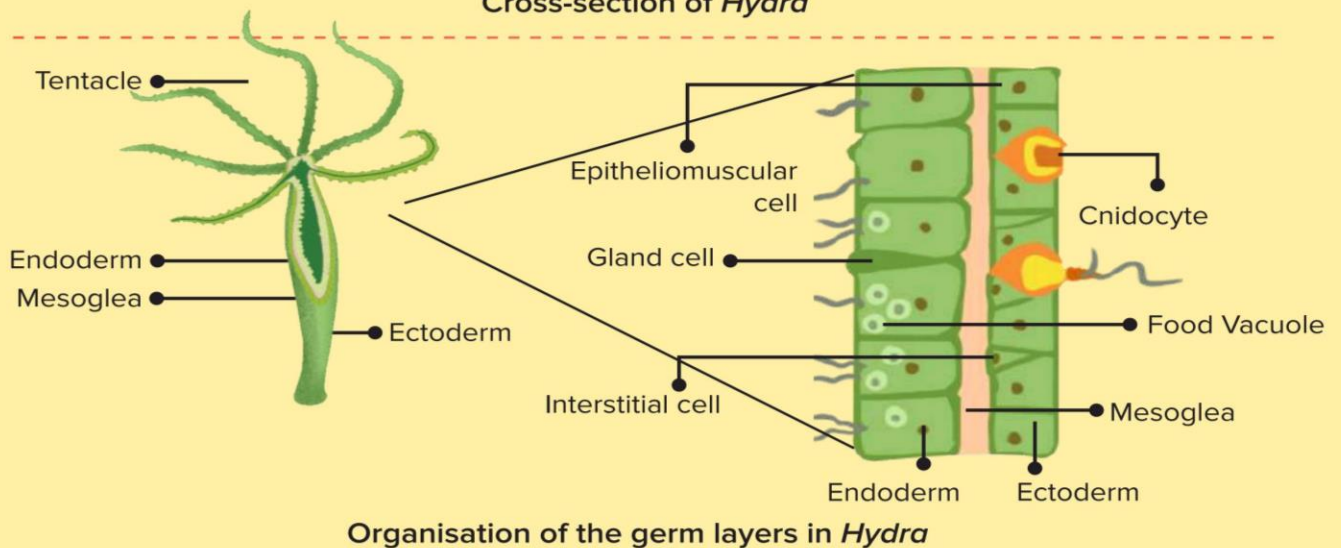
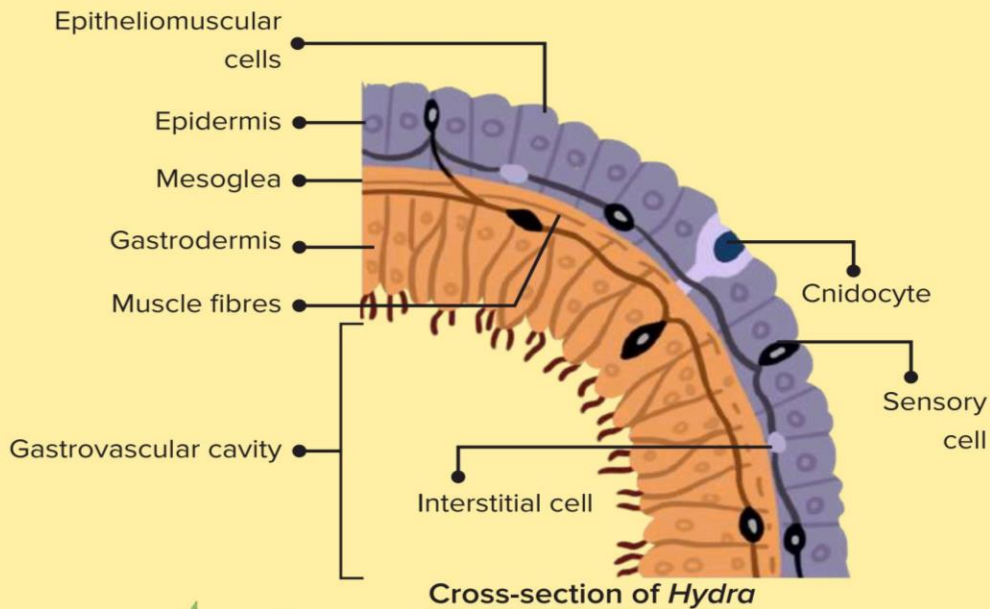
- Exhibit **diploblastic** organisation with two germ layers:
  - Outer **ectoderm layer**
  - Inner **endoderm layer**
- They also have an **undifferentiated middle layer** known as the **mesoglea**.



Diploblastic organisation of Cnidarians

**Level of organisation**

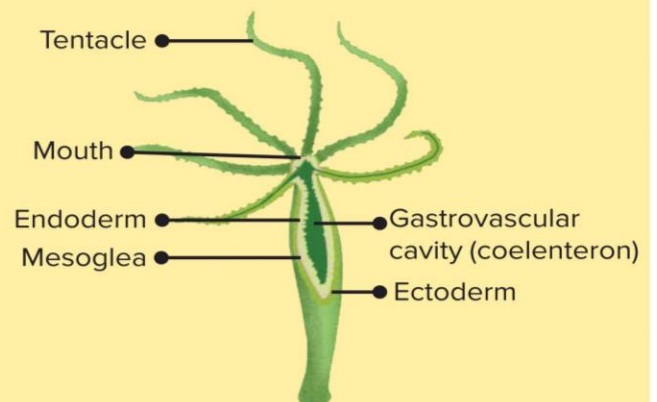
- Exhibit **tissue level of organisation**: Cells performing similar functions are grouped into tissues. Tissues are not organised into organs.



### Feeding and Digestion

#### Digestive system/alimentary canal is incomplete

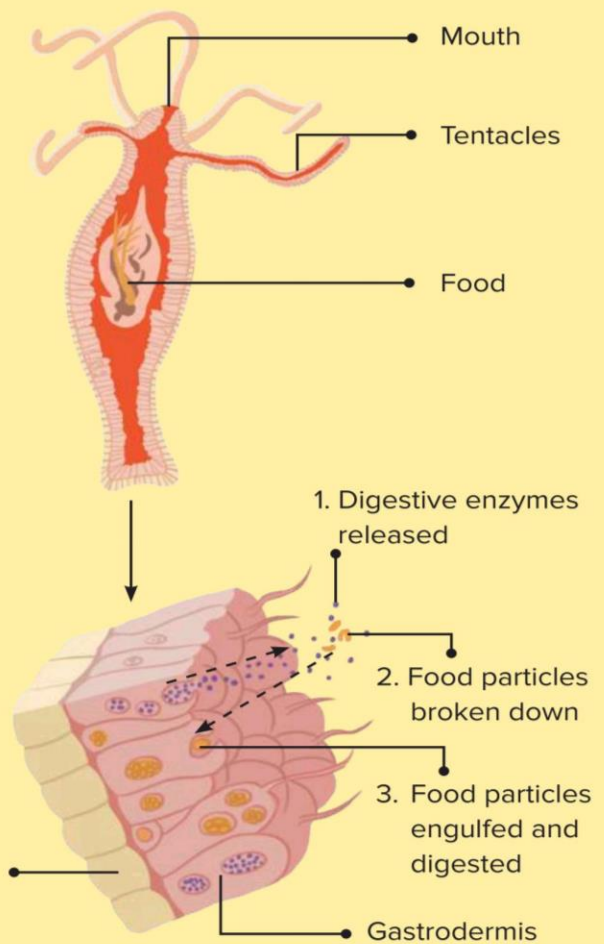
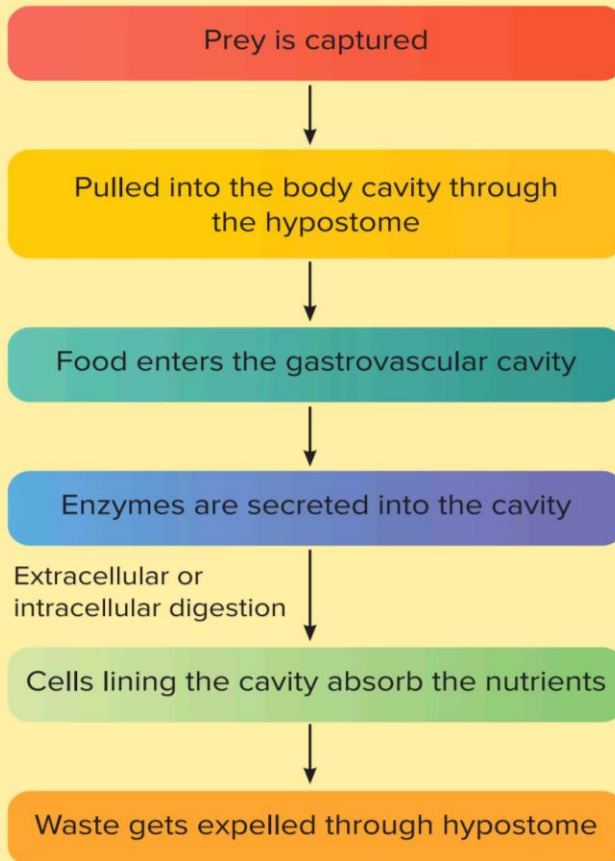
- Digestive system has a single opening known as the **hypostome** which bears the mouth.
- The mouth opens to a hollow **gastrovascular cavity** or the '**coelenteron**' (Hence the name 'Coelenterata').
- **Digestion:**
  - Intracellular
  - Extracellular



**Incomplete digestive system of *Hydra***



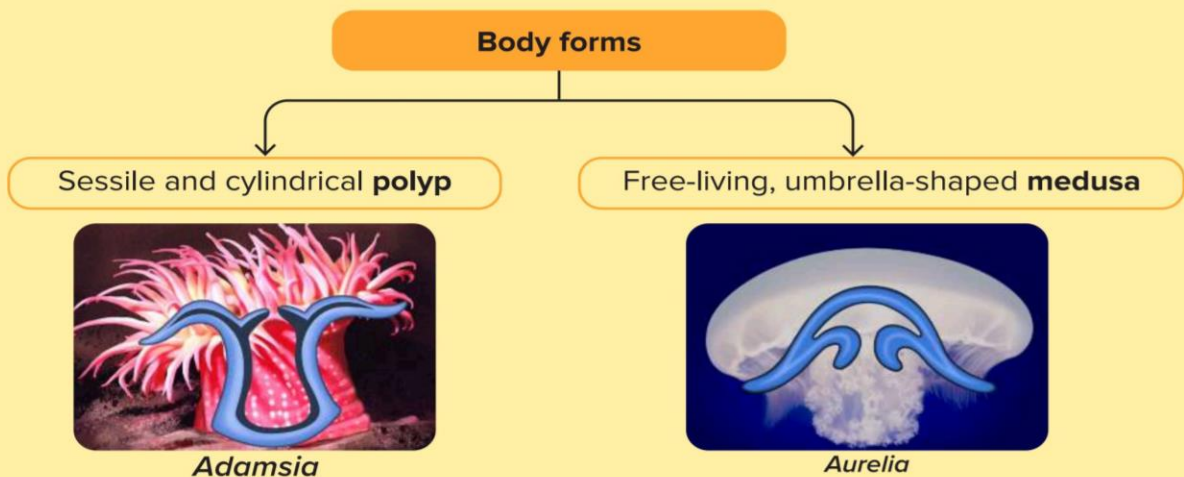
- The process of feeding and digestion can be summarised as follows:



Feeding and digestion in cnidarians

### Basic body forms of cnidarians

- Cnidarians show two basic body forms:



Adamsia



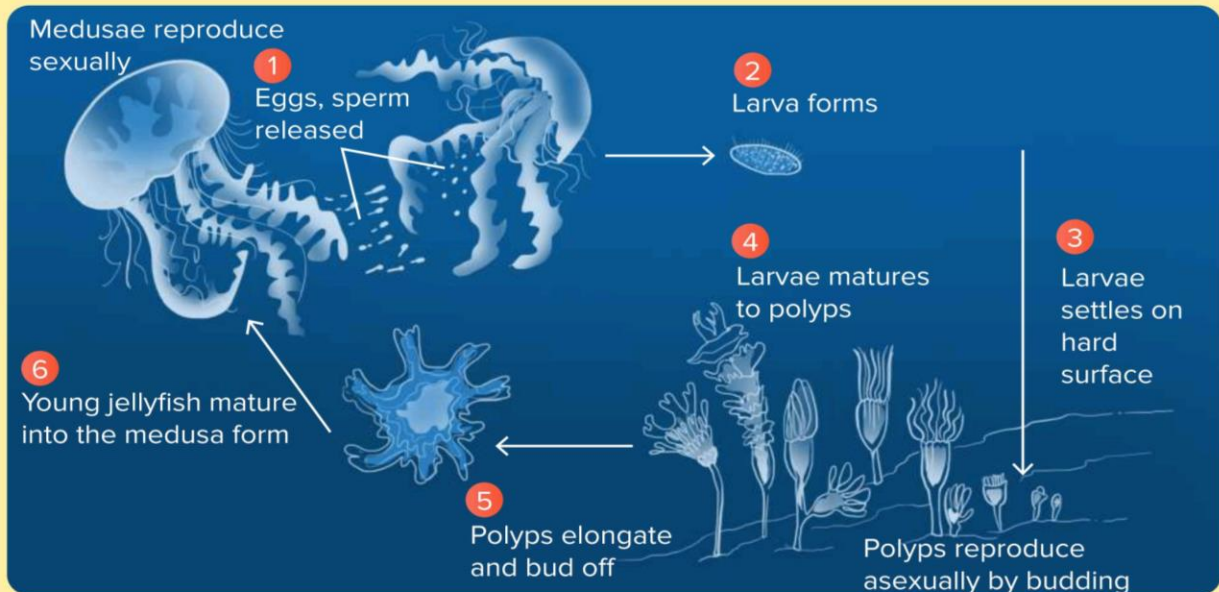
Aurelia





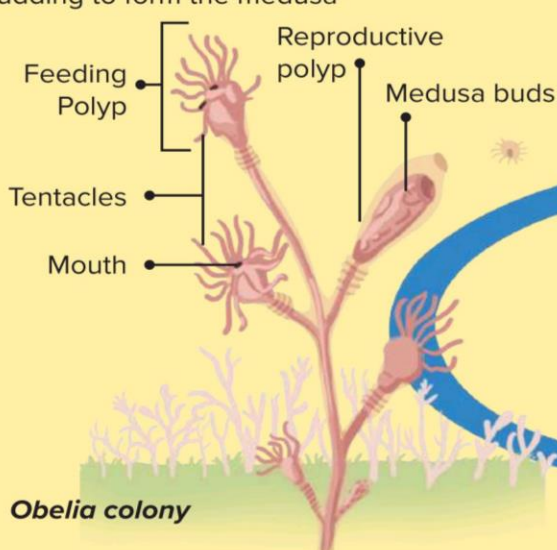
### Alternation of Generation or Metagenesis

- Some cnidarians remain in one form, either **polyp** or **medusa**, for their entire life cycle.
- Other cnidarians exist in **both forms** at different phases of their life cycle. This is known as **metagenesis** or **alternation of generation**.
- During metagenesis:
  - **Polyps** reproduce **asexually** by budding to form a large number of **medusae**.
  - The **medusae** reproduce **sexually** to give rise to **polyps** by the production of **gametes**.
- Metagenesis in Jellyfish and *Obelia* is depicted below:

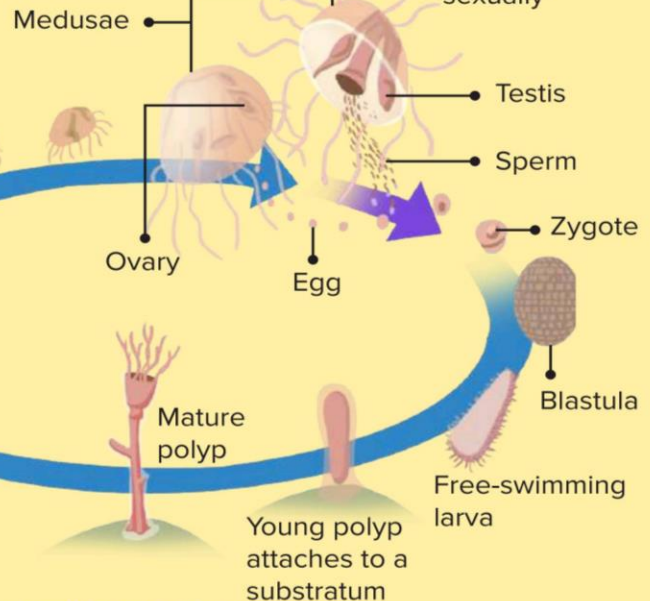


### Alternation of generation in jellyfish

Polyps reproduce asexually by budding to form the medusa



Medusa reproduce sexually



### Alternation of generation in *Obelia*



Did you know?



**Great Barrier Reef**

**Corals** are made up of hundreds and thousands of individual coral polyps. Coral reefs are underwater structures made from calcium carbonate secreted by corals. The **Great Barrier Reef** is a large colony of corals which are visible from space!

### Colonial Cnidarians

Some Cnidarians, like *Physalia*, come together to form large colonies.

**Jellyfish**  
Single organism



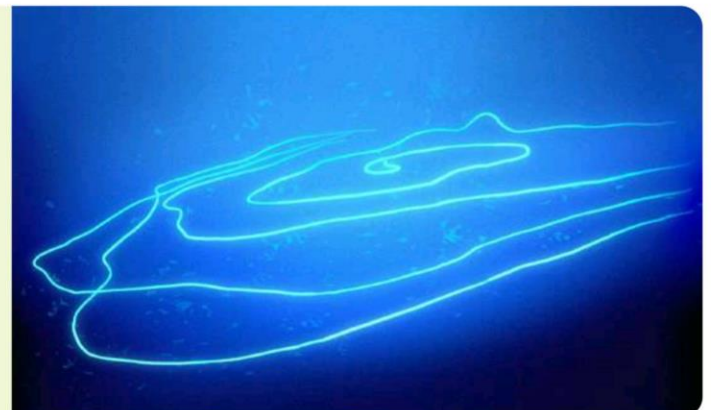
***Physalia***  
Colonial organism



Did you know?

### World's largest String of Coelenterates!


The World's largest String of Coelenterates is a long stretch of millions of jellyfish-like invertebrates, found off the coast of Australia. The structure is over 100 feet long!







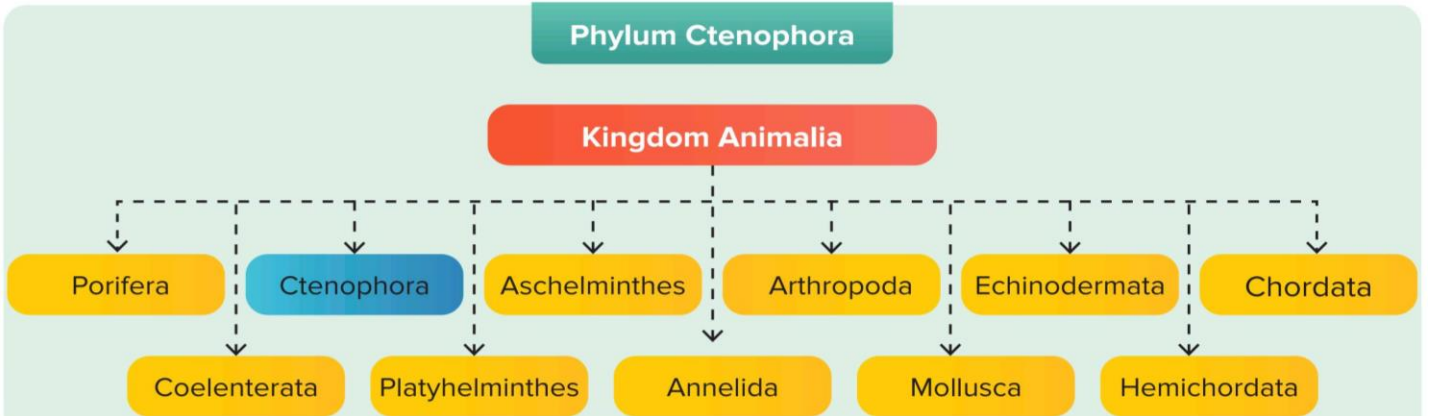
### Symbiosis between the Clownfish and Sea anemone

Adaptations of the clownfish and the sea anemone	Benefits to the clownfish	Benefits to the sea anemone
<ul style="list-style-type: none"> <li>The clownfish is protected by a thick mucous layer.</li> <li>As the clownfish grows, it mixes its own mucous layer with that of the anemone for protection.</li> </ul>	<ul style="list-style-type: none"> <li>A safe home that protects it from predators.</li> </ul>  <p>Tentacles of the sea anemone</p>	<ul style="list-style-type: none"> <li>The clownfish helps in cleaning the sea anemone.</li> <li>It scares away predatory fish such as the butterfly fish.</li> <li>It provides nutrients in the form of waste.</li> </ul>

### Differences between Phylum Porifera and Phylum Cnidaria

	Symmetry	Segmentation	Digestive tract	Other features
<b>Porifera (Sponges)</b>	Absent	Absent	Mouth and anus absent	<ul style="list-style-type: none"> <li>Porous body</li> <li>Attached to rocks</li> <li>Filter feeder</li> </ul>
<b>Cnidaria (Corals, Jellyfish)</b>	Radial	Absent	Mouth is present but anus is absent	<ul style="list-style-type: none"> <li>Stinging cells</li> <li>Tentacles</li> </ul>





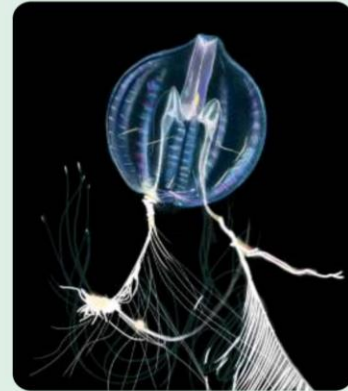
**Characteristics of Phylum Ctenophora**

**Habitat**

- Exclusively **marine**

**Bioluminescent**

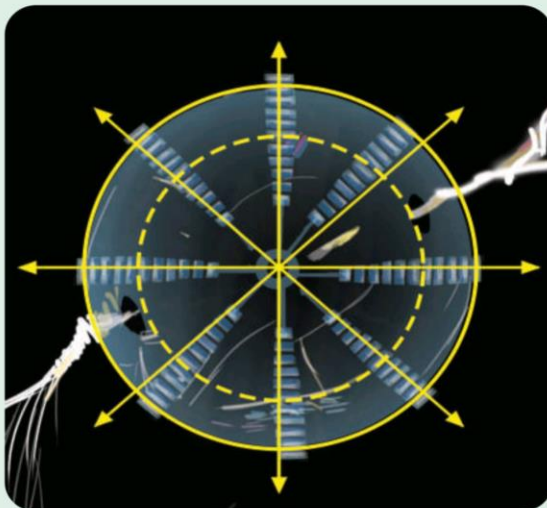
- It is the property of a living organism to emit light.



*Pleurobrachia*

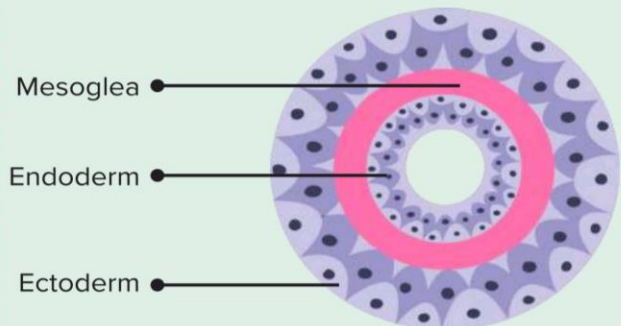
**Symmetry**

- Exhibit **radial** symmetry



**Germ layer organisation**

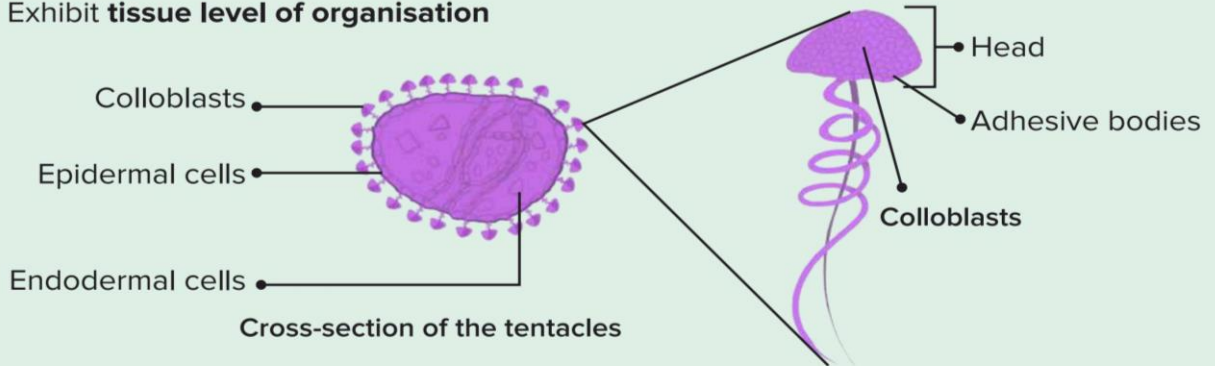
- Exhibit **diploblastic** organisation with two germ layers:
  - Outer ectoderm layer
  - Inner endoderm layer
 They also have an **undifferentiated middle layer** known as the **mesoglea**.



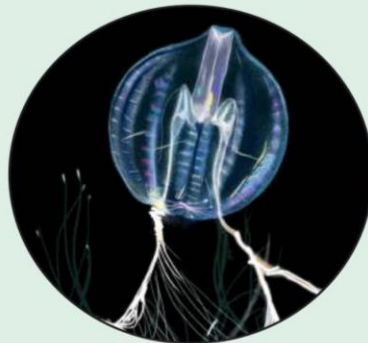


**Level of Organisation**

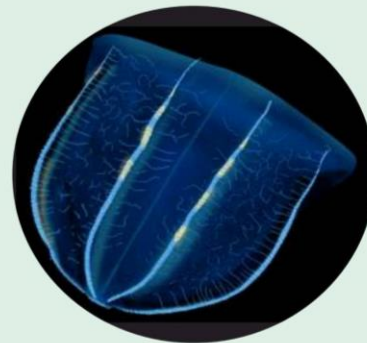
- Exhibit **tissue level of organisation**



Tissue level organisation in Ctenophora



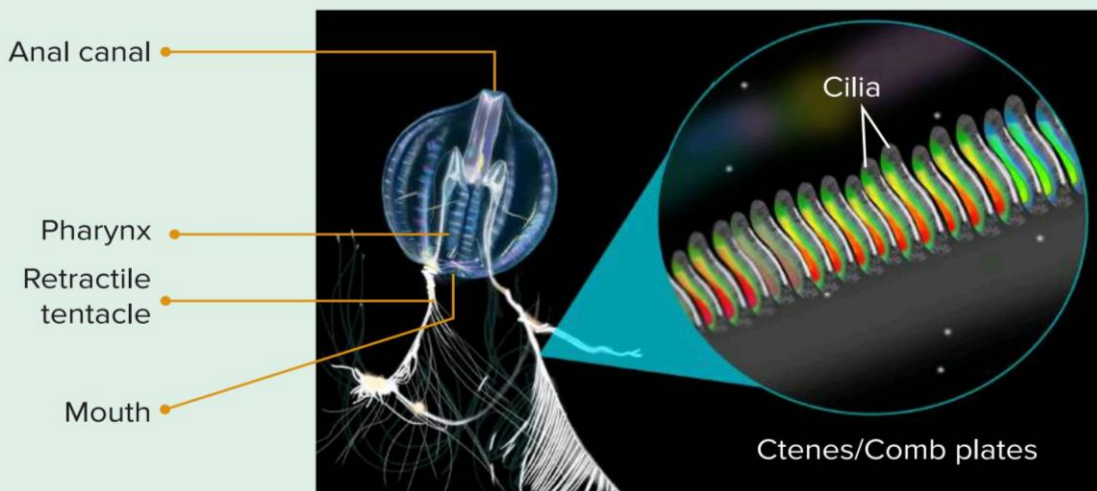
*Pleurobrachia*



*Ctenoplana*

**Comb plates**

- Ctenophores have 8 external rows of **ciliated comb plates**.
- Comb plates are used for **locomotion**.
- 'Ctene' = Comb in Greek; hence the name 'Ctenophora'
- Ctenophores are also called '**Comb jellies**'

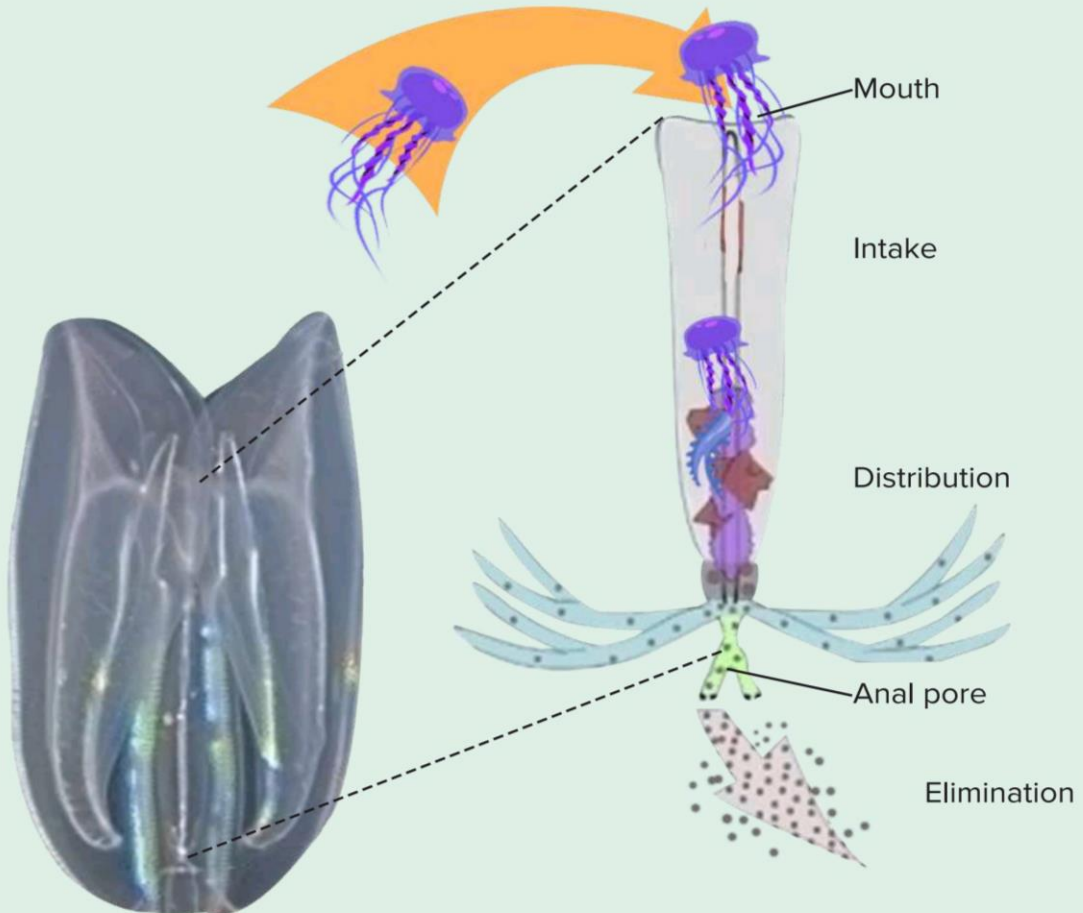


Comb plates in *Pleurobrachia*



### Feeding and Digestion

- Carnivorous - feed on other ctenophores and **cnidarian jellies**
- Digestion is both **extracellular** and **intracellular**
- Digestive system is **complete** with the following components:
  - **Mouth**
  - **Gut** that extends through the entire body
  - **Anal pore** for removal of waste



Complete digestive system of ctenophores

### Reproduction in Ctenophores

- Only **sexual** reproduction
- They are **hermaphrodites** : Sexes are not separate; function as both males and females
- Show **external fertilization**: Egg and sperm are released into the water
- **Development-Indirect**
  - Fertilised eggs develop through the larval **stage** and hatch into adults.



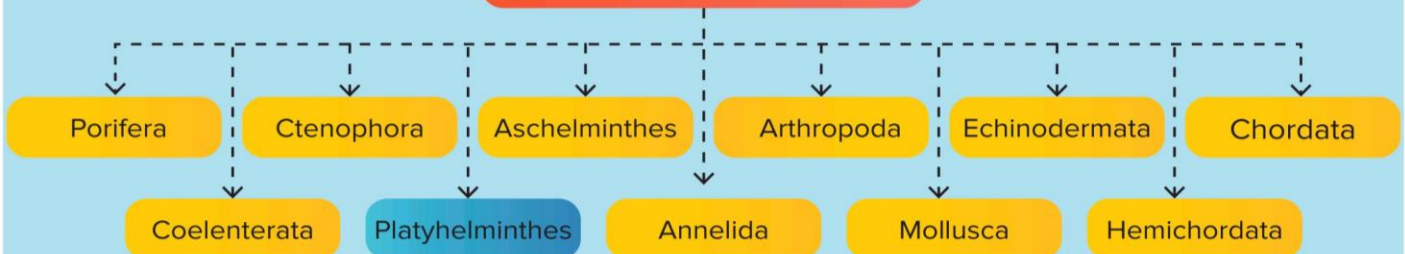


### Differences between Phylum Coelenterata and Phylum Ctenophora

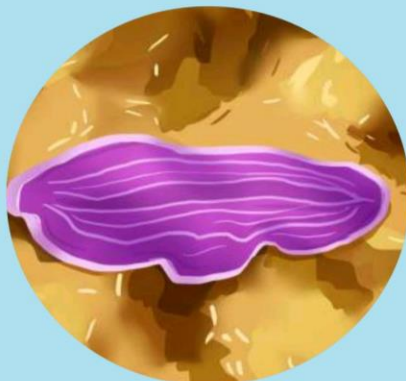
Characteristics	Coelenterata	Ctenophora
Habitat	Both marine and freshwater	Exclusively marine
Diversity	Highly diverse	Less diverse
Body symmetry	Radial	Radial
Specialized cells	Presence of cnidoblasts	Presence of comb plates and sticky cells known as colloblasts to trap prey
Digestion	Extracellular and intracellular	Extracellular and intracellular
Digestive system	Incomplete	Complete
Bioluminescence	Shown by few organisms	Shown by many organisms

### Phylum Platyhelminthes

#### Kingdom Animalia



- Includes **flatworms** like *Fasciola*, *Planaria*, *Taenia*, etc.
- Have a **dorsoventrally flattened body**, which means the body is **flattened on both the upper and lower surfaces**.



*Prostheceraeus roseus*



*Taenia*



## Characteristics of Phylum Platyhelminthes

### Habitat

- Mostly **endoparasites** (Example: Flatworms)
- Some are **free-living** (Example: *Planaria*)

### Parasites

These are organisms that live in or on a host organism and derive their nutrients and take shelter from the host.

#### Ectoparasites

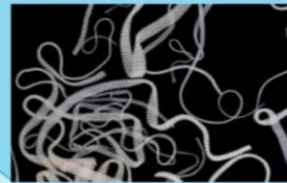
Live on the external surface of the host body



E.g., Head louse, an insect, lives in between human hair

#### Endoparasites

Live inside the host in the digestive tract, body cavities, organs, and tissues of the host

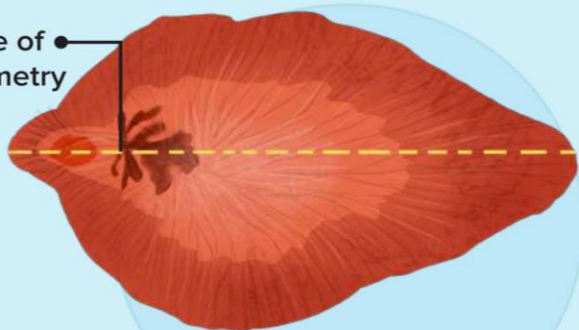


E.g., Tapeworm lives in the intestine of humans

### Symmetry

Exhibit **bilateral** symmetry

Plane of symmetry

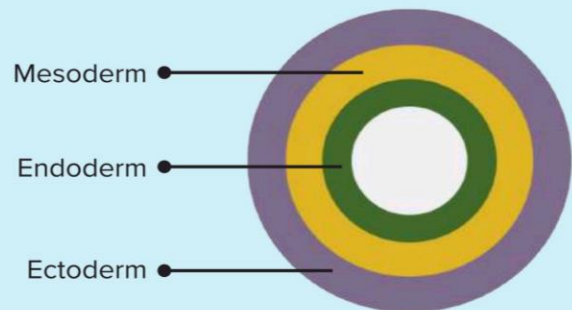


Liver fluke

### Germ layer organisation

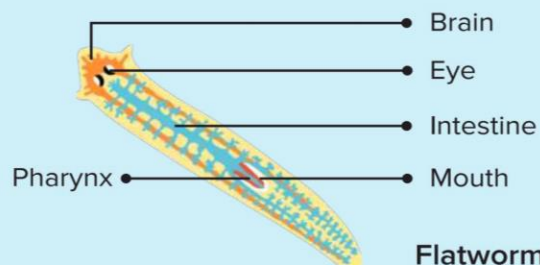
They are **triploblastic acoelomates** having three germ layers:

- Outermost **ectoderm** layer
- Innermost **endoderm** layer
- Middle **mesoderm** layer



### Level of Organisation

Exhibit **organ level** of organisation



Flatworm





Platyhelminthes is the first phylum to show

Bilateral symmetry

Organ level of organisation

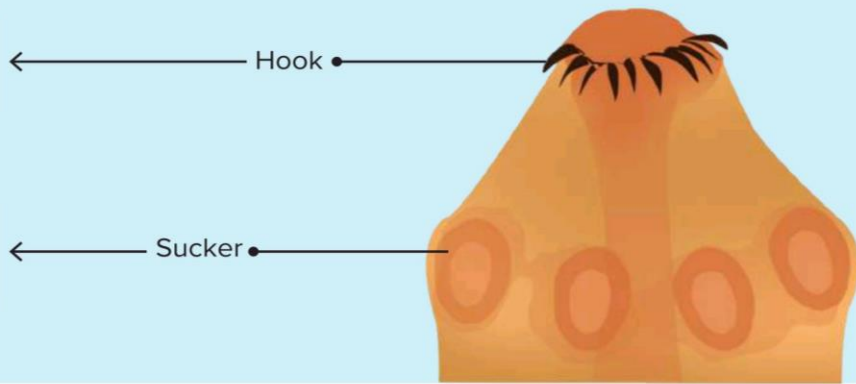
Triploblastic

### Absorption of nutrients from the host by endoparasitic platyhelminthes

Appendages present on endoparasites for deriving nutrients from the host are given in the figure below:

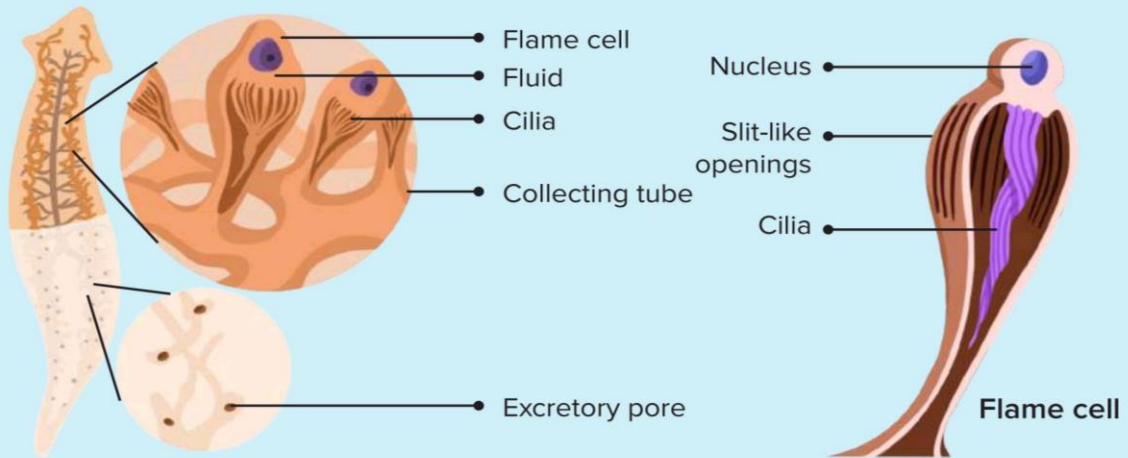
Hooks allow the organism to attach to the host.

Suckers absorb nutrients from the host.



### Excretory organs in platyhelminthes

- **Flame cell** is a specialised excretory cell.
- They have a cluster of **cilia**, resembling a flickering flame (*Hence, 'flame cells'*).
- Flame cells come together to form a **network**.



Excretory organs in flatworm

#### Process of waste removal

Fluid filters, through the cilia in the flame cell

The collecting tubules collect the waste

Waste is expelled from the excretory pore

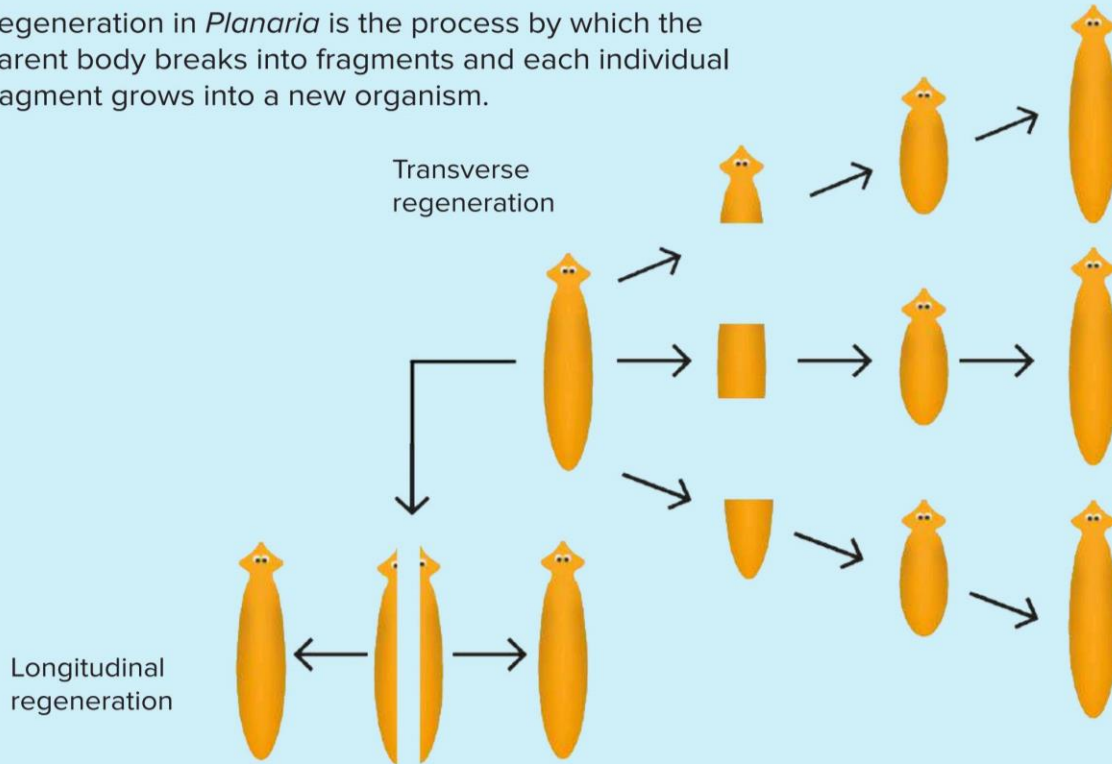




## Reproduction in Platyhelminthes

### (a) Asexual reproduction in *Planaria* - Regeneration

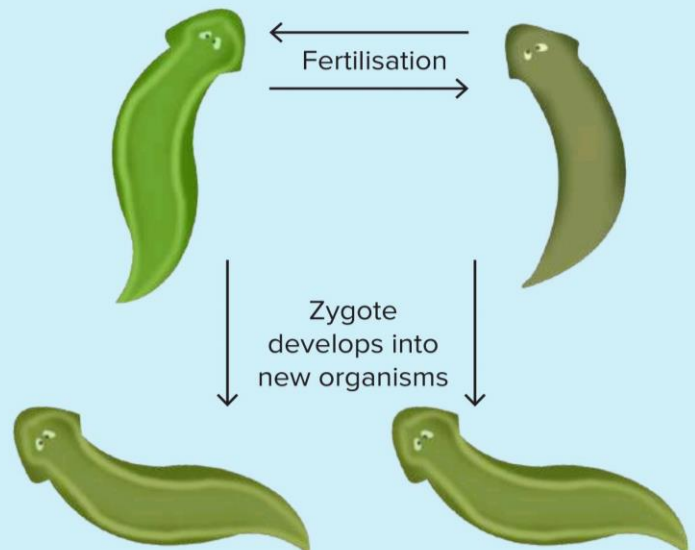
Regeneration in *Planaria* is the process by which the parent body breaks into fragments and each individual fragment grows into a new organism.



Regeneration in *Planaria*

### (b) Sexual reproduction in *Planaria*

- They are **hermaphrodites** - sexes are not separate
- Testes and ovaries both are present in the same organism but they **do not self-fertilise**. When mating, the organisms exchange sperm and each individual is fertilised by the sperm from another individual.
- Fertilisation is **internal**.
- **Indirect development** with many **larval** stages.

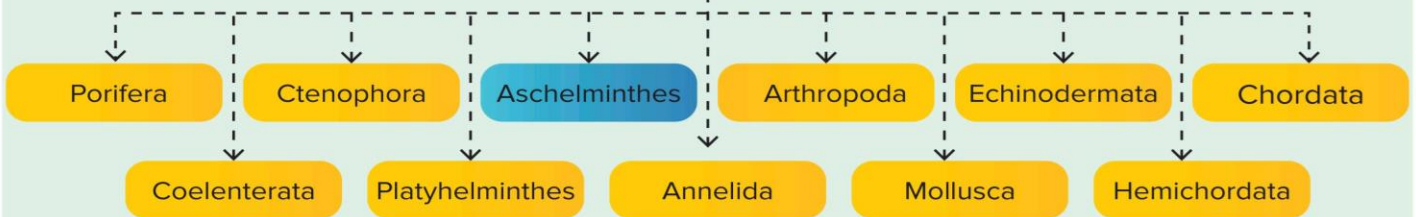


Stages of development in *Planaria*

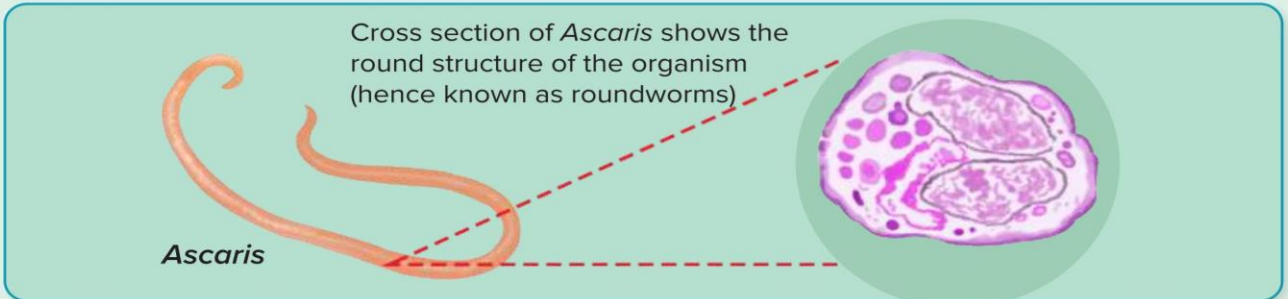
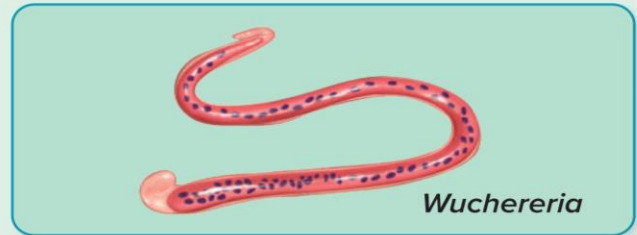
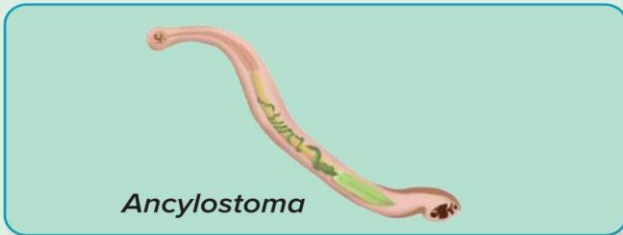


**Phylum Aschelminthes**

**Kingdom Animalia**



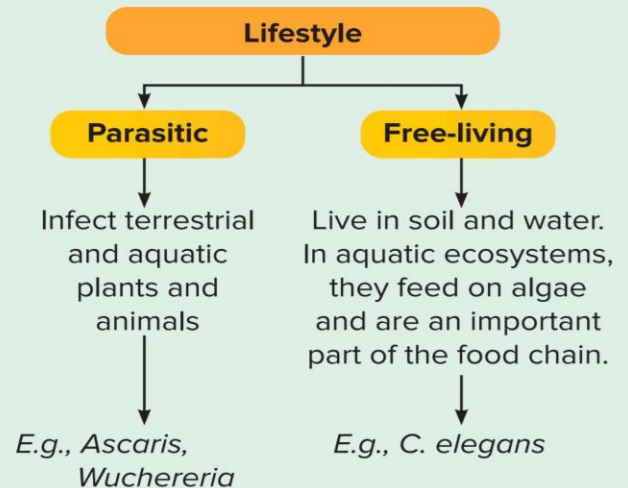
- Includes roundworms like ***Ascaris***, ***Wuchereria***, ***Ancylostoma***, etc.
- Show high individual count and great species diversity
- Members of this phylum are also known as **Nematodes**.



**General characteristics**

- **Diverse habitat**
- **Terrestrial** - Mountains, deserts, oceanic trenches
- **Aquatic** - Freshwater, marine

**Lifestyle**





### Organ system level of organisation

They have the following organ systems:

- Digestive system
- Excretory system
- Reproductive system

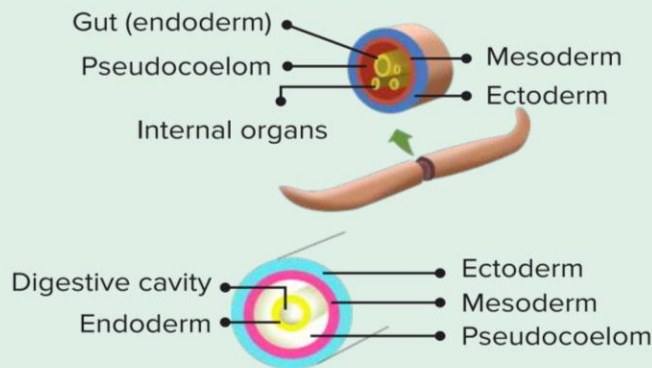
Aschelminthes is the first phylum to show organ system level of organisation.

### Symmetry

- Bilaterally symmetrical

### Germ layer organisation

- Triploblastic
- Pseudocoelomates - The coelom, or the body cavity, is not derived from the mesoderm.



Germ layer organisation and the pseudocoelom



### Did you know?



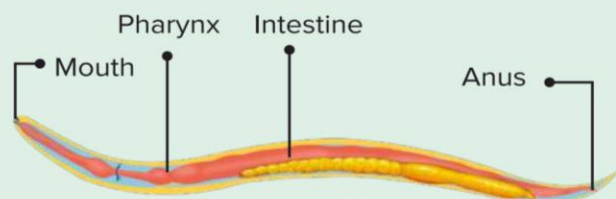
*Caenorhabditis elegans*

*Caenorhabditis elegans* is a free-living soil nematode. It has been extensively studied and researched and is probably **best understood animal** on Earth.

It is the first animal to have its genome completely sequenced. This is because *C. elegans* has many genes similar to that of humans. Study on *C. elegans* has led to great insight on animal development, neurobiology and behavior.

### Digestive System

- The digestive system is **complete**, consisting of an alimentary canal that opens with the mouth, has a muscular pharynx and ends with an anus.



Digestive system of nematodes

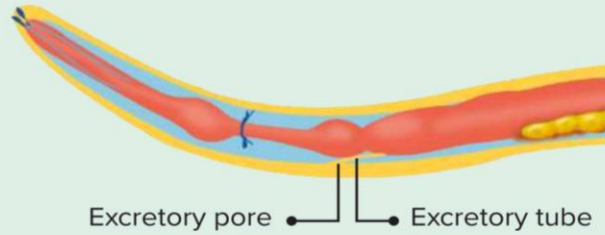




### Excretory system

The excretory system consists of:

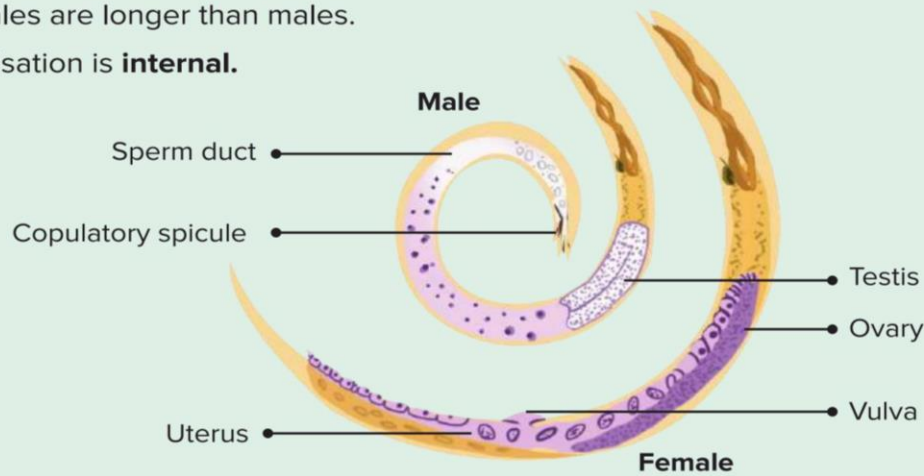
- An **excretory tube**: Removes wastes from the body cavity.
- An **excretory pore**: Eliminates wastes from the body.



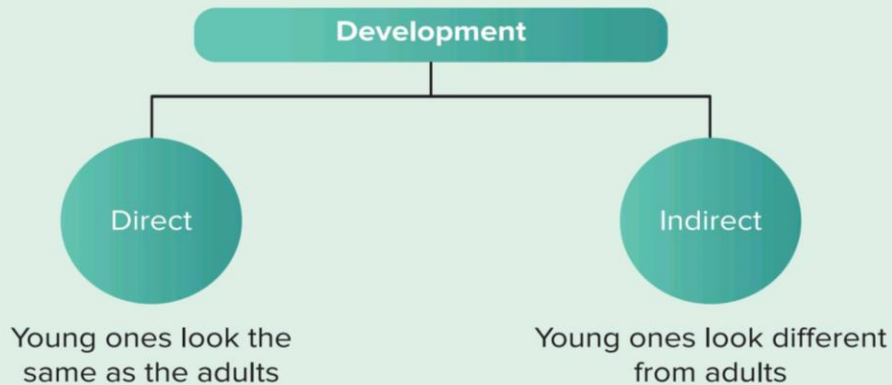
Excretory system of nematodes

### Reproductive system

- **Dioecious**: Sexes are separate.
- Females are longer than males.
- Fertilisation is **internal**.



Reproductive organs in male and female nematodes





**Infectious nematodes**

Infectious nematodes		Description	
Disease	Causative Nematode	Source of infection	Description
<b>Ascariasis</b>	<i>Ascaris lumbricoides</i>	<ul style="list-style-type: none"> <li>Ingestion of eggs</li> <li>Unwashed hands/ fingernails</li> <li>Unwashed or uncooked fruits and vegetables</li> </ul>	<p>Ascaris lives in the intestine of the host. Eggs are passed through the faeces of an infected person.</p> 
<b>Ancylostomiasis</b> (Hookworm infection)	<i>Ancylostoma duodenale</i>	<ul style="list-style-type: none"> <li>Adult hookworms can penetrate the feet of people walking on contaminated soil.</li> <li>Some forms can also be transmitted through ingestion of larvae.</li> </ul>	 <p>Hookworms live in the small intestine of the host. Eggs are passed through the faeces of an infected person.</p>
<b>Lymphatic filariasis</b> (Elephantiasis)	<i>Wuchereria bancrofti</i>	Mosquito bites	<p>The parasite infects the lymphatic system causing the arms, legs, and scrotum to swell up.</p> 



### Differences and similarities between Platyhelminthes and Aschelminthes


Characteristics	Platyhelminthes	Aschelminthes
Body shape	Dorsoventrally flattened	Round
Symmetry	Bilaterally symmetrical	Bilaterally symmetrical
Level of organisation	Organ level	Organ system level
Coelom	Acoelomate	Pseudocoelomate
Germ layers	Triploblastic	Triploblastic
Fertilisation	Internal	Internal
Developmental stages	Indirect	Direct and indirect



### Summary Sheet

### Phylum Cnidaria (Coelenterata)

#### General characteristics

Level of organisation	Tissue level	 <p>Jellyfish</p>
Germ layer organisation	Diploblastic	
Symmetry	Radial	
Life cycle	Show alternation of generation between the polyp and medusa form	
Reproduction	Sexual	

#### Unique characteristics

- Presence of stinging cells called cnidoblasts
- Corals secrete calcium carbonate to form reefs

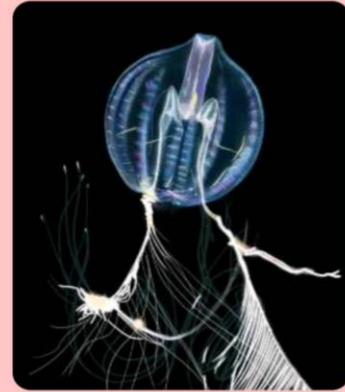




### Phylum Ctenophora

#### General characteristics

Level of organisation	Tissue level
Germ layer organisation	Diploblastic
Symmetry	Radial
Reproduction	Sexual



*Pleurobrachia*

#### Unique characteristics

- Presence of ciliated comb plates
- Exhibit bioluminescence

### Phylum Platyhelminthes (Flatworms)

#### General characteristics

Level of organisation	Organ level
Germ layer organisation	Triploblastic
Symmetry	Bilateral
Coelom	Acoelomate
Reproduction	Asexual (Regeneration) Sexual



Tapeworm

#### Unique characteristics

- Mostly endoparasites, only a few are free-living
- Presence of hooks and suckers
- Specialised excretory cells known as flame cells

**First phylum to show bilateral symmetry, organ level of organisation, and triploblastic condition**



## Phylum Aschelminthes (Roundworms)

### General characteristics

<b>Level of organisation</b>	Organ system level
<b>Germ layer organisation</b>	Triploblastic
<b>Symmetry</b>	Bilateral
<b>Coelom</b>	Pseudocoelomate
<b>Reproduction</b>	Sexual
<b>Life cycle</b>	Free-living, parasitic



*Wuchereria*

### Unique characteristics

- Well developed digestive, excretory, and reproductive systems
- Cause diseases like ancylostomiasis, lymphatic filariasis, etc.

**First animals to show organ system level of organisation**



# 03 PHYLUM ANNELIDA, PHYLUM ARTHROPODA



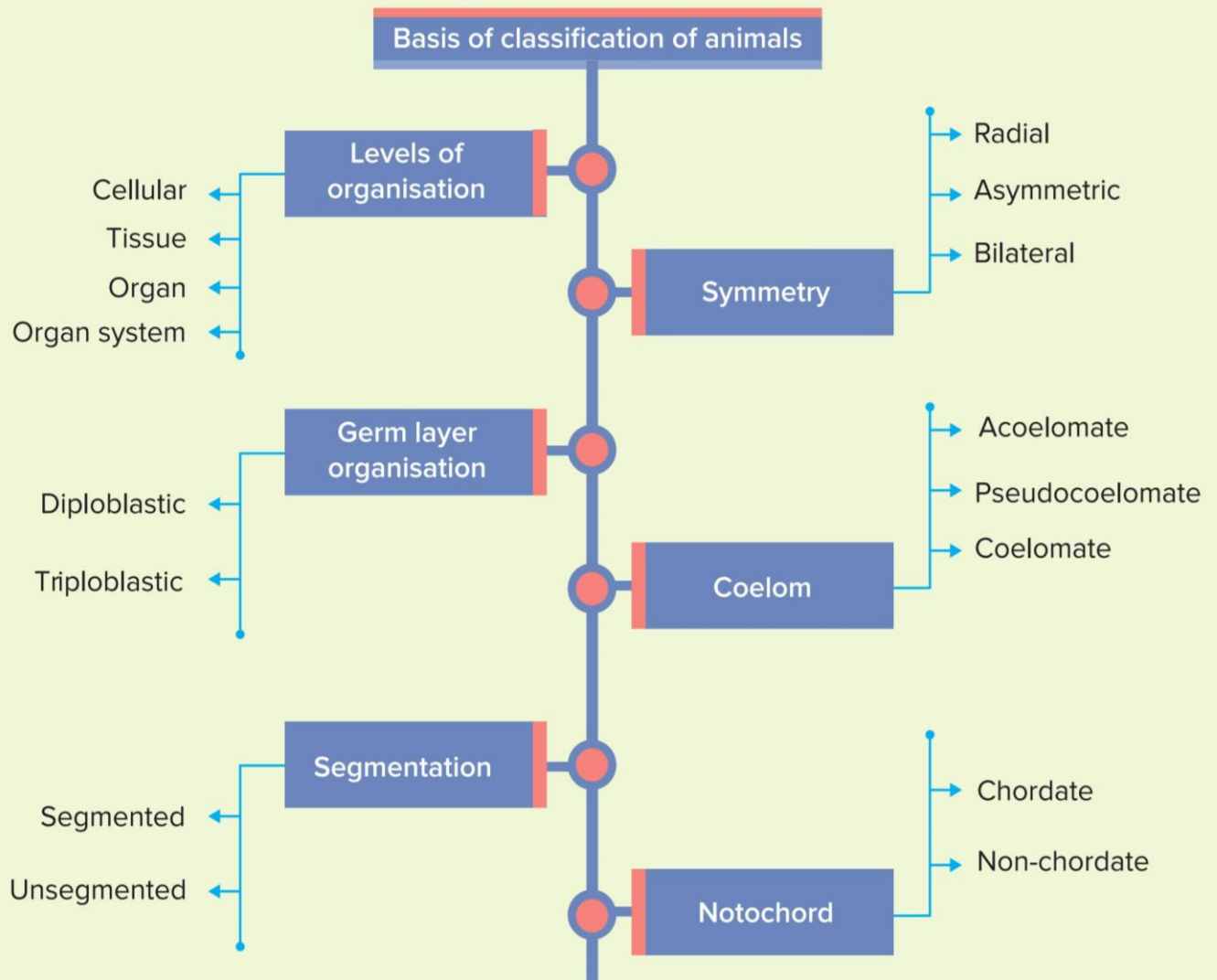
## Key Takeaways

Characteristic features of:

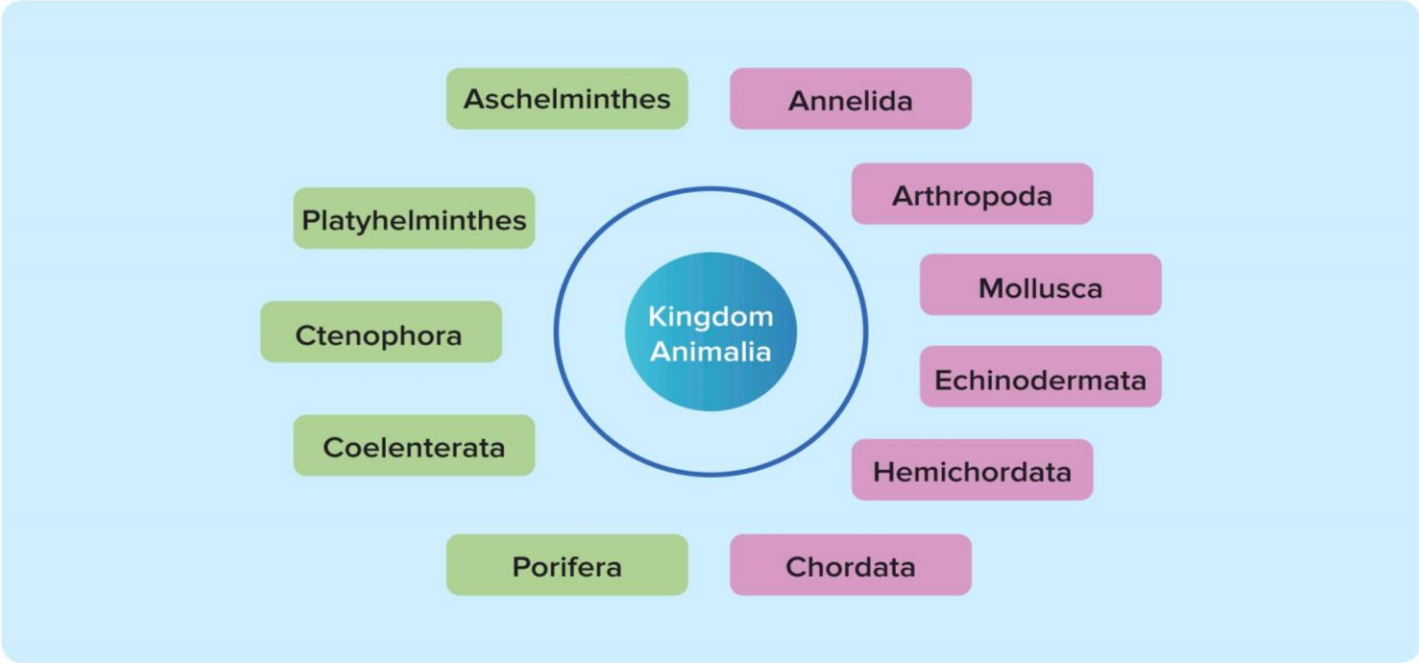
- Phylum Annelida
- Phylum Arthropoda



## Prerequisites

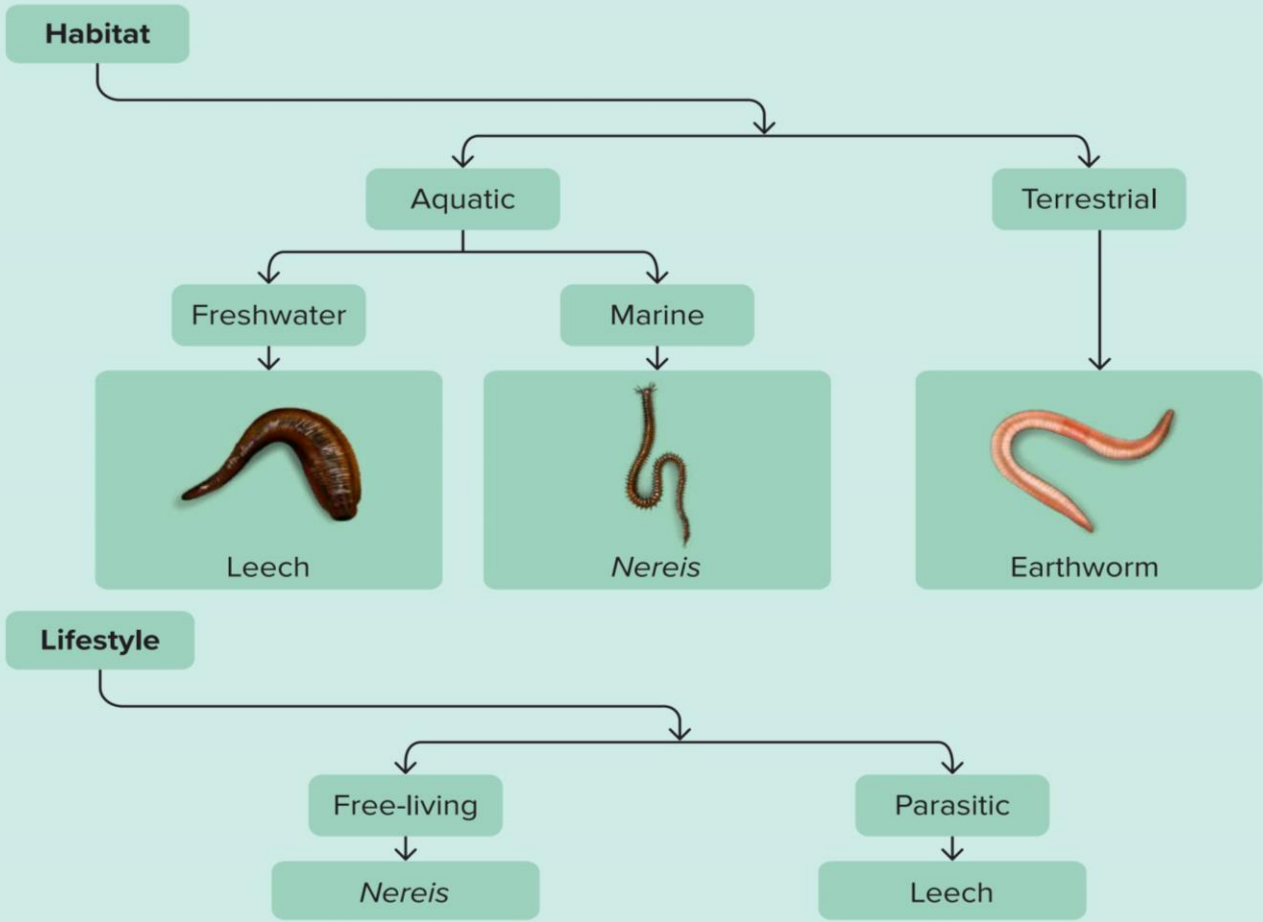






**Phylum Annelida**

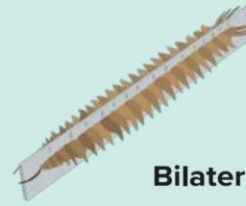
**Characteristics of Phylum Annelida**





**Symmetry**

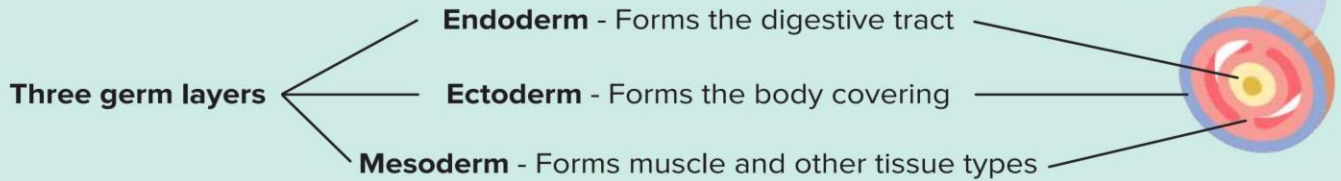
- Exhibit **bilateral symmetry**
- Body can be divided into two equal halves when cut along a single plane



**Bilateral symmetry in annelids**

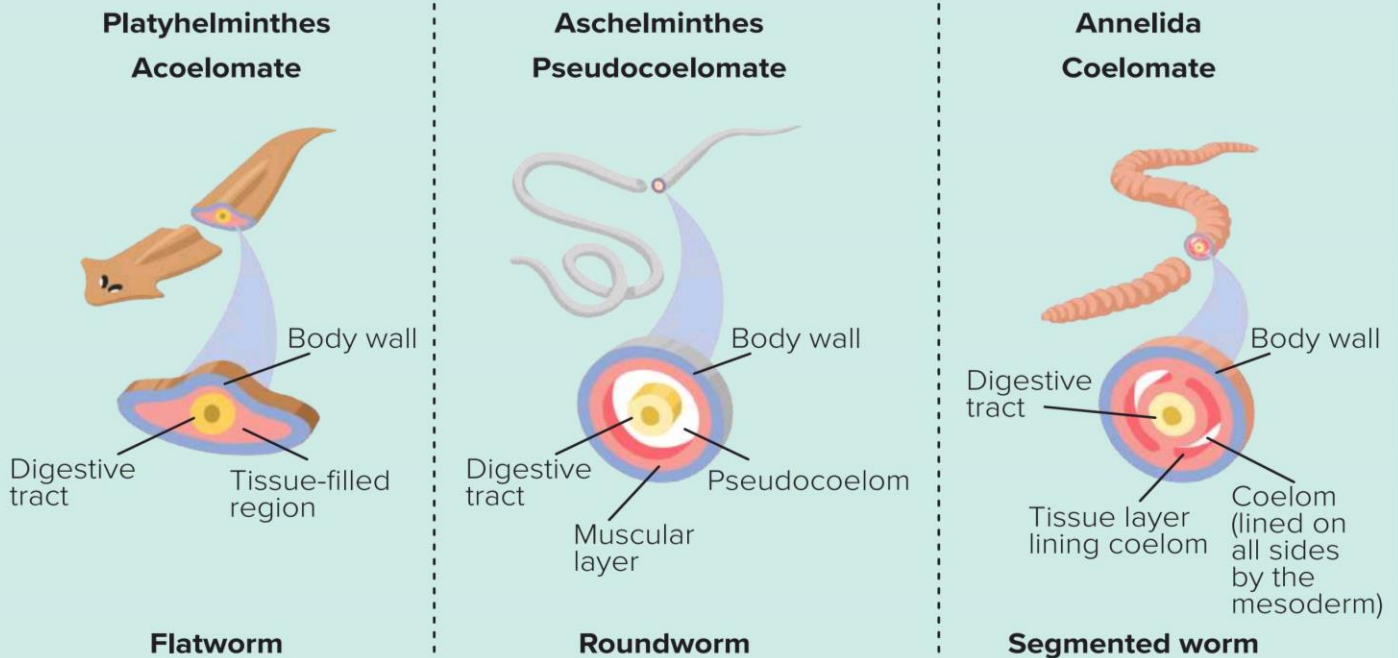
**Germ layer organisation**

- Exhibit **triploblastic** organisation with three germ layers as shown below:



**First coelomate animals**

- Have a true coelom (body cavity)



**Comparison between the acoelomate Platyhelminthes, pseudocoelomate Aschelminthes, and coelomate Annelida**

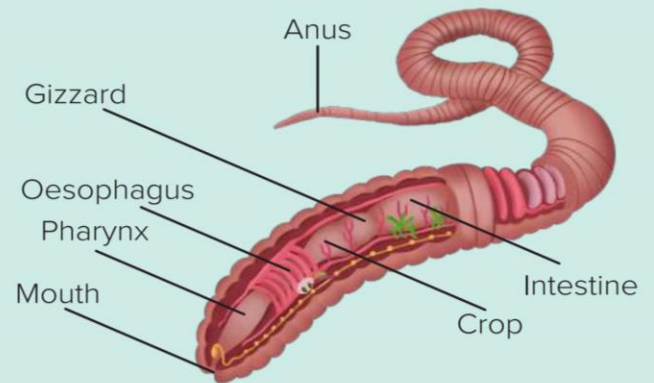


### Level of body organisation

Exhibit organ-system level of organisation. The following organ systems are seen in annelids:

### Complete digestive system

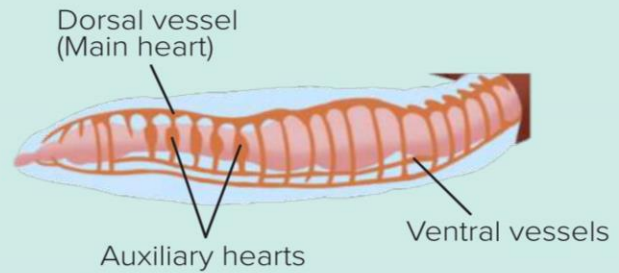
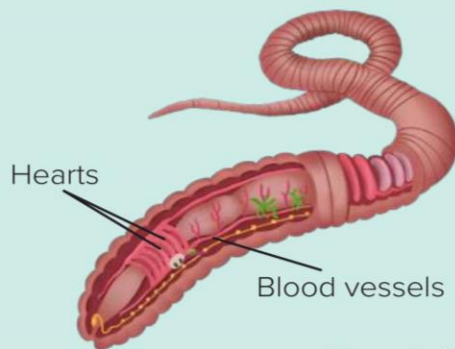
- Have an **alimentary canal** that starts from mouth and ends at the anus



**Complete digestive system in an earthworm**

### Closed circulatory system

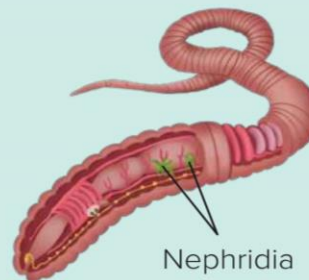
- Blood is circulated through a series of **vessels**
- Have **aortic arches** that function as the **heart** and pump blood through the blood vessels



**Closed circulatory system in earthworms**

### Excretory system

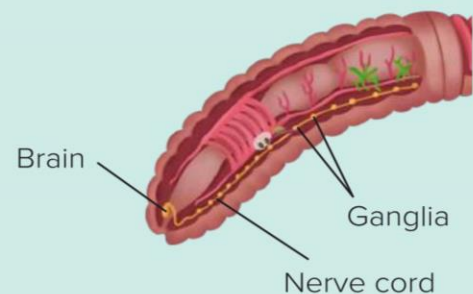
- Have **nephridia**
- Special excretory organs that help in **osmoregulation** (maintenance of the osmotic balance of the solutes and fluids in the body)



**Excretory system in earthworm**

### Nervous system

- Brain is formed by a **pair of ganglia**
- **Double nerve cord** is present on the ventral side

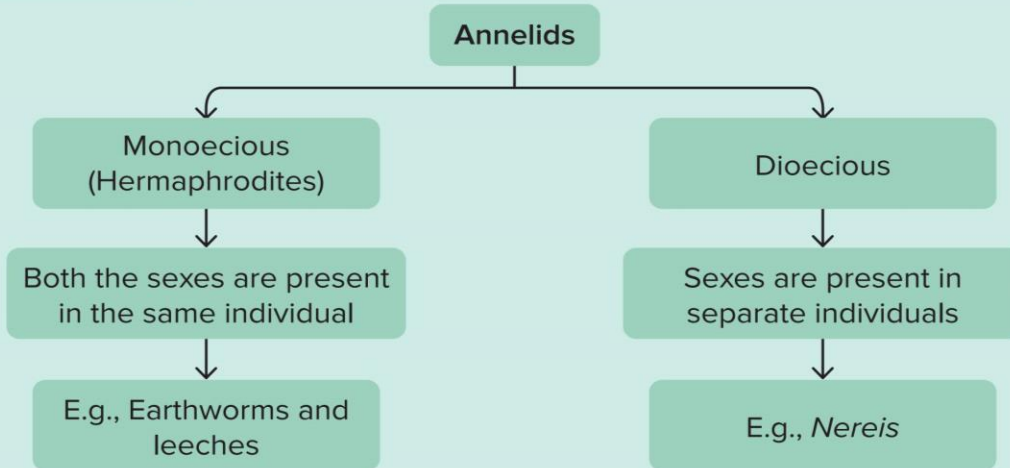


**Nervous system in earthworm**



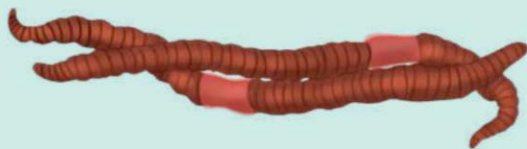


## Reproductive system



## Sexual Reproduction

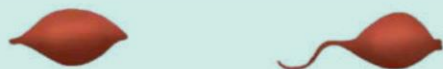
- Involves the fusion of gametes, which are reproductive cells
  - **Sperm** - Male gamete
  - **Ovum** or **egg** - Female gamete
- Types of fertilisation
  - **Self-fertilisation** - Fusion of gametes belonging to the same organism
  - **Cross-fertilisation** - Fusion of gametes belonging to different organisms
  - Even though earthworms are hermaphrodites, they **rarely self-fertilise**.
- **Process of sexual reproduction in earthworms:**



**Mating of earthworms**



**The egg case slipping off**



**Hatching of new worms**

Two earthworms **mate** by joining together

↓  
**Secretions** from the **accessory glands** help the worms join during mating

↓  
- **Sperm** from one earthworm are **deposited in the spermatheca** of the other worm  
- **Spermatheca** is a structure that **stores the sperm** for fertilisation

↓  
- **Clitellum** is the unsegmented region of the earthworm

- A tube of mucus secreted by the clitellum forms an **egg case (cocoon)**

- **Fertilization** of gametes happens inside the cocoon

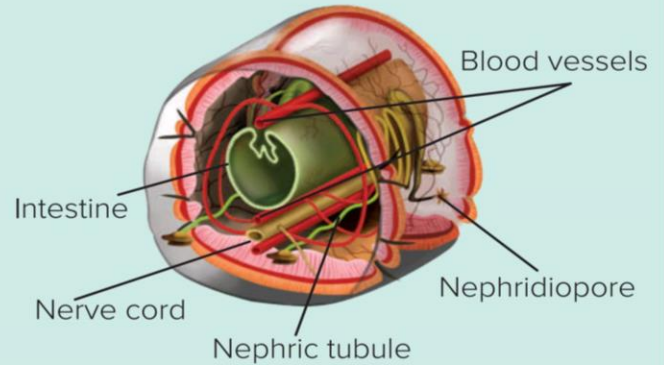
↓  
The egg case slips off from the body of the worm

↓  
**New worms hatch** from the eggs



### Metameric Segmentation

- The body has a **linear series of segments** with fundamentally similar structures.
- Structures like the gut, blood vessels, and nerve extend through the entire length of the body.
- For example, each segment of an earthworm has the alimentary canal, nerve cord, nephridia, and blood vessels.



### Locomotion

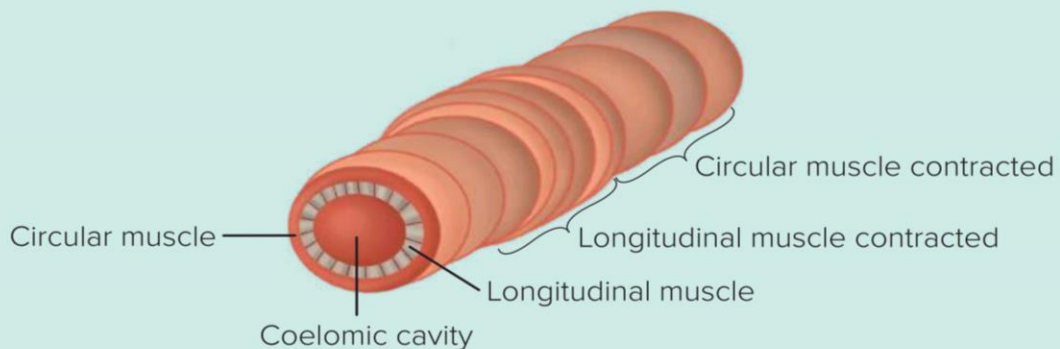
#### Types of Muscles Involved

##### Longitudinal muscles

- Run **lengthwise** along the body
- Help the worm **decrease in length** and **increase in width**

##### Circular muscles

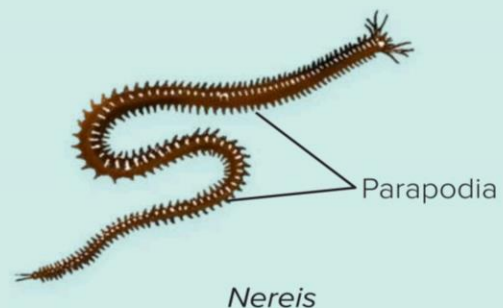
- **Encircle** the body
- Help the worm **increase in length** and **decrease in width**



#### Muscles involved in locomotion in earthworm

### Parapodia

- **Leg appendages** that help in swimming in water
- Present in every segment
- Found in some aquatic annelids like *Nereis*





## Importance of Annelids

**Earthworms** are **decomposers** that live in soil. They have the following functions:

- **Fertilisation** of the soil
- **Aeration** of the soil

## Phylum Arthropoda

### Characteristics of Phylum Arthropoda

#### Habitat

Conquers all types of habitats

#### Terrestrial



Cockroach



Spider



Butterfly



Locust

#### Aquatic



Prawn



Lobster



Crab



### Did you know?

#### Hercules beetle

Also known as Rhinoceros beetle, the Hercules beetle is the longest beetle and has 6 legs, just like the cockroach. It is the strongest creature on Earth for its size. It can carry 850 times its weight!



Hercules beetle

#### Widow spiders

Widow spiders are a group of 32 species of highly venomous spiders. They are found everywhere except the polar regions. If a widow spider bites, the pain that is experienced is localised to the bitten area, and in some cases, severe sweating, elevated blood pressure and pulse, nausea, vomiting, weakness, and other ailments may be experienced.



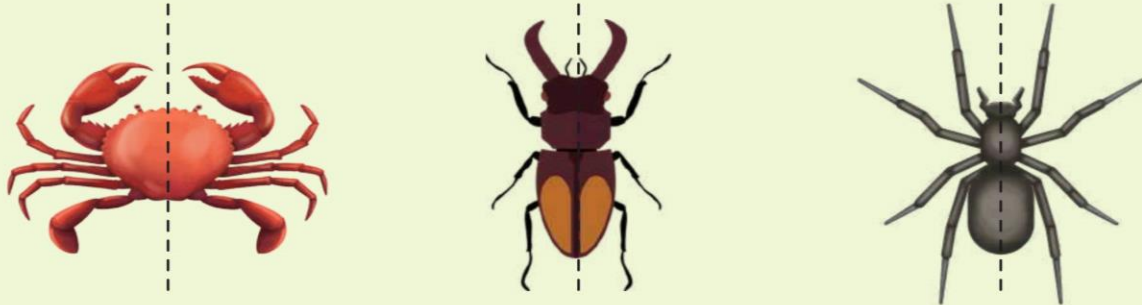
Widow spider





**Symmetry**

- Exhibit **bilateral symmetry**
- Body can be divided into two equal halves along a central axis



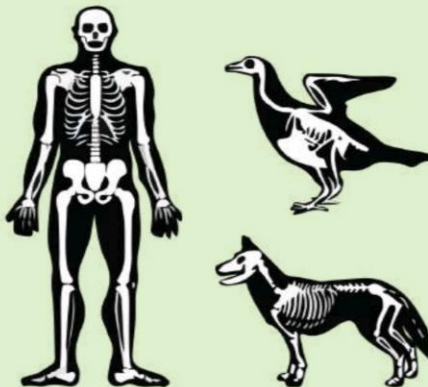
**Bilateral symmetry in arthropods**

**Exoskeleton**

Presence of a **chitinous exoskeleton**

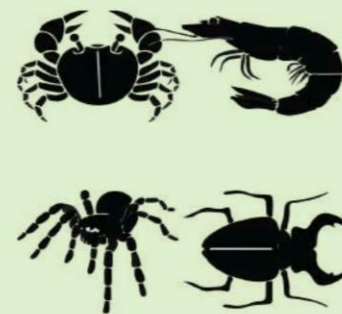
**Endoskeleton**

Seen in humans, mammals, birds, etc.

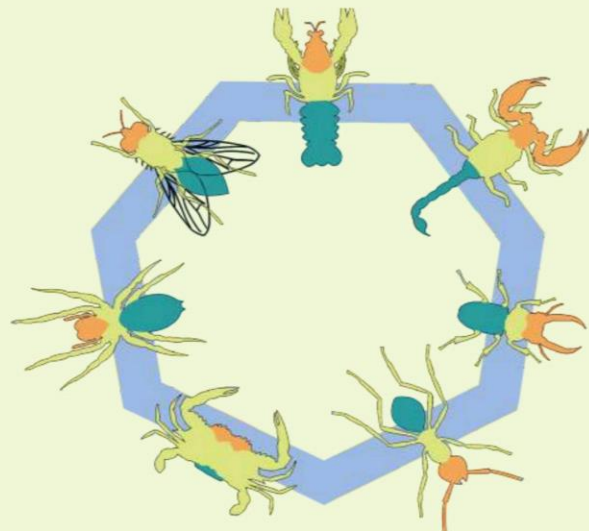
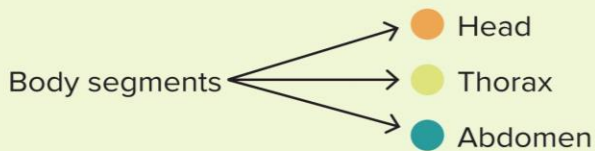


**Exoskeleton**

Seen in arthropods



**Exhibit segmented bodies**



**Body segments in arthropods**



## Examples

For example, in cockroaches, the head thorax and abdomen are further segmented as follows:

- Head : 6 segments
- Abdomen : 10 segments
- Thorax : 3 segments
- Unlike annelids, segments in arthropods are **specialised for particular functions** like feeding, locomotion, reproduction, etc.



## Did you know?

### Deathstalker scorpion

The Deathstalker scorpion has a venom which is a powerful mixture of neurotoxins. The venom has a low lethal dose. While a sting from this scorpion is extremely painful, it normally would not kill a healthy adult human. However, young children, the elderly, or infirm patients (such as those with a heart condition and those who are allergic) are at a greater risk.



### Cyanide millipede

It is known as the chemist of the arthropod world. This millipede produces hydrogen cyanide (HCN) to hunt its prey and to protect itself against any threats.



## Presence of jointed appendages

- In Greek, '**arthos**' means '**joint**', and '**pod**' means '**leg**'. Hence, the name '**arthropoda**' refers to animals that have jointed appendages.
- Such legs allow greater **flexibility** and range for **movement**.



Jointed appendages

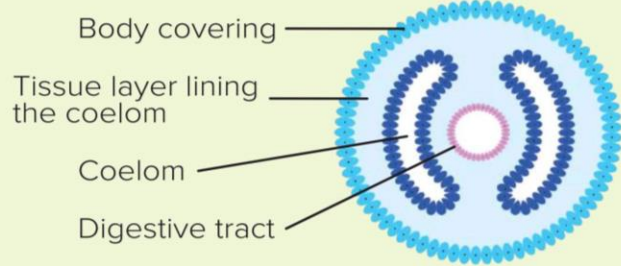
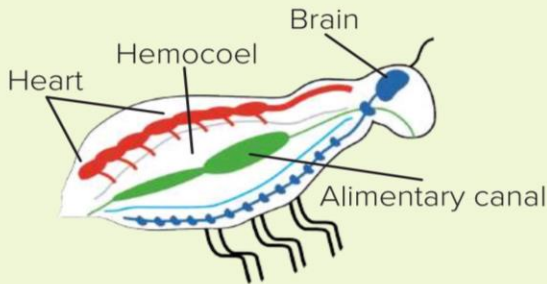
## Germ layer organisation

- Arthropods exhibit **triploblastic** organisation with three germ layers
  - Ectoderm
  - Mesoderm
  - Endoderm



### Coelom

- They are **coelomates**.
- Have a **fluid-filled cavity** that is **lined by the mesoderm**
- The cavity is present between the body wall and the gastrointestinal cavity.



**Presence of the coelom in arthropods**

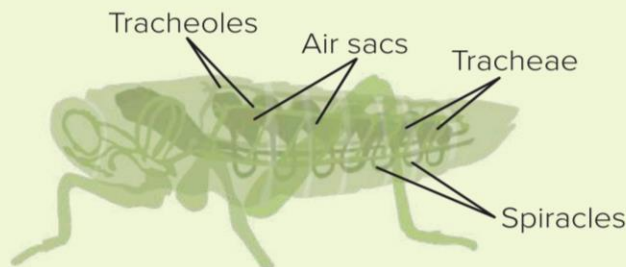
### Level of organisation

Arthropods exhibit an **organ-system level** of organisation

### Respiratory system

#### Tracheal system

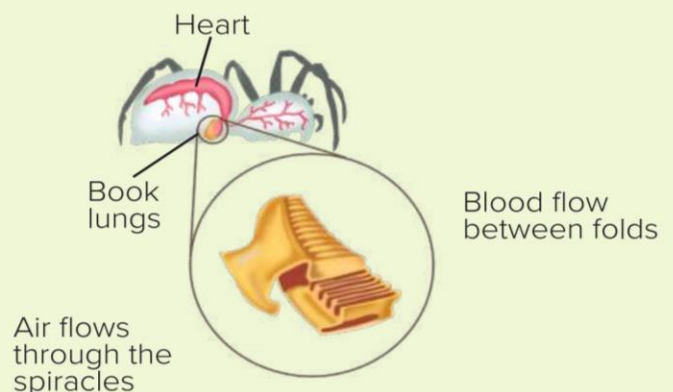
Comprises a system of tracheal tubes connected to air sacs that help in the exchange of gases



**Tracheal system**

#### Book lungs

- Perform the function of lungs
- Seen in some arthropods like spiders and scorpions
- The book lungs have **many folds** and resemble a book
- **Air flows** on one side and the other side comprises the **blood**
- The exchange of gases between the lungs and the blood happens in-between the folds.



**Book lungs**





### Book gills

- **Flap-like structures** that are seen in aquatic arthropods like the Horseshoe crab
- Unlike book lungs and tracheal systems, they are **external** and are usually **modified appendages**.
- They do not look like books, but are called so because book lungs were discovered first and book lungs are believed to have evolved from the book gills.



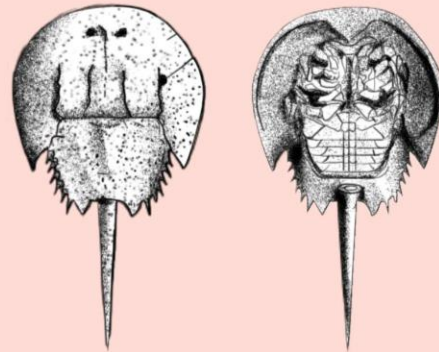
Book gills



### Did you know?

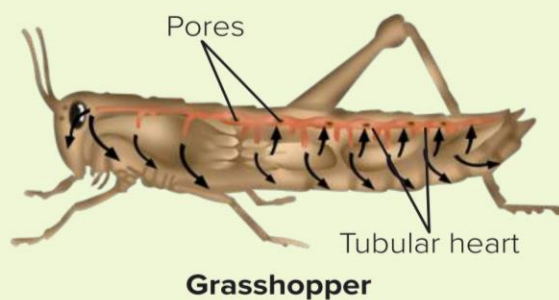
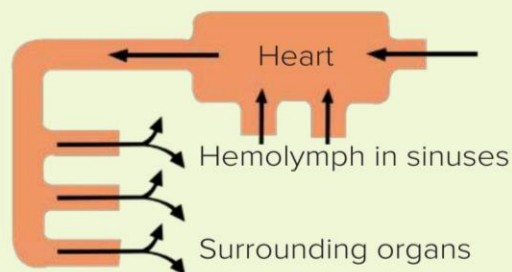
#### Living Fossil - Horseshoe crab

An organism that resembles another organism that is found in fossil records is known as a living fossil. The horseshoe crab is known to be a living fossil. It has remained on earth for millions of years.



### Open circulatory system

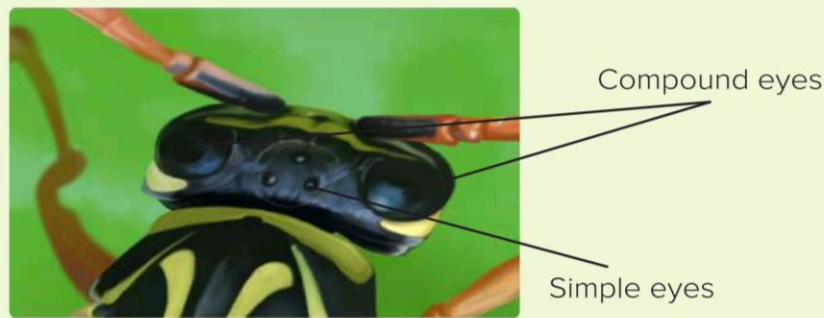
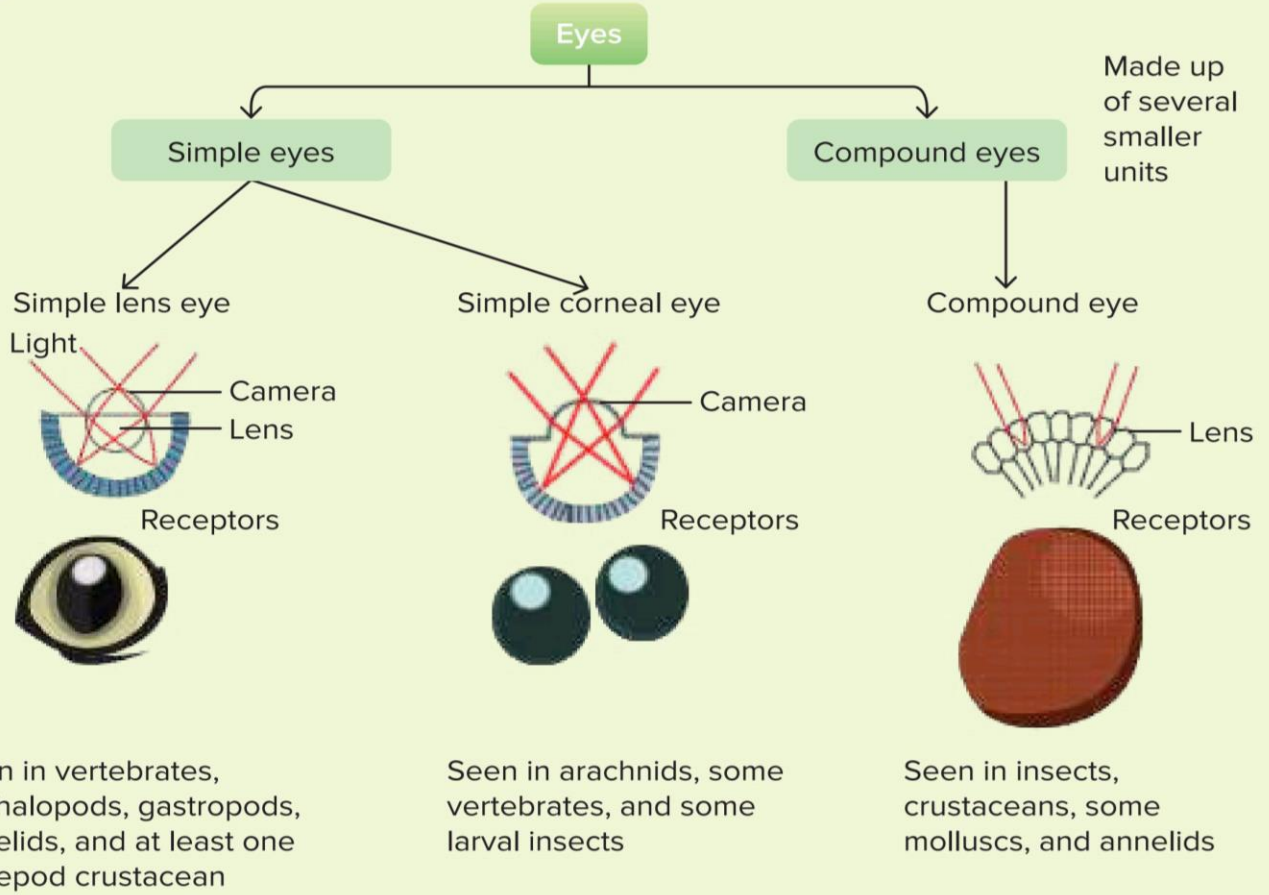
The fluid that flows through the sinuses is known as the **hemolymph**.





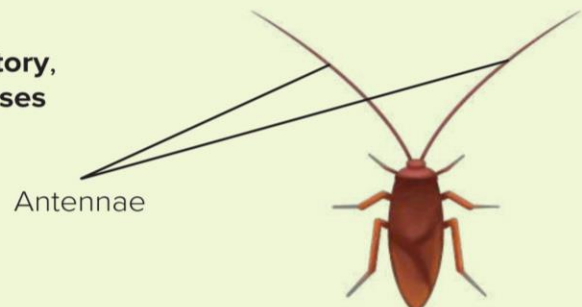
**Sensory system**

**Eyes**



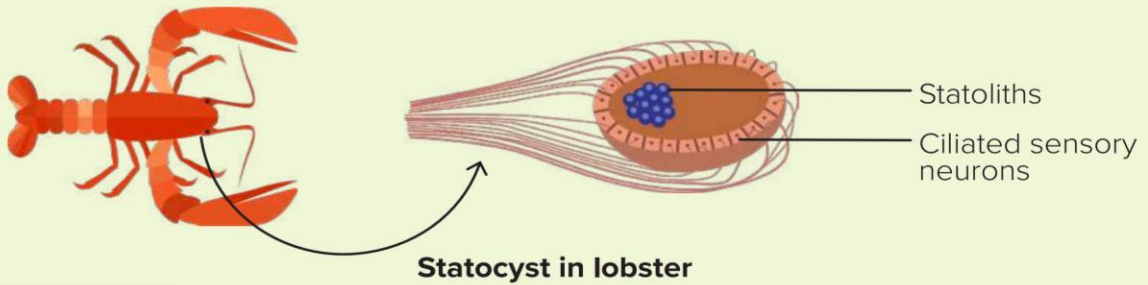
**Antennae**

- Sensory appendages that generate the **olfactory, gustatory, tactile, thermal, and humidity senses**



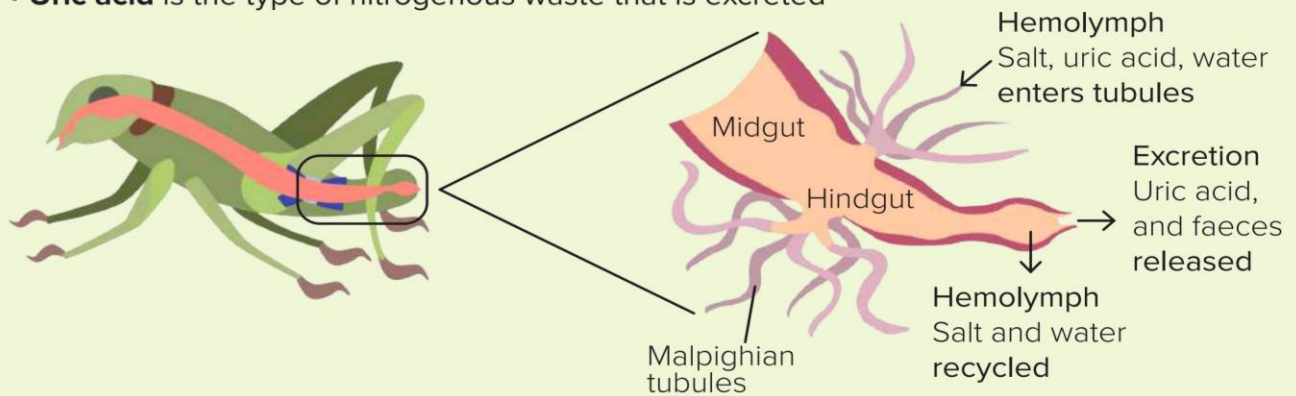


**Statocyst** is a **balancing organ** seen in some aquatic arthropods such as lobsters.



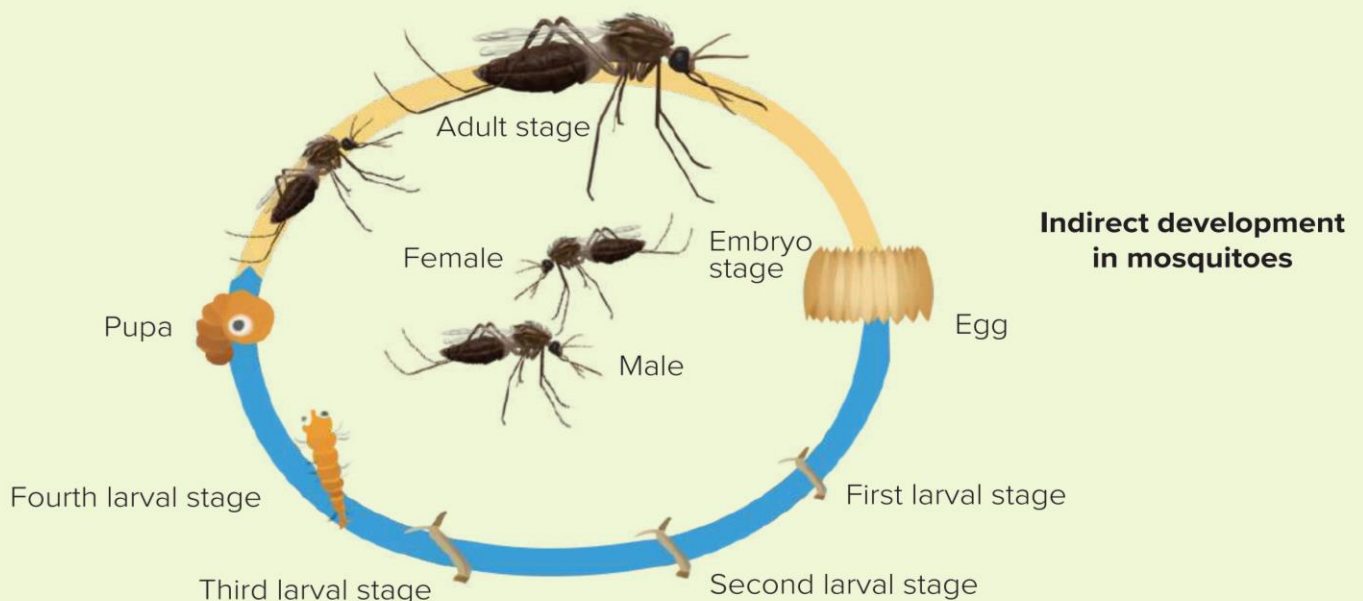
### Excretory system

- **Malpighian tubules** are the excretory organs
- **Uric acid** is the type of nitrogenous waste that is excreted



### Reproductive system

- Mostly **dioecious** (sexes are present in different individuals)
- **Fertilisation**
  - **Internal** - Fusion of gametes occurs within the body
- Mostly **oviparous** - Egg laying organisms
- **Development**
  - **Indirect** - An intermediate larval or nymphal stage is involved
  - **Direct** - No intermediate larval stage







### Did you know?

#### Giant coconut crab

With a weight of up to 4.1 kg (9.0 lb), it can grow up to 1 m (3 ft 3 in) in length from head to tip of the leg.



### Arthropods - Friends or Foes?

#### Dangerous arthropods

- Some are **venomous**.



Deathstalker scorpion



Widow spider

- Some are **vectors** for diseases.



*Anopheles, Culex and Aedes* Mosquitoes



Ticks

- Some are **pests**.



*Locusta* (Locust) a crop pest



## Benefits of arthropods

- **Silk** is obtained from **silkworms**.



*Bombyx mori* (Silk worm)

- **Beeswax** and **honey** are obtained from **honey bees**.



**Beeswax**



**Honey**



*Honey bees*

- Preparation of **nail polishes**

- Some nail polishes are made from **shellac**. Lac is **natural dye** that is obtained from the ***Laccifer lacca*** insect that produces this resin.
- This is purified and used in gel nail polishes to give red colour.



**Nail polish**




*Laccifer lacca* (Lac insect)



Summary Sheet


Phylum Annelida	
General characteristics	
Habitat	Terrestrial or aquatic
Lifestyle	Free-living or parasitic
Level of organisation	Organ-system level
Germ layer organisation	Triploblastic coelomates
Symmetry	Bilateral
Sexes	Monoecious or dioecious
Unique characteristics	
Metameric segmentation	
Nephridia - Special excretory organs that help in osmoregulation	



**Earthworm**

First animals to have a coelom

Phylum Arthropoda	
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Symmetry	Bilateral
Sexes	Monoecious or dioecious
Unique characteristics	
Segmented body	
Jointed appendages	



**Spider**