Diversity in Living Organisms

Introduction to Diversity in Living Organisms

- We all know that there are abundant of living organisms present on the earth. Many organisms are not identical to each other.
- This variety of living beings present on the earth is called as a **Biodiversity**.
- Biologist have identified and classified more than 1.7 million species of organisms on this earth. Most of these species are found in the tropical regions of the world.
- There is a separate branch of Biology called **Taxonomy** which identifies, names and classifies different organisms present on the earth.
- **Carolus Linnaeus** is known as the **Father of the Modern Taxonomy**.

Classification of Living Things

- **Classification presented by Aristotle** – He classified animals on the basis of their habitats – land, water and air.
- But it can be easily observed that the animals that live at a particular habitat say land are still so different from each other.
- Therefore it was decided to classify the living organisms on the basis of a hierarchy.
- This hierarchical classification was based on the similarities and dissimilarities in the characteristics of the living organisms.
- Organisms having similar characteristics were placed in a similar category.
- **Why do we need to classify organisms?**

  1. If we classify organisms into several categories it will be easier for us to study them.
  2. It will help us in understanding how did these organisms evolve.
  3. We can also understand how different organisms are related to each other.
  4. We can learn why different organisms are found at distinct geographical conditions.

- **What is evolution?**

  Over a course of time the living organisms accumulate changes. These changes could be in their body type or size or their features. These changes allow them to survive better with the change in environment. This is called **Evolution**. This concept was introduced by Charles Darwin.

Primitive and Advanced Organisms

- **Primitive Organisms** are the ones that have an ancient or body design. Their bodies haven't undergone many changes with time. They are called '**Lower**' organisms as well.
- **The Advanced Organisms** are those who have recently acquired body changes. They are also called as '**Higher**' organisms.

Hierarchy Classification - Formation of Kingdoms

Biologists categorized different organisms into several kingdoms.

Classification	Proposed by	Type of organisms

Two kingdom classification	Carolus Linnaeus in 1758	1. Plants
		2. Animals
Five Kingdom classification	Robert Whittaker in 1959	1. Monera
		2. Protista
		3. Fungi
		4. Plantae
		5. Animalia
	Carl Woese in 1977	1. Monera
		(i) Archaea
		(ii) Eubacteria
		2. Protista
		3. Fungi
		4. Plantae
		5. Animalia

The order of Classification

1. Kingdom
2. Phylum / Division
3. Class
4. Order
5. Family
6. Genus
7. Species

Species is called as the **Basic Unit of Classification**. Species is a group of organism which can interbreed with each other. The picture below explains how humans are classified in a hierarchical order.

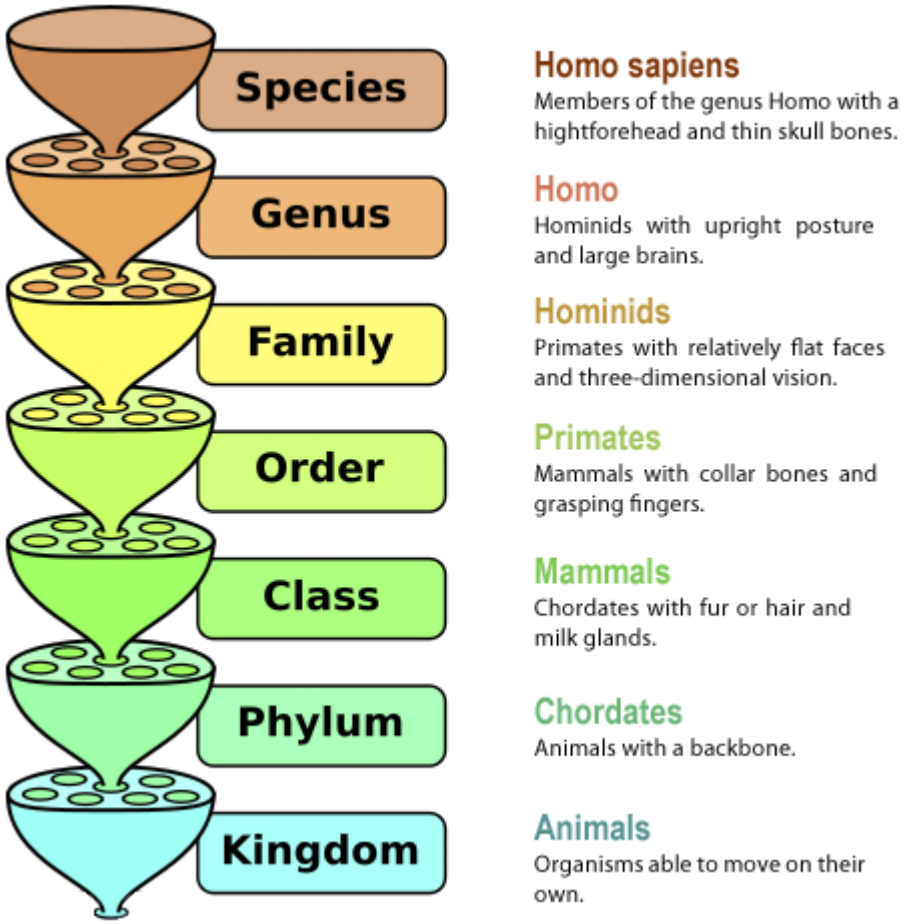


Figure 1 - Hierarchical Order of Classifying Humans

Five Kingdom Classifications

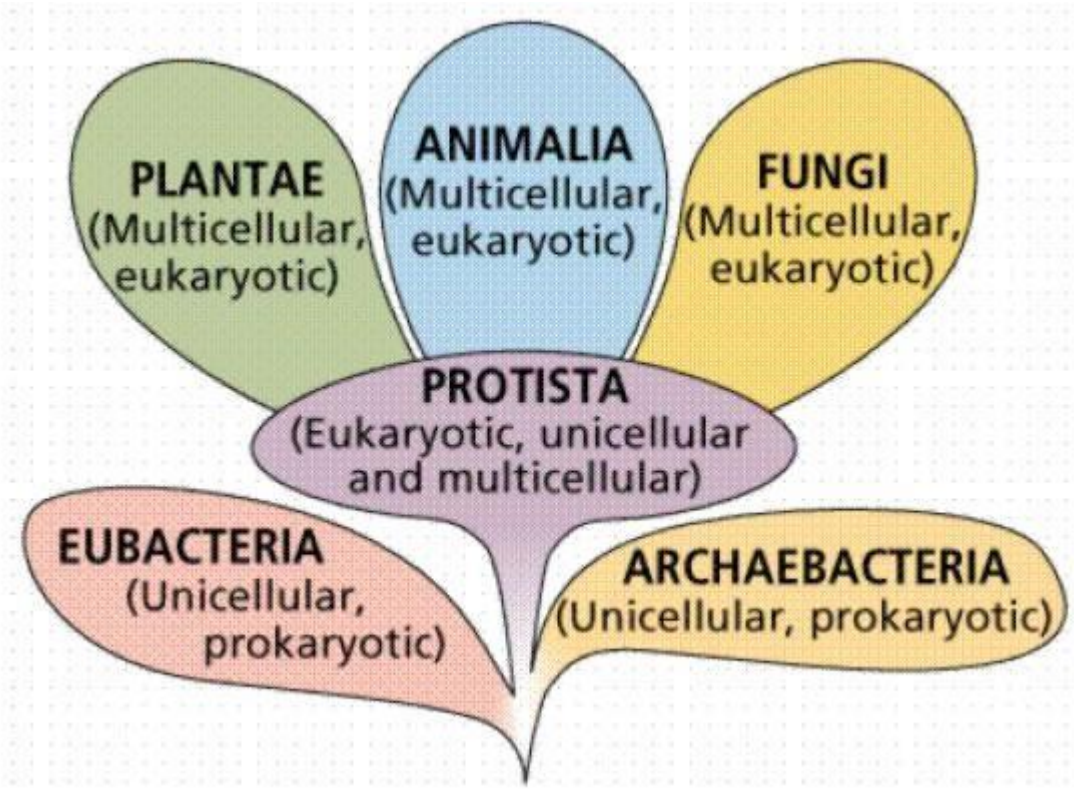


Figure 2 - Five Kingdom Classification

How scientists came up with the idea of kingdoms?

The scientists divided organisms into seven kingdoms on the basis of following criterion -

- **The organization inside the cells**
  - **Prokaryotic Cells** – Cells with no definite nucleus
  - **Eukaryotic Cells** – Cells with a definite nucleus
- **The organization of cells in the body**
  - **Unicellular** – Single-celled organisms
  - **Multicellular** – Multi-cell organisms
- **How organisms obtain their food**
  - **Autotrophs** – Produce their food on their own
  - **Heterotrophs** – Depend on other organisms for their food

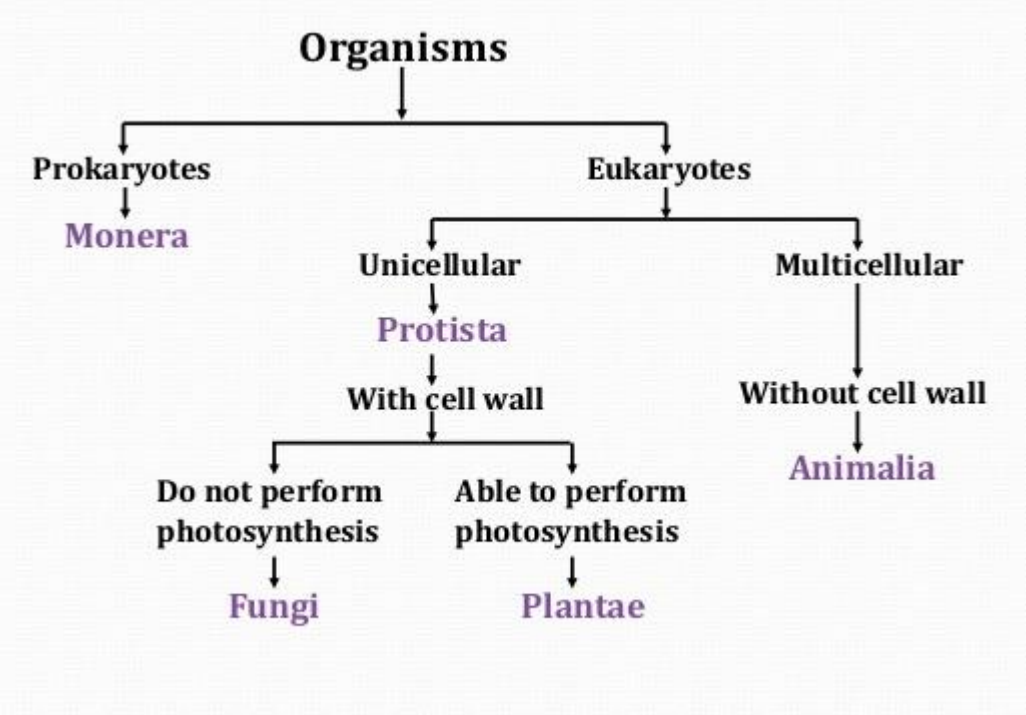


Figure 3 - Classification of Organisms

	Monera	Protista	Fungi	Plantae	Animalia
rganization nside the cells	Consists of Prokaryotes.	Eukaryotes – some of them use appendages to move around such as flagella (whip-like structure) and Cilia (hair-like structure)	Eukaryotes	Eukaryotes	Eukaryotes
rganization f cells in the ody	Unicellular	Unicellular	Initially unicellular. Can become multicellular in later stages of life	Multicellular	Multicellula
rganisms btain their ood	Some of them are autotrophs like blue green algae while others are heterotrophs	Both autotrophs and heterotrophs	Heterotrophs. Most of them are decomposers or may be parasitic.	Autotrophs	Heterotroph

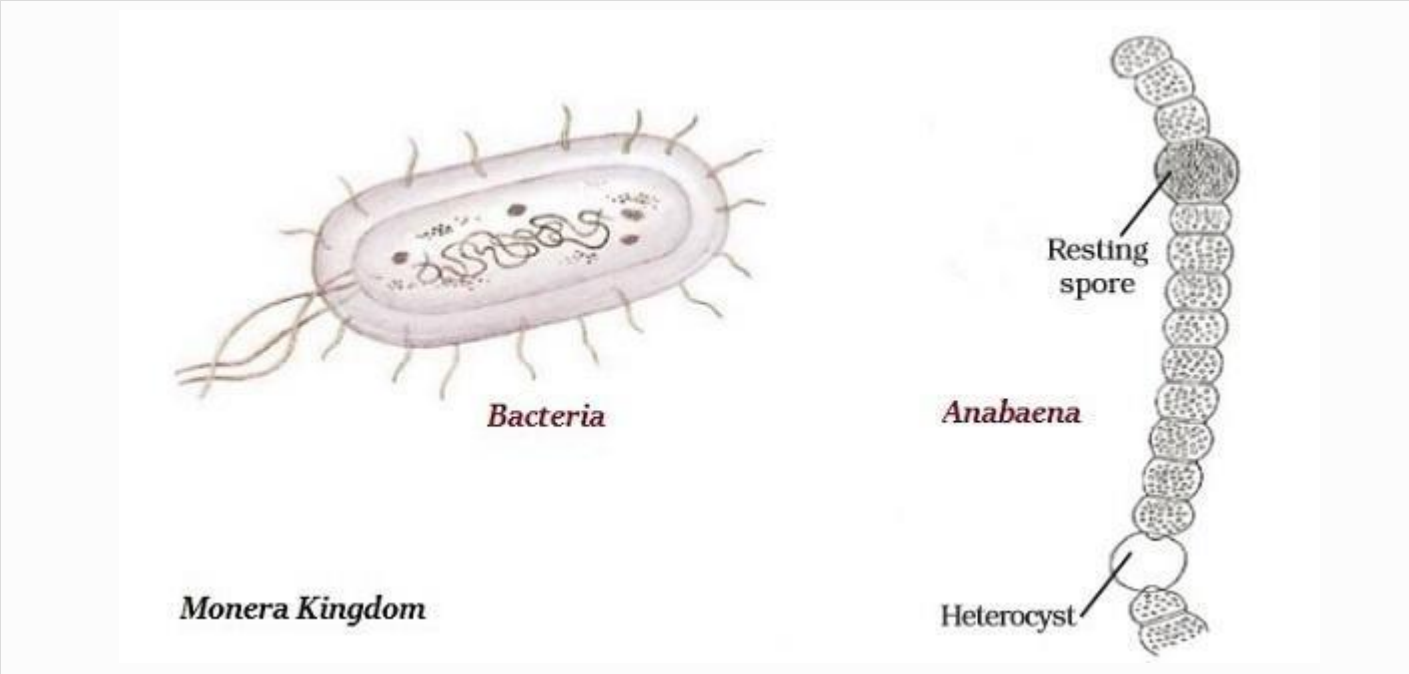
resence of ell wall	Some lack a cell wall while others have a cell wall	Only some have cell wall	Have cell walls. They are made up of complex sugar called chitin.	Have cell walls made of cellulose.	No cell wal
xample	Blue-green algae, Bacteria, Mycoplasma	Protozoan, Diatoms and Golden algae	Yeast and Mushroom (Agaricus), Rhizopus (Bread mould), Pencillium	Flowering plants, moss	Insects, reptiles

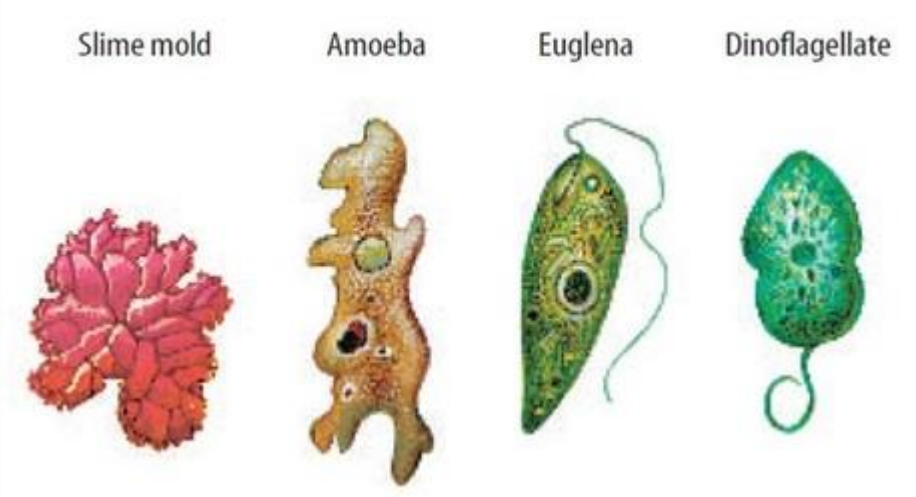
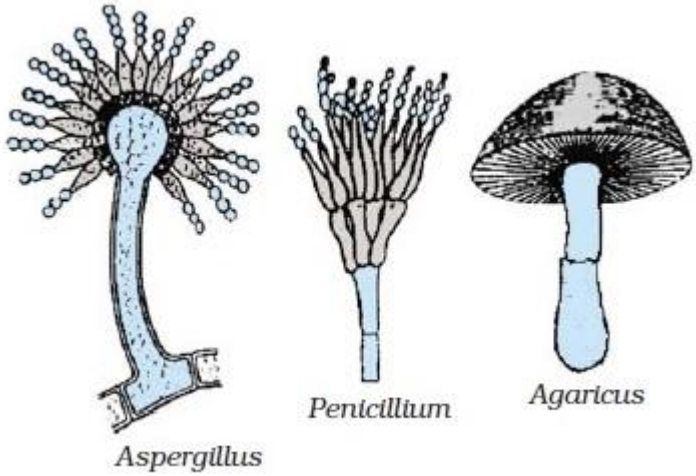
Archaea Kingdom

The monera kingdom is further classified as **Archaea.** These are microbes (bacteria) that can live in harsh conditions. Since they can live in extreme temperatures they are also called **Extremophiles**. These organisms lack a cell wall. Their cell membrane is made up of lipids.

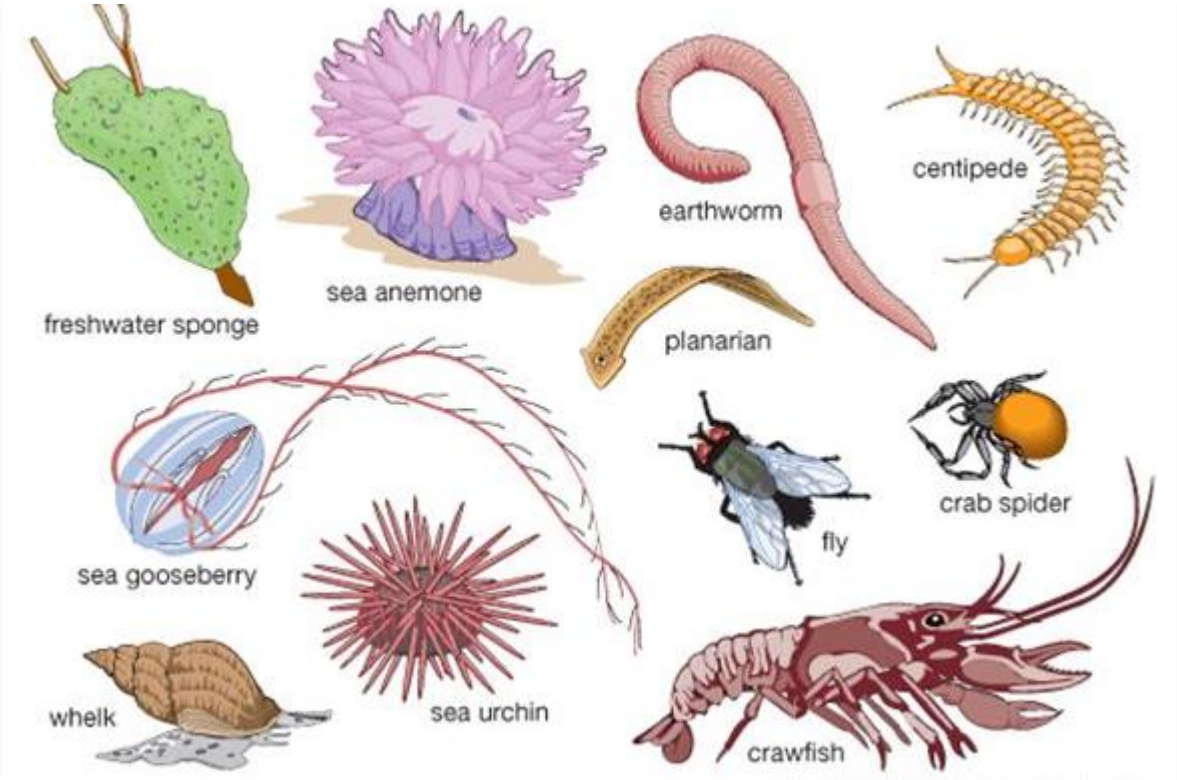
They are further classified into three categories, based on their habitat:(Olympiad)

Halophiles	Thermophiles	Methanogens
hese are salt loving bacteria. They ve in extremely salty water.	They live in boiling water such as hot springs and volcanoes.	They are found in the guts of animals like cow and sheep. They produce methane gas from their dung.

Moner	

Protista	
Fungi	
Plantae	

Animalia



Who are Saprophytes?

Fungi also called as **Saprophytes** because they grow over the organic material and survive on them.

What are Symbiotic relationships?

Some species of fungi live in permanent mutually dependent relations with blue-green algae. They are said to have a symbiotic relationship. **For Example**, Lichens are often found on the bark of the trees.

Kingdom Plantae

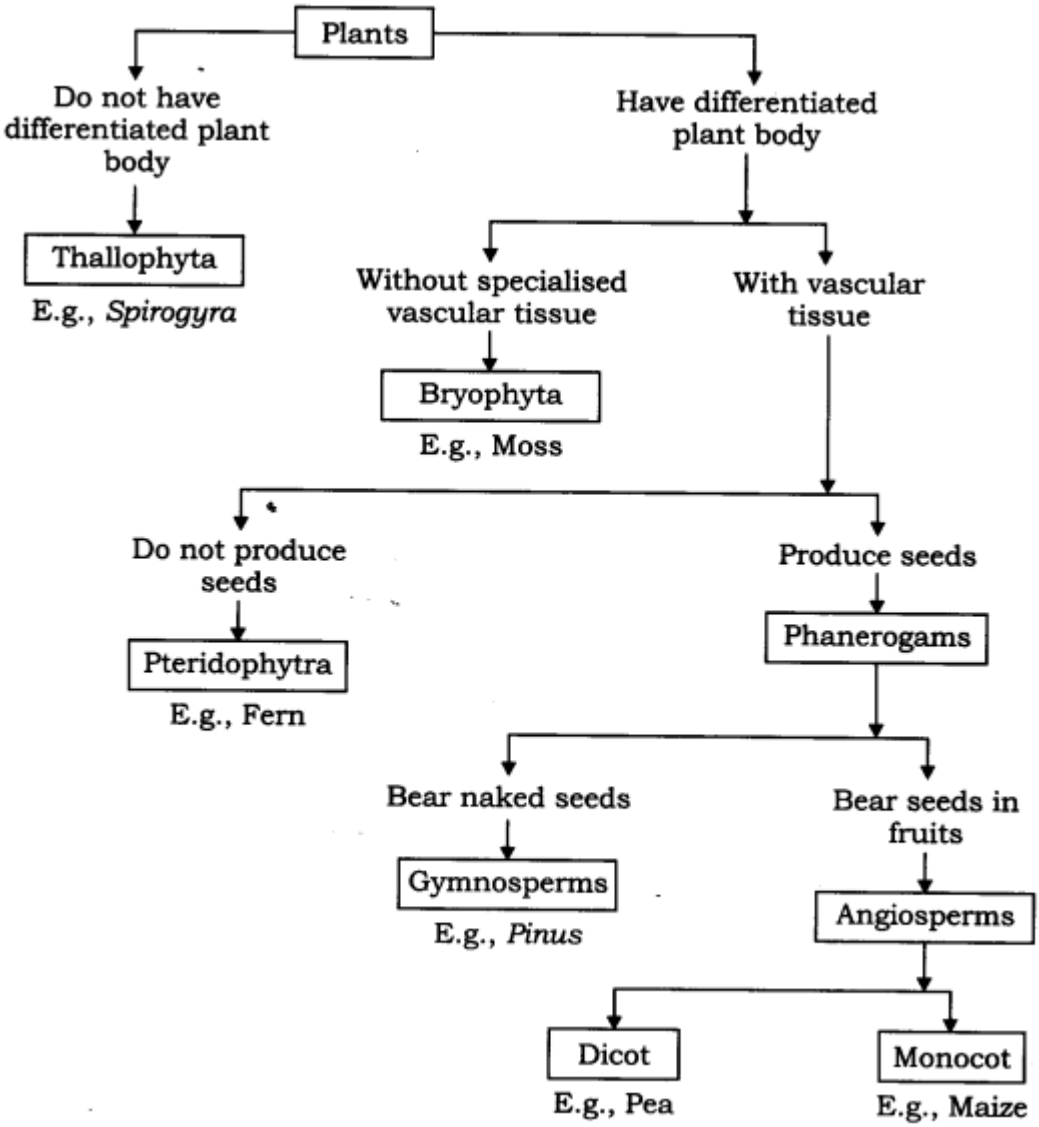


Figure 9 - Plant Kingdom

The criteria of classification in Planate:

- **Components of Plants** – whether they are distinct or not
- **Presence of Special Tissues** in plants for the transportation of food and water
- **Presence of Seeds** – whether the seeds are present inside the fruits or not

Classification of plants on the ability to produce seeds -

- **Cryptogams –** These plants do not have well developed reproductive organs. The organs cannot be seen clearly as well and appear as if they are hidden. **Example** are Thallophyta, Bryophyta and Pteridophyta.
- **Phanerogams** – These plants have well developed reproductive organs hence they can produce seeds. They are further classified as the ones which have seeds hidden inside fruits or not - **Gymnosperms** and **Angiosperms**

Criteria	Thallophyta	Bryophyta	Pteridophyta
omponents of plants	No distinct components. Undifferentiated Body	Little differentiated body. Distinct components are present as leaves and stem	Distinct components are present as roots, leaves and stem

resence of special ssues- Vascular tissue	No	No	Yes
resence of seeds	No	No	No
ound in	Aquatic environment, snow	First terrestrial plants but but need water for sexual reproduction. So called as Amphibian of plant kingdom.	Terrestrial or dry areas
xample	Spirogyra, Ulothrix, Volvox	Moss and liverworts	Ferns

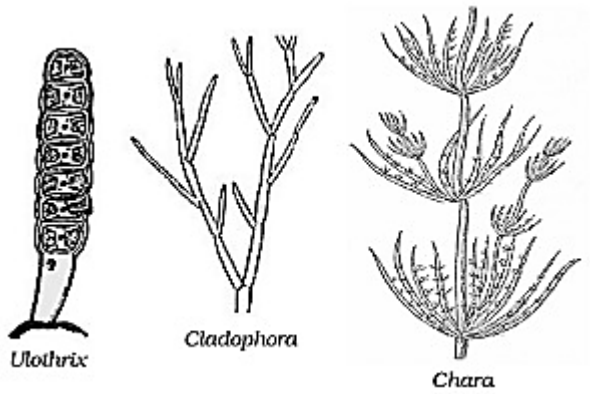


Figure 10 - Examples of Thallophyta

Figure 11 - Examples of Bryophyta

Figure 12 - Examples of Pteridophyta

	Gymnosperms	Angiosperms
he ability to produce seeds	Naked seeds	Seeds develop in an organ which then turns into the fru

xistence	Exist for long time periods, Evergreen	Grow for varied time periods
ype	Woody, No flowers	Flowering plants
leaning	Gymno – naked	Angio – Covered
	Sperm – seeds	Sperma – seeds
xample	Pines, Deodar	Mustard, Maize

What are Cotyledons?

The seed leaves in Angiosperms are called **Cotyledons**. They turn green on the germination of the seeds. Angiosperms can be divided into two types on the basis of the presence of cotyledons in them-

- Monocotyledons or monocots
- Dicotyledons or Dicots

Criteria	Monocotyledons or Monocots	Dicotyledons or Dicots
Cotyledons (Seed Leaves)	Single Cotyledon	Two Cotyledons
Leaves	Long leaves, with parallel veins	Broad leaves with network of veins
Roots	Fibrous	Long taproot
Floral Parts	Multiples of three	Multiples of four or five
Example	Corn, Wheat, Grass	Rose, Sunflower, Lily

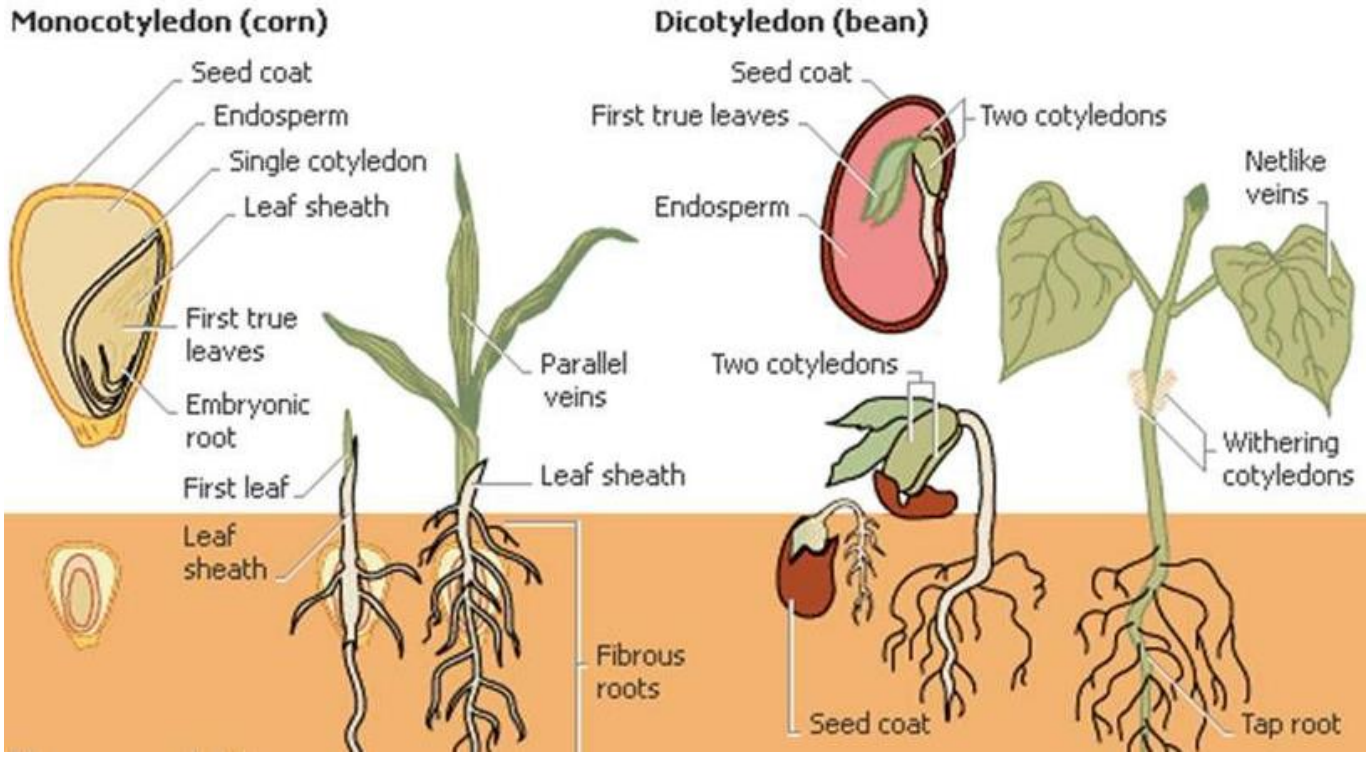


Figure 13 - Monocots vs Dicots

Kingdom: Animalia

Basic Characteristics of the Animalia Kingdom

1. Animals are eukaryotic, multicellular organisms that lack a cell wall.

2. They are heterotrophs therefore they rely on others for food.

3. They have a growth pattern. The adult animals have a specific shape and size.

4. Most of the organisms have well-defined organ systems such as **Respiratory System**, **Digestion System** and so on.

5. Most of the animals can move. They aren't stationary as **Plants**.

6. Animals have a nervous system which is why they are able to respond to an external stimulus.

Animals are classified on the basis of differences in their body type and design. The body cavity or coelom in animals contains the organs. Based on the presence of body cavity animals can be categorized as:

1. Coelomate – They have true body cavity called **Coelom**
2. Pseudocoelomate – It means false cavity. They have a body cavity which is filled with fluid
3. Acoelomate – They have no body cavity at all.

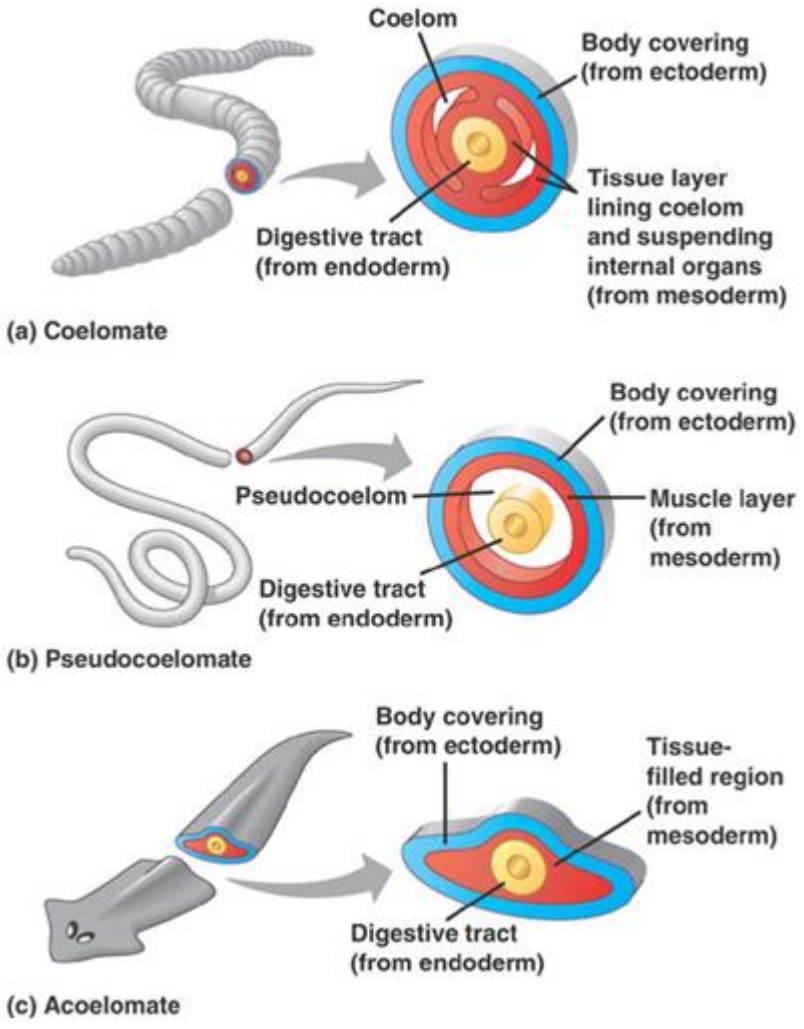


Figure 14

1. Phylum- Porifera

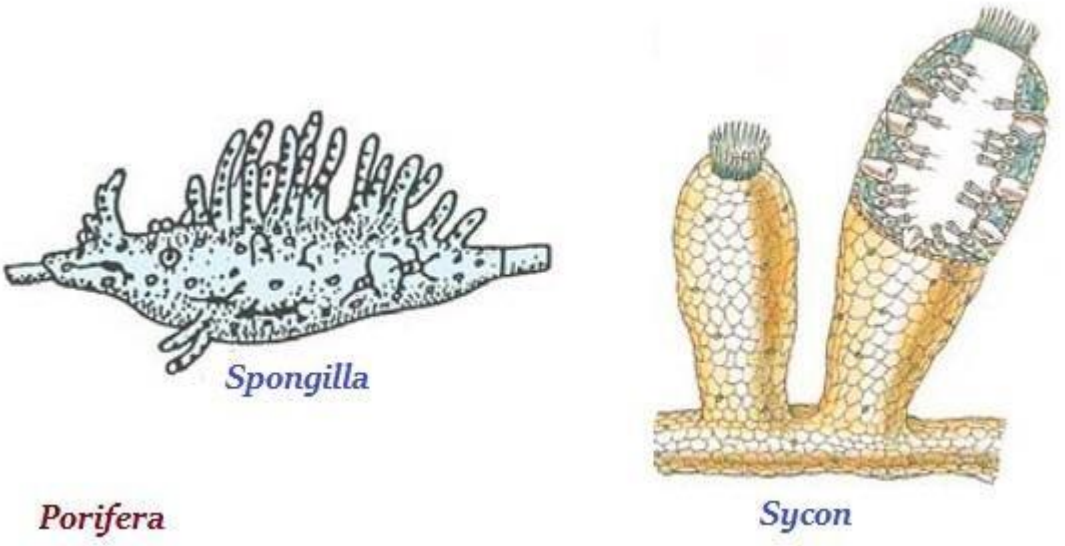


Figure 15 - Phylum- Porifera

- Level of Organization – Cells are present
- Symmetry – Asymmetrical
- Segmentation – No segments
- Body Cavity/ Coelom – No
- Presence of Organs – No
- Examples – Sycon, Spongilla, Euspongia
- Other Characteristics-
  - They cannot move and are attached to a support.
  - They have pores in their body
  - These pores form a Canal system through which water and food circulate in the body and waste is removed.
  - They have a skeleton made of spongin protein and calcium carbonate – hard covering on them

2. Phylum- Coelenterata

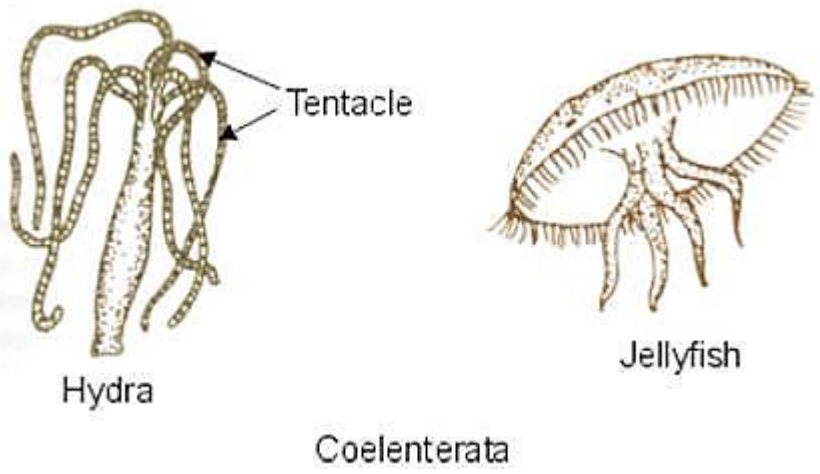


Figure 16 - Phylum- Coelenterata

- Level of Organization – Tissues, Cells have two layers – so called as **Diploblastic Organism**

- Symmetry – Radial
- Segmentation – No segments
- Body Cavity/ Coelom – No
- Presence of Organs – No
- Examples – Aurelia (Jelly fish) and Adamsia (Sea Anemone)
- Other Characteristics –
    - Some of them live in colonies - They are physically attached to each other such as **Corals**
    - Some of them live solitary such as **Hydra**

3. Phylum Platyhelminthes

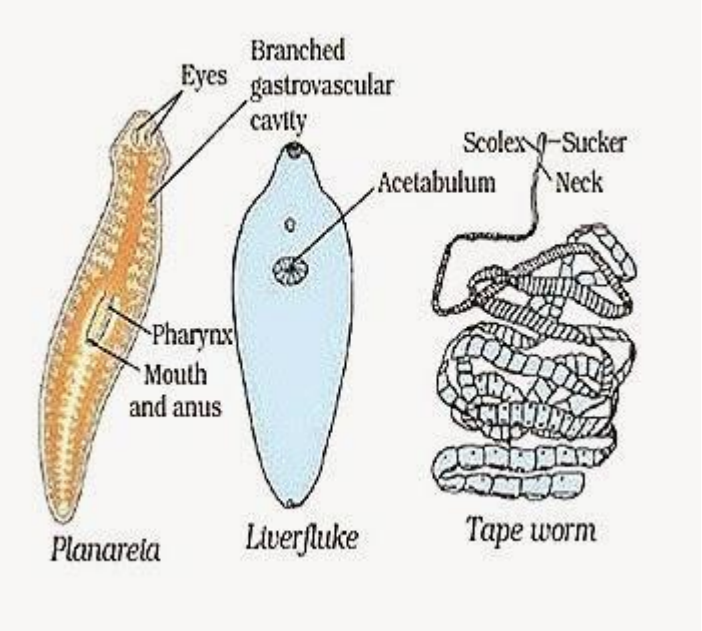


Figure 17 - Phylum Platyhelminthes

- Level of Organization – Organs, The cells have three layers – so are called **Triploblastic**
- Symmetry – Bilaterally Symmetrical - Left half of the body is identical to the right half
- Segmentation – No segments
- Body Cavity/ Coelom – No so called as **Acoelomates**
- Presence of Organs – Yes
- Examples – Taenia solium (Tapeworm), Fasciola hepatica (Liver Fluke)
- Other Characteristics -
    - They have a flat body and thus are called **Flatworms**
    - They can be Free-living like Planaria or parasitic.

4. Phylum Nematoda

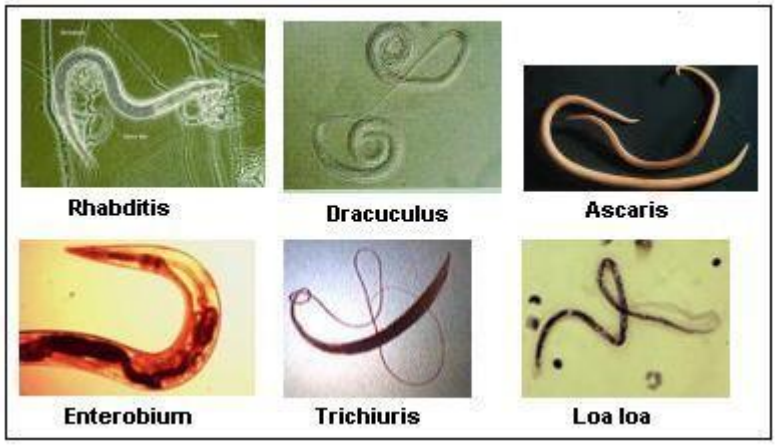


Figure 18 - Phylum Nematoda

- Level of Organization – Tissues so are called **Triploblastic**
- Symmetry – Bilaterally Symmetrical - Left half of the body is identical to the right half
- Segmentation – No segments
- Body Cavity/ Coelom - False body cavity so called as **Pseudocoelomates**
- Presence of Organs – Organ System Level Organisation
- Examples – Parasitic worms and worms in the intestine
- Other Characteristics–
  - They are called as **Round Worms**.
  - Sexual dimorphism visible - Female and male worms are distinct.

5. Phylum Annelida

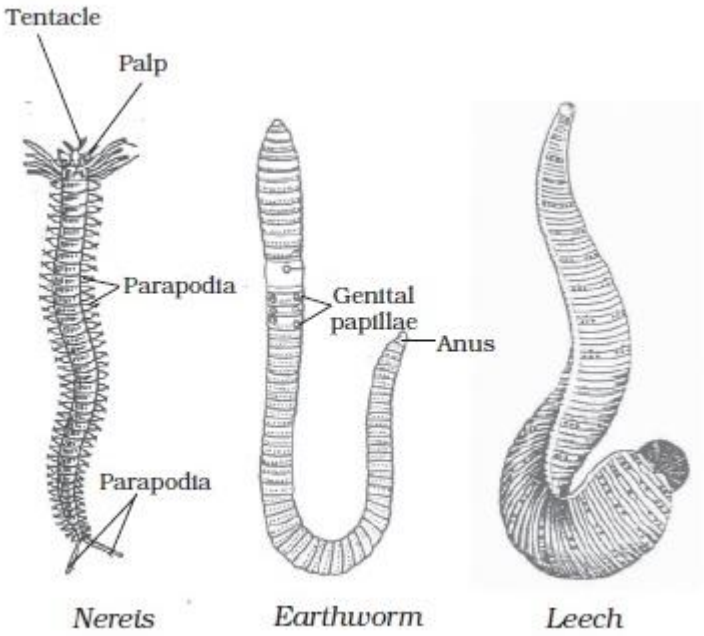


Figure 19 - Phylum Annelida

- Level of Organization – Organ system level, the cells have three layers so called **Triploblastic**
- Symmetry – Bilaterally Symmetrical
- True Segmentation – Present (organs can be identified separately)

- Body Cavity/ Coelom – True body cavity so called as **Coelomates**
- Presence of Organs – Definite organs
- Examples – Leech, Earthworms
- Other Characteristics –
  - They are found in freshwater and marine water.
  - They have closed Circulatory system.

6. Phylum Arthropoda

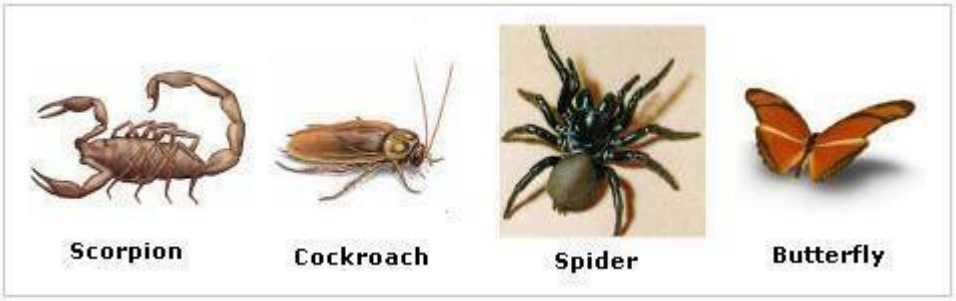


Figure 20 - Phylum Arthropoda

- Level of Organization – Organ systems
- Symmetry – Bilaterally symmetrical
- Segmentation – Present (organs can be identified separately)
- Body Cavity/ Coelom – True body cavity
- Presence of Organs – Definite organs
- Examples – Prawns and butterflies
- Other Characteristics
  - They have jointed legs
  - They have an open circulatory system – There are no well-defined blood vessels
  - They have chitinous exoskeleton

7. Phylum Mollusca

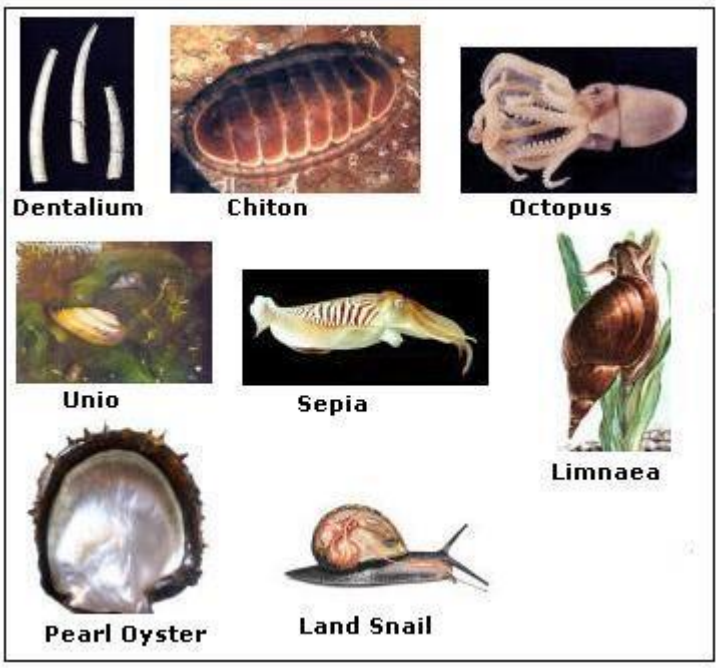


Figure 21 - Phylum Mollusca

- Level of Organization – Organ systems, The cells have three layers– called **Triploblastic**
- Symmetry – Bilaterally symmetrical
- Segmentation – Little segmentation
- Body Cavity/ Coelom – Reduced
- Presence of Organs – Definite organs
- Examples – Snails
- Other Characteristics
    - Body is divided into head, Visceral Mass and Muscular Foot.
    - Some of the molluscs have hard external shell like that of Snails and some have internal reduced shell like that in Octopus.
    - They have an open circulatory system
    - There is a kidney-like organ for excretion

8. Phylum Echinodermata

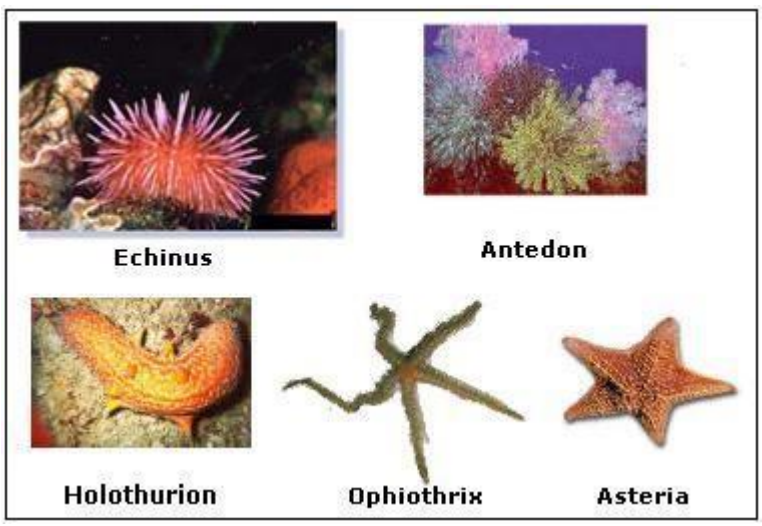


Figure 22 - Phylum Echinodermata

- Level of Organization – Organ systems, the cells have three layers — called **Triploblastic**
- Symmetry – Bilaterally symmetrical in larval stage and Radially symmetrical in Adults.
- Segmentation – No
- Body Cavity/ Coelom – True body cavity
- Presence of Organs – Definite organs
- Examples – Starfish, Sea cucumber
- Other Characteristics-
    - They have Spiny dermis made of calcium carbonate
    - They have a water vascular system which helps in feeding and locomotion.

9. Phylum Chordata

Characteristics of Chordates -

- They have a notochord. It is a rod-shaped structure that provides skeletal support to the body. It is found in the embryonic stage of all chordates and in adult stages for some chordates.
- A nerve cord that connects brain.
- Most aquatic animals have a Pharyngeal slit that allows the exit of water
- They have a post-anal Tail made up of muscles and skeletal elements that helps in balancing.

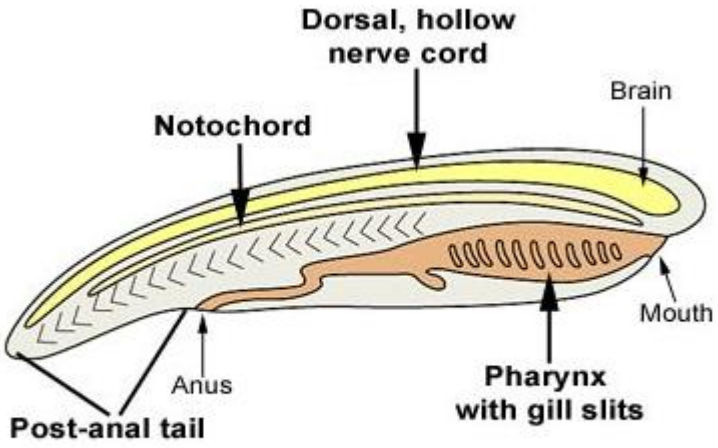


Figure 23 - Characteristics of Chordates

Subphylum Protochordate

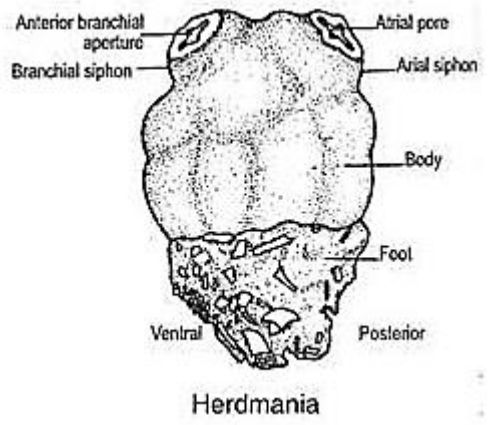


Figure 24 - Subphylum Protochordate

- Level of Organization – Organ systems, the cells have three layers– called **Triploblastic**
- Notochord present in some stage of life.
- Symmetry – Bilaterally symmetrical
- Segmentation – No
- Body Cavity/ Coelom – Present
- Presence of Organs – Definite organs
- Examples – Ascidia, Herdmania

Subphylum Vertebrata

Figure 25 - Subphylum Vertebrata

- Level of Organization – Organ systems, highly developed tissues, the cells have three layers – Upper layer and the inner layer – called **Triploblastic**
- Symmetry – Bilaterally symmetrical

- Segmentation – Yes
- Body Cavity/ Coelom – Present, well-defined
- Presence of Organs – Definite organs
- Examples – Mammals , Birds, Fishes
- Other Characteristics -
    - They have vertebral column developed from notochord.
    - The internal skeleton muscles can attach at various points of the body
    - There is a dorsal hollow nerve cord in the upper side of the back

Cold-blooded Animals and Warm- blooded Animals

Cold-blooded Animals	Warm-blooded Animals
hey cannot maintain a constant body temperature	They can maintain a constant body temperature
hey obtain heat from the environment surrounding them	They obtain heat from the food they eat
heir body temperature can vary as per the surrounding emperature	They maintain a temperature of around 35 – 40 degree Celsius irrespective of the surrounding temperature
hey regulate heat in their bodies by changing colors or by eing in sunlight	They regulate their body heat by metabolic processes and adaptive mechanisms such as hibernation and sweating.
xamples – Fishes, Reptiles, Insects, Amphibians	Examples – Mammals and Birds

	Body Type	Heart Chambers	Cold-blooded / Warm- blooded (Body Temperature)	Respiration	Reproduction	Found at	Examples
isces / ish	They have scales or plates on their body,a muscular tail, some have skeleton made up of cartilage, some have skeleton made up of bones and cartilage	2 chambers	cold blooded	gills	Eggs	Water	Synchiropus splendidus (Mandarin fish), Scoliodon (Dog fish)
mphibia	Have smooth and slimy skin	3 Chambers	cold blooded	Gills in larval stage and lungs in adult stage	Eggs	Land and water.	Toad, Hyla (Tree frog)
eptilia	Have dry scales	3 Chambers except Crocodile which has 4	Cold blooded	lungs	Eggs	Land, Water	Turtles, King Cobra

		heart chambers					
ves / irds	They have waterproof skin which is covered with feathers,They have a beak or bill rather than teeth, Their forelimbs are developed into wings, They have hollow bones or pneumatic bones	4 Chambers	Warm blooded	Lungs	Eggs	Land, air	Crow, Pigeon
lammalia	Have skin with hair and sweat glands	4 Chambers	Warm blooded	Lungs	give birth to young ones except Duck billed Platypus and Echidna	Land, water, air	Humans. Cats

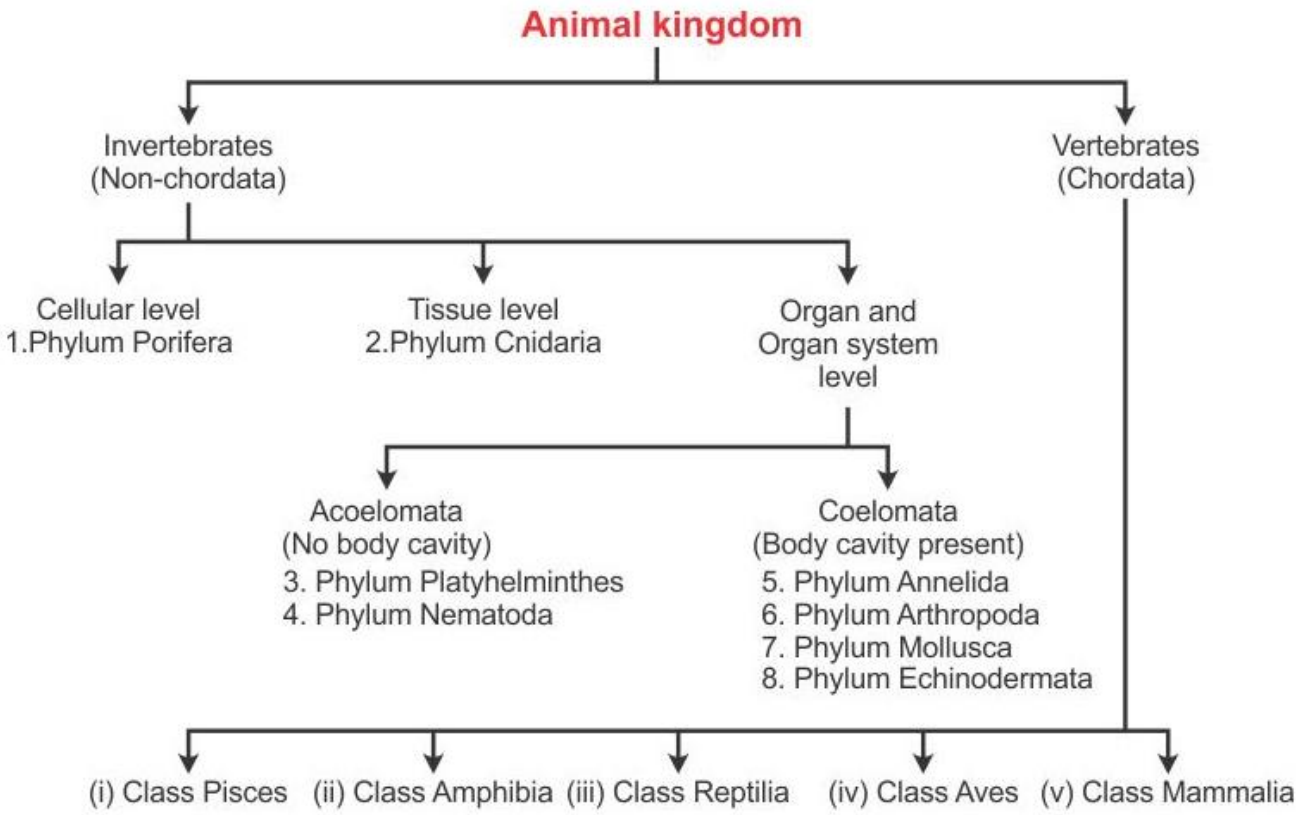


Figure 26 - Classification of Animalia Kingdom

Nomenclature of Living Organisms

Why is nomenclature required?

It will help people identify an organism with a standard name anywhere in the world.

The whole hierarchy of an organism is not mentioned in the name. Only genus and species of the organisms are mentioned. Concept of Binomial nomenclature was given by Carolus Linnaeus.

Conventions for Binomial Nomenclature –

- Genus name starts with a capital letter
- Species name starts with a small letter
- The scientific name of an organism is written in Italics while printing
- The genus name and species name should be underlined separately while writing
- Some examples of scientific name
    - **Leo:** Panthera leo
    - **Tiger:** Panthera Tigris
    - **Human:** Homo sapiens
    - **Mango:** Mangifera indica