



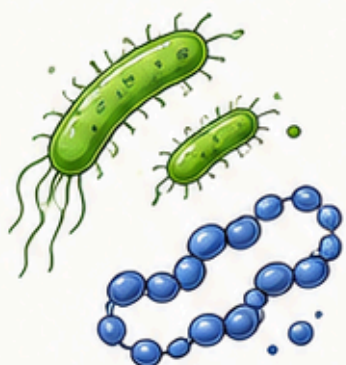
# FIVE KINGDOM CLASSIFICATION



In 1969, **R.H. Whittaker** proposed a natural system of classification in which all living organisms are divided into **five kingdoms**.

## FIVE KINGDOMS

### 1. MONERA

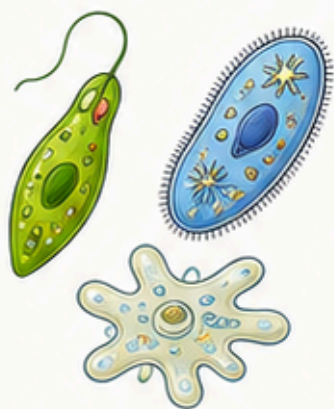


Unicellular prokaryotic organisms. Cell has no true nucleus or membrane-bound organelles.

#### Examples

- Bacteria
- Cyanobacteria (Blue-green algae)

### 2. PROTISTA



Mostly unicellular eukaryotic organisms. Live in water or moist environments.

#### Examples

- Amoeba
- Paramecium
- Euglena

### 3. FUNGI



Eukaryotic, mostly multicellular organisms. Heterotrophic; absorb food from dead and decaying matter.

#### Examples

- Mushroom
- Yeast
- Aspergillus

### 4. PLANTAE



Multicellular eukaryotic organisms. Autotrophic; prepare their own food by photosynthesis.

#### Examples

- Moss
- Fern
- Mango tree

### 5. ANIMALIA



Multicellular eukaryotic organisms. Heterotrophic; obtain food by ingestion.

#### Examples

- Insects
- Fish
- Humans

## KEY FEATURES OF FIVE KINGDOMS

| Feature                                                                                        | Monera                                          | Protista                                        | Fungi                                     | Plantae                          | Animalia                         |
|------------------------------------------------------------------------------------------------|-------------------------------------------------|-------------------------------------------------|-------------------------------------------|----------------------------------|----------------------------------|
|  Cell Type   | Prokaryotic                                     | Eukaryotic                                      | Eukaryotic                                | Eukaryotic                       | Eukaryotic                       |
|  Cell Number | Unicellular                                     | Mostly unicellular                              | Mostly multicellular                      | Multicellular                    | Multicellular                    |
|  Nutrition   | Autotrophic / Heterotrophic                     | Autotrophic / Heterotrophic                     | Heterotrophic (absorptive)                | Autotrophic (photosynthetic)     | Heterotrophic (ingestive)        |
|  Cell Wall   | Present (peptidoglycan)                         | Absent in most                                  | Present (chitin)                          | Present (cellulose)              | Absent                           |
|  Habitat     | Everywhere (soil, water, air, inside organisms) | Moist places, fresh water, sea water            | Moist places, on dead and decaying matter | Terrestrial, fresh water, marine | Terrestrial, fresh water, marine |
|  Movement    | Some motile with flagella                       | Some motile with cilia, flagella or pseudopodia | Non-motile                                | Non-motile                       | Mostly motile                    |



This five-kingdom system shows the great diversity of life on Earth and helps us understand the relationships among living organisms.







# MEMBERS OF KINGDOM MONERA

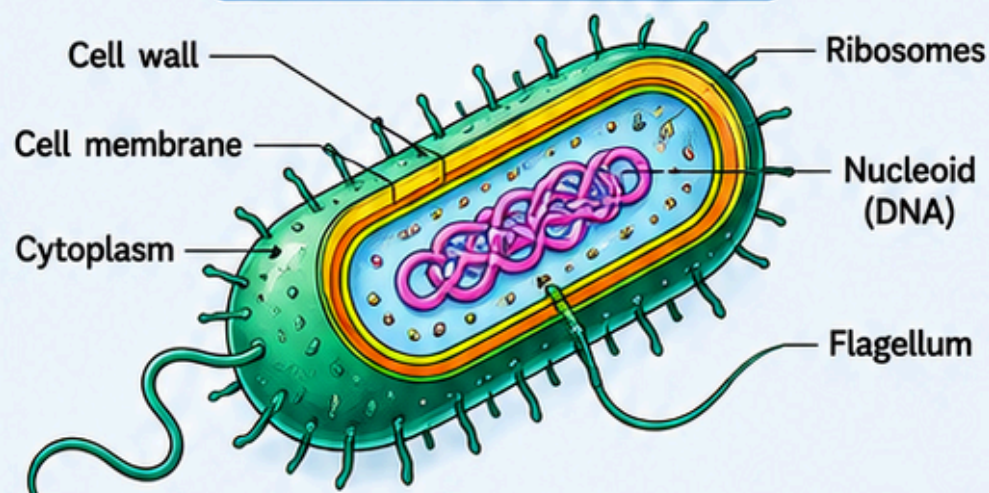


Kingdom Monera includes unicellular, microscopic, prokaryotic organisms. The two important groups are **Bacteria** and **Cyanobacteria**.

## BACTERIA

Bacteria are unicellular, prokaryotic organisms found almost everywhere.

### Structure of a Bacterium



### Common Shapes of Bacteria

**Cocci**  
(Spherical)



**Bacilli**  
(Rod-shaped)



**Spirilla**  
(Spiral)



**Vibrio**  
(Comma-shaped)



### Examples & Uses of Bacteria

#### Useful Bacteria

- ✓ Lactobacillus – used in curd and cheese making.
- ✓ Rhizobium – fixes nitrogen in the soil.
- ✓ Decomposer bacteria – break down dead matter and recycle nutrients.



#### Harmful Bacteria

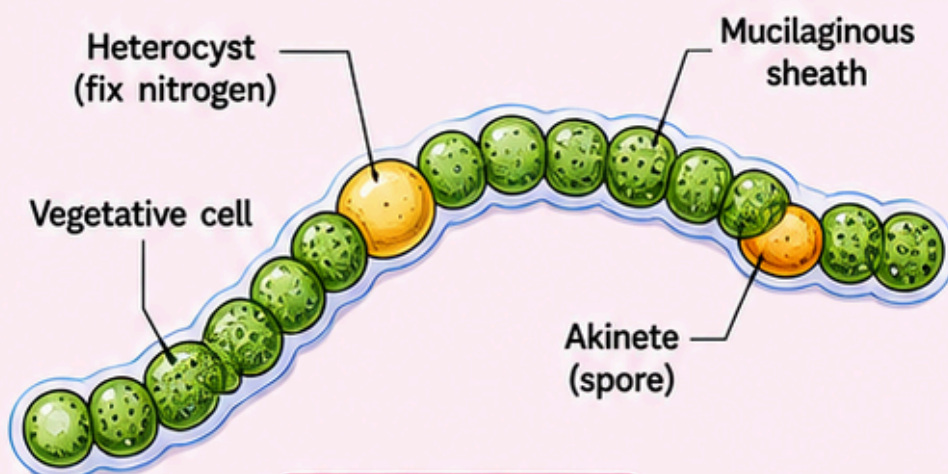
- ✗ Mycobacterium tuberculosis – causes tuberculosis.
- ✗ Vibrio cholerae – causes cholera.
- ✗ Salmonella – causes food poisoning.



## CYANOBACTERIA

Cyanobacteria are photosynthetic bacteria. Also called **blue-green algae**.

### Structure of a Cyanobacterium



### Types / Forms

**Nostoc**



**Anabaena**



**Oscillatoria**



### Importance of Cyanobacteria

- ✓ Perform photosynthesis and release oxygen.
- ✓ Some fix atmospheric nitrogen and enrich soil.
- ✓ Used as biofertilizers in paddy fields.
- ✓ Spirulina – used as nutritious food supplement.



## BACTERIA vs CYANOBACTERIA

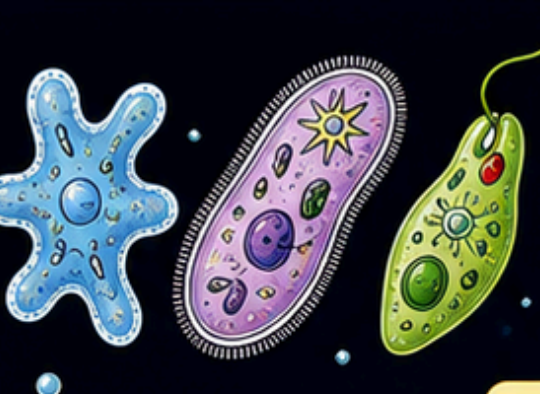
| Feature                                                                                         | Bacteria                    | Cyanobacteria                                |
|-------------------------------------------------------------------------------------------------|-----------------------------|----------------------------------------------|
|  Type of Cell | Prokaryotic                 | Prokaryotic                                  |
|  Cell Wall    | Present (peptidoglycan)     | Present (without peptidoglycan)              |
|  Habitat      | Found almost everywhere     | Mostly in water, moist soil, and rice fields |
|  Nutrition    | Autotrophic / Heterotrophic | Autotrophic (photosynthetic)                 |

## KEY POINTS

- ★ Monerans are simple, unicellular and microscopic.
- ★ They do not have a true nucleus and membrane-bound organelles.
- ★ Bacteria help in decomposition, nutrient cycling, and are used in many industries.
- ★ Cyanobacteria are important for oxygen production and soil fertility.







# COMMON PROTISTS

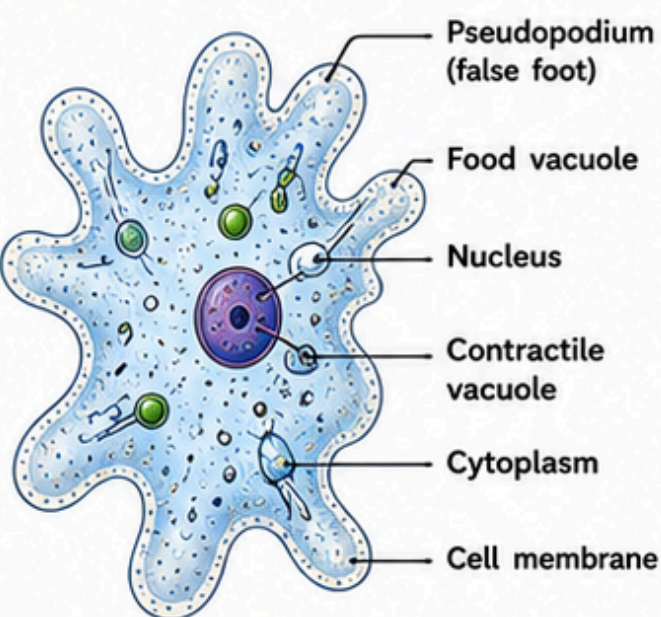
## Amoeba, Paramecium & Euglena



Protists are mostly unicellular eukaryotic organisms. They live in water or moist places.

### 1. AMOEBA

*Amoeba proteus*

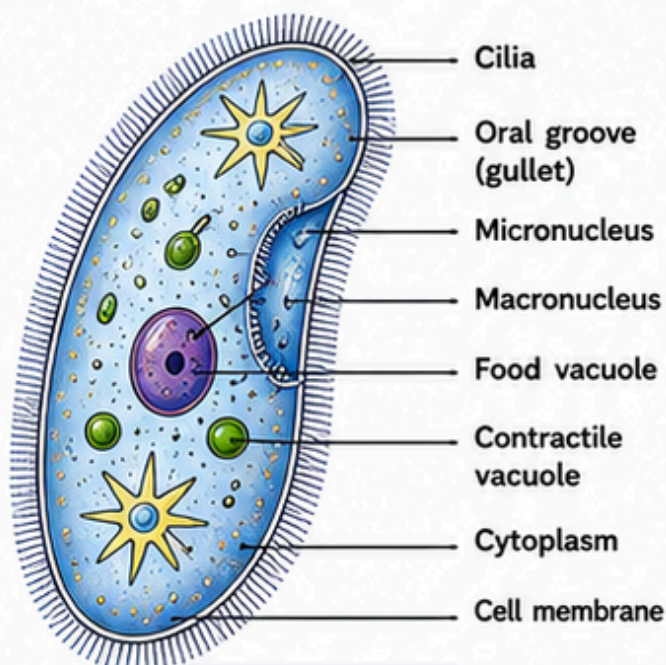


#### Key Features

- Irregular shape.
- Moves and captures food using pseudopodia (false feet).
- Food is engulfed by the cell membrane (phagocytosis).
- Has a contractile vacuole for removing excess water.
- Heterotrophic.
- Reproduces by binary fission.

### 2. PARAMECIUM

*Paramecium caudatum*

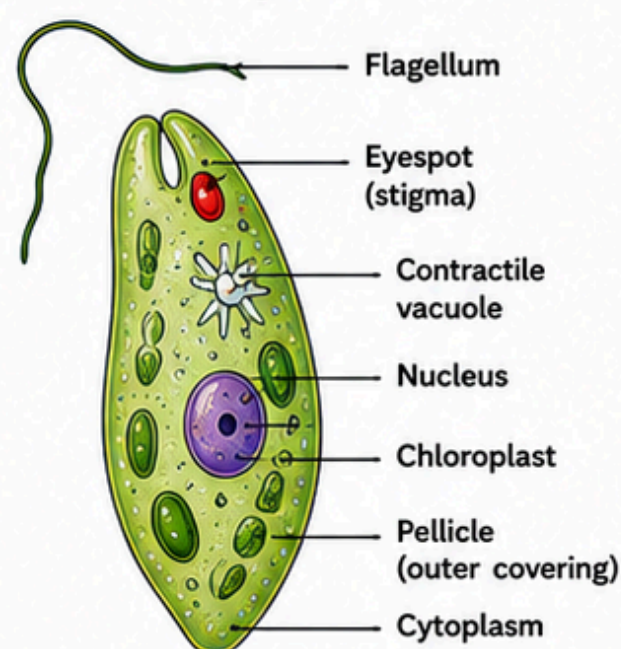


#### Key Features

- Slippery, oval shape.
- Covered with cilia for movement.
- Oral groove leads food to mouth (cytostome).
- Has two nuclei – macro-nucleus (large) and micro-nucleus (small).
- Has contractile vacuoles for osmoregulation.
- Heterotrophic.
- Reproduces by binary fission (transverse).

### 3. EUGLENA

*Euglena viridis*



#### Key Features

- Elongated, spindle-shaped.
- Has a flagellum for movement.
- Contains chloroplasts; can prepare its own food by photosynthesis.
- Also shows heterotrophic nutrition in absence of light.
- Has a contractile vacuole.
- Reproduces by longitudinal binary fission.

### QUICK COMPARISON

| Feature             | Amoeba                 | Paramecium                | Euglena                                         |
|---------------------|------------------------|---------------------------|-------------------------------------------------|
| Shape               | Irregular              | Oval (slippery)           | Elongated (spindle-shaped)                      |
| Mode of movement    | Pseudopodia            | Cilia                     | Flagellum                                       |
| Nucleus             | Single                 | Two (macro & micro)       | Single                                          |
| Nutrition           | Heterotrophic          | Heterotrophic             | Autotrophic (in light), Heterotrophic (in dark) |
| Special structure   | Pseudopodia            | Cilia, Oral groove        | Chloroplast, Eyespot                            |
| Contractile vacuole | Present                | Present (2)               | Present                                         |
| Habitat             | Pond water, moist soil | Pond water                | Pond water, stagnant water                      |
| Reproduction        | Binary fission         | Transverse binary fission | Longitudinal binary fission                     |



Though single-celled, protists show great diversity in structure, movement and nutrition. They are an important link between plants, animals and microbes.







# FUNGI

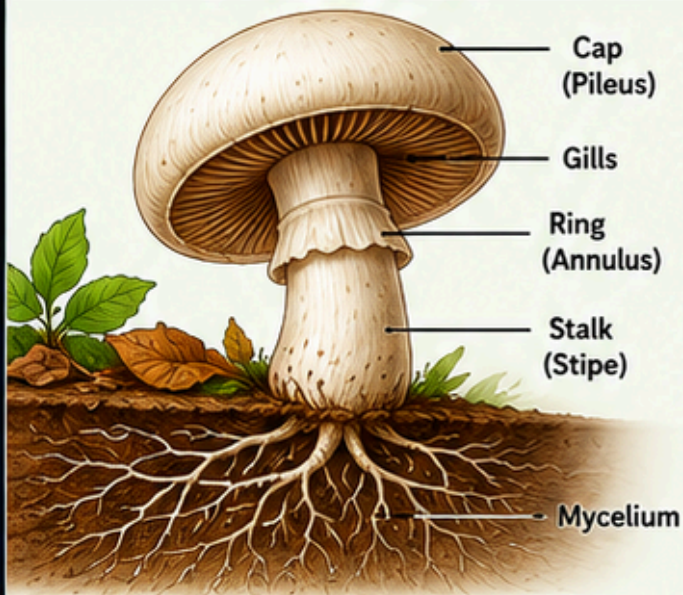
## MUSHROOM, YEAST & ASPERGILLUS



Fungi are eukaryotic organisms that lack chlorophyll. They are heterotrophic and play important roles in nature and in human life.

### MUSHROOM

(*Agaricus bisporus*)



#### General Features

Multicellular and macroscopic fungus with a well-developed fruiting body.



#### Structure

Consists of hyphae that form a mycelium. The fruiting body (mushroom) consists of cap, gills and stalk.



#### Habitat

Grows on moist soil, decaying organic matter, compost, etc.



#### Reproduction

Produces spores on gills of the cap (Basidiomycete).

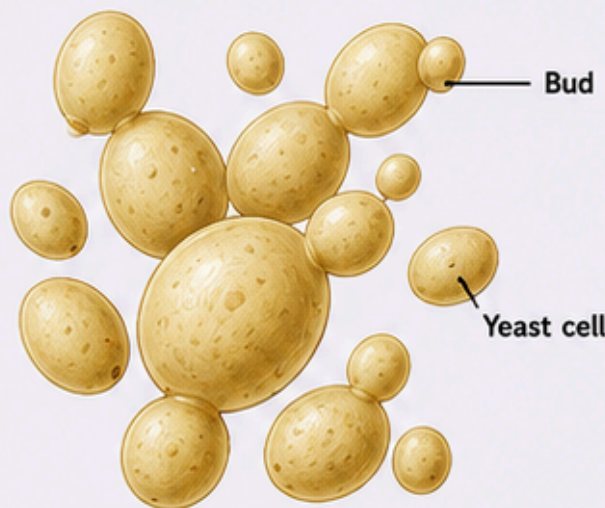


#### Importance

Edible mushroom. Rich in proteins, vitamins and minerals.

### YEAST

(*Saccharomyces cerevisiae*)



#### General Features

Unicellular fungus. Cells are oval or round and reproduce by budding.



#### Structure

Single-celled (unicellular) organism with a true nucleus and cell wall made of chitin.



#### Habitat

Found in sugary substances like fruit juices, nectar, milk, etc.



#### Reproduction

Asexual reproduction by budding.

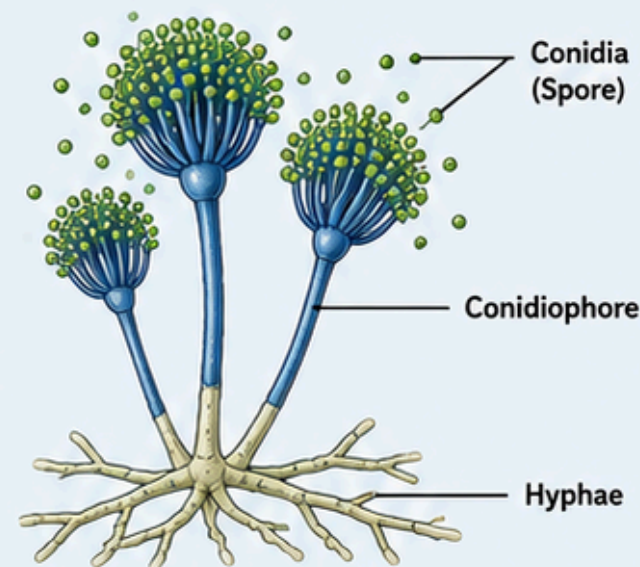


#### Importance

Used in baking (bread), fermentation (alcoholic beverages), and in the production of bioethanol.

### ASPERGILLUS

(*Aspergillus niger*)



#### General Features

Multicellular filamentous fungus (mould).



#### Structure

Composed of branched hyphae forming a mycelium. Asexual spores (conidia) are produced at the tips of conidiophores.



#### Habitat

Found on bread, rotting food, soil, fruits, etc.



#### Reproduction

Asexual reproduction by spores (conidia).



#### Importance

Produces citric acid, enzymes and antibiotics. Also, some species cause food spoilage.

### QUICK COMPARISON

| Feature        | Mushroom ( <i>Agaricus</i> )                          | Yeast ( <i>Saccharomyces</i> )   | Aspergillus ( <i>A. niger</i> )               |
|----------------|-------------------------------------------------------|----------------------------------|-----------------------------------------------|
| Type           | Multicellular (macroscopic)                           | Unicellular (microscopic)        | Multicellular (microscopic mould)             |
| Body Structure | Hyphae → Mycelium → Fruiting body (cap, stalk, gills) | Single cell (budding form)       | Hyphae → Mycelium → Conidiophores with spores |
| Reproduction   | By spores on gills                                    | By budding                       | By spores (conidia)                           |
| Example Use    | Food (edible), nutritious                             | Baking, fermentation, bioethanol | Citric acid, enzymes, antibiotics             |

### KEY POINTS

- ★ Fungi are heterotrophic and absorb nutrients from organic matter.
- ★ They play vital roles as decomposers, in food, medicine and industry.
- ★ Examples: Mushroom (*Agaricus*), Yeast (*Saccharomyces*), Aspergillus (*A. niger*).





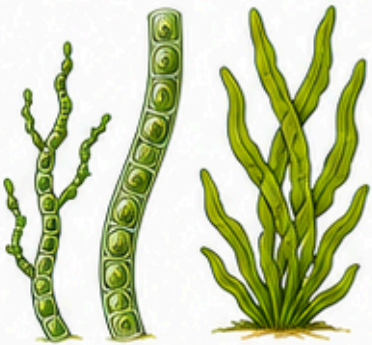
# PLANT KINGDOM CLASSIFICATION

Plants are multicellular eukaryotic organisms. They are **autotrophic** (prepare their own food by photosynthesis) and have cell wall made of **cellulose**.

Plants are classified into **five** major groups.

## 1. THALLOPHYTA (Algae)

Simplest group of plants.  
Body is thallus – undifferentiated into root, stem and leaves.  
Mostly aquatic.



### Examples

Chlamydomonas, Spirogyra, Ulothrix

### Key Features

- Body is thallus.
- No true roots, stems and leaves.
- Mostly aquatic.
- Reproduce by spores, fragmentation or zoospores.
- May be unicellular, colonial or multicellular.

## 2. BRYOPHYTA (Mosses)

Small, green plants of moist places. Known as amphibians of plant kingdom.



### Examples

Marchantia, Funaria (Moss)

### Key Features

- Body is differentiated into stem-like, leaf-like and root-like parts (rhizoids).
- No vascular tissue.
- Reproduce by spores.
- Requires water for fertilization.
- Live in moist and shady places.

## 3. PTERIDOPHYTA (Ferns)

First group of vascular plants. Have true roots, stem and leaves. Reproduce by spores.



### Examples

Fern (Pteris), Equisetum, Selaginella

### Key Features

- Well developed roots, stems and leaves.
- Vascular tissues (xylem & phloem) present.
- Do not produce seeds or flowers.
- Reproduce by spores.
- Mostly terrestrial, live in moist places.

## 4. GYMNOSPERMS (Naked Seed Plants)

Seed plants in which seeds are naked (not enclosed in fruit). Mostly woody plants.



### Examples

Pinus (Pine), Cycas, Cedrus

### Key Features

- Have well developed roots, stems and leaves.
- Vascular tissues present.
- Produce seeds, but seeds are not enclosed in fruit.
- Mostly evergreen trees and shrubs.
- Reproduce by seeds.

## 5. ANGIOSPERMS (Flowering Plants)

Most advanced and largest group of plants. Have flowers and fruits. Seeds are enclosed in fruits.



### Examples

Hibiscus, Pea, Mango, Wheat

### Key Features

- Have well developed roots, stems and leaves.
- Vascular tissues present.
- Produce flowers and fruits.
- Seeds are enclosed in fruits.
- Very large and diverse group.

## COMPARISON OF FIVE PLANT GROUPS

| Feature           | Thallophyta<br>(Algae)                | Bryophyta<br>(Mosses)                      | Pteridophyta<br>(Ferns)                | Gymnosperms<br>(Naked Seed Plants)     | Angiosperms<br>(Flowering Plants)      |
|-------------------|---------------------------------------|--------------------------------------------|----------------------------------------|----------------------------------------|----------------------------------------|
| Body organisation | Thallus                               | Stem-like, leaf-like, root-like (rhizoids) | Well differentiated root, stem, leaves | Well differentiated root, stem, leaves | Well differentiated root, stem, leaves |
| Vascular tissue   | Absent                                | Absent                                     | Present                                | Present                                | Present                                |
| Reproduction      | By spores, fragmentation or zoospores | By spores                                  | By spores                              | By seeds (naked)                       | By seeds (enclosed in fruit)           |
| Flowers           | Absent                                | Absent                                     | Absent                                 | Absent                                 | Present                                |
| Fruits            | Absent                                | Absent                                     | Absent                                 | Absent                                 | Present                                |
| Habitat           | Mostly aquatic                        | Moist and shady places                     | Moist terrestrial places               | Terrestrial (usually dry)              | Terrestrial (all kinds)                |
| Examples          | Spirogyra, Chlamydomonas              | Marchantia, Funaria                        | Pteris (Fern), Selaginella             | Pinus (Pine), Cycas                    | Hibiscus, Pea, Mango, Wheat            |



From simple algae to complex flowering plants, each group shows a step in the evolution of plants and contributes to the beautiful **diversity of life** on Earth.





# SPIROGYRA

## Thallophyta (Algae)

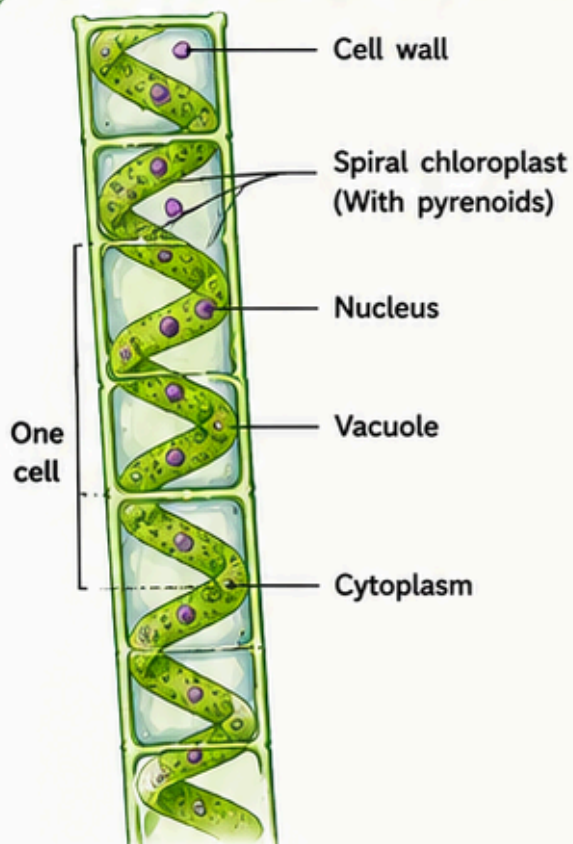
Spirogyra is a filamentous green alga. It belongs to the group **Thallophyta** which includes simple plants with thallus body and no true roots, stems or leaves.

### 1. Habit and Habitat

- Spirogyra grows in fresh water such as ponds, ditches, slow flowing streams and moist places.
- It forms green, slimy mats or floating filaments.



### 2. Structure of Spirogyra Filament

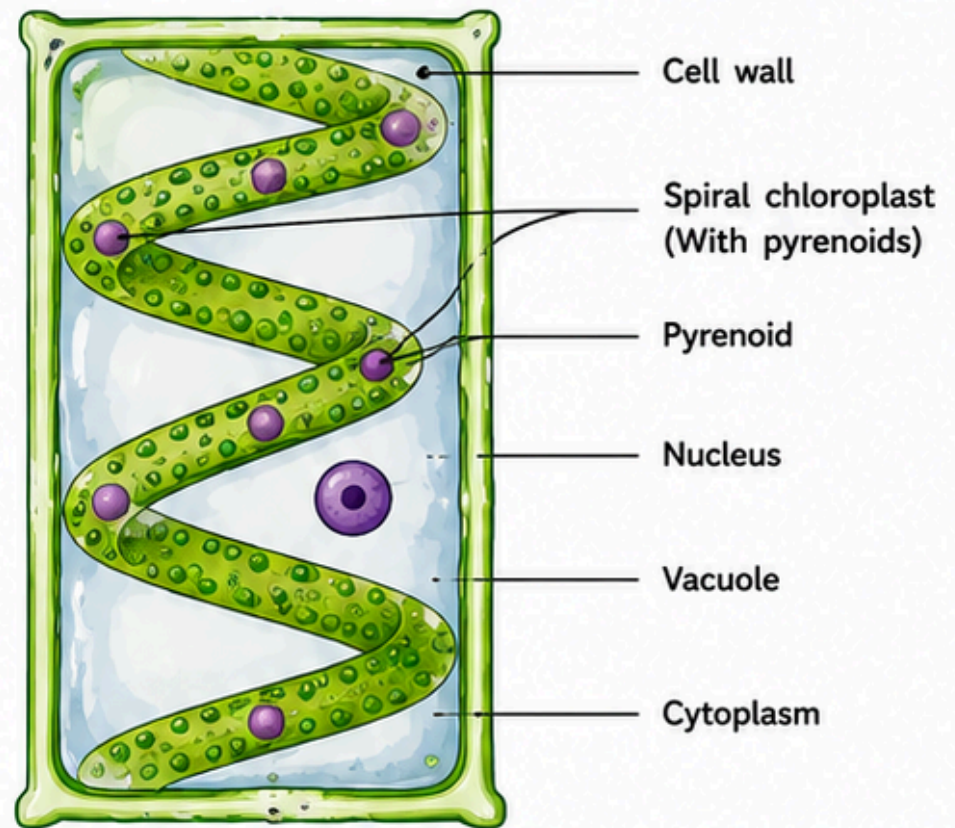


Many cells joined to form a filament

#### Key Features

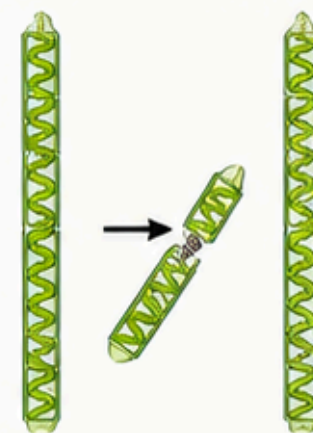
- Filament is unbranched and made up of many cylindrical cells.
- Each cell has a cell wall made of cellulose.
- A large central vacuole is present.
- Cytoplasm forms a thin layer along the cell wall.
- One or more spiral chloroplasts with pyrenoids are present.
- A single nucleus is present near the centre.

### 3. Structure of a Single Cell (Enlarged View)



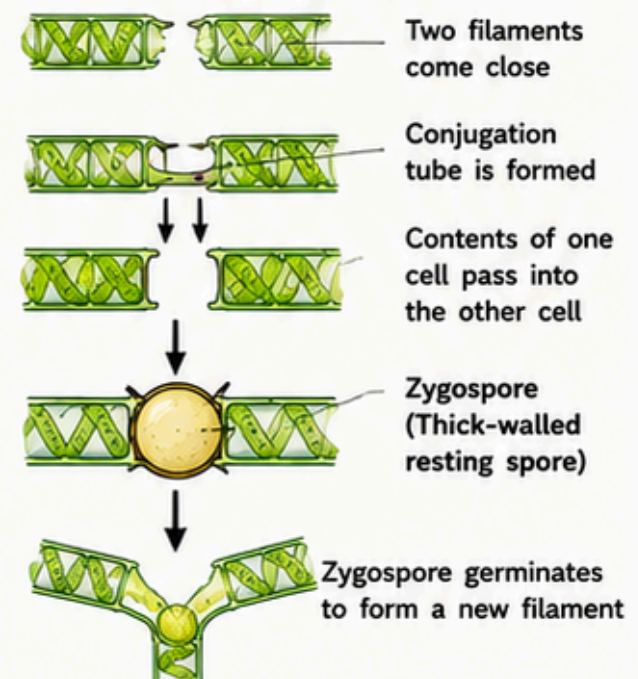
### 4. Reproduction

#### Asexual Reproduction (Fragmentation)



The filament breaks into small pieces. Each piece grows into a new filament.

#### Sexual Reproduction (Conjugation)



### 5. Importance of Spirogyra

- It adds oxygen to water bodies.
- It is a food for some aquatic animals.
- It helps in maintaining the ecological balance.



### 6. Thallophyta (General Characters)



Body is thallus (undifferentiated plant body).



No true roots, stems and leaves.



Cell wall is present (made of cellulose).



Mostly aquatic or live in moist places.



Reproduce by spores, fragmentation or zoospores.



May be unicellular, colonial or multicellular.



Autotrophic (prepare their own food).





# BRYOPHYTA

## (The Mosses)



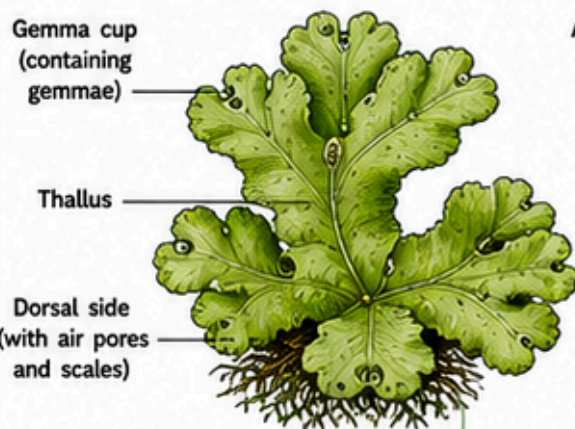
Bryophyta are small, non-vascular plants. They have root-like, stem-like and leaf-like structures but no true roots, stems or leaves. They live in moist and shady places.

Examples: Marchantia (Liverwort) and Moss (Funaria)

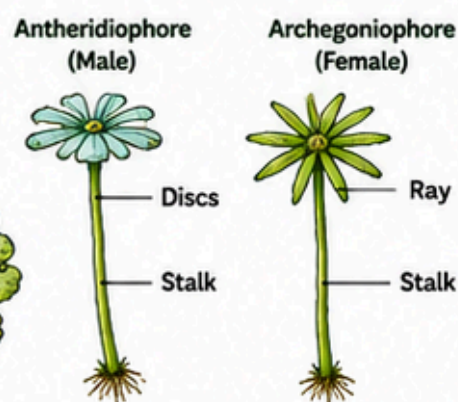
### 1. MARCHANTIA (LIVERWORT)

A thalloid liverwort. The body is flat, green and lobed. It grows on moist soil.

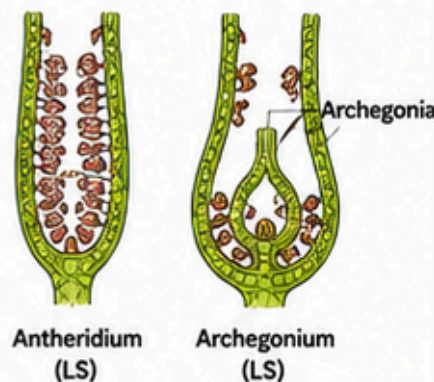
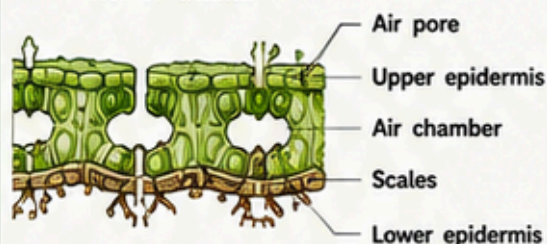
#### A. Vegetative Structure



#### B. Reproductive Structure



#### T.S. of thallus



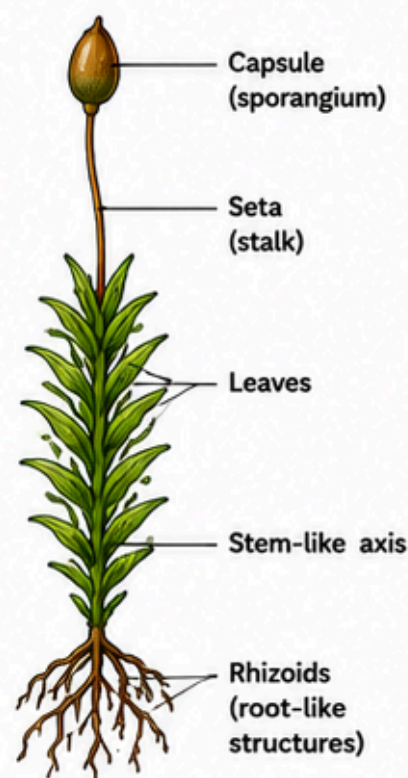
#### Key Features of Marchantia

- Thalloid body, dorsiventral (different upper and lower sides).
- Contains air pores and scales.
- Has gemma cups for vegetative reproduction.
- Reproduces sexually by antheridia and archegonia.
- Requires water for fertilization.

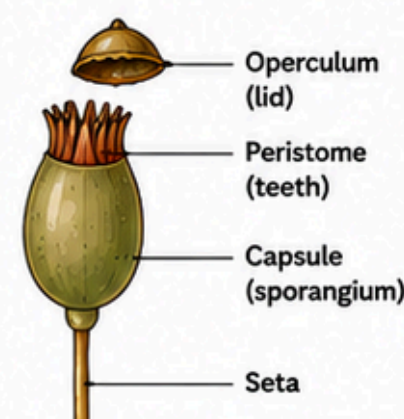
### 2. MOSS (FUNARIA)

A leafy moss. The plant has a stem-like axis with many small leaves.

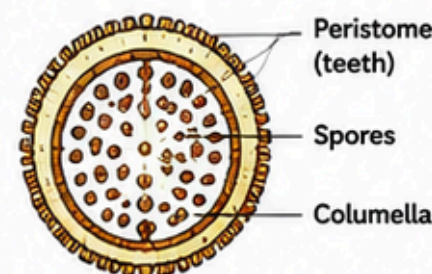
#### A. Gametophyte (Leafy Green Plant)



#### B. Capsule (Sporophyte)



#### C. T.S. of Capsule



#### Key Features of Moss (Funaria)

- Leafy gametophyte with stem-like axis and leaves.
- Has rhizoids instead of true roots.
- Sporophyte (capsule + seta) is dependent on gametophyte.
- Sporangium produces spores for reproduction.
- Requires water for fertilization.

### COMPARISON: MARCHANTIA vs MOSS

| Feature    | Marchantia (Liverwort)                                            | Moss (Funaria)                  |
|------------|-------------------------------------------------------------------|---------------------------------|
| Body       | Thalloid, flat and lobed                                          | Leafy, with stem-like axis      |
| Rhizoids   | Absent                                                            | Present                         |
| Leaves     | Absent                                                            | Present (small, many)           |
| Gametangia | On special stalked structures (antheridiophore & archegoniophore) | On the same plant (at the tip)  |
| Sporophyte | Small, short-lived, dependent                                     | Well-developed (capsule + seta) |
| Habitat    | Moist soil, damp places                                           | Moist soil, rocks, damp places  |
| Example    | Marchantia (Liverwort)                                            | Funaria (Moss)                  |

### General Characters of Bryophyta



Non-vascular plants



Have root-like, stem-like and leaf-like parts



Live in moist and shady places



Reproduce by spores



Sexual reproduction requires water



Show vegetative reproduction (gemmae)



Sporophyte is dependent on gametophyte



Bryophytes are called the “**amphibians of the plant kingdom**” as they are the first land plants.







# FERN

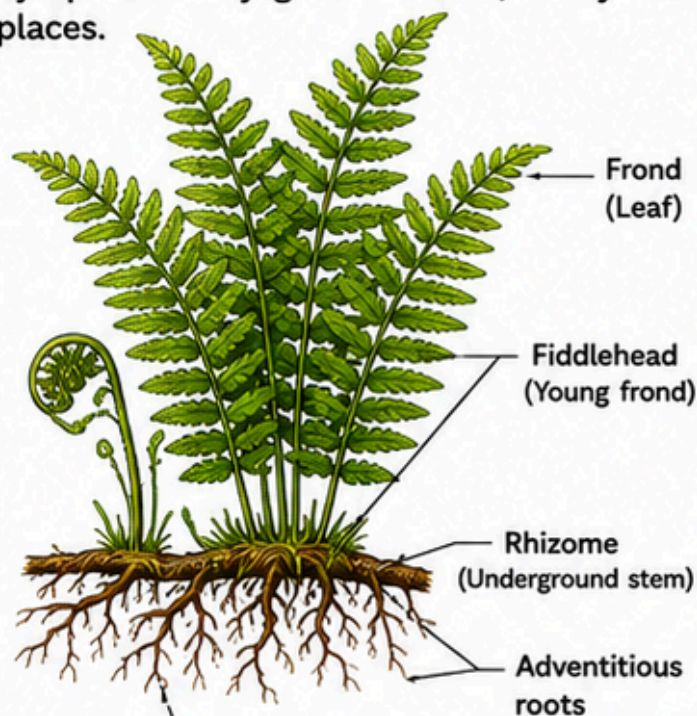


## & CROSS-SECTION OF FERN STEM

### XYLEM & PHLOEM

#### FERN – A PTERIDOPHYTE

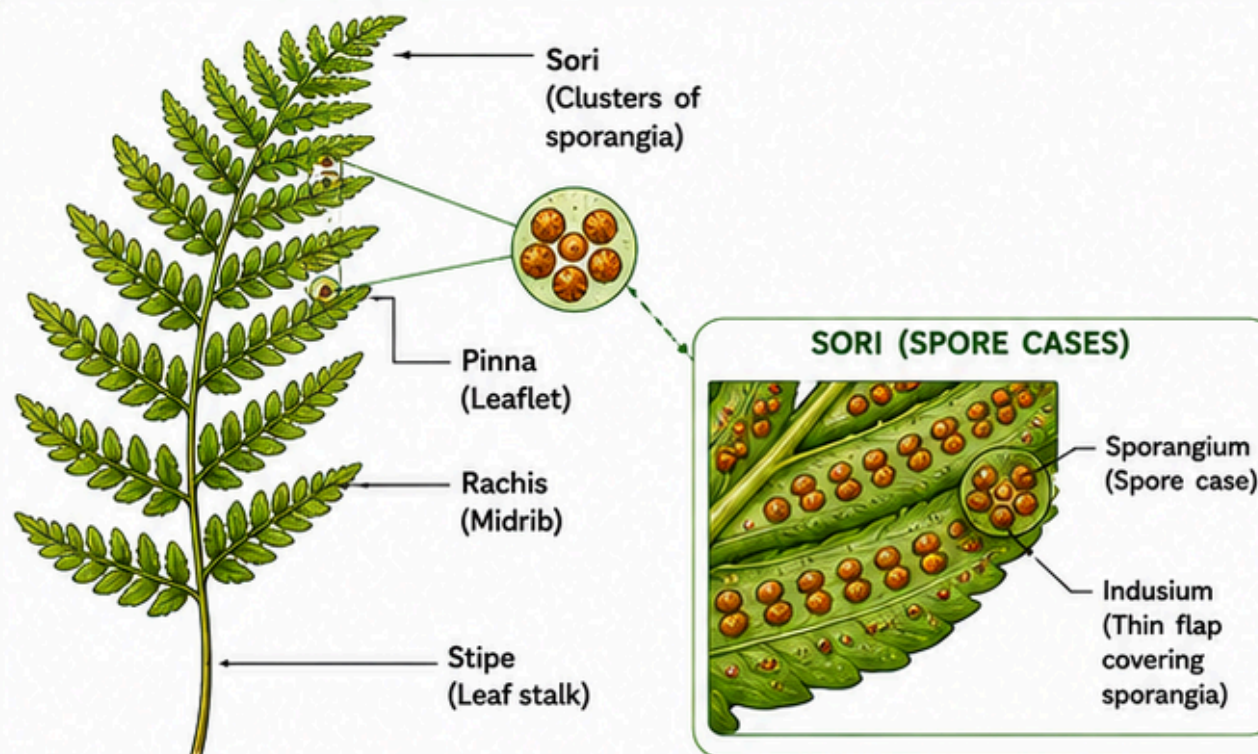
Ferns are vascular plants. They have true roots, stem and leaves. They reproduce by spores. They grow in moist, shady places.



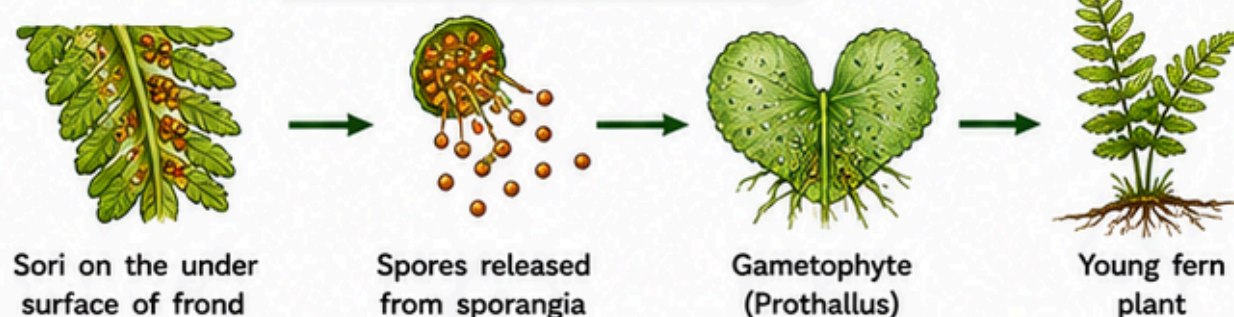
#### KEY FEATURES OF FERNS

- Have true roots, stem and leaves.
- Well-developed vascular tissues.
- Leaves are called fronds.
- Sori (spore cases) are present on the lower surface of fronds.
- Reproduce by spores.
- Require water for fertilization.

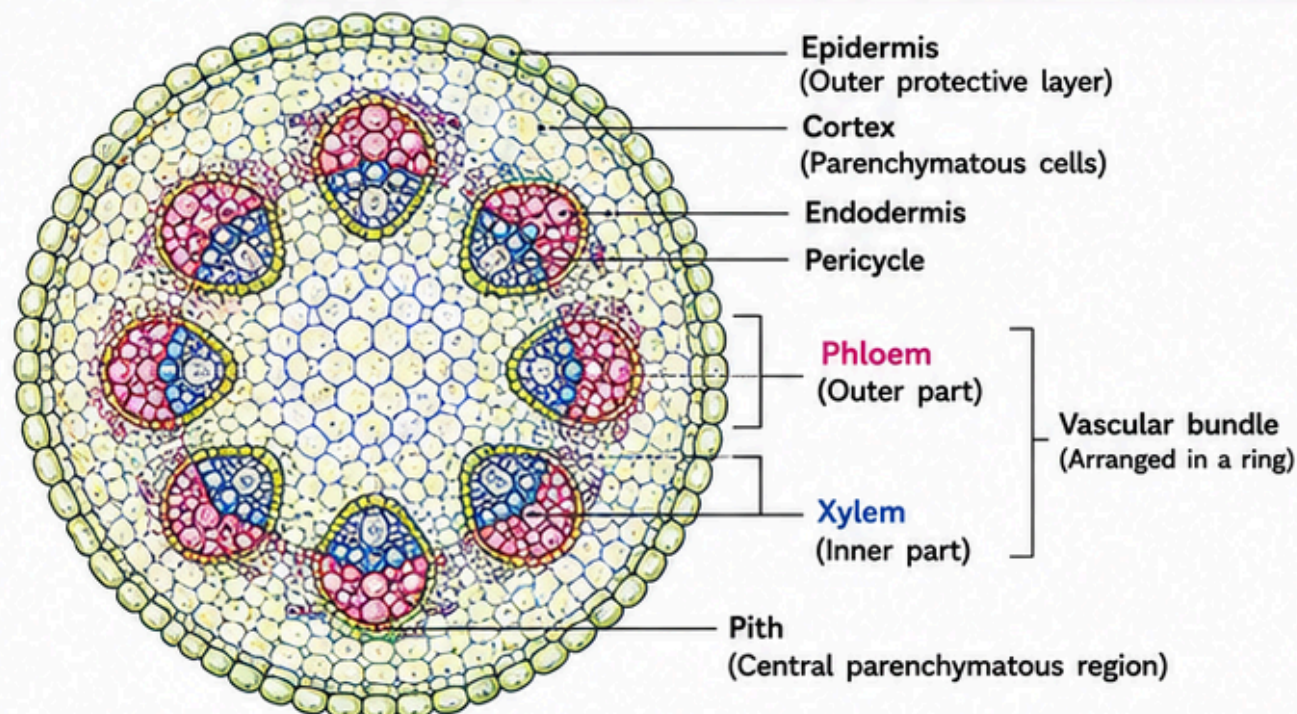
#### PARTS OF A FERN FROND



#### LIFE CYCLE OF FERN (Brief)



#### CROSS-SECTION OF FERN STEM (T.S.) – SHOWING XYLEM & PHLOEM



#### PHLOEM

- Lies towards the outer side of the vascular bundle.
- Made up of sieve tubes, companion cells, phloem parenchyma and phloem fibres.
- Transports food (prepared by leaves) to all parts of the plant.

#### XYLEM

- Lies towards the inner side of the vascular bundle.
- Made up of tracheids, vessels, xylem parenchyma and xylem fibres.
- Transports water and minerals from roots to all parts of the plant.



Ferns are important plants in nature. They help in maintaining ecological balance and are also used as ornamental plants.







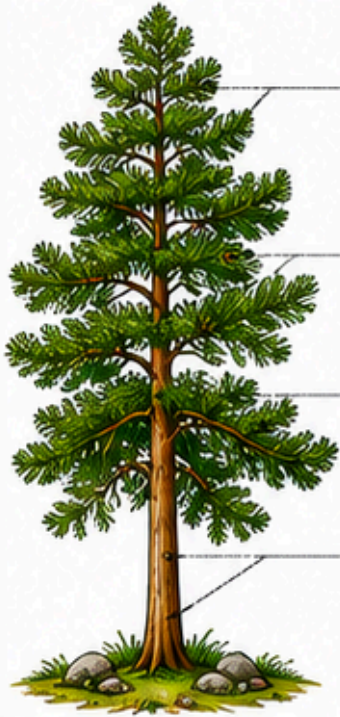
# PINE CONE

## GYMNOSPERM



Pine (Pinus) is a gymnosperm. It bears **naked seeds** on the scales of cone. It does not produce flowers or fruits.

### PINE TREE (Pinus)



- Evergreen tree with needle-like leaves.
- Well-developed tap root.
- Woody, branched stem.
- Resin canals present.

### KEY FEATURES OF GYMNASPERMS

- Seeds are naked (not enclosed in fruits).
- Do not produce flowers or fruits.
- Mostly evergreen trees or shrubs.
- Well-developed vascular tissues.
- Reproduce by seeds.
- Examples: Pine, Cycas, Cedrus.

### PINE CONES – MALE AND FEMALE

#### 1. MALE CONE (Microstrobilus)



- Small, yellowish cones.
- Pollen grains are produced in pollen sacs.
- Produces pollen (male gametes).
- Usually found in clusters at the base of young shoots.



- Pollen sac
- Pollen grains

#### 2. FEMALE CONE (Megastrobilus)



- Large, woody cone.
- Each scale bears two ovules on its upper surface.
- Ovules are naked (not enclosed in ovary).
- After fertilization, ovules develop into seeds.



- Ovules (Naked)
- Cone scale

### LIFE CYCLE OF PINE (Very Brief)



Mature pine tree (Sporophyte)



Male cone produces pollen grains.



Pollen grain (Male gamete)



Pollen reaches the ovule (by wind).



Fertilization takes place in ovule.



Seed develops on the scale and is dispersed by wind.

### COMPARISON: GYMNASPERM vs ANGIOSPERM

| Feature            | Gymnosperm (Pine)             | Angiosperm (Flowering Plant) |
|--------------------|-------------------------------|------------------------------|
| Reproductive organ | Cones (strobili)              | Flowers                      |
| Seeds              | Naked, exposed on cone scales | Enclosed within fruits       |
| Ovules             | Naked                         | Enclosed in ovary            |
| Fertilization      | By pollen (wind pollination)  | By pollen (wind/pollination) |
| Fruit formation    | Absent                        | Present                      |
| Examples           | Pine, Cycas, Cedrus           | Mango, Rose, Sunflower       |

### IMPORTANCE OF PINES

- Timber is used in construction and furniture.
- Resin is used in turpentine, varnishes and medicines.
- Paper is made from pine wood pulp.
- Cones and leaves add to the beauty of nature.
- Help in maintaining environmental balance.



Pine is an important gymnosperm that has survived for millions of years and continues to play a vital role in our environment.







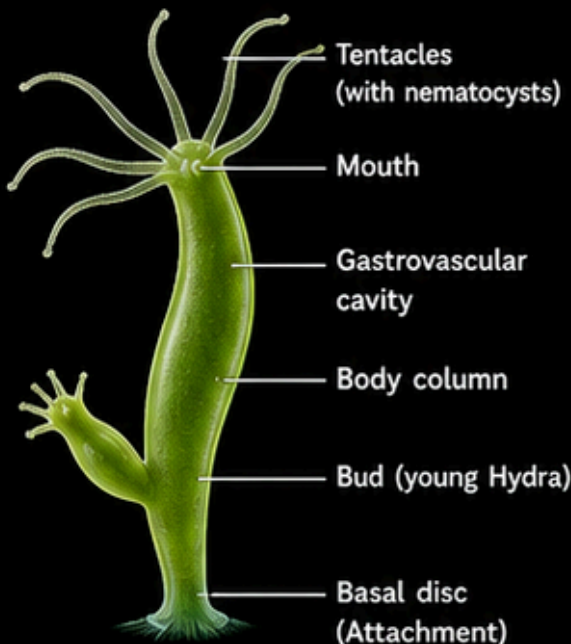
# HYDRA

## TISSUE-LEVEL ORGANISATION



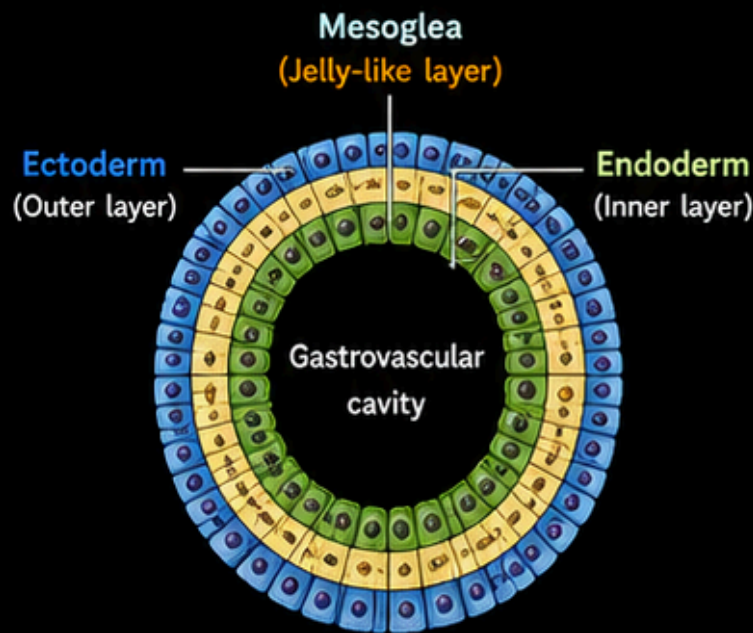
Hydra is a small, freshwater cnidarian. It has a simple body with **two tissue layers** – **ectoderm** and **endoderm**, and a jelly-like layer **mesoglea** in between.

### 1. ABOUT HYDRA



- Found in clean freshwater ponds and streams.
- Radially symmetrical, diploblastic (two germ layers).
- Shows tissue-level organisation.
- Reproduces by budding.
- Carnivorous – captures prey with tentacles.

### 2. TISSUE-LEVEL ORGANISATION IN HYDRA



- **Ectoderm:** Outer cellular layer protects the body and contains specialized cells for defence and sensation.
- **Mesoglea:** Non-cellular, jelly-like layer for support and flexibility.
- **Endoderm:** Inner cellular layer lines the gastrovascular cavity and helps in digestion and absorption.

### 3. CELL TYPES IN HYDRA

#### Epidermis (Ectoderm)

#### 1. Epithelial Muscle Cell



Covering and protection; shows contractile ability.

#### 2. Nematocyte (Stinging Cell)



Contains nematocysts for defence and capturing prey.

#### 3. Sensory Cell



Detects stimuli from the environment.

#### 4. Interstitial (Stem) Cell



Undifferentiated cells; give rise to other cell types and help in regeneration.

#### Gastrodermis (Endoderm)

#### 5. Nutritive Muscle Cell



Digest food and absorb nutrients; shows contractile ability.

#### 6. Gland Cell



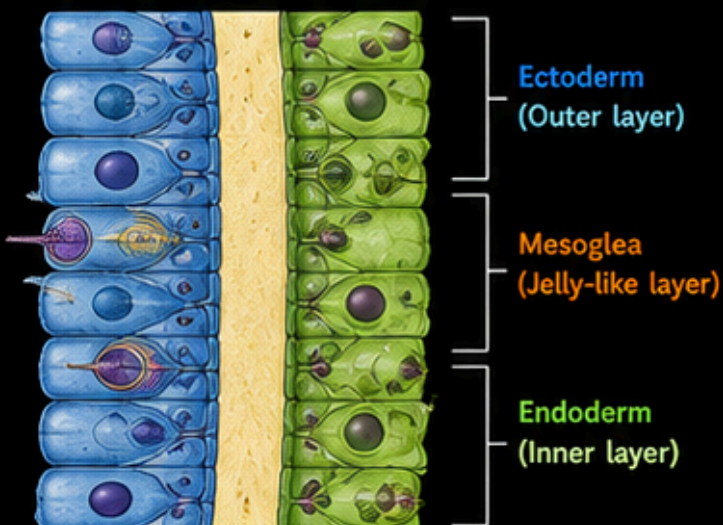
Secretes digestive enzymes into the gastrovascular cavity.

#### 7. Interstitial (Stem) Cell



Undifferentiated cells; give rise to other cell types and help in regeneration.

### 4. T.S. OF HYDRA BODY WALL



### 5. KEY FEATURES

- ★ Hydra has two tissue layers – ectoderm and endoderm.
- ★ The layers are separated by a jelly-like mesoglea.
- ★ Shows tissue-level organisation (diploblastic).
- ★ Cells are organized into tissues that perform specific functions.
- ★ Interstitial cells help in growth, repair and regeneration.
- ★ Hydra can regenerate a whole organism from small pieces.



### 6. IMPORTANCE OF HYDRA



Model organism to study basic body plan and regeneration.



Helps in understanding evolution of multicellular organisms.



Useful in research on developmental biology and stem cells.



Maintains balance in freshwater ecosystems by controlling small invertebrates.



Hydra is a simple organism, but it shows true **tissue-level organisation**, which is an important step in the **evolution of complex animals**.







# ANGIOSPERM TREE

## GULMOHAR

(*Delonix regia*)



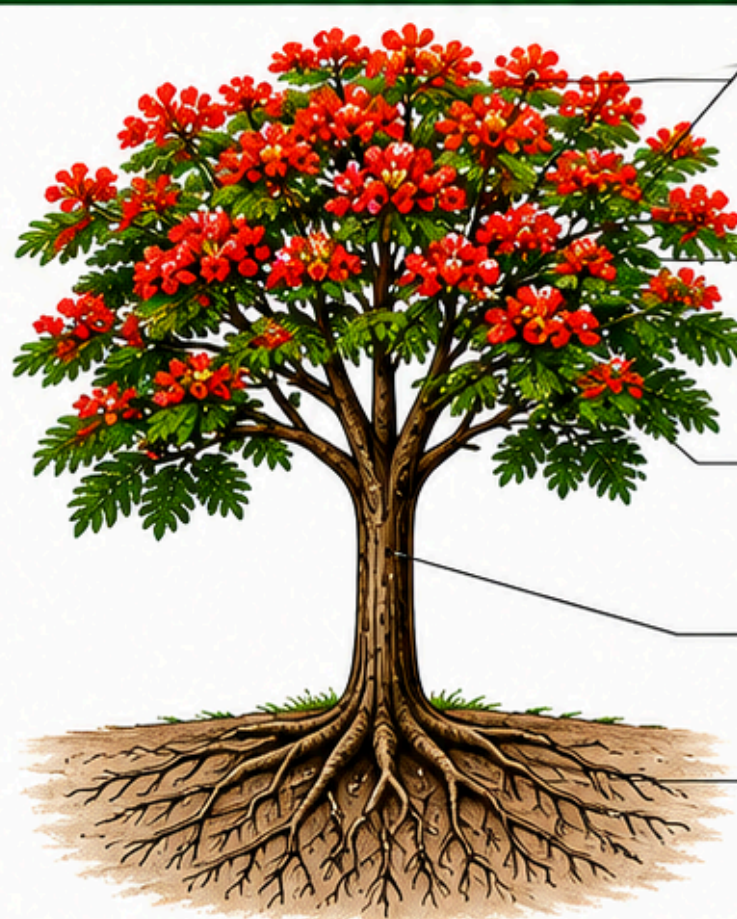
Gulmohar is a beautiful flowering tree and a true angiosperm. It has well-developed roots, stems and leaves. It produces **flowers** and **fruits**, and bears **seeds** enclosed within the fruit.

### 1. ABOUT GULMOHAR TREE



- **Scientific Name** : *Delonix regia*
- **Common Name** : Gulmohar
- **Family** : Fabaceae (Leguminosae)
- **Type** : Angiosperm (Flowering Plant)
- **Habitat** : Grows well in tropical and subtropical regions.
- It is an ornamental tree widely planted along roads, parks and gardens.

### 2. PARTS OF GULMOHAR TREE



**Flower**  
Bright red, 5-petaled flowers with long stamens.



**Leaf**  
Compound, bipinnate leaves with many small leaflets.



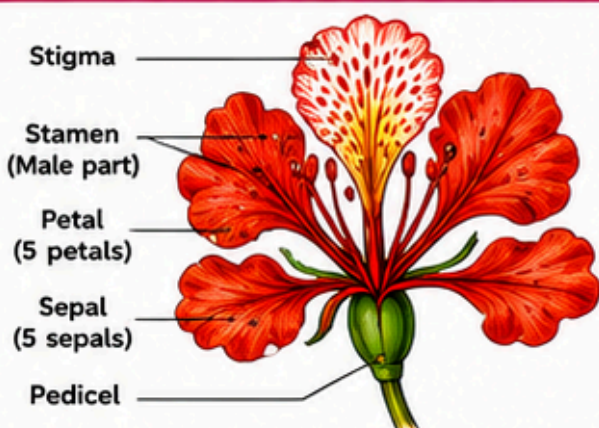
**Fruit (Pod)**  
Long, flat, woody pod containing seeds.



**Stem (Trunk)**  
Strong, woody and branched.

**Roots**  
Tap root system with many lateral roots.

### 3. FLOWER OF GULMOHAR



#### Key Features

- Flowers are bright red or orange.
- Actinomorphic (radially symmetrical).
- Bisexual – have both stamens (male) and pistil (female).
- Insects are attracted for pollination.

### 4. FRUIT (POD) AND SEEDS



Fruit (Pod)



Seeds

#### Key Features

- Fruit is a long, flat, woody pod (legume).
- Seeds are formed inside the pod.
- Seeds are enclosed in the fruit.

### 5. ANGIOSPERM FEATURES IN GULMOHAR

- Produces flowers.
- Forms fruits (pods).
- Seeds are enclosed within the fruit.
- Has well-developed vascular tissues (xylem and phloem).
- Has true roots, stems and leaves.
- Undergoes double fertilization (a unique feature of angiosperms).

### 6. LIFE CYCLE OF GULMOHAR (Brief)



### 7. IMPORTANCE OF GULMOHAR



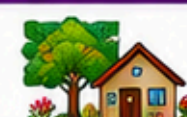
Beautiful ornamental tree.



Provides shade along roads and avenues.



Helps in maintaining ecological balance by absorbing CO<sub>2</sub> and releasing O<sub>2</sub>.



Enhances the beauty of gardens, parks and surroundings.



Provides habitat and food for birds and insects.



Gulmohar is a perfect example of an angiosperm – it has **flowers**, **fruits** and **seeds**, and makes our environment beautiful and green!







# ANIMAL CLASSIFICATION – MAJOR INVERTEBRATE GROUPS ★



Invertebrates are animals without a backbone.

## 1. PORIFERA (Sponges)



- Simplest animals
- Body full of pores
- No true tissues or organs
- Mostly aquatic

Example: Sponge

## 2. CNIDARIA (Coelenterates)



- Radial symmetry
- Stinging cells (cnidocytes)
- Tissue-level organisation
- Aquatic (mostly marine)

Example: Hydra,  
Jellyfish

## 3. PLATYHELMINTHES (Flatworms)



- Flat, unsegmented body
- Bilateral symmetry
- Organ-level organisation
- Free-living or parasitic

Example: Planaria,  
Tapeworm

## 4. NEMATODA (Roundworms)



- Cylindrical, unsegmented
- Bilateral symmetry
- Organ-level organisation
- Free-living or parasitic

Example: Ascaris  
(Roundworm)

## 5. ANNELIDA (Segmented Worms)



- Segmented body
- Bilateral symmetry
- Well-developed organs
- Aquatic or terrestrial

Example:  
Earthworm, Leech

## 6. ARTHROPODA (Jointed-Leg Animals)



- Segmented body
- Jointed legs
- Hard exoskeleton
- Largest group

Examples: Insects,  
Spiders, Crabs

## 7. MOLLUSCA (Molluscs)



- Soft body
- Usually with shell
- Muscular foot
- Aquatic or terrestrial

Examples: Snail,  
Octopus, Mussel

## 8. ECHINODERMATA (Spiny-skinned Animals)



- Spiny skin
- Radial symmetry
- Water vascular system
- Exclusively marine

Examples: Starfish,  
Sea urchin

## 9. HEMICHORDATA (Acorn Worms)



- Worm-like body
- Proboscis, collar, trunk
- Deuterostomes
- Marine

Example:  
Balanoglossus

## 10. BRYOZOA (Moss Animals)



- Tiny colonial animals
- Filter feeders
- Aquatic (mostly marine)

Example:  
Sea Mat

### KEY POINTS TO REMEMBER

- ✓ Invertebrates do not have a backbone.
- ✓ They show great diversity in body forms and habitats.
- ✓ They range from simple sponges to highly developed arthropods.
- ✓ Arthropoda is the largest invertebrate group.
- ✓ They play important roles in nature.

### IMPORTANCE OF INVERTEBRATES



Pollination



Food  
source



Maintain  
soil fertility



Build  
reefs



Maintain  
ecological  
balance

**Small Creatures, Big Impact!**

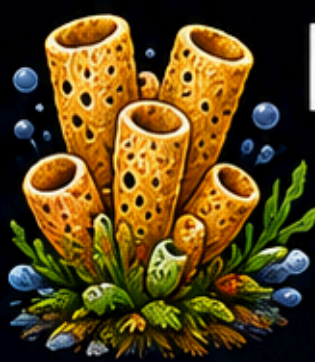
Invertebrates keep our planet healthy and thriving.



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# MAJOR INVERTEBRATE GROUPS – COMPARISON

**Porifera, Cnidaria, Platyhelminthes, Nematoda, Annelida, Arthropoda, Mollusca & Echinodermata**



Invertebrates are animals without a backbone.  
They show great **diversity** in body structure, habitats and modes of life.

| FEATURES                     | PORIFERA<br>(Sponges)            | CNIDARIA<br>(Coelenterates)                     | PLATYHELMINTHES<br>(Flatworms)       | NEMATODA<br>(Roundworms)                | ANNELIDA<br>(Segmented<br>Worms)     | ARTHROPODA<br>(Jointed-Leg<br>Animals) | MOLLUSCA<br>(Molluscs)               | ECHINODERMATA<br>(Spiny-skinned<br>Animals) |
|------------------------------|----------------------------------|-------------------------------------------------|--------------------------------------|-----------------------------------------|--------------------------------------|----------------------------------------|--------------------------------------|---------------------------------------------|
|                              |                                  |                                                 |                                      |                                         |                                      |                                        |                                      |                                             |
| 1. Body Organisation<br>     | Asymmetrical                     | Radial symmetry                                 | Bilateral symmetry                   | Bilateral symmetry                      | Bilateral symmetry                   | Bilateral symmetry                     | Bilateral symmetry                   | Radial symmetry (pentaradial in adults)     |
| 2. Body Structure<br>        | Pores all over the body          | Diploblastic (two germ layers)                  | Triploblastic, Acoelomate            | Triploblastic, Pseudocoelomate          | Triploblastic, Coelomate (segmented) | Triploblastic, Coelomate (segmented)   | Triploblastic, Coelomate             | Triploblastic, Coelomate                    |
| 3. Level of Organisation<br> | Cellular level                   | Tissue level                                    | Organ level                          | Organ level                             | Organ level                          | Organ system level                     | Organ system level                   | Organ system level                          |
| 4. Body Cavity<br>           | No true body cavity              | No body cavity                                  | Acoelomate (no body cavity)          | Pseudocoelom (false body cavity)        | Coelom (true body cavity)            | Coelom (true body cavity)              | Coelom (true body cavity)            | Coelom (true body cavity)                   |
| 5. Digestive System<br>      | Absent (intracellular digestion) | Incomplete (one opening acts as mouth and anus) | Incomplete (mouth, no anus)          | Complete (mouth and anus)               | Complete (mouth and anus)            | Complete (mouth and anus)              | Complete (mouth and anus)            | Complete (mouth and anus)                   |
| 6. Circulatory System<br>    | Absent                           | Absent                                          | Absent                               | Absent                                  | Closed type                          | Open type (hemocoel)                   | Open type (hemocoel)                 | Water vascular system                       |
| 7. Respiration<br>           | By diffusion through cells       | By diffusion                                    | By diffusion through body surface    | Through body surface                    | Through moist skin                   | Gills, tracheae or book lungs          | Gills (lamellate) or lung            | Dermal gills and tube feet                  |
| 8. Excretion<br>             | By diffusion                     | By diffusion                                    | Flame cells (protonephridia)         | Excretory canals/ Renette cells         | Nephridia (segmentally distributed)  | Malpighian tubules/ Green glands       | Kidneys (nephridia)                  | No special organs (diffusion)               |
| 9. Nervous System<br>        | Absent                           | Nerve net                                       | Ladder like nervous system           | Nerve ring and longitudinal nerve cords | Cerebral ganglia and nerve cord      | Brain and ventral nerve cord           | Ganglia and nerve cords              | Nerve ring and radial nerves                |
| 10. Locomotion<br>           | Sessile                          | Polyp – Sessile<br>Medusa – Free swimming       | Muscular contraction (cilia in some) | Thrashing movements                     | Setae and parapodia                  | Jointed appendages or wings            | Muscular foot                        | Tube feet                                   |
| 11. Habitat<br>              | Mostly aquatic                   | Mostly aquatic                                  | Freshwater, marine & parasitic       | Soil, water, plants & animals           | Aquatic, freshwater or terrestrial   | All habitats – land, water, air        | Aquatic, freshwater or terrestrial   | Exclusively marine                          |
| 12. Examples<br>             | Sycon, Euspongia                 | Hydra, Jellyfish, Sea anemone                   | Planaria, Taenia, Fasciola           | Ascaris, Wuchereria, Enterobius         | Earthworm, Nereis, Leech             | Cockroach, Spider, Prawn               | Pila (Snail), Octopus, Unio (Mussel) | Starfish, Sea urchin, Sea cucumber          |

## KEY POINTS TO REMEMBER

- ✓ Invertebrates lack a backbone but show great diversity in size, shape and habitat.
- ✓ They range from simple **cellular** organisms (sponges) to complex animals with **organ systems** (arthropods, molluscs).
- ✓ Arthropoda is the **largest** and most diverse invertebrate group.
- ✓ Echinoderms are exclusively marine and show **radial symmetry** in adults.





# LEVELS OF CLASSIFICATION

Living things are grouped in a systematic hierarchy based on their similarities and differences.

| LEVEL                                                                                                                    | DESCRIPTION                                                                                                                                                                                             | EXAMPLE (HUMAN)                                                                                                                                       | HIERARCHY (BROAD → SPECIFIC)                                                                                                                                     |
|--------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>1 KINGDOM</b><br><br>(Largest Group) | <ul style="list-style-type: none"> <li>Highest taxonomic rank.</li> <li>Includes all organisms with basic similarities in cell structure, mode of nutrition, and other fundamental features.</li> </ul> | <b>Animalia</b><br>(Kingdom of Animals)<br>                         |  All animals belong to the Kingdom Animalia.                                  |
| <b>2 PHYLUM</b><br>                    | <ul style="list-style-type: none"> <li>Second highest rank.</li> <li>Organisms share a common body plan and fundamental organization.</li> </ul>                                                        | <b>Chordata</b><br>(Phylum Chordata)<br>                          |  Humans belong to Phylum Chordata (backbone present at some stage).          |
| <b>3 CLASS</b><br>                    | <ul style="list-style-type: none"> <li>Subdivision of a phylum.</li> <li>Organisms have more similar characteristics and internal organization.</li> </ul>                                              | <b>Mammalia</b><br>(Class Mammalia)<br>                          |  Humans belong to Class Mammalia (have mammary glands, hair, warm-blooded). |
| <b>4 ORDER</b><br>                    | <ul style="list-style-type: none"> <li>Subdivision of a class.</li> <li>Organisms are more closely related and share many similar traits.</li> </ul>                                                    | <b>Primates</b><br>(Order Primates)<br>                          |  Humans belong to Order Primates.                                           |
| <b>5 FAMILY</b><br>                   | <ul style="list-style-type: none"> <li>Subdivision of an order.</li> <li>Organisms are more closely related and have common characteristics.</li> </ul>                                                 | <b>Hominidae</b><br>(Family Hominidae)<br>                       |  Humans belong to Family Hominidae.                                         |
| <b>6 GENUS</b><br>                    | <ul style="list-style-type: none"> <li>Subdivision of a family.</li> <li>Includes very closely related organisms that are almost similar.</li> </ul>                                                    | <b>Homo</b><br>(Genus Homo)<br>                                  |  Humans belong to Genus Homo.                                               |
| <b>7 SPECIES</b><br>                  | <ul style="list-style-type: none"> <li>Lowest and most specific rank.</li> <li>Organisms can interbreed and produce fertile offspring.</li> </ul>                                                       | <b><i>Homo sapiens</i></b><br>(Species <i>Homo sapiens</i> )<br> |  Humans belong to Species <i>Homo sapiens</i> . (Only one human species)    |

## KEY POINTS

- Classification helps us to organize the vast diversity of living organisms.
- As we move from Kingdom to Species, the group size decreases and similarities increase.
- Binomial Nomenclature (written in italics) uses Genus + species name.

**Example:**  
*Homo sapiens*







# CLASSIFICATION OF **TIGER** & **PEA PLANT**

## TAXONOMIC HIERARCHY

Taxonomic hierarchy is a step-by-step system used by scientists to classify organisms based on their similarities and evolutionary relationships.



| TAXONOMIC LEVEL                                                                                                          |  <b>TIGER</b>                                                     |  <b>PEA PLANT</b>                                            |
|--------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>1 KINGDOM</b><br>(Highest Rank)<br>  | <b>Animalia</b><br>(Kingdom of Animals)<br>                      | <b>Plantae</b><br>(Kingdom of Plants)<br>                    |
| <b>2 PHYLUM / DIVISION</b><br>         | <b>Chordata</b><br>(Phylum Chordata)<br>                       | <b>Magnoliophyta</b><br>(Division Magnoliophyta)<br>       |
| <b>3 CLASS</b><br>                    | <b>Mammalia</b><br>(Class Mammalia)<br>                        | <b>Magnoliopsida</b><br>(Class Dicotyledonae)<br>          |
| <b>4 ORDER</b><br>                    | <b>Carnivora</b><br>(Order Carnivora)<br>                      | <b>Fabales</b><br>(Order Fabales)<br>                      |
| <b>5 FAMILY</b><br>                   | <b>Felidae</b><br>(Family Felidae)<br>                         | <b>Fabaceae</b><br>(Family Fabaceae)<br>                   |
| <b>6 GENUS</b><br>                    | <b>Panthera</b><br>(Genus Panthera)<br>                         | <b>Pisum</b><br>(Genus Pisum)<br>                          |
| <b>7 SPECIES</b><br><br>(Lowest Rank) | <b><i>Panthera tigris</i></b><br>(Species Panthera tigris)<br> | <b><i>Pisum sativum</i></b><br>(Species Pisum sativum)<br> |



### KEY POINTS

- ★ As we move from Kingdom to Species, the number of organisms in each group decreases.
- ★ Organisms in the same species are very similar and can interbreed to produce fertile offspring.
- ★ This system helps in the proper identification and study of living things.



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