



# TARGET PRELIMS 2024

## BOOKLET-37; S&T-11

### BIOLOGY BASICS-2

### CLASSIFICATION OF LIFE

#### 1. TABLE OF CONTENTS

1. <i>Table of Contents</i> .....	0
2. <i>Diversity in Living Organisms</i> .....	1
1) Introduction .....	1
2) The Hierarchy of Classification Groups .....	1
2) Animal Kingdom: Animalia .....	6
2) In-Vertebrates.....	8
Porifera:.....	8
B) Coelenterate (Cnidaria) .....	8
C) Platyhelminthes (Platy -> Flat and Helminth-> worm).....	9
D) Nematoda (Aschelminthes) .....	9
E) Annelids .....	10
E) Arthropods (Arthro -> Jointed; Pods -> Appendages).....	10
F) Mollusca.....	11
G) Echinoderms (Echina -> Spiny; Derm -> Skin) .....	12
H) Protochordates .....	12
3) Vertebrates .....	12
A) Fishes (Pisces) .....	12
B) Amphibians (Amphi – Dual; Bio - Life) .....	13
C) Reptiles (Rept is a Latin word which means “crawl”) .....	13
D) Aves.....	14
E) Mammals .....	14
4) Floral Diversity: Plant Kingdom .....	16
Thallophyta (derived from Thallus -> Undifferentiated plant body) .....	16
Bryophytes (Bryon -> Moss; Phyton -> plant) .....	17
C) Pteridophyte (Pteris -> Ferns; Phytos -> Plant).....	17
Spermatophytes (Dispersed by seeds) .....	18
A) Gymnosperms (seeds not enclosed) E.g., conifers .....	18
B) Angiosperms (Seed enclosed) E.g. Flowering Plants.....	18
3. <i>Summary Chart: Classification of Plants</i> .....	19

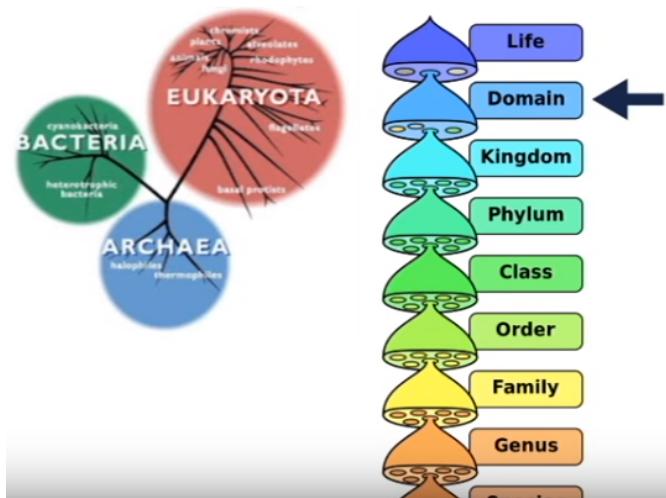
## 2. DIVERSITY IN LIVING ORGANISMS

### 1) INTRODUCTION

- Attempts at classifying living things into groups have been made since time immemorial.
  - Greek thinker **Aristotle** classified animals according to whether they lived on land, in water or in the air. This was a simple way of looking at life but misleading too.
- **Classification and Evolution**
  - Classification of life forms is closely related to the evolution. The living organisms which have evolved from same ancestor would tend to fall in the same group during classification.

### 2) THE HIERARCHY OF CLASSIFICATION GROUPS

- Various biologists have tried to classify all living organisms into broad categories, called the **Kingdoms**.
  - The classification Robert Whittaker (1969) proposed is widely used and has **five kingdoms**
    - Monera
    - Protista
    - Fungi
    - Plantae
    - Animalia
  - The number of Kingdoms were **expanded to 7 in 2015 by Ruggerio**. These are Monera, Archaea, Protozoa, Chromista, Fungi, Plants and Animals.
    - This classification also has **two super kingdoms** (Prokaryota and Eukaryota)
  - In 1990, a **three-domain system** (Archaea, Bacteria and Eukaryota) of biological classification was introduced by Carl Woese.
  - **More About Archaea** (or archaea bacteria)
    - Almost 10% of the life is found in the form of archaea. They are found almost everywhere (human gut, gut of a cow, extreme environment etc.)
    - **Key features**
      - They are prokaryotes (no nucleus or cell organelles)
      - **Cell wall present** (like bacteria)
      - **Membranes**

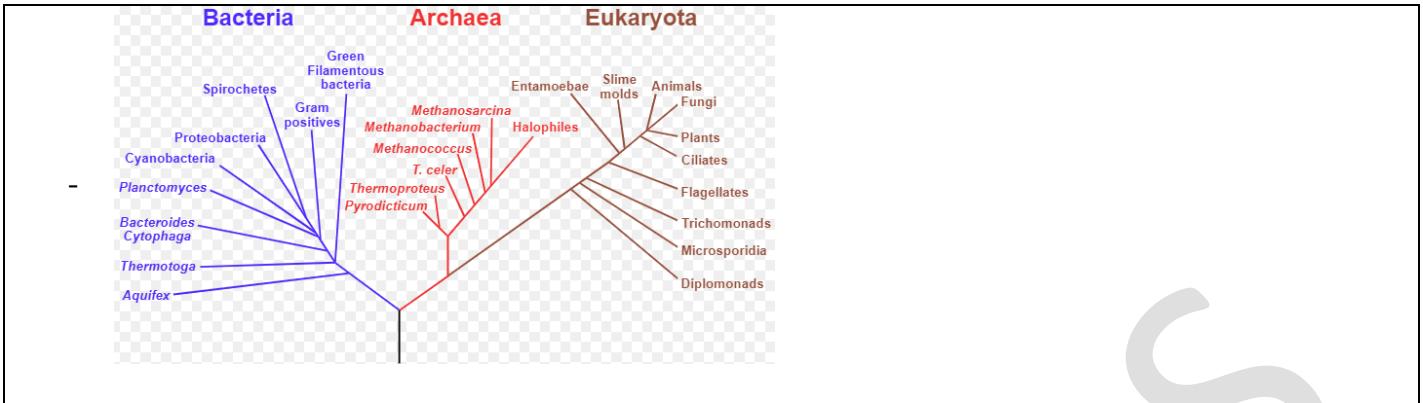


- **Metabolism** -> Phototrophs (e.g. halobacterium), Lithotroph (e.g. methanogen), Organotrophs (e.g. sulfolobus)
- **Many of these Archaea** are **extremophiles** (organisms that can thrive in extreme environments where most other forms of life can't live). This include glaciers, acid mine drainage and deep sea hydrothermal vents. Some categories of extremophiles are thermophiles, Psyhcrophiles, radio-resistant microbes, halophiles etc.
- The above groups have been formed based on the cell structure, mode and source of nutrition and body organization.
- **Further classification is done by naming the sub-groups at various levels** as given in the following scheme:
  - **Kingdom**
    - **Phylum** (For animals) / **Division** (for plants)
      - Class
      - Order
      - Family
      - Genus
      - Species
  - **Humans**
    - Kingdom: Animalia
    - Phylum: Chordata
    - Class: Mammalia
    - Order: Primates
    - Family: Hominidae
    - Genus: Homo
    - Species: Homo Sapiens
  - Thus, by separating organisms on the basis of a hierarchy of characteristics into smaller and smaller groups, we arrive at a basic unit of classification, which is a **species**.
    - Broadly, a species includes all organisms that are similar enough to breed and perpetuate.

In some recent classification mechanism **Domain** is considered the highest classification of life. The concept of domain was only introduced in 1990s, before which Kingdom held the highest rank of classification.

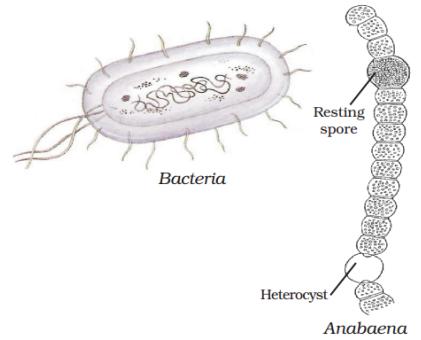
#### **Need of this classification:**

- Earlier all living organisms were divided into Prokaryotes (bacteria) and Eukaryotes (everything else).
- But, later it was found that some of the organisms which were earlier classified as bacteria, were from a completely different lineage. Though they were prokaryotes, they were not bacteria.
- This led to creation of three domains: **Eukarya, Bacteria and Archaea**.
- The domains highlight the enormous evolutionary differences among organisms. It was **Carol Woese** who separated Monera into bacteria and archaea and proposed a **three domain system**.
-



## 1) MONERA (MONERA AND ARCHAEA)

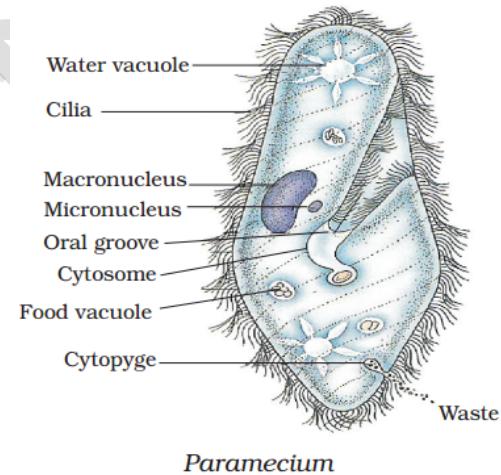
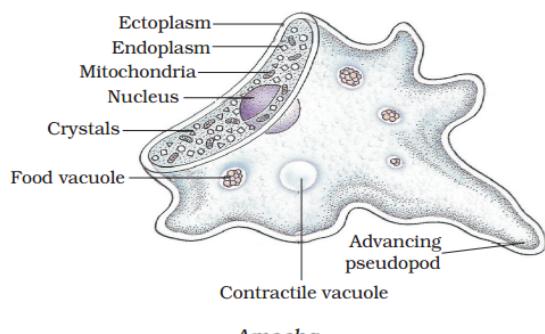
- All Prokaryotes are found in this Kingdom. Don't have a defined nucleus or organelles. Don't show multicellular body design.
  - Note: All Kingdoms except Monera have Eukaryotes
  - Show diversity based on other characteristics
    - Cells walls - some have some not.
    - Autotrophic or heterotrophic
  - E.g.: **bacteria**, blue green algae or cyanobacteria (it is considered a bacterium, and the term algae is reserved for Eukaryotic organisms only, it is autotrophic), mycoplasma (lacks a cell wall around their cell membrane), Anabaena (a genus of filamentous cyanobacteria, that exists as plankton)
  - **Spirulina: A wonder Food Supplement**
    - Spirulina is a blue green alga (family: Monera) that was earlier classified as a plant (algae) because of its richness in plant pigments as well as its ability to photosynthesize.
    - New understanding of its genetics, physiology and biochemical properties caused scientists to move it to the Bacteria Kingdom and the Cyanobacterium Phylum.
    - It is a free floating filamentous micro-algae that grow generally in oceans and salty lakes in subtropical climate.
    - It is cultivated worldwide and has been consumed for centuries for its high nutritional content and health benefits.
    - The nutritional value of Spirulina is well-recognized with its unusual high protein content (60-70% by dry weight) and its richness in vitamins (particularly B12) minerals, essential fatty acids, and other nutrients.
    - It is consumed in the form of capsules, tablets, flakes, syrups, or powder.
    - However, there is still not enough evidence to determine if spirulina supplements are safe. Medical studies are currently underway to verify spirulina as a dietary supplement and its potential health effects.
    - **Composition of Spirulina**
- |         |        |
|---------|--------|
| Protein | 60-70% |
|---------|--------|



Carbohydrate	16-20%
Lipid	5-7%
Mineral	6-9%
Moisture	2.5%-6%

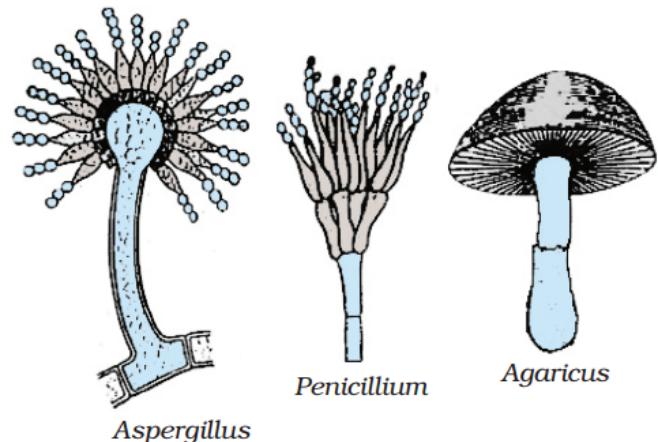
## 2) PROTISTA (OR PROTOZOA)

- Protista is a diverse group of Eukaryotic organisms that are not plants, animals, or fungi (It's a **hodgepodge category**, and eukaryotes that don't fit in plants, animals, and fungi are included in this category)
- They can be unicellular, multicellular or colonial. They can also be found in almost every habitat on earth.
- They can be autotrophic, heterotrophic, or mixotrophic and can produce both sexually and asexually.
- There are several major groups of Protists including:
  - i. **Algae:** Photosynthetic protists that range from single celled organisms to large multi-cellular seaweeds (it lacks cellular characteristics of plants and hence not classified as plants). They can be found in freshwater or marine ecosystems and are very important primary producers of aquatic ecosystem.
  - ii. **Protozoa:** They are heterotrophic protists and are typically unicellular and motile. They can be free living or parasitic. They play a significant role in nutrient cycling and as prey for other organisms. Some protozoa can cause diseases in humans and animals such as Malaria (Plasmodium falciparum) and sleeping sickness.
  - iii. **Slime Molds:** Protists that can exist as single cells or as large, multicellular aggregates. They are important decomposers in forest ecosystem.
  - iv. **Water Molds:** They are mostly parasitic and can cause diseases in plants and animals.
- They have significant economic and ecological importance (for e.g. algae are used as food sources for animals and humans. Others play significant role in health and biotechnology sector. Some of these organisms use appendage, such as hair like cilia or whip like flagella for moving around.



### 3) FUNGI

- These are heterotrophic, Eukaryotic organisms.
- They use decaying organic material as food and are therefore called **saprophytes**.
- Many of them have the capacity to become multicellular organism at some stage of life.
- They have cell walls made of tough complex sugar called chitin.
- **E.g.**
  - i. Yeast, Mushrooms, molds etc.
- Some fungal species live in permanent mutually dependent relationship with blue-green algae (or cyanobacteria). Such relationships are called Symbiotic. These symbiosis life forms are called **lichens**.
  - i. We have all seen lichens as slow-growing dark coloured patches on the bark of trees.



#### ▫ Recent Development

##### i. **Kirajadi / Yarsagambu / Yartsa gunbu**

- Scientific Name: Ophiocordyceps Sinesis (O. Sinesis)
- It is classified as medicinal mushroom.
- It is an entomopathogenic fungus (a fungus that grows on insects) found in mountainous regions of India, Nepal and Tibet
- It parasites larva of ghost moths and produces a fruiting body which is valued as an herbal remedy.
- The fungus germinates in the living larva, and kills and mummifies it, and then a dark brown stalk-like fruiting body which is a few centimetres long emerges from the corpse and stands upright.
- **Uses**
  - Used in traditional Asian medicines in countries such as Nepal, China, Bhutan etc.
  - In 2012, BBC magazine reported how it is transforming local economies in Himalayas.
- **Endangered in China**
  - Overharvesting and overexploitation has led to the classification of the specie as endangered in China.
- **Other names**
  - Caterpillar fungus, Yartsa Gunbu, etc.



### 4) PLANTAE

- **Autotrophic, Eukaryotic, mostly Multicellular with cell walls.**
  - They use chlorophyll for photosynthesis.

- Thus, all plants are included in this group.
- They all have cell walls made of cellulose.
- **Note:** Algae are classified under Protista, but some biologists classify multi-cellular algae under Plantae
- **Note:** Three of the five kingdoms have cell walls.
  1. **The Plant Kingdom:** All Plants have cell walls made up of cellulose.
  2. **The Fungi Kingdom:** Most fungi have cell walls made of Chitin, a complex carbohydrate that provides structural support and protection
  3. **The Monera Kingdom:** Bacteria and Cyanobacterium (also known as blue green algae) in Monera kingdom have cell walls made of peptidoglycan, a polymer made of sugars and amino acids that provides support and protection.

## 5) ANIMALIA

- Organisms which are multicellular eukaryotes without cell walls.
- They are all Heterotrophic.

**Note:** **Viruses** are not classified in any kingdom yet because they are not really alive. They only show signs of life

## 2) ANIMAL KINGDOM: ANIMALIA

- These are organisms which are Eukaryotic, multicellular, and heterotrophic.  
The Animal Kingdom is classified into several phyla, each with distinct characteristics and traits. The following are the major phyla of the Animal Kingdom:

1. **Porifera (Sponges)**
2. **Cnidaria**
3. **Platyhelminthes (Flatworms):** These are bilaterally symmetrical animals with flattened bodies and primitive nervous systems.
4. **Nematoda (Roundworms):** These are unsegmented, cylindrical animals with a complete digestive system.
5. **Annelida (Segmented Worms):** These are bilaterally symmetrical animals with a segmented body and a closed circulatory system.
6. **Mollusca (Snails, clams, octopuses):** These are soft-bodied animals with a muscular foot and a mantle that secretes a shell in some species.
7. **Arthropoda (Insects, spiders, crustaceans):** These are segmented animals with jointed legs and an exoskeleton made of chitin.
8. **Echinodermata (Starfish, sea urchins):** These are radially symmetrical animals with a spiny exoskeleton and a water vascular system.
9. **Chordata:** These are animals with a notochord, a dorsal nerve cord, and pharyngeal gill slits at some point in their development. Chordates include vertebrates and non-vertebrates like tunicates and

lancelets. Chordates are divided into three subphyla: Urochordata or Tunicata, Cephalochordata and Vertebrata.

### Chordata:

Chordates are a major phylum within the Animal Kingdom that includes animals that have a number of shared characteristics, including:

- 1) **Notochord:** It is a flexible rod-like structure that runs along the dorsal (back) side of the body, providing support and allowing for movement.
  - In vertebrate subgroup of chordates, the notochord develops into spine, and in wholly aquatic species this helps the animal swim by flexing its tail.
- 2) **Dorsal Nerve Chord:** A nerve cord that runs along the back of the body, and in some cases develops into spinal cord in vertebrates.
- 3) **Phryngeal Gill Slits:** Pouches in the pharynx region of the body that are used for respiration in aquatic species and may be modified for other functions in terrestrial species.
- 4) **Post-Anal Tail:** A tail that extends beyond the anus, present at some point in the life cycle of many chordates.
  - **Note:** In humans and apes, the tail is reduced to a tiny tailbone called 'Coccyx'.

- They can be broadly classified as **Vertebrates and Invertebrates**.
- **Vertebrates** are animals with backbones and spinal columns i.e. these animals have a **true vertebral column and internal skeleton**, allowing for a completely different distribution of muscle attachment points to be used for movement.
  - Vertebrates are bilaterally symmetrical, triploblastic (derived from three embryonic cell layers – ectoderm, mesoderm and endoderm), coelomic and segmented, with complex differentiation of body tissues and organs.
  - All chordates (Phylum) possess the following features
    1. Have a notochord
    2. Have a dorsal nerve cord
    3. Are triploblastic
    4. Have paired gill pouches
    5. Are coelomate
  - Vertebrates are the most advanced organisms on Earth. Although they represent a very small percentage of all animals, their size and mobility often allow them to dominate their environment. Vertebrates can further be classified into following **5 groups**
    - Fishes
    - Amphibians
    - Reptiles
    - Birds
    - Mammals



## 2) IN-VERTEBRATES

- Invertebrates are animals without backbones. More than 98% animal species in the world are invertebrates. Invertebrates don't have internal skeleton made of bone.
  - Many invertebrates have a fluid-filled, hydrostatic skeleton, like the jelly fish or worm.
  - Others have a hard-outer shell, like insects and crustaceans.
- Invertebrates can be classified as:

### PORIFERA:

- The word porifera means organisms with holes.
- These are non-motile animals attached to some solid support.
- There are holes or pores all over the body. These lead to canal system that helps in circulating water throughout the body to bring food and oxygen.
- These animals are covered with hard outside layers or skeleton.
- The body design involves very minimal differentiation and division into tissues. They are commonly called sponges and are mainly found in marine habitats.
- They are considered one of the simplest forms of multicellular animals and are found in both fresh water and marine environments.
- They are important aquatic animals – They provide habitat for other organisms and help filter water. They are also used in various industrial applications such as cleaning and polishing.

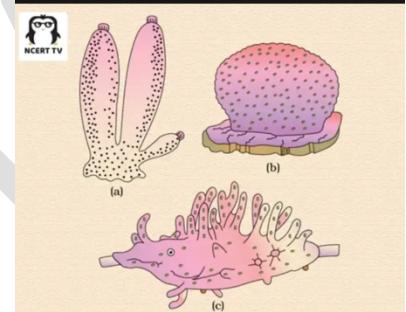
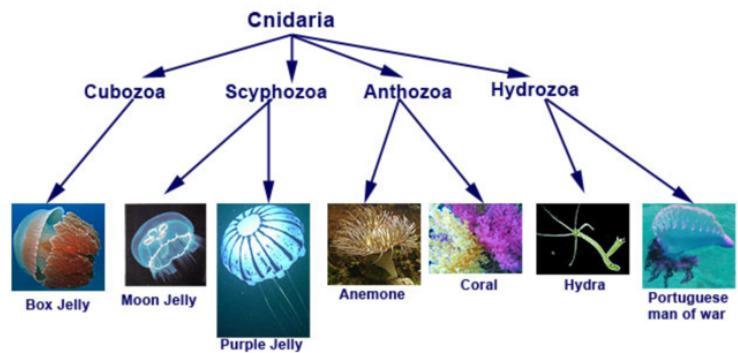


Figure 4.5 Examples of Porifera : (a) Sycon (b) Euspongia (c) Spongilla

### B) COELENTERATE (CNIDARIA)

- It is the phylum of organisms that include corals, anemones, hydroids and jelly fish.
- They were the first animals to move, sense and hunt.
  - They are characterized by tentacles. These tentacles allow organisms to move around and sense the surrounding environment. The cells on tentacles are called Cnidocytes. They are used to inject venom and paralyze the prey. It is due to the presence of Cnidocytes that the phylum is called Cnidaria.
- They are aquatic and mostly live in marine water and some in fresh water (e.g. Hydra).
- Some of these Cnidarias live attached life and are called Polyp (Greek word for attached).
- Other Cnidarians like jelly fish can move around.
- Their body is radially symmetrical.
- They show more body design differentiation.

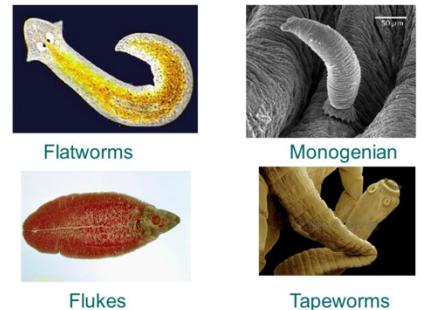


- They are **diploblastic organisms** as their embryonic body is made up of **two layers** of cells (outer Ectoderm and Inner Endoderm). One makes up the **cells on the outside of the body**, and the other **makes the inner lining of the body**.
- They have **tissue level organization** and were first animals to develop this. These animals also show **gastrovascular cavity** and **primitive nervous system**. The gastrovascular cavity has a **single opening**. Because of the presence of cavity, they are also called **Coelenterate** (Coel -> Cavity; and Enteron -> Intestine).
- Some of these species live in **colonies (Corals)**, while others have a **solitary lifespan (Hydra)**.

### C) PLATYHELMINTHES (PLATY -> FLAT AND HELMINTH-> WORM)

- **More complex** than Porifera and Coelenterate.
- The body is **bilaterally symmetrical**, meaning that the left and the right half of the body has the same design.
- There are **three layers of cells** (Ectoderm, Mesoderm and Endoderm) from which **differentiated tissues can be made**, which is why such animals are called **triploblastic**.
- This **allows outside and inside body linings** as well as some organs to be made. There is thus **some degree of tissue formation**.
- However, there is **not true internal body cavity** or **Coelom**, in which well-developed organs can be accommodated.
  - **Note:** Flat worms are the **only triploblastic organism**, which **don't have Coelom**.
  - Some flatworms have **rudimentary organs**.
- The body is **flattened dorsiventrally** (like ribbon), meaning from top to bottom, which is why these animals are called **flatworms**.
- **Either free living or parasitic**.
- Some of the members of this phylum are **harmful and can cause diseases**. They live like **endo-parasites** in humans or other organisms.
  - E.g. **Tape worm (Taenia solium)**, Liverflukes (*Fasciola*) -> infects liver
- Some of them can be useful as well **for e.g. Planaria** is used to feed on mosquito larvae and can be used to control mosquitoes.
- Some flatworms are **very long** (upto 90 feet)

### Phylum Platyhelminthes



Flatworms

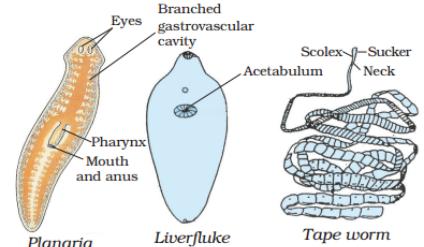
Monogenian



Flukes

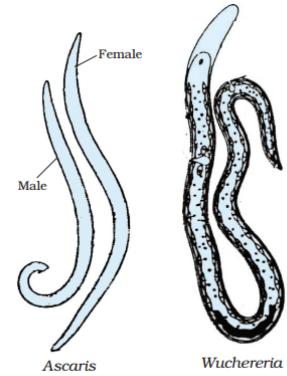


Tapeworms



### D) NEMATODA (ASHCHELMINTHES)

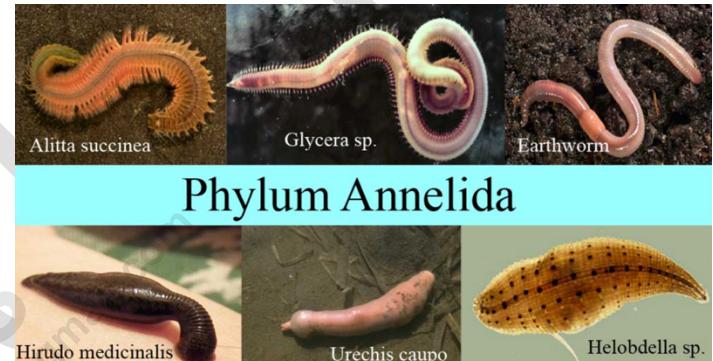
- The nematode body is also bilaterally symmetrical and triploblastic.
- However, the body is cylindrical rather than flattened. Thus, it is this phylum which saw the beginning of Coelom, but coelom is not truly developed and thus it is the only phylum which has false coelom or pseudo coelom.
- There are tissues, but no real organs, although a sort of body cavity or a pseudo-coelom, is present.
- These are very familiar as parasitic worms causing diseases, such as the worms causing elephantiasis (filarial worms) or the worms in the intestines (roundworms or pinworms).



**Fig. 7.15:** Nematodes (Aschelminthes)

### E) ANNELIDS

- They are defined as triploblastic, bilaterally symmetrical, metamerically segmented, a coelomate worm with a thin flexible cuticle around the body.
- They show a very important step in animal evolution -> Segmentation. Segments on annelids are usually ring like (Annulus is the Greek word of ring and hence the name Annelida)
- They are mostly aquatic; marine or fresh water; some are terrestrial, burrowing.
- Body organization is that of an organ system level.
- E.g.
  - **Earthworms** -> which help in ploughing of the land
  - **Leech** -> It sticks to the animal body to suck blood.



**Phylum Annelida**

### E) ARTHROPODS (ARTHRO -> JOINTED; PODS -> APPENDAGES)

- Probably the largest group of animals. They make upto 75% - 80% of the world's animal species and thus are most abundant.
- 
- These animals are bilaterally symmetrical and segmented.
- They have jointed legs (the word arthropods mean jointed legs).

<b>Segmentation</b> (Head, Thorax and Abdomen): This segmentation helps an organism to travel and protect its sensitive organs. Each segment has a pair of legs attached for smooth locomotion.	<p>A diagram of a beetle with labels indicating its anatomical regions: 'Head' at the anterior end, 'Thorax' in the middle, and 'Abdomen' at the posterior end. The thorax is shown with three pairs of legs attached to its segments.</p>
---	--

- They are triploblastic, and Coelomic (i.e., they possess true coelom or body cavity). There is an open circulatory system so the blood doesn't flow in well-defined blood vessels. The coelomic cavity is blood filled (therefore there Coelom is also called **Haemocoel**).

- They also have **an exoskeleton** which is hard, external skeleton made up of **Chitin**.
- They include cockroaches, crabs, butterflies, beetles, scorpions, shrimp, spider, lobster, lice, ticks, termites, potato bugs, and sea monkeys.
- Reproduction:**
  - Most of them are oviparous (egg laying) (e.g., butterfly)
  - Some are viviparous (give birth to young ones) (e.g., scorpions)

<p><b>Indirect Development:</b> In most arthropods, young ones are <u>totally different from adults</u> (these young ones are called Larvae) [E.g. Butterfly].</p> <p>The process of development of Larvae into an adult is called <u>Metamorphosis</u>.</p>	
<p><b>Direct Development:</b> Here larval stage is not included</p>	<p>E.g. Scorpions</p>

- Arthropods include animals such as **insects, crustaceans and arachnids**. Largest group of arthropods are the insects. The next largest group are crustaceans, including lobsters and crabs. The arachnids include spiders and ticks.
- **Insects** are the largest group of arthropods. Very adaptable, living almost everywhere in world. Exoskeleton that covers their entire body. Insects body consists of three parts: the head, thorax and abdomen.
  - e.g. Beetle, butterfly, moth, dragonfly, bee etc.
- **Crustaceans** live mostly in ocean or other waters. **Hard external shell** which protects their body.
  - E.g. Crab, lobsters and barnacle.
- **Arachnids: Spiders, Ticks and Scorpions**
  - Like other arthropods, the arachnids have a hard exoskeleton and joint appendage for walking. Most have four pairs of legs. Unlike other arthropods, arachnids do not have antenna.
  - E.g. spider, scorpion etc

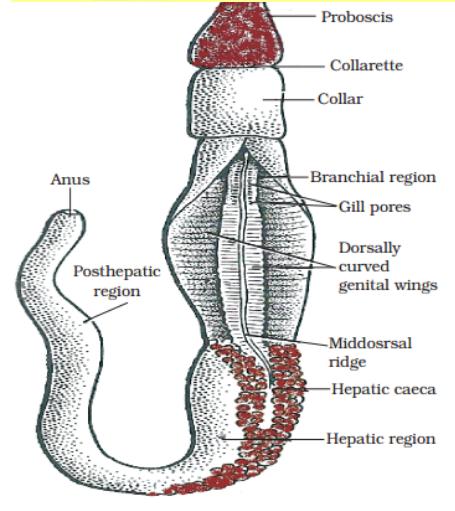
## F) MOLLUSCA

- This is the second largest phylum of the animal kingdom.
- In the animals of this group, there is bilateral symmetry (they can be asymmetric also)
- The coelomic cavity is reduced.
- Little segmentation
- There is an open circulatory system and kidney like organ for excretion.
- There is a foot that is used to move around.
- Most mollusks have a soft, skin like organ covered with a hard-outside shell.
- Some live on land such as snail or slug.
- Other mollusks live in water, such as the oyster, mussel, clam, squid octopus etc.



## G) ECHINODERMS (ECHINA -> SPINY; DERM -> SKIN)

- **Exclusively free-living marine animals** (All echinoderms are exclusively marine) [i.e. there are no freshwater or terrestrial echinoderms known yet]
- They are **triploblastic** and have a **coelomic cavity**.
- **Most have arms that radiate from the centre of their body.** Centre body contains **organs** and mouth for feeding.



## H) PROTOCHORDATES

- They are **informal category of animals**, named mainly for convenience to **describe invertebrate animals that are closely related to vertebrates**.
- These animals are **bilaterally symmetrical**, **triploblastic** and have a **coelom**.
- In addition, they show **a new feature of body design**, namely a **notochord**, atleast at some stages during their lives.
- The notochord is a **long-rod like support structure** (chord= string) that runs along the back of animal separating the nervous tissues from the gut. It provides **a place for muscle to attach for ease of movement**.
- Protochordates may not have a proper notochord present at all stages in their lives or for entire length of the animal.
- They are **marine animals**
- e.g. *Balanoglossus*, *Herdmania* and *Amphioxus*.

## 3) VERTEBRATES

Phylum Vertebrata can be divided into five classes (Fishes, Amphibians, Reptiles, Bird and Mammals)

### A) FISHES (PISCES)

- **Exclusively aquatic** (live in water)
- **Breathe in water using gills**, not lungs

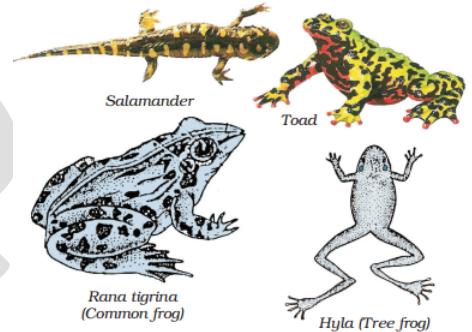
- **Cold blooded** (there body temperature change with change in environmental temperature)
- Have scales and fins
- **Lay many eggs.**
- **2 chambered heart**
- Body is streamlined, and a muscular tail is used for movement.
- **Many kinds of fish**
  - Some with skeletons made entirely of cartilage, such as sharks
  - Some with skeleton made of both bone and cartilage, such as tuna or rohu.

**Note:** Sometimes fish are divided into two different classes (based on the presence and absence of jaws; **Cyclostomes** -> Jawless fishes, they have sucker mouth e.g. Hag fish; **Pisces** -> Jawed fishes)

**Other differences:** Cyclostomes are only found in marine water. They don't have scales or paired fins.

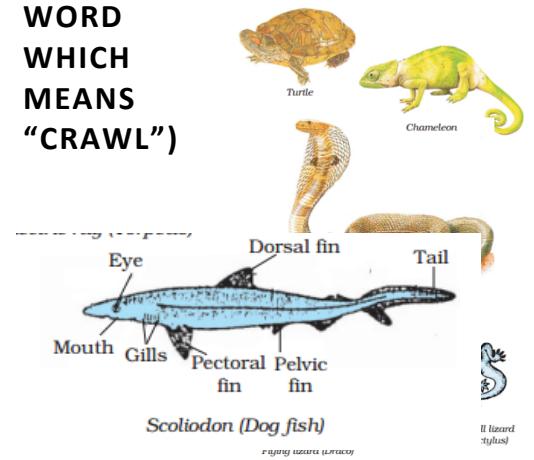
## B) AMPHIBIANS (AMPHI – DUAL; BIO - LIFE)

- **Differ from fish in lack of scale** and have a 3-chambered heart.
- Have Mucus glands on Skin -> Moist smooth skin
- **Cold blooded**
- Live on land & water
- Webbed feet
- Breathe with lungs and gills
- Four legs (sometimes none)
- **Lay many eggs**
  - These eggs are laid in water to avoid dehydration. Thus, the larvae initially have gills to breathe in water. These gills will be replaced by lungs in adult stage.
- **3 chambered hearts:** (Note: larvae has 2 chambers and adults have 3 chambers)
- E.g.
  1. Frogs, toads, and salamanders are some examples



## C) REPTILES (REPT IS A LATIN WORD WHICH MEANS "CRAWL")

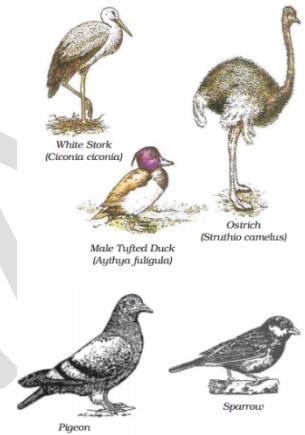
- These were the first terrestrial vertebrates.
- **Cold Blooded**
- Have scales (to protect them from sun and from abrasions while moving on ground)
- Have dry skin
- Usually lay eggs with tough coverings
  - Don't need to lay eggs in water, unlike amphibians.
- **Ear holes instead of ears**
- 4 legs or no legs.



- **Heart:** Most reptiles have **a three chambered heart**. Crocodilians have 4 chambered hearts, turtles have a three-chambered heart but with an incomplete wall in a single ventricle, so their heart is functionally four chambered.
- **E.g**
  - Snakes, turtles, lizards, and crocodiles are some examples

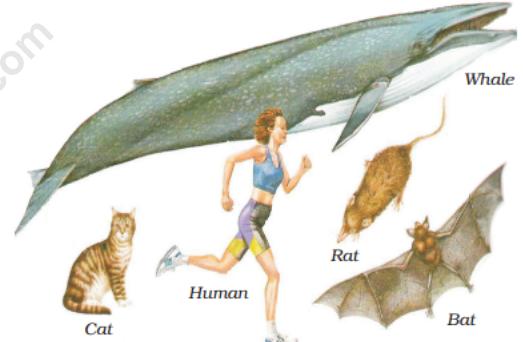
#### D) AVES

- **Have feathers:** Feathers are actually modification of scales from their ancestor reptiles. The older scales can still be spotted on the legs of birds. Feathers help in insulation and keep them warm.
- **Warm blooded:** Feathers allow birds to keep themselves at constant temperature. This warm blooded nature allow birds to face their environmental nature.
- **Wings:** In birds, the fore limbs are modified into wings. This helps birds to fly. They have hollow bones which reduce their body weight and allow them to fly easily.
- Lay eggs
- Have 2 legs
- Earholes instead of ears
- Breathe through lungs.
- **Four chambered heart** (all birds) -> to provide them continuous supply of large quantity of oxygen.



#### E) MAMMALS

- **Warm blooded**
- Have hairs or fur
- Skin has hairs as well as sweat and oil glands.
- Most give birth to live young mostly
  - **However**, a few of them, like the platypus and echidnas lays eggs and some like Kangaroos give birth to very poorly developed young ones.
- **Mammary glands:** Mammal mother's nurse the young ones with milk i.e. mammals have glands to give milk
- Breath with lungs
- Mammals live on all sorts of environment including the ocean, underground and on land.
- **Ears that stick out** (external ears evolved for the first time in Mammals)
- **Heart: 4 chambered heart (all mammals)**
- Blue whale is also mammal, so is bat.



**Fig. 7.25: Mammalia**

**Note:** Amphibians, Reptiles, Birds and Mammals are together called **Tetrapods**. They have two forelimbs and two hindlimbs.

Adult snakes don't have limbs, but extremely young snake embryos do). Ancestors of today's snakes once sported full-fledged arms and legs, but genetic mutations caused the reptiles to lose all four of their limbs about 150 million years ago.

**LevelUpIAS**  
Dnyaneshwar.mogal.ias@gmail.com  
8421928891

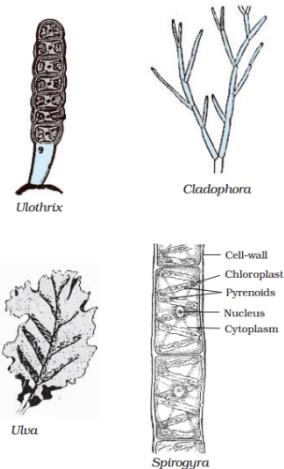
## 4) FLORAL DIVERSITY: PLANT KINGDOM

- **General Features:**
  - » Eukaryotic
  - » Multicellular
  - » Non-motile (Sedentary)
  - » Cell walls (Cellulose)
    - Thus, the most abundant sugar on earth is cellulose.
  - » Autotrophic
- In terms of **plant diversity**, India ranks tenth in the world and fourth in Asia. India represents nearly 11% of the world's known floral diversity.
- **Plant Kingdom** is classified in various sub-categories on the basis of following features:
  - » Extent of Differentiation of plants parts like stem, roots, leaves etc.
  - » Presence of special tissues (Xylem and Phloem)
  - » Ability to bear seeds
  - » Naked Seeds and Fruits enclosed seeds
  - » Ability to produce **flowers**
- **On the above grounds**, plants have been classified into five divisions:



### THALLOPHYTA (DERIVED FROM UNDIFFERENTIATED PLANT BODY)

- Plants that **don't have well differentiated body design** fall in this group. They are not differentiated between roots, stems and leaves. The plants in this group are commonly called algae. The plants are predominantly aquatic.
  - Please note: In Protista we have unicellular algae, and generally all multicellular algae are put in Plantae Kingdom.
- **Features:** Eukaryotic, Multicellular, non-motile, cell walls made of cellulose, autotrophic.
- E.g. Spirogyra, Ulothrix, Cladophora, Ulva, Chara etc.
- **Usefulness of Thallophyta in our life:**
  - Seaweeds can be used for food purpose (soup made of sea weeds is popular in Korea and Japan)
  - Production of Biofuels



- Anti-biotics development
  - Gellies that we get in icecreams and other sweets are extracted from an organism called Gelatin which is a Thallophyta.
- **Harmful Algae's:**
- **Karenia Brevis** is an alga which produces toxin and is harmful for aquatic life.
  - **Eutrophication (algal bloom)**

### BRYOPHYTES (BRYON -> MOSS; PHYTON -> PLANT)

- They are part of Bryophyta division of Kingdom Plantae.
- Have **well differentiated body parts** like stems and leaves.
- However, no specialized tissue for conduction of waters and other substances from one part of the plant body to another.
- **Reproduction through Spores** (not seeds). All Bryophytes reproduce through spores and not seeds.
- E.g. Moss (Funaria), Marchantia, Liverworts, Hornworts, Mosses)

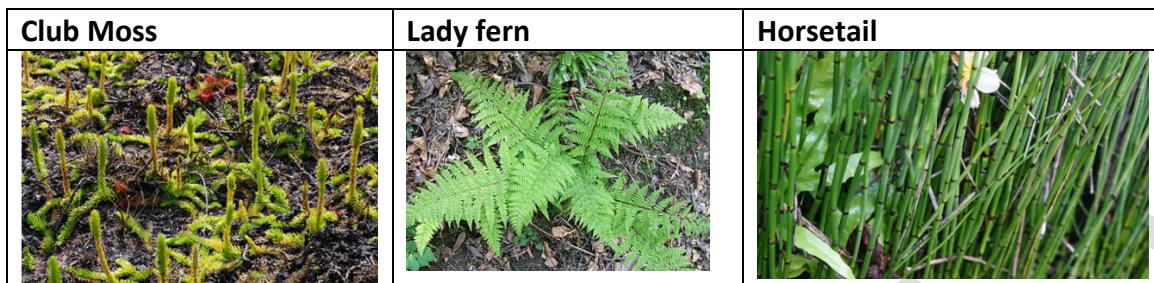
Mosses	Liver Worts
	

- They cannot circulate rainwater through their stems and leaves but must absorb it from environment that surrounds them. Therefore, they would be found in moist environments and not dry conditions. The plant body is differentiated into a small stem and simple leaves, but true roots are absent.
- **Note:** Ally Bryophytes reproduce through spores and not seeds.
- Bryophytes are the second largest group of green plants in India distributed largely in Eastern Himalaya, North-Eastern India, Western Himalaya and the Western Ghats.
- Mosses consist of the major component of Indian bryo flora followed by liverworts and hornworts.

### C) PTERIDOPHYTE (PTERIS -> FERNS; PHYTONS -> PLANT)

- They are the most basic vascular plants – having simple reproductive system lacking flowers and seeds.
  - **Vascular Plants:** Have specialized tissues for conduction of water and other substances from one part of the plant body to another. (Xylem and phloem).
- **Well Differentiated body parts:** Well differentiated plant body into **roots, stem and leaves**.
- **Reproduction through Spores.** Produce **neither flowers nor seeds**, so they are referred to as **Cryptogams**.

- Most of them are terrestrial plants flourishing well in moist and shady places (thus avoiding sunlight), and some of them are aquatic. This group include vascular cryptogams like club-mosses, horse-tails and ferns which are universally distributed all over the world.



- Note:** About 1/3<sup>rd</sup> of the Pteridophytes are epiphytes (i.e., they grow on other plants)
- Note:** **Thallophyte, Bryophytes and Pteridophytes** are called Cryptogams. This is because they have hidden (Crypto) reproductive organs. These plants are flowerless and seedless.
- In India,** the north-eastern region (including eastern Himalaya) is rich in pteridophytes diversity, followed by south India (including eastern and western Ghats) and north India (including western Himalayas)

## SPERMATOPHYTES (DISPERSED BY SEEDS)

### A) GYMNOSPERMS (SEEDS NOT ENCLOSED) E.G., CONIFERS

- Group of seed producing plants that include conifers, cycads, Ginkgo and Gnetales. (Origin of word: Greek, gymnos: naked, sperma: seed). This is named so after the unenclosed condition of their seeds. The naked condition of seeds of gymnosperm stands in contrast to the seeds and ovules of flowering plants (angiosperms), which are enclosed within an ovary. In Gymnosperms ovules are present on the surface of the megasporophylls and are directly pollinated by the pollen grains. There is nothing like ovary, style, and stigma, and naturally there is no fruit.
- E.g., Pines, Deodar, Cycads (look like palm tree, but they are not. Palms are angiosperms)



### B) ANGIOSPERMS (SEED ENCLOSED) E.G. FLOWERING PLANTS

- The word is made from two Greek words: angio means covered, and sperma - means seed.
- Angiosperms, the flowering plants are the most diverse group of land plants. Angiosperms are the seed producing plants like the gymnosperms and can be distinguished from the gymnosperms by characteristics including flowers, endosperm within the seeds, and the production of fruits that contain the seed.
- These are the most highly developed plants which bear flowers having conspicuous accessory and essential whorls.
- Carpels have the ovary, style and stigma. With the stimulus of fertilization the ovary generally develops into fruit and the ovules in seeds. Thus, the seed remains within the fruit.

- Plant embryos in seeds have structure called **cotyledons**. Cotyledons are called 'seed leaves' because in many instances they emerge and become green when the seed germinates.
  - Thus, cotyledons represent a bit of pre-designed plant in the seed.
- The angiosperms are divided into **two groups on the basis of number of cotyledons** present in the seed.
  - **Monocotyledons/ monocots:** Plants with seeds having a single cotyledon (embryonic leaf). They are generally grass and grass-like flowering plants. (E.g. wheat, rice maize etc are a monocotyledons). Other economically important monocotyledons include Palms, Bananas, gingers, turmeric, onion, garlic etc.
  - **Dicots:** Plants with seeds having two cotyledons are called dicots.



<b>Monocots</b>				
Embryos	Leaf venation	Stems	Roots	Flowers
 One cotyledon	 Veins usually parallel	 Vascular bundles usually complexly arranged	 Fibrous root system	 Floral parts usually in multiples of three
<b>Dicots</b>				
 Two cotyledons	 Veins usually netlike	 Vascular bundles usually arranged in ring	 Taproot usually present	 Floral parts usually in multiples of four or five

- India has more than 7% of the world's known flowering plants

### 3. SUMMARY CHART: CLASSIFICATION OF PLANTS

