DIVERSITY IN LIVING ORGANISM

CONTENTS

➢ CLASSIFICATION

The method of arranging organisms into groups on the basis of similarities & differences is called classification.

➢ TAXONOMY

The taxonomy is the study of diversity & kind of organism & the evolutionary relationship among them.

➢ BASIS OF CLASSIFICATION

Some examples of such characters, used in grouping and sub-grouping of organisms, are as follows :

◈ **Cells are prokaryotic or eukaryotic :**

- Organisms may be grouped into two broad categories on the basis whether they possess prokaryotic cells or eukaryotic cells. In case of prokaryotic cells the nuclei and other organelles are not clearly developed. The eukaryotic cells, on the other hand, have membrane-bound organelles, including a nucleus.

◈ **Cells occur singly or in clusters :**

- Many organisms are unicellular, *i.e.*, made up of only one cell, *e.g. Amoeba*. Others are multicellular. *i.e.*, cells groups together to form single organism (*e.g.*, insect). In case of multicellular organisms the different groups of cells carry out specialized functions.

◈ **Organism is photosynthetic or takes food from outside** :

- Green plants perform photosynthesis and synthesise their own food. Animals cannot perform photosynthesis. They get food from outside.

◈ **Organisation of different body parts :**

- Grouping of organism may be done on the basis of body organization. For example, plants possess stem, root and leaves. Similarly, the animals possess specialized organs to perform different functions. The characteristics based on body design used for classification of plants is quite different then used for classifying animals.

➢ HIERARCHY OF CLASSIFICATION GROUPS

In classification, the organisms that closely resemble one another are placed in a group. These groups are further placed in larger groups on the basis of close similarities. The larger groups are again placed in still larger groups. The various grouping levels or ranks in classification are known as categories. Each category has its specific name. There are seven major categories.

- Species
- Genus
- Family
- Order
- Class
- Phylum (for animals)/division (for plants)
- Kingdom

Species :

- Species is the lowest category regarded as **basic unit of classification**. It is a group of similar individuals which resemble with each other in morphology, breed among themselves but not with others and probably descended from a common ancestor.

Genus :

- A genus is a group of closely resembling spcies having a common ancestry. All the species in a genus show similarities in broad features of their organization but differ in minor details.

Family :

- A family represents a larger group of closely related genera. It is composed of one or more genera. For example, the genus *Felis* of cats and the genus *Panthera* of lion, tiger and leopard are placed in the family *Felidae* because all these animals have retractile claws.

Order :

- An order is a group of closely related families. For example, the family Felidae (that includes cats) and the family canidae (that includes dogs) are assigned to the order carnivore because both cats and dogs have large canine teeth and are fleash eaters.

Class :

- A class is a group of related order.

Phylum/Division :

- Phylum (in case of animals) or Division (in case of plants) is a group of related classes.

Kingdom :

- Kingdom is the highest category in biological classification. It is a group in Phyla (in case of animals) or divisions (in case of plants).

- The various categories used in biological classification can be arranged in a hierarchy (*i.e.*; ranked one above the other). It was introduced by Linnaeus and is, therefore, called Linnaenan hierarchy. The hierarchy indiciates the various levels of Kinship (*i.e.*, relationship by blood). Nearer the categories in hierarchy the greater is the similarity between their organisms. The hierarchy of major categories is given below -

Kindom

Phylum/Division

(for animals) (for plants)

Class

Order

Family

Genus

Species

➢ BINOMIAL NOMENCLATURE

- Proposed by Carolus Linnaeus.
- According to this system of nomenclature, each animal or plant is given two names : the first one is the generic name and the second one is the name of the species.
- Scientific names are always in *Latin*.

- The first letter of the generic name is always capitalized and that of the specific name is written in small letter. For example, the scientific name of frog is *Rana tigrina*, in which *Rana* is the generic name and *tigrina* is the name of the species.

◈ **Two Kingdom Classification :**

- Father of taxonomy - Carolus Linnaeus. He preposed following kingdoms.
  Plantae :
- Which included Bacteria, Fungi, Algae, Mosses, Liverworts, Ferns, Conifers and Flowering plants.
  Animalia :
- Included Protozoan, Sponges, Jelly fishes, Worms, Crabs, Insects, Millipedes, Centipedes, Spiders, Snails, Star fishes, Snakes, Frogs, Birds and Mammals.

◈ **Three Kingdom Classification :**

- This was suggested by german biologist, **E. Haeckel** in 1866.
- As some microscopic single celled forms were unlike plants or animals altogether and could not be placed in earlier system, thus three kingdom system was proposed. It includes (1) plantae, (2) Animalia, (3) **Protista** ... contained all single celled organisms like protozoans and unicellular algae.

◈ **Four Kingdom Classification :**

- This was developed by **Copeland** in 1966.
- As prokaryotes (Organisms without true nucleus) were different from eukaryotes (organism with true nucleus), a new group, **monera** was formed.

◈ **Five Kingdom Classification :**

- This most favoured scheme was proposed by **R.H. Whittaker** in 1969. Fungi could not find a suitable place in earlier system of classifications and thus whittaker's five kingdom theory found favour amongst most biologists.
- This classification includes :

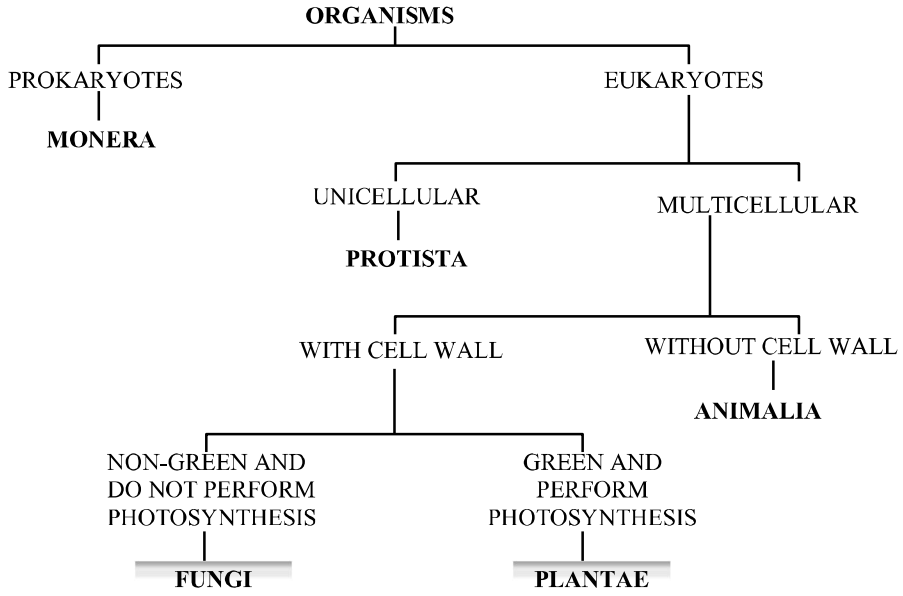
  (a) Plantae (b) Animalia

  (c) Fungi (d) Protista

  (e) Monera.

◈ **Six Kingdom Classification** :

- It was proposed by Woese, Kandler and Wealis (1990). They divided monera into Archae bacteria and Eubacteria.



◈ **Kingdom : Monera (Gk. Monos – Single)**

Kingdom, Monera includes the most ancient, the smallest, the simplest and the most plentiful **prokaryotes**. These organisms are most primitive. Monerens are characterized by the following.

- The organisms are mostly unicellular. The cyanobacteria are, however, filamentous.
- They do not have a definite nucleus. The genetic material is a circular, double-stranded, helical DNA (Deoxyribonucleic acid) not enclosed by a nuclear envelope. Such organisms which do not have a definite nucleus are called **prokaryotic**.
- The cytoplasm of organisms is devoid of membrane bound organelles, *i.e.*, mitochondria, plastids, Golgi apparatus, lysosomes, endoplasmic reticulum, centrosome, etc. are lacking. However, the ribosomes are present.
- Cell wall is generally present. some of prokaryotes do not have cells wall.
- The mode of nutrition of organisms in this group can be either : (i) **Autotrophic** (*i.e.*, synthesize their own food by photosynthesis) or (ii) **Heterotrophic** (*i.e.* get their organic food from the environment).
- Single stranded flagella are present in many monerans. Kingdom Monera includes true bacteria, actinomycetes, cyanobacteria or blue green algae, mycoplasma and archaebacteria.

◈ **Kingdom : Protista (Gk. Protistos-First of all) -**

Kingdom Protista includes unicellular eukaryotic organisms. They are characterized by the following :

- Protists are mostly aquatic and live wherever there is water.
- The cell structure is typically eukaryotic. The protoplasm is surrounded by a distinct plasma membrane. In addition, some protists have an outer covering of pellicle, cuticle, shell or cellulose wall.
- The genetic material is the linear, double-stranded, helical DNA, complexed with proteins, organized into dinstinct chromosomes. The chromosomes are enclosed by nuclear envelope. Nucleolus is present.
- The cytoplasm contains memberane bound organelles such as mitochondria, plastids, Golgi bodies, endoplasmic reticulum, ribosome, etc.
- Their mode of nutrition can be autotrophic or heterotrophic.
- Motile protists move from one place to another with the help of pseudopodia, flagella or cilia.

Unicellular protists have been broadly divided into ***three*** major groups.

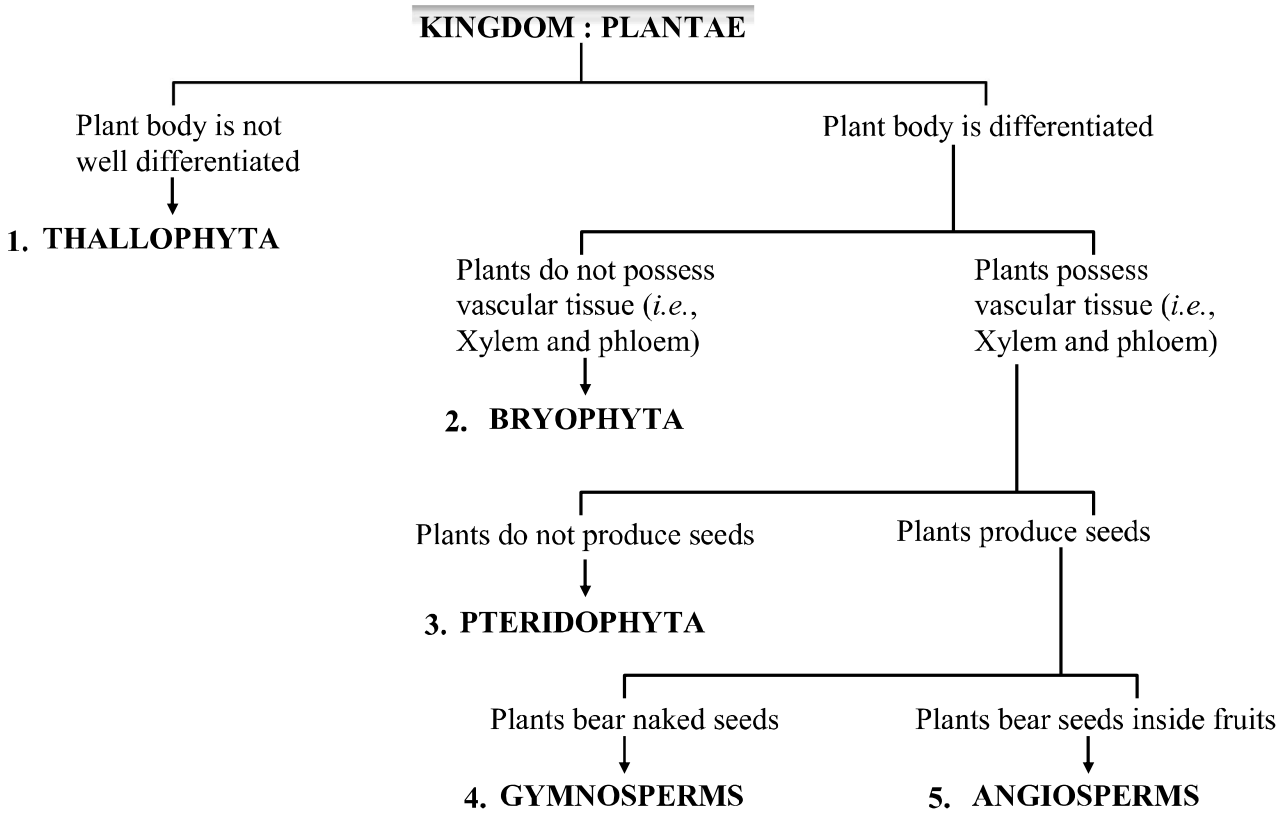
- The protistan algae – eg., euglena, diatoms
- Slime moulds
- Protozoan protists – amoeba paramecium

◈ **Kingdom : Fungi -**

- Fungi are multicelled, non photosynthetic organism.
- Some fungi are microscopic while others can be seen with the naked eyes.
- Some fungi are unicellular while others are multicellular consisting of numerous filaments known as hyphae.
- The hyphae branch profusely and from a network called mycelium.
- Since fungi Lack chlorophyll they can't synthesise their own food and therefore they either lead a parasitic or sporophytic life.
- The Parasitic fungi may infect the host superficially or they may penetrate the host tissues (Ectoparasite and endoparasite).
- The fungi develop haustoria which help in absorption of nutrients from the host. Ex. mucor

KINGDOM PLANTAE & ANIMALIA

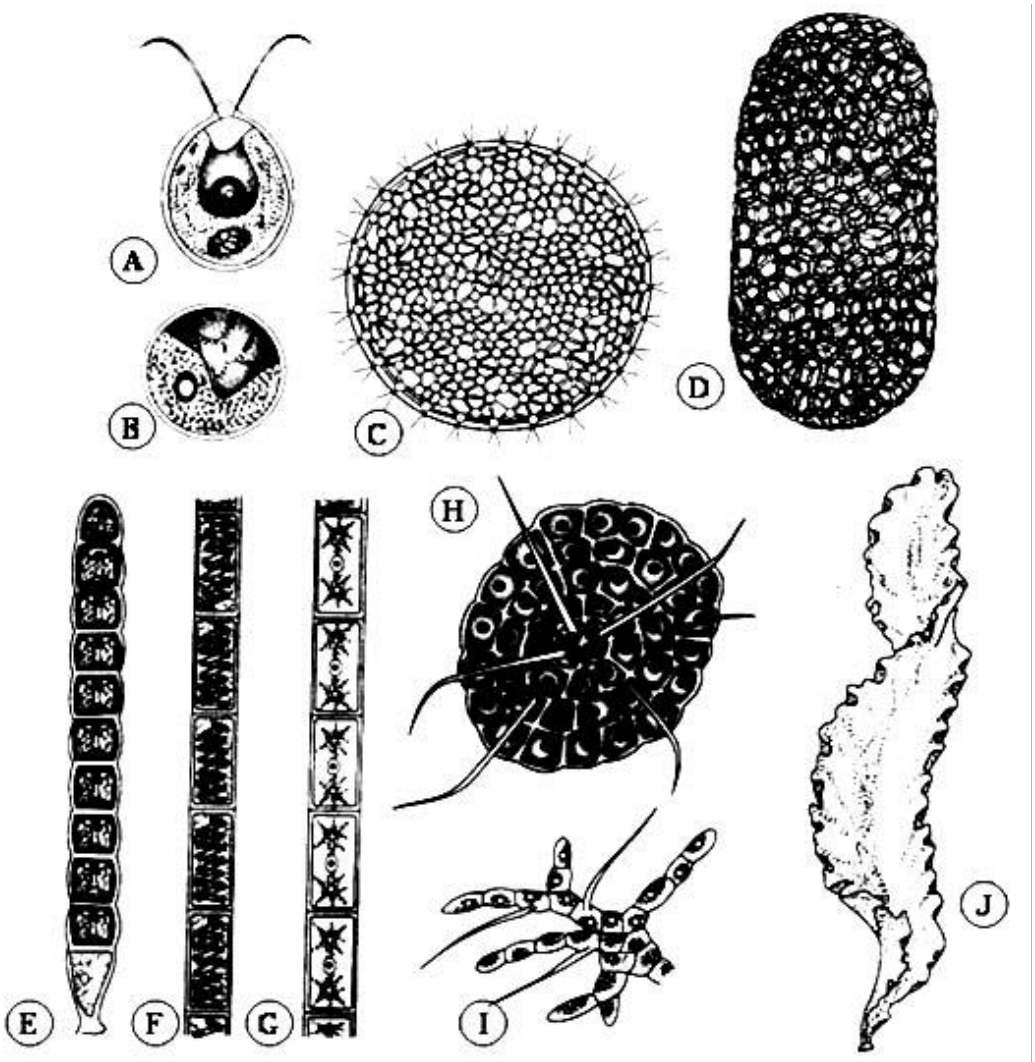
◈ **Kingdom : Plantae of Plant Kingdom -**



Division : Thallophyta (Algae) -

The plants in this divisions are commonly called **algae**. The terms "Algae " was coined by C. Linnaeus which means 'sea weeds'. The division is characterized by the following :

- The division comprises of most primitive and simple plants not differentiated into true roots, true stem and true leaves. Therefore, they are **thalloid** (thallus-like) and placed under the division-**thallophyta**.
- They are predominatly aquatic, occur both in marine (sea water) as well as fresh water habitats. However, some are terrestrial and grow in moist places.
- Algal cells possess photosynthesis. Thus, the algae are photoautotrophs.
- Some algae have additional accessory pigments of other colours (such as red, brown, yellow, etc.) and accordingly they have beeen classified into different groups. such as green algae, red algae, brown algae etc.).
- The plants are thalloid (figure). The plant body may be unicellular (Chlamydomonas, Chlorella), colonial (*Volvox*, *Hydrodictyon*), filamentous unbranched (*Spirogyra*, *Ulothrix*), filamentous branched (*Chara, Cladophora*), heterotrichous (*Ectocarpus*) or foliaceous (*Laminaria*, *Ulva*, *Fucus*, *Sargassum*).

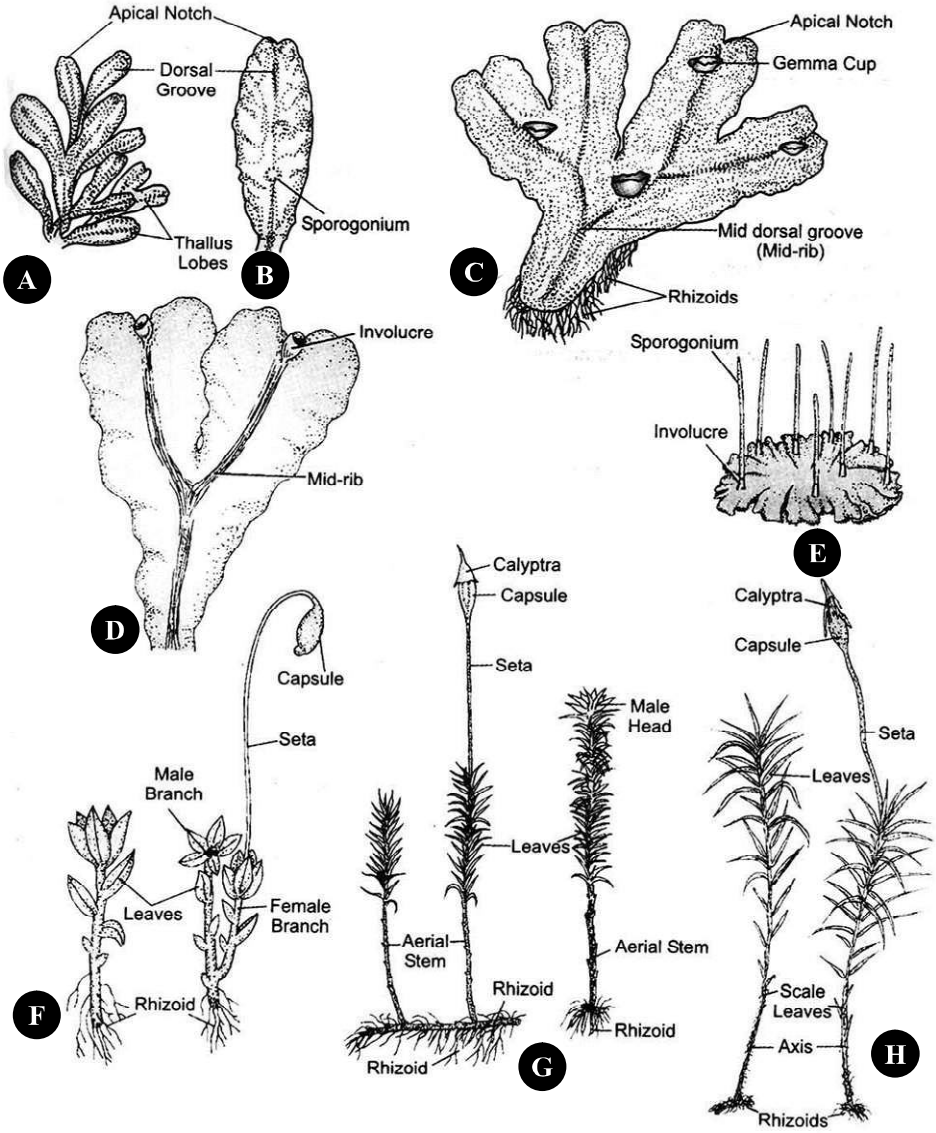


Algae A. Chlamydomonas, Bh Chlorella, C Volvas, D Hydrodictyon
E. Ulothrix, F. Spirogyra, G. Zygnema, H. Coleochaete scutata

- The reproductive organs are unicellular non-jacketed gametangia. The contents of reproductive structure are completely converted into spores or gametes.
- After fertilization, embryo is not formed.

Division : Bryophyta -

- The division **Bryophyta** (Greek word *Bryon* = moss **;** *phyton* = plant) includes the simplest and most primitive non-vascular land plants having an embryo stage in their life cycle.
- The plants are essentially terrestrial but require water at every step in the life cycle. They usually grow in moist and shady places – on the sides of ditches, ponds, pools, lakes; on the banks of streams; damp soil; wet hills and many other similar habitats. They are called **amphibians of the plant kingdom**.
- The main plant body is **gametophyte** (haploid body responsible to produce gametes). It is flat, green thallus and lacks true leaves and roots. Plants are fixed by means of hair-like **rhizoids.**
- The vascular tissues (xylem and phloem) are completely absent.
- Sex organs are multicellular. The male sex organs are **antheridia** and female sex organs are **archegonia.**
- An **embryo** is formed upon fertilization. Sporophyte lives as a parasite over gametophyte.
- Examples (figure) Liverworts (*Riccia*, *Marchantia*), hornworts (*Anthoceros*) and Mosses (*Funaria*, *Polytrichum.*



A- Bryophytes, B- Riccia, C- Marchantia, D- Pellia, E-Anthoceros, F-Funaria, G-Polytrichum, H-Pogonatum

Division Pteridophyta :

- They are found mainly in shady or damp places.
- The plant body is made up of root, stem and leaves.
- They have well developed vascular system.
- These plants have no flowers and do not produce seeds.
- Sex organs are multicellular and jacketed by sterile cells.

Dryopteris

- Club mosses - *Selaginella*, *Lycopodium* ("ground pine"); horsetails - *Equisetum*; and ferns - *Marsilea*.

Gymnosperm :

- The seeds produced by these plants are naked and are not enclosed within fruits.

  (i) Cycadae, e.g. *Cycas* etc.

  (ii) Coniferae, e.g. *Pinus*, *Ginkgo*, etc.

Cycas

PTERIDOPHYTES	GYMNOSPERMS
1 Vascular tissue are present but secondary growth is absent.	Vascular tissues are present and secondary growth is present.
2 Ovule and seeds are not formed.	Ovule and seeds are formed.

Angiospermae :

- Angiosperms are highly evolved plants and they produce seeds that are enclosed within the fruit.
- The reproductive organs are aggregated in a flower.

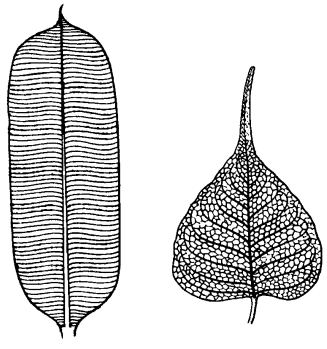
Angiosperms

Dicotyledonae (Dicots) | Monocotyledonae (Monocots)

❑ **Dicotyledonse -**

- The seeds produced by these plants have embryos with two fleshy leaves, the cotyledons.
- Their leaves have reticulate venation, with a network of veins.
- The root system has a prominent tap root.

Examples : Pea (*Pisum sativum*), potato (*Solanum tuberosum*), sunflower (*Helianthus annuus*), rose (*Rosa indica*), banyan (*Ficus religiosa*), neem (*Melia indica*), apple (*Malus silvestris*).



Parallel Pinnate **Reticulate Pinnate**

VENTION IN LEAVES

❑ **Monocotyledonse -**

- The seeds of these plants have only one cotyledon.

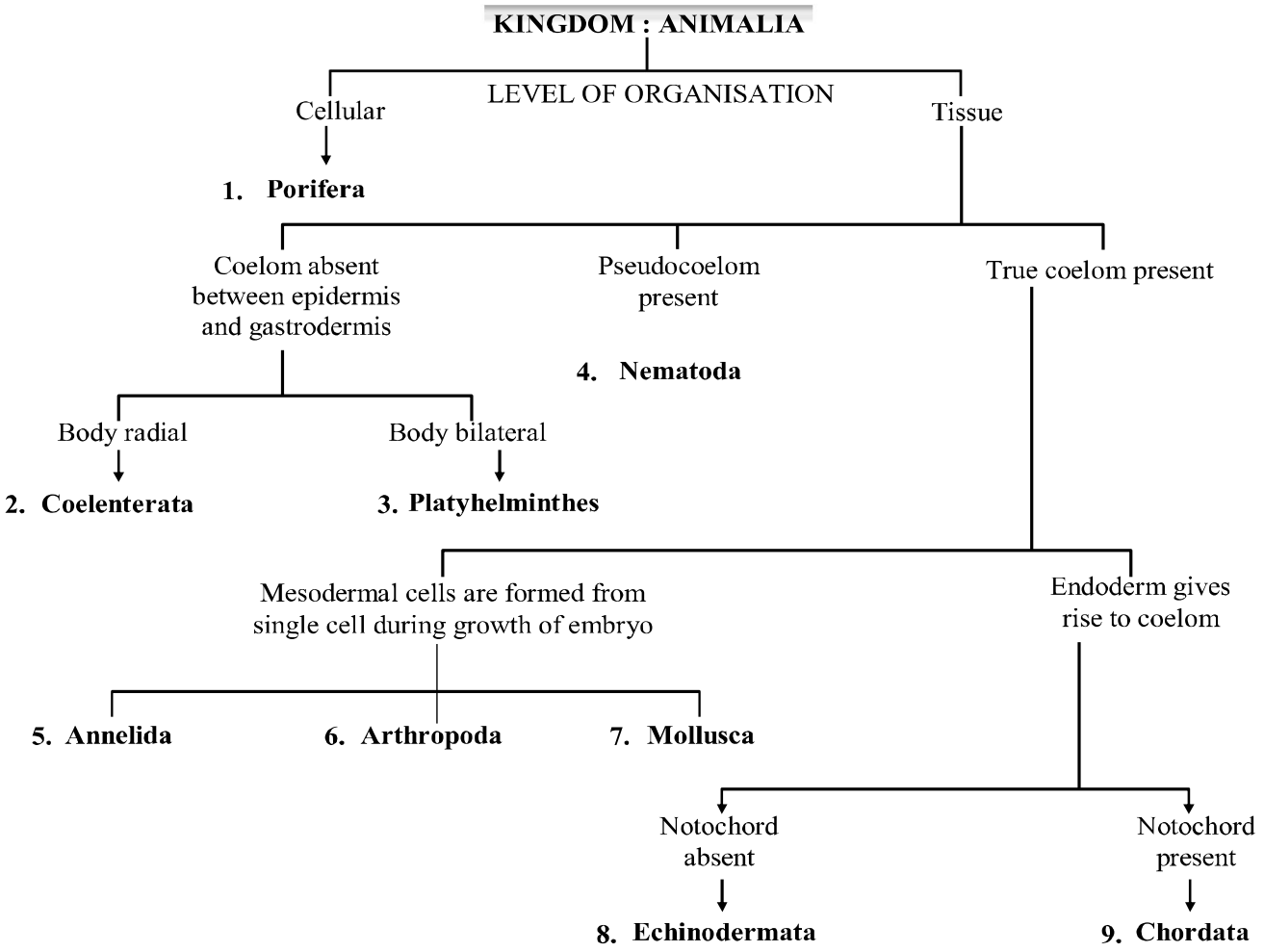
- Their leaves have parallel venation.
- The root system consists of similar fibrous roots.
- The vascular bundles are scattered and closed (i.e. lack cambium). Secondary growth does not occur.
- **Examples :** Maize (*Zea mays*), Wheat (*Triticum vulgare*), rice (*Oryza sativa*), onion (*Allium cepa*), sugarcane (*Saccharum officinarum*), barley (*Hordeum vulgare*), banana (*Pandanus*), Coconut and grasses.

MONOCOTS	DICOTS
1 Parallel venation is present in leaf.	Reticulate venation is present in leaf.
2 Embryo consists of only one cotyledon.	Embryo consists of two cotyledons.
3. Example - **Maize**	Example - **Pea**

◈ **Kingdom : Animalia or Animal Kingdom -**

Characters of the Kingdom : Animalia :

- These organisms are multicellular, eukaryotic and without chlorophyll.
- The cells possess no cell walls and plastids.
- Central vacuoles are absent but small vacuoles may occur.
- Most of them are free moving (except sponges and some coelentrates)
- Nutrition is primarily ingestive.
- Reproduction is generally sexual and the haploid stage is represented only by gametes.
- Growth of organisms stops when the adult stage is reached.



Phylum - Porifera :

- Sessile (stalk-less) and marine except one group that lives in fresh water.
- Simplest multicellular, diploblastic animals.
- Have organisation at cellular colony level. Thus, cells are loosely held together and do not form tissues.
- Asymmetrical or radially symmetrical. Sponges may be vase-like, rounded, sac-like branched.
- Body is perforated by numerous pores, the ostia that open into a canal system having canals and chambers lined with collared flagellated cells or choanocytes.

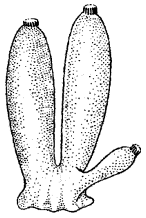
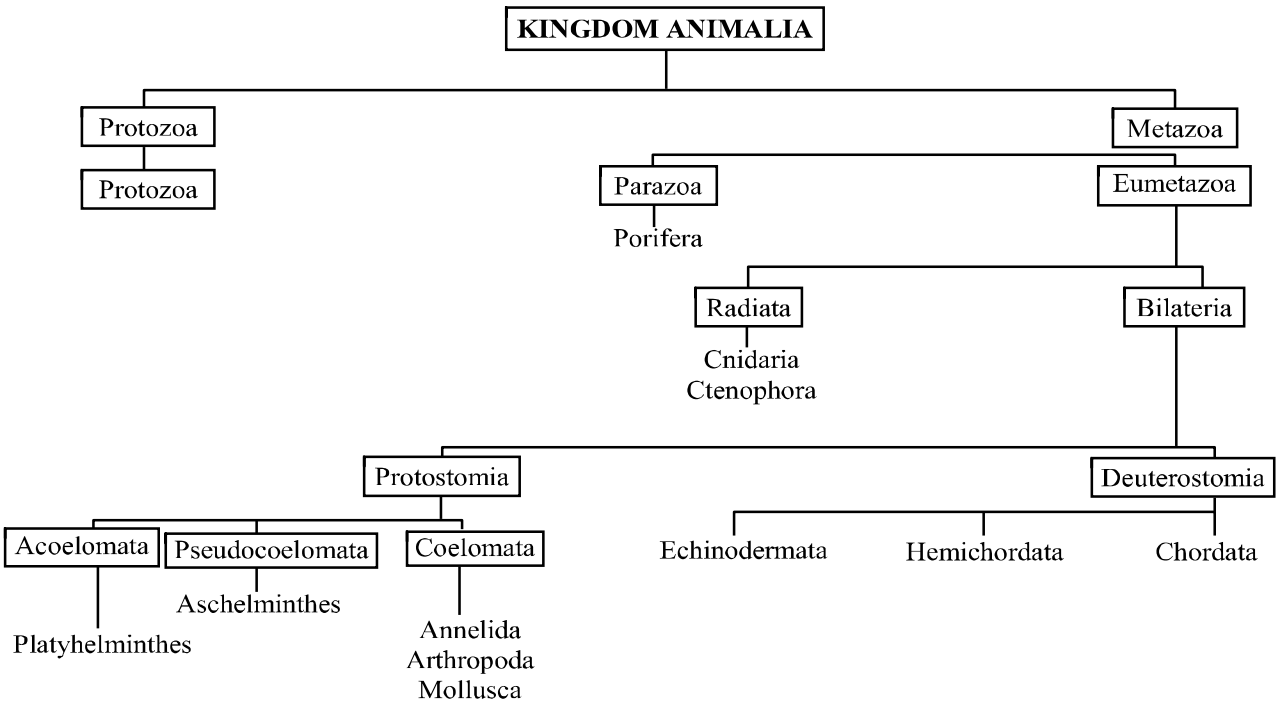


Fig- Sycon

- **Examples** - Sycon, Euplectella, (Venus flower basket) Spongilla (Fresh water sponge).

Phylum - Cnidaria (Coelenterata) :

- Aquatic, mostly marine, a few such as *Hydra* are fresh water solitary or colonial forms.



- Cnidarians or coelenterates are multicellular, diploblastic animals with tissue grade of organisation.
- Body shows radial symmetry.
- Possese specialized cells (cnidoblasts) bearing stinging organoids called nematocysts. Nematocysts serve the functions of paralysing the prey by injecting poison or to hold the prey.

Fig - Hydra

- Exhibit the phenomenon of polymorphism (Ex- Physalia).
- Body shows two main forms, the polyps and the medusae.
- **Examples** - Hydra, Obelia (sea fur) , Aurelia(jelly fish), Metridium (sea anemone).

Phylum - Platyhelminthes :

- Bilaterally symmetrical and dorsoventrally flattended animals.
- Body thin, soft, leaf-like or ribbon-like.
- Digestive cavity (when present) with a single opening, the mouth (anus is absent).
- Suckers and hooks are usually present.
- Circulatory and respiratory system and skeleton are absent.
- Excretory system consists of blind tubules called protonephridia.
- **Examples** : *Dugesia* (Planaria), *Fasciola* (liver fluke), *Schistosoma* (Blood fluke), *Taenia solium* (Pork Tape worm).

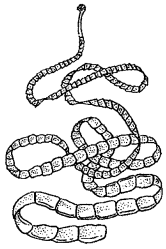


Fig - Taenia solium

Phylum - Aschelminthes or nematoda

- They are parasitic or free-living.
- They are triploblastic, unsegmented and show bilateral symmetry.
- Body cavity is not a true coelom.
- Alimentary canal is complete.
- Sexes are separate.
- **Examples** : *Ascaris* (Round worm), *Enterobius* (Pin worm), *Wuchereria* (filaria worm)

Ascaris lumbricoides

Phylum - Annelida :

- They occur in moist soil, fresh water and sea.
- They are elongated, with segmented body and bilateral symmetry.
- First animals with true body cavity (coelom).
- Body bears lateral appendages for locomotion in the form of chitinous setae or parapodia.

Fig - Earthworm

- **Examples :** *Nereis* (sand worm) *Aphrodite* (sea mouse), *Pheretima* (earthworm), *Hirudinaria* (Cattle leech)

Phylum - Arthropoda :

- Body is covered with a thick chitinous covering.
- Respiration through general body surface, by gills, air tubes (tracheae) or book-lungs.
- Body segments are grouped into two regions-cephalothorax (head and thorax together and abdomen, or three regions-head, thorax and abdomen.
- Triploblastic, bilaterally symmetrical and metamerically segmented animals.
- Each body segment usually bears paired lateral and jointed legs or appendages.

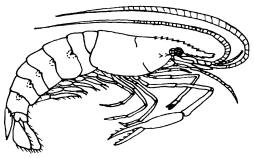


Fig - Prawn

- **Example :** *Palemon* (Prawn), *Daphnia* (water flea), *Limulus* (King crab), *Palamnaeus* (Scorpion)

Phylum - Mollusca :

- They have soft, unsegmented body.
- Body is divided into three regions (head visceral mass and ventral foot).

Fig - Pila

- Outer surface is covered by a hard calcareous shell.
- Respiration is by gills called ctenidia.
- The sexes are usually separate.
- Examples : *Chiton*, *Pila* (Snail), *Unio* (Fresh water mussel), *Octopus* (Devil fish).

Phylum - Echinodermata :

- They are marine, gregarious (live in groups) and free-living animals.
- Shape may be star-like, spherical or elongate.
- Body surface is covered all over by calcareous spines.
- Aristotle's lantern for mastication.
- Their symmetry is radial in adults but bilateral in larvae.
- Tube feet for locomotion.
- These are unsegmented.
- Body cavity is modified into a water-vascular system or ambulacral system with tube like outward extension for locomotion, called tube feet.
- **Examples :** *Asterias* (Star fish), *Echinus* (Sea urchin), *Holothuria* (Sea cucumber), *Antedon* (Feather star)

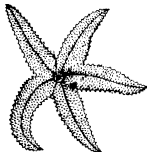
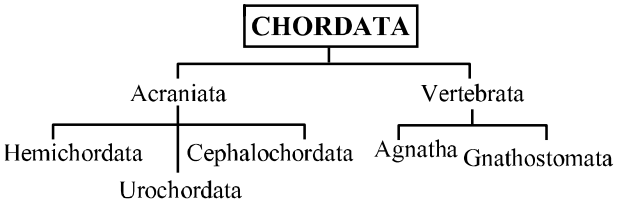


Fig- Star fish

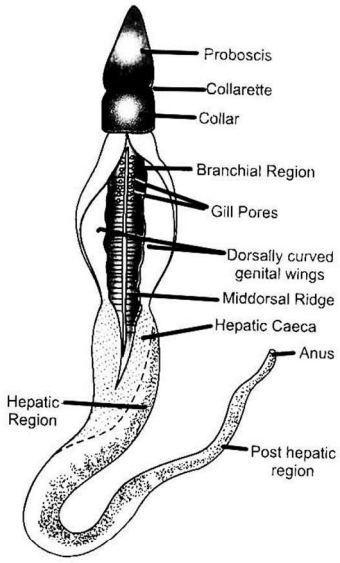
Phylum - Chordata

- Chordata are characterized by following basic features :
- A dorsal, hollow, tubular nerve cord.
- Notochord present.
- Gill slits in the pharynx.
- Tail behind the anal opening.
- Ventral heart.



Sub-phylum : Protochordata

- The sub-phylum protochordata includes animals which are bilaterally symmetrical, unsegmented, tripolblastic and have a body cavity or coelom.
- The animals belonging to protochordata possess a **notochord** at some stage in the life history. This is flexible rod that lies between the dorsal nerve tube and the gut.
- The notochord provides a place for muscles to attach. It increases internal support and locomotory power.
- Protochordates are usually marine, soft, have worm-like or vase-like forms.
- **Examples :** *Balanoglossus* (a corn worm or tongue worm), *Herdmania* and *Amphioxus*, etc.



Balanoglossus (a corn worm of tongue worm)

Sub-phylum : Vertebrata

- The sub-phylum vertebrata includes animals which are bilaterally symmetrical, triploblastic, coelomic and segmented.
- The animal body typically consists of four regions : head, neck , trunk and tail.
- The notochord is replaced partly or fully by a jointed vertebral column (back bone) in the adult. The body of vertebrates is characterized by the presence of a well developed skeletal system that allows a special distribution of muscle attachment points to be used for movement.
- Besides vertebral column and internal skeleton the vertebrates have a well developed nervous system (brain) and sense organs (eyes, ears and nose).
- The vertebrates have a complex differentiation of body tissues or organs.
- There are two pairs of appendages (fins or limbs)
- Respiration is by gills in lower aquatic vertebrates. Higher land forms have lungs for gaseous exchange.
- Sexes are separate.

Subphylum Vertebrata is divided into seven classes :

- Class : Pisces
- Class : Amphibia
- Class : Reptilia
- Class : Aves
- Class : Mammalia

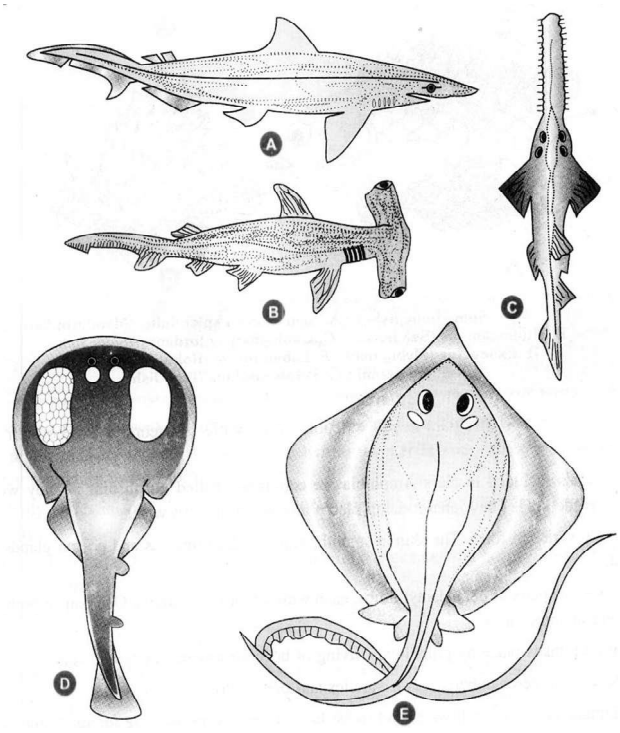
◈ **Pisces**

- The animals belonging to class-Pisces are commonly called **fishes**. They exclusively live in water
- The skin of fishes is covered with scales/plates, which helps these animals to live in water
- The body may be long, laterally compressed and spindle shaped or dorsiventrally flattened and disc shped. It usually consists of head, trunk and a musclular tail.

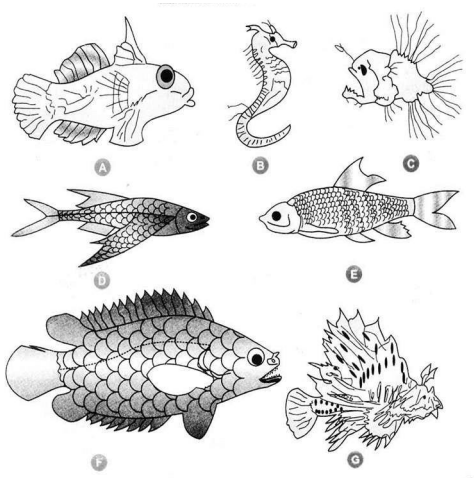
- The muscular tail and fins help them to swim in water and move from one places to another.
- Fishes are cold-blooded animals and their hearts have only two chambers – one auricle and one ventricle.
- Fishes obtain oxygen dissolved in water and breathe through gills.
- They are egg laying animals. Fertilization is external.

There are many kinds of fishes. They have been broadly grouped under three categories.

- **Cyclostoma :** The round mouthed fishes. Examples, The hag fish, the lamprey.
- **Chondrichthyes :** The cartilaginous fishes. Examples *Scoliodon* (dog fish or the Indian Shark), sting ray, electric ray (Torpedo) (figure).
- **Osteichthyes :** The bony fishes. Examples, *Labio rohita* (Rohu), Hippocampus (Sea horse), Tuna, etc.



Some cartilaginous fishes A. Scoliodon (dog fish or the Indian shark); B. Sphyrna (hammer headed shark); C Pristis (Saw-fish); D. Torpedo (the electric ray); E. Sting ray



Some bony fishes : A. Synchiropus (Mandarin fish); B. Hippocampus (Sea horse); C. Caulophyryne jordani (Angler fish); D. Exocoetus (Flying fish); E. Labeo rohita (Rohu); F. Anabas (Climbing perch); G. Perois voltians (Lion fish)

Class - Amphibia :

- In evolutionary terms, amphibians form the first group among the chordates to live out of water and to comprise first four-legged (tetrapod) land vertebrates. They live on land but lay their eggs in water. Amphibians are vertebrates leading two lives.
- These cold blooded animals live partly in fresh water and partly on land (moist places).
- Skin is smooth or rough, moist, slimy, glandular and mostly without scales.
- Heart 3 chambered.
- Body with distinct head and trunk, no neck.
- Two pairs of pentadactyl (five digit) limbs are present. Digits or toes without claws. Limbs may be absent in some cases.

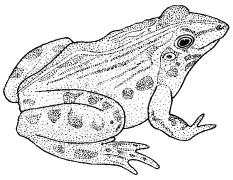


Fig - Bufo

- **Example :** *Ichthyophis*, *Amphiuma (congo ell)*, *Salamandra*, *Ambystoma*, *Necturus*, *Rana* (bull frog), *Bufo* (toad), *Hyla* (tree-frog).

Class - Reptilia :

- Cold-blooded, terrestrial or aquatic vertebrates with body covered with dry water-proof skin having horny scales or scute plates.
- Heart 3½ chambered. Crocodyles have 4 chambered heart.

- Body varies in form and is usually divided into head, neck, trunk and tail.
- Limbs tetrapodous pentadacytle (five-toed) type with clawed digits (limbs are absent snakes and some lizards).
- Tympanum small and depressed.
- Teeth are present in all reptiles except in tortoises and turtles.
- **Example :** *Kachuga* (roofed-terrapin), *Testudo* (land-tortoise), *Uromastix* (sand-lizard), *Hemidactylus* (wall lizard), *Calotes* (garden-lizard), *Draco* (flying-lizard) *Chamaeleon*, Cobra etc.

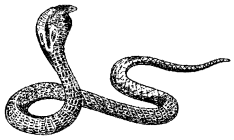


Fig - Cobra

Class - Aves :

- Warm-blooded, tetrapodous vertebrates (birds) with various flight adaptations.
- Size ranges from smallest humming bird to largest ostrich.
- Heart 4 chambered.
- Horny scales persist on the feet but feathers cover most of the body. Cutaneous glands are absent.
- Boat-shaped body is divisible into head, neck, trunk and tail.
- Fore-limbs modified into wings for flight. Kiwis have vestigial wings.
- **Example :** *Gallus* (chicken), *Passer* (house sparrow), *Corvus* (crow), *Columba* (pigeon), *Psittacula* (parrot), *Pavo* (peafowl peacock), *Eudynamys* (koel), *Bubo* (owl)

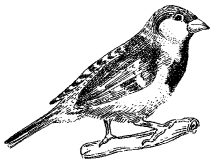
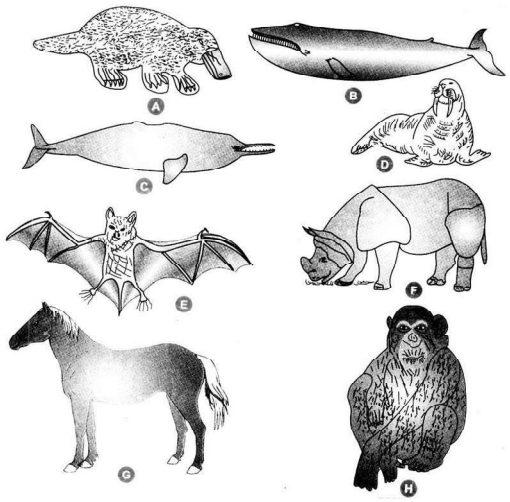


Fig - Passer (house sparrow)

Class - Mammalia :

- Mammals are primarily terrestrial vertebrates. They occur in all sorts of habitats from the polar regions to the tropics.
- The body is variously shaped and generally divisble into head, neck, trunk and tail.
- The skin is glandular and mostly covered by a horny epidermal exoskeleton of **hair**.
- There are two pairs of pentadactyl limbs. These are variously adapted for various purposes.
- Respiration occurs only by lungs.
- The heart is four chambered, having two auricles and two ventricles.
- Sexs are usually distinguishable externally.
- Mammals are mostly viviparous (alive-bearing). However, some are oviparous and lay eggs (*e.g.*, platypus and echidna. Kangaroos give brith to very poorly developed young ones). They are characterized by having milk-secreting mammary glands in the females for sucking the young for some time after birth.
- Examples : *Macropus* (Kangaroo), *Bat*, *Ratuus* (rat), *Oryctolagus* (rabit), *Felis* (cat), *Panthera* (lion, tiger, leopard), *Canis* (dog) *Elephas* (elephant), *Balaena* (whale), *Macaca* (monkey), *Hamo* (man), *Pan* (chimpanzee)



Mammalia A. *Ornithorhynchus* (Duck-biled platypus); B. *Bamenoptera* (the whale); C. *Platanista gangetica* (the dolphin); D. *Odobenus* (the walrus); E. *Scotophilus* (the bat); F. *Rhinoceros*; G. *Equus cabalus* (Horse); H. *Pan* (Chimpanzee)