Diversity in Living Organisms

Biodiversity or biological diversity means the variety of living organisms present on a particular region. There are about 20 lac organisms known on the Earth which differ from one another in external form, internal structure, mode of nutrition, habitat, etc.

The warm and humid tropical regions of the Earth between the tropic of Cancer and the tropic of Capricorn have a rich diversity of life, i.e. plants, animals, and microorganisms and are called **the region of mega Biodiversity.** India is one of the 12 countries which consist of more than half of the biodiversity of the Earth.

Taxonomy – It is a branch of biology which deals with identification, nomenclature, and classification of organisms. Carolus Linnaeus is called the father of taxonomy.

Classification

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

Importance of classification:

- It makes the study of wide variety of organisms easy and in systematic manner.
- It helps to understand how the different organisms have evolved with time.
- It helps to understand the inter-relationships among different groups of organisms.
- It forms a base for the study of other biological sciences, like biogeography.

Basis of classification:

There are the certain features or properties used for the classification of living organisms which are known as **characteristics**. Organisms with same characteristics are placed in same groups.

Classification system

1. Two kingdom classifications: Carolus Linnaeus in 1758 classified the living organisms into two groups as plants and animals.

2. Five kingdom classification: H. Whittaker in 1959 further classified the organisms into five kingdoms as Kingdom Monera, Kingdom Protista, Kingdom Fungi, Kingdom Plantae, and kingdom Animalia.

Note – Carl Woese in 1977 further divided kingdom Monera into archaebacteria (or Archae) and Eubacteria (or Bacteria).

Hierarchy of classification

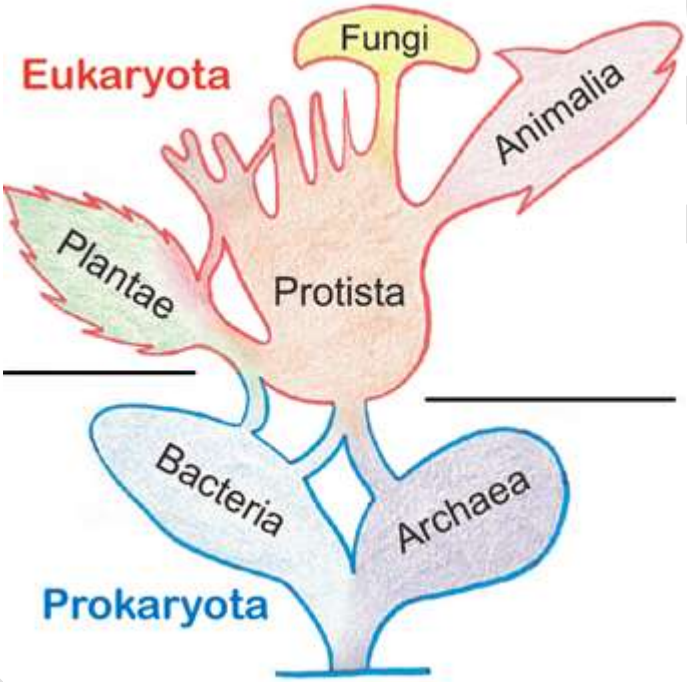
Linnaeus proposed a classification system by arranging organisms into taxonomic groups at different levels according to the characteristics they have. The groups or the levels from top to bottom are:

1. Kingdom
2. Phylum(Animals) / Division(Plants)
3. Class
4. Order
5. Family
6. Genius
7. Species

Species: A species is a group of living beings which can reproduce among themselves and keep their population alive.

Hierarchical naming of Human

The Five kingdom classification



The major characteristics considered for classifying all organisms into five major kingdoms are:

1. Type of cellular organization –

a) Prokaryotic cells: These are primitive and incomplete cells without well – defined nucleus.
b) Eukaryotic cells: These are advanced and complete cells with well – defined nucleus.

2. Body organization –

a) Unicellular organisms: These are organisms made up of single cell with all activities performed by the single cell.
b) Multicellular organisms: These are organisms made up of large number of cells with different functions performed by different cells.

3. Mode of obtaining food –

a) Autotrophs: These are the organisms that make their own food by photosynthesis.
b) Heterotrophs: These are the organisms which depend on other organisms for food.

Nomenclature – An organism can have different names in different languages. This creates confusion in naming organism. So, a scientific name is needed which is same in all languages. Binomial nomenclature system given by Carolus Linnaeus is used for naming different organisms.
Following are some conventions in writing the scientific names:

- Genus should be written followed by the species.

- First letter of the genus should be capital and that of the species should be in small letter.
- When printed the name should be written in italics and when written with hands genus and species should be underlined separately.

Example – *Homo sapiens* for humans, *Panthera tigris* for tiger.

Kingdom 1: Monera

Following are its basic features:

- Prokaryotic, Unicellular.
- Can be autotrophic or heterotrophic.
- May or may not have cell wall.
- Examples- Anabaena and Bacteria (heterotrophic), Cyano-bacteria or Blue green algae (autotrophic).

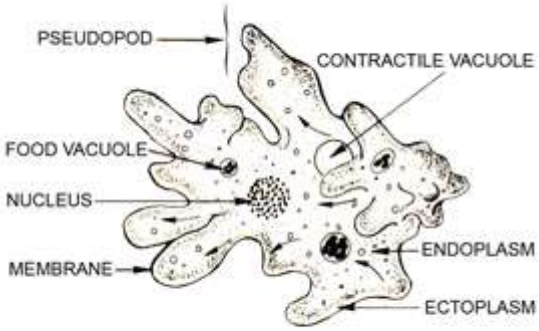
BACTERIA

ANABAENA

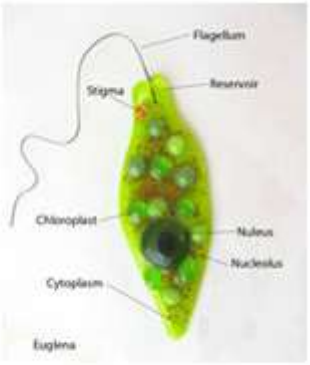
Kingdom 2 : Protista

Following are its basic features:

- Eukaryotic, Unicellular.
- Can be autotrophic or heterotrophic.
- May have cilia, flagella or pseudopodia for locomotion.
- Examples: plants like- Unicellular algae, Diatoms; animals like- protozoans (Amoeba, Paramecium, Euglena); fungi like- slime molds and water molds.



AMOEBA



EUGLENA

Kingdom 3: Fungi

Following are its basic features:

- Eukaryotic
- Mostly multicellular but sometimes unicellular(yeast)
- Source of food:

a) Mostly **saprophytes** – these organisms use decaying material for food.

b) Some **parasitic** – these organisms live inside body of other living organism to have food and can be disease causing.

c) Symbiotic relation – these are relations between two organisms in which they live together for benefit of one or both. Lichens are a symbiotic relation between fungi and cyanobacteria. Here fungi gets food from cyanobacteria and in return cyanobacteria gets water and protection from sunlight through fungi.

- Cell wall is made of chitin
- Examples-mushrooms(Agaricus), green mold(Penicillium), smut(Aspergilus)

PENICILIUM

AGARICUS

Kingdom 4: Plantae

Following are its basic features:

- Eukaryotic, Multicellular
- Autotrophs
- Cell wall present

Basis of division in Kingdom Plantae

1. Differentiated body parts: Body is differentiated into leaves, stems, roots, flower, etc.

2. Presence of vascular tissue: There are two types of vascular tissues present in the plants:
   - Xylem: helps in transport of water.
   - Phloem: helps in transport of food.

3. Reproduction through seeds or spores:
   - Phanerogamae: Plants with seeds are called phanerogamae. They contains embryo with stored food and are multicellular.
   - Cryptogamae: Plants with spores are called cryptogamae. They contains only naked embryo and are generally unicellular.

4. Seeds are inside the fruit or naked:
   - Angiospermae – these are plants with seeds inside the fruit and bears flowers.
   - Gymnospermae – these are plants with naked seeds and do not bear flowers.

Note – If xylem and phloem are absent the plants would be small as transport of food and water will be difficult.

Division 1: Thallophta

Following are its basic features:

- Basic and elementary plants with undifferentiated body parts.
- Generally called algae.
- No vascular tissue present.
- Reproduce through spores.
- Mainly found in water.
- Example- Ulva, Spirogyra, Ulothrix, Cladophora, Chara.

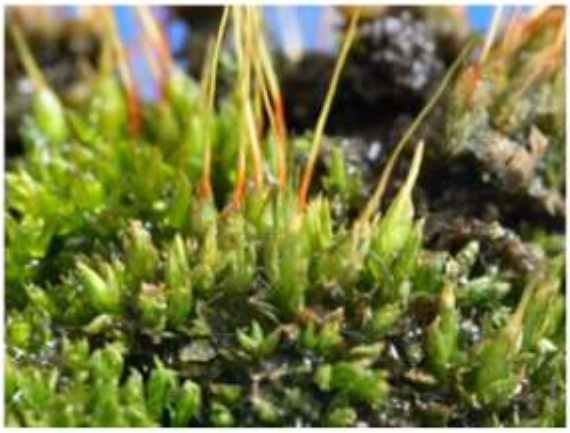
SPIROPGYRA

ULVA

Division 2: Bryophyte

Following are its basic features:

- Body structure differentiated but not fully developed.
- No vascular tissues present.
- Reproduce through spores.
- Found on both land and water therefore known as **'Amphibians of Plantae kingdom'.**
- Example – liverwort(Marchantia, Riccia), mosses(Funaria), hornwort (dendrocerous).



FUNARIA

RICCIA

Division 3: Pteridophyta

Following are its basic features:

- Differentiated body structure- leaves, stems, roots,etc.
- Vascular tissues present.
- Reproduce through spores
- Examples- Marsilea, fern, horsetails

MARSILEA

FERN

Division 4: Gymnosperms

Following are its basic features:

- Differentiated body parts
- Vascular tissues
- Naked seeds without fruits or flowers
- Perennial, evergreen and woody
- Examples- Pines(deodar), Cycus, Ginkgo.

PINUS

CYCUS

Division 5: Angiosperms

Following are its basic features:

- Also known as **Flower – bearing plants.**
- Later on flower becomes fruit.
- Seeds are inside the fruit.
- Embryos in seeds have structure called They are also called seed leaves because in many plants they emerge and become green when they germinate.

Angiosperms are further divided on the basis of number of cotyledons into two parts:

S.No.	Features	Monocots	Dicots
1.	Seed	One cotyledon	Two cotyledons
2.	Root	Fibrous root	Prominent primary root
3.	Stem	False or hollow	Strong
4.	Leaf	Parallel venation	Reticulate venation
5.	Flower(petals)	Five or multiple of five	Three or multiple of three
6.	Example	Potato, Sunflower, Banyan, wheat etc.	Peanuts, Beans, Mango etc.

Kingdom 5: Animalia

Basis of classification of Animalia kingdom:

1. Symmetry:

i) Bilateral symmetry: it is when an organism can be divided into right and left halves, identical but mirror images, by a single vertical plane.

ii) Radial symmetry: it is when an organism is equally spaced around a central point, like spokes on a bicycle wheel.

2. Germ layers: in embryonic stages there are different layers of cells called germ cells. The three different types of germ cells are –

- Ectoderm – It is the outermost layer which forms nail, hair, epidermis, etc.
- Endoderm – It is the innermost layer which forms stomach, colon, urinary bladder, etc.
- Mesoderm – It is the middle layer between ectoderm and endoderm which forms bones, cartilage, etc.

So, according to the number of germ layers present in embryonic stage, animal could be:

i) Diploblastic – organisms which derived from two embryonic germ layers (ecto and endo).
ii) Triploblastic – organisms which derived from all the three embryonic germ layers.

3. Coelom: Body cavity or coelom is important for proper functioning of various organs. For example, heart which has to contract and expand needs some cavity or empty space, which is provided by the coelom.

On the basis of presence or absence of coelom, organisms are divided into:

i) Acoelomates – these are the simple organisms having no body cavity.

ii) Coelomates – these are complex organisms having true cavity lined by mesoderm from all sides. These are further sub- divided into **schizocoelomates or protostomes**(coelom formed due to splitting of mesoderm) and **enterocoelomates or dueterostomes**(coelom formed from pouches pinched off from endoderm)

iii) Pseudo coelomate – these are organisms having false coelom. They have pouches of mesoderm scattered between endoderm and ectoderm.

4. Notochord: it is a long rod like structure, which runs along the body between nervous tissues and gut and provides place for muscle to attach for ease of movement.
Organisms could be:

- Without notochord
- With Notochord
- With Notochord in initial embryonic stages and vertebral column in adult phase.

Phylum 1: Porifera or sponges

Following are its basic features:

- Cellular level of organization.
- Non motile animals.
- Holes on body which led to a canal system for circulation of water and food.
- Hard outside layer called as skeletons.
- Examples – Sycon, Spongilla, Euplectelia.

SYCON

EUPLECTELIA

Phylum 2: Coelenterata

Following are its basic features:

- Tissue level of organization
- No coelom
- Radial symmetry, Diploblastic
- Hollow gut
- Can move from one place to another.
- Examples: hydra, sea anemone, jelly fish(solitary) ; corals (colonies)

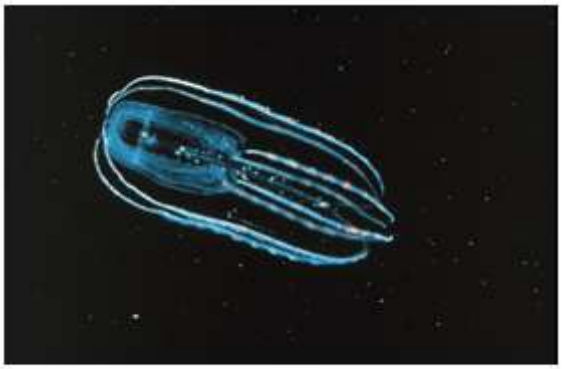
SEA ANNEMON

CORALS

Phylum 3: Ctenophores

Following are its basic features:

- Tissue level of organization
- No coelom present
- Radial symmetry, Diploblastic
- Have Comb plates for locomotion
- Aquatic
- Examples- Pleurobrachia



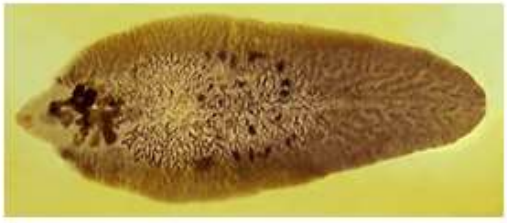
PLEUROBRACHIA

Phylum 4: Platyhelminthes

Following are its basic features:

- Also called **flat worms.**
- No coelom present
- Bilateral symmetry, Triploblastic
- Free living or parasite
- Digestive cavity has one opening for both ingestion and egestion.
- Example – Planaria (free living), Liver fluke (parasitic).

PLANARIA



LIVER FLUKE

Phylum 5: Nematode

Following are its basic features:

- False coelom
- Bilateral symmetry, Triploblastic
- Cylindrical
- Many are parasitic worms living inside human body, and can cause various diseases, like Filarial worm causes elephantiasis, Round worms and Pin worms live in human intestine.
- Example – Ascaris, Wulchereria.

ASCARIS

WULCHERERIA

Phylum 6: Mollusca

Following are its basic features:

- Coelom present
- Triploblastic, bilateral symmetry
- Soft bodies sometimes covered with shell
- Generally not segmented
- No appendages present
- Muscular foot for movement
- Shell is present
- Kidney like organ for excretion
- Examples – Chiton, Octopus, Pila, Unio.

CHITON

OCTOPUS

Phylum 7: Annelida

Following are its basic features:

- Second largest phylum
- Coelom present
- Bilateral, triploblastic
- Segmented (segments specialized for different functions)
- Water or land
- Extensive Organ differentiation
- Examples – Earthworm, Leech, Nereis

EARTHWORM

NEREIS

Phylum 8: Arthropoda

Following are the basic features:

- Largest phylum (consist of 80%of species)
- Generally known as insects.
- Coelom present
- Bilateral, triploblastic
- Segmented, sometimes fused
- Tough exo-skeleton of chitin
- Joint appendages like feet, antenna
- Example- Prawn, Scorpio, Cockroach, Housefly, Butterfly, Spider,

PRAWN

HOUSEFLY

Phylum 9: Echinodermata

Following are its basic features:

- Spiny skin, Marine
- No notochord
- Coelom present , bilateral symmetry, triploblastic
- Endoskeleton of calcium carbonate.
- Water vascular system for locomotion.
- Bilateral symmetry before birth and radial symmetry after birth.
- Example- Antedon, Sea cucumber, Star fish, Echinus.

SEA CUCUMBER

STAR FISH

Phylum 10: Hemichordata

Following are its basic features:

- Small group of marine animals
- Cylindrical, Bilateral symmetry, triploblastic
- Coelom present
- Gills for respiration
- Examples – Balanoglossus

BALANOGLOSSUS

Phylum 11: Chordata

Following are its basic features:

- Bilateral symmetry, Triploblastic
- Coelom present
- Notochord
- Gills present at some phase of life.
- Dorsal nerve chord
- Post anal tail present at some stage of life, For example, present in humans in embryonic stages.
- Subdivided into two

(a) Prochordata –

- Notochord at some stage of life
- Marine
- Example- Herdemania, Amphioxus,

(b) Vertebrata –

- Notochord converted to vertebral column
- 2,3,4 chambered heart
- Organs like kidney for excretion
- Pair appendages

- Example- humans(4 chambered), frog(3 chambered), fishes(2 chambered)

Vertebrates are divided into five classes namely Pisces, Amphibia, Reptillia, Aves and Mammalia.

Following are some common features of the five classes of vertebrates:

S. no	Features	Pisces	Amphibian	Reptilia	Aves	Mammalia
1.	Inhabit	Water	Water and land	Water and land	Water land and air	Land or water
2.	Respiratory organs	Gills	Gills, lungs	lungs	lungs	lungs
3.	Heart	2 chambered	3 chambered	3 chambered	4 chambered	4 chambered
4.	Maintenance of Body temperature	Cold-blooded	Cold-blooded	Cold-blooded	Warm-blooded	Warm-blooded
5.	Young ones	Eggs	Eggs in water	Eggs with tough coating on land	Eggs	Young babies except platypus and echidna.
6.	Skin	Skin covered with scales	Mucus glands in skin	Skins covered with scales	Skin covered with feathers	Hair, oil and sweat glands are present on the skin
7.	Special features	Streamlined body				Mammary glands which produces milk for children.
8.	examples	Anabas, Dog fish, Angler fish, Mandarin fish, Electric ray, String fish, Sea horse, Flying fish.	Salamander, common frog, Toad, Hyla (tree frog).	Turtle, Snakes, Lizard, Flying lizard, Crocodile, Chameleon.	Ostrich, Sparrow, Crow, Pigeon, Tufted Duck, White Stork.	Humans, Lion, Tiger, Cat, Bat, Whale.

Note –

- **Warm blooded organism:** these are organisms which maintain same body temperature irrespective of outside temperature. Example – humans. Human's body temperature is approximately 37^{o}.
- **Cold blooded organisms:** these are organisms which changes their body temperature as per surrounding temperature. Example – frog
- Fishes are divided into two on the basis of skeleton:
  i) Fishes with bony skeleton called **bony fishes**. Example- Tuna.
  ii) Fishes with cartilage skeleton called **Cartilaginous fishes**. Example – Shark

Classification and evolution

Evolution is a process by which a new species is developed from an old species with gradual changes. Charles Darwin first described this idea of evolution in his book 'The Origin of species' in the year 1839.

More complex organisms develop from the simpler organisms. The older, simpler organisms are called **primitive or lower organisms** while the younger, complex organisms are called **advanced or higher organism**s.

Evolution and classification is somehow related, as classification of organism is done considering how evolution has occurred. While organisms classified in same group are likely to have evolved in similar ways.