

## CHAPTER - 00

# THE LIVING WORLD

Biology is the science of life and living process. It is the study of life on earth and the story of evolution of living organism on earth. The word biology is originating from two greek words Bios-means life and logos means study so biology is known as Life science.

Living world is wonderful and the wide range of living types is amazing. They live in a wide range of habitats. They vary in their size, shape, structure, interactions, adaptations etc.

- Some organisms are unicellular Eg: Amoeba, Bacteria, Paramecium, Euglena
- Some are multicellular Eg. Higher plants and animals
- Some are prokaryotes: Eg: Bacteria
- Some are eukaryotes: Eg: Higher plants and animals
- **Autotrophs**  
Eg. Algae, green plants, photosynthetic bacteria, Nitrifying bacteria
- **Heterotrophs**
  - (a) Saprophytic
  - (b) Parasitic
  - (c) Symbiotic
- Organisms are diverse based on their **habitat and ecology**  
Eg: Aquatic, terrestrial, Air borne organisms

### Characteristics of living organisms

#### (i) **Growth**

- It is increasing mass and increasing number of individuals (two characteristics of growth).
- In living organisms, growth is **internal**, ie, occurs by cell division
- Multicellular organisms grow by cellular enlargement and cell division. Which contributes to an increase in size of the cell and increase in no. of cells. So growth and reproduction are exclusive events
- Plants show indeterminate or indefinite growth throughout their life span by meristematic cell.
- Animals show definite growth pattern, ie. growth takes place only upto a particular age.
- Unicellular organisms grow by the accumulation of protoplasmic content due to cellular enlargement and their cell divides, so growth and reproduction are inclusive events.

- **Non-living** things can also show an increase in size by the accumulation of materials on the outer surface (**External growth**)
- So, growth can not be taken as a defining property of living organisms

## (ii) **Reproduction**

- It is the capacity to produce young ones of their own kind. Reproduction maintains the continuity of species.
- In organisms, reproduction takes place by 2 ways
  - (a) Asexual : Uniparental
  - (b) Sexual : Biparental
- In lower organisms, common reproductive mechanism is asexual. It is different in different organisms.
  - 1) Binary fission - Bacteria
  - 2) Budding - Yeast, Hydra
  - 3) Regeneration - Planaria (Flat worms)
  - 4) Fragmentation - Filamentous algae like spirogyra, Fungi, Protonema of moss
  - 5) Spore formation - Fungi
- In unicellular organisms, reproduction is synonymous with growth, ie, increase in number of cells.
- In higher organisms, common reproductive mechanisms is sexual, which involves formation and fusion of gametes.
- Some living organisms cant reproduce. (Mule, worker bees, Infertile human couples)
- So, reproduction is also cannot be an all inclusive defining character of living organism but, no non - living objects can reproduce by itself.

## (iii) **Metabolism**

- The sum total of all biochemical reactions in a living cell
- It may be

(i) <b>anabolism</b>	ii) <b>Catabolism</b>
Constructive process	Destructive process
(simple → complex)	(complex → simple)
Eg: Photosynthesis, protein synthesis	Eg: Cellular respiration/Oxidation of food material
- No non-living object exhibits metabolism
- Isolated metabolic reactions outside the body of an organism, performed in a test tube is neither living nor non-living.
- **It is a defining property** except in invitro. Invitro is only a living reaction, but not living things

## (iv) **Cellular organisation**

- All living organisms are made up of basic structural and functional units ie, cells
- **It is a defining property of living organism.**

- In higher organisms, cells are organised into tissues, organs and to organs system.  
Cell → Tissues → Organs → Organ system → organism  
The property of tissue is not present in the constituent of cells and so on ie, each level of organisation has its own properties.

#### (v) **Consciousness**

- It is the ability of living organisms to sense their environment and surroundings and respond to it.
- These external stimuli can be physical, chemical or biological.
- Plants can respond to stimuli such as light, temperature water, etc (tropic movements, photoperiodic requirements for flowering)
- Animals are aware of their environment with the help of sense organs
- Only human beings have self consciousness.
- **So it is a defining property of living organism**  
**So organisms are self replicating, evolving and self regulating interactive systems capable of responding to external stimuli.**

#### **Biodiversity**

Biodiversity is the diversity of organism that seen in the biosphere. Each different kind of plant, animal or organism that we can see represent a species. The number of species that are known and described ranges between 1.7 – 1.8 million. The diversity is the result of organic evolution and diversity can be identified through classification.

Of these 70% are animals and plant form 22%. Among animals insect are the richest group.

#### **Systematics**

- It deals with diversity of living organisms and their inter-relationships (taxonomic and phylogenetic relationships)
- The word systematics was derived from the Latin word 'systema' which means the systematic arrangement of living organisms
- The word 'systematics' was coined by Carolus Linnaeus.
- **New systematics** was introduced by Julian Huxley

#### **Taxonomy**

Taxonomy is the principle and procedure of arranging organism to proper group based on similarity and dissimilarity.

- The word 'taxonomy' was coined by A.P. de Candolle
- Father of taxonomy: Carolus Linnaeus

The basic process of taxonomy includes

#### **Characterisation, Identification, classification and nomenclature**

- Earliest classification is based on 'uses' of various organism as sources of food clothing and shelter.
- Modern taxonomic study include morphology, anatomy, cell structure developmental process and ecological information.

## Nomenclature

- It is the system of providing name to an organism. So that they can be easily recognised and differentiated from others.

**Vernacular nomenclature:** Naming an organism by using local or regional language

## Scientific nomenclature

- It is the universally accepted single name system of an organism.
- (i) **Polynomial nomenclature:** Naming an organism using many words
- (ii) **Trinomial:** Naming an organism using 3 words (genus, species, subspecies - animals /variety - plants)
- (iii) **Binomial nomenclature**
  - A system of naming an organism by using 2 words: Genus name and species name
  - Proposed by Carolus Linnaeus
  - Reference books of Binomial system are **Systema naturae**, **Species plantarum**

## Rules and Regulations

- Biological names are in Latin and written in Italics.
- Each name has 2 parts: Genus name (generic epithet) and species name (specific epithet)
- Genus name should start with capital letter and species name with small letter
- Biological names when handwritten should be underlined separately or printed in italics
- Name of the author written after species name in an abbreviated form

Eg. *Homo sapiens* Linn. (Humans)

*Panthera tigris* (Tiger)

*Mangifera indica* (Mango tree)

*Ocimum sanctum* (Tulsi) etc.

## Naming codes

ICBN: International Code for Botanical Nomenclature

ICZN: International Code of Zoological Nomenclature

ICNB: International Code for the Nomenclature of Bacteria

ICNCP: International Code for the Nomenclature of Cultivated Plants

ICVN: International Code of Viral Nomenclature

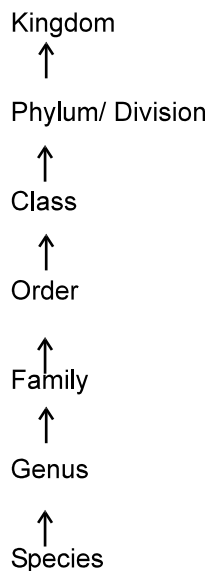
## Classification

- It is the process by which any thing is grouped into convenient categories based on their characteristics. The scientific term for these categories is taxa / taxon.

## Taxonomical Hierarchy (T.H)

- In taxonomic studies there are seven obligate categories are present.
- The systematic arrangement of these taxonomic groups or categories in an order with kingdom at the top and species at the base is known as taxonomic hierarchy.

- Hierarchy is the arranging rank or categories one above the other in a particular order.
- Each level in these hierarchy is known as taxon, ie, a unit of classification.



### Species

- Species is the lowest category in the hierarchy
- It is the basic unit of classification
- The term 'species' coined by John Ray
- It is group of morphologically similar members that are reproductively isolated. ie, they can interbreed producing fertile offsprings.
- The currently accepted definition of biological species concept was given by **Ernest Mayer/ Darwin of 20<sup>th</sup> Century**

ie, "Species is the members of a population that can potentially interbreed and produce fertile young ones". They are reproductively isolated.

Eg. Tiger (*Panthera tigris*)

Lion (*Panthera leo*)

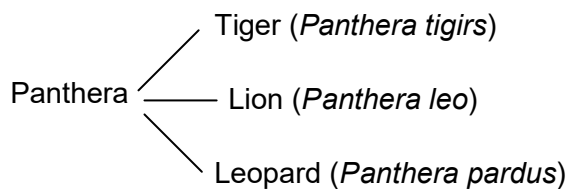
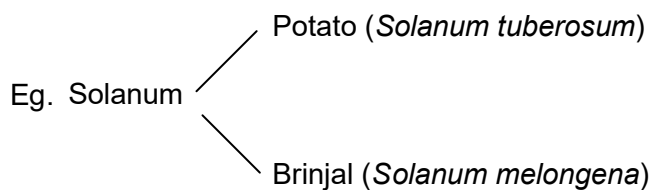
Potato (*Solanum tuberosum*)

Humans (*Homo sapiens*)

Here, tigris, leo, tuberosum, sapiens etc represents specific epithet.

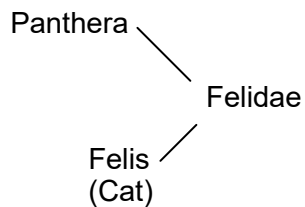
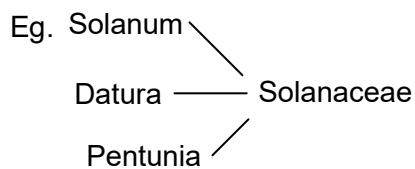
### Genus

- ◆ They are group of related species, which has more characters in common.



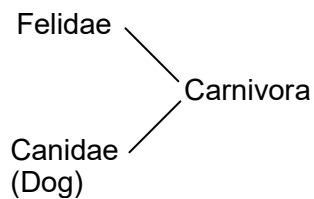
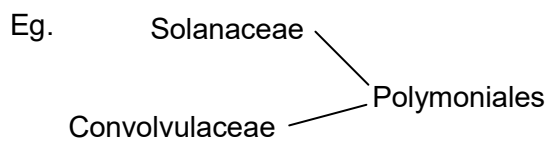
### Family

- ◆ They are group of related genera.



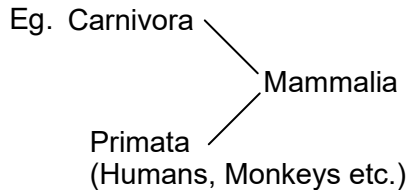
### Order

- ◆ It is group of related families which exhibit a few similar characters.



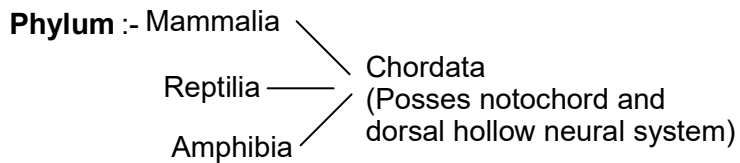
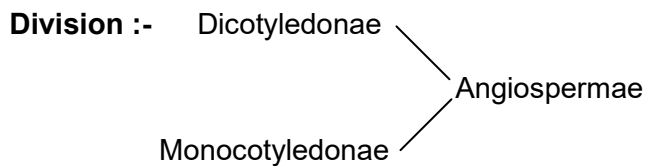
## Class

- ◆ It includes related orders.



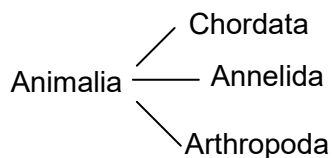
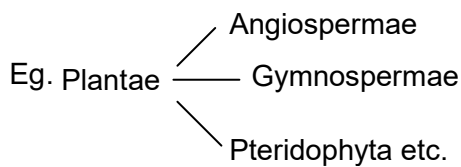
## Phylum / Division

- ◆ They are group of related classes.
- ◆ Term phylum - used in animal classification  
division - in plant classification



## Kingdom

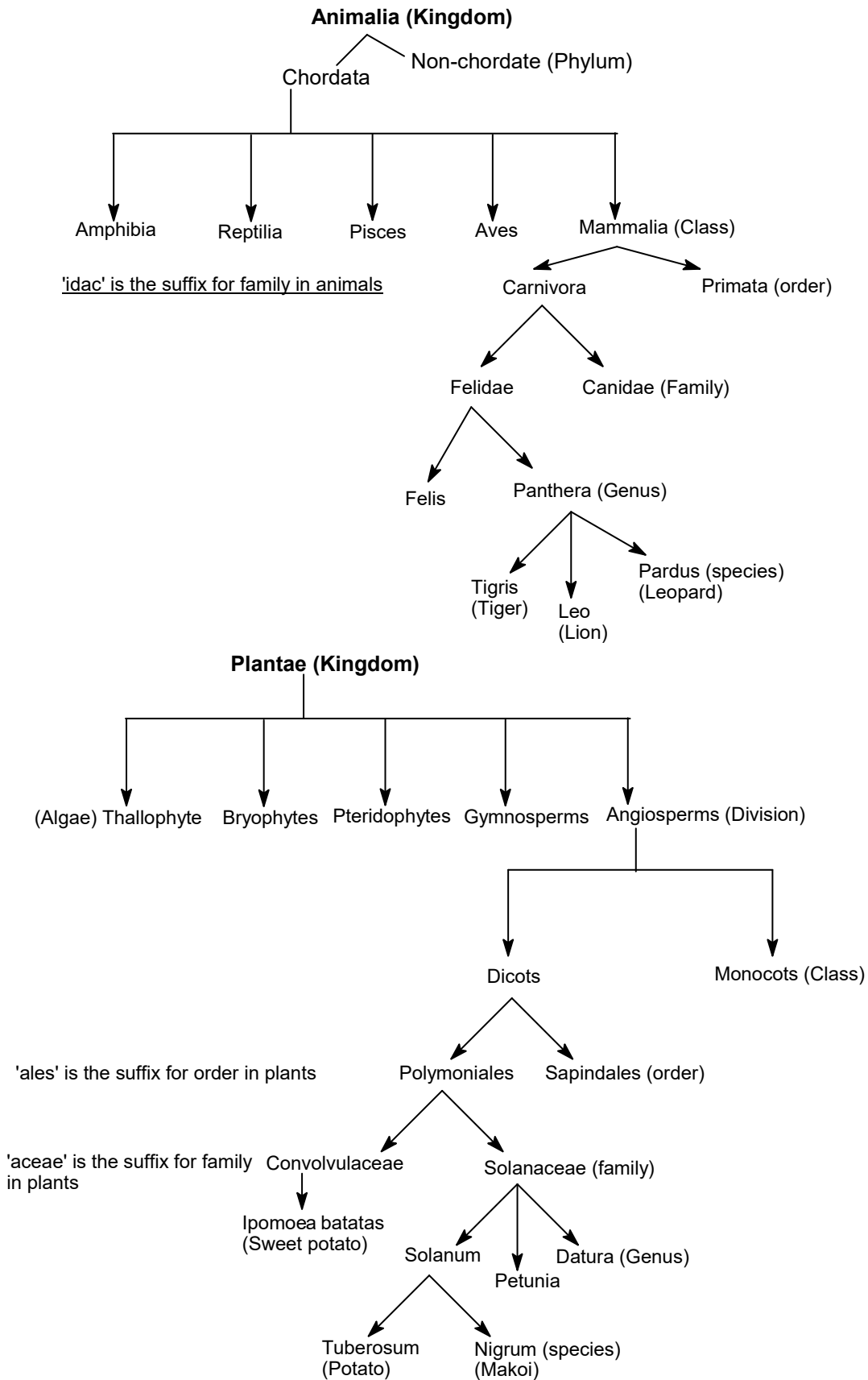
- ◆ Highest category in the hierarchy.



- ◆ **From species to kingdom, the number of common characteristics goes on decreasing, but diversity increases.**

ie, Lower the taxa, more are the common characteristics and fewer the diversity than higher categories.

## Taxonomic Categories Showing Hierarchical Arrangement





### Organisms with their taxonomic category

Common Name	Biological Name	Genus	Family	Order	Class	Phylum/ Division
Man	<i>Homo sapiens</i>	<i>Homo</i>	Hominidae	Primata	Mammalia	Chordata
Housefly	<i>Musca domestica</i>	<i>Musca</i>	Muscidae	Diptera	Insecta	Arthropoda
Mango	<i>Mangifera indica</i>	<i>Mangifera</i>	Anacardiaceae	Sapindales	Dicotyledonae	Angiospermae
Wheat	<i>Triticum aestivum</i>	<i>Triticum</i>	Poaceae	Poales	Monocotyledonae	Angiospermae

### Taxonomic Aids/Taxonomical Tools

- Taxonomic study requires intensive laboratory and field studies.
- Certain techniques, procedures and stored information that are helpful in the identification and classification of organisms are called taxonomical aids.

#### (i) Herbarium - Storage + Technique

- It is a store house containing a collection of dried, pressed, preserved plant specimens on a sheet of paper, for **quick reference, Identification of plant, study of ecology of different place** ie, a store house or repository for future use
- **Largest herbarium in the world: Herbarium at Royal Botanical Garden (R.B.G) Kew garden in London**
- **Largest herbarium in India : Central National Herbarium in Indian Botanical Garden - Kolkata**

### Steps in Herbarium Preparation (6 steps)

- a) **Collection:** Plant materials are collected with the help of digger, cutter, knives etc. **Vasculum** is a **wooden or metallic box** used to **carry** the collected plant specimens and **prevent dehydration**.
- b) **Drying and pressing:** Using plant press
- c) **Poisoning:** Using fungicides
- d) **Mounting:** The dried, pressed, preserved plant materials are pasted on a standard sized herbarium sheet (29×41 cm).
- e) **Labelling:** On the right bottom end  
It should have biological/botanical name, common English name, local name, name of the family, date of collection, place of collection, name of collector.
- f) **Storage:** Herbarium sheets are arranged based on an accepted system of classification. i.e., Bentham and Hooker's classification (Natural system of classification) as it is good to study the taxonomy of flowering and seed bearing plants.

**(ii) Botanical garden**

- It is a collection of living plants for reference
- It is an ex-situ conservation mechanism of plants
- Each plant in the botanical garden is labelled with botanical name and name of its family for identification
- Purpose of botanical garden:
  - Aesthetic Purpose
  - Research Institute
  - Germplasm Collection
  - On site teaching
  - Conservation of plants
  - Largest Botanical Garden
    - (i) In world: Royal Botanical Garden / Kew Garden in London
    - (ii) In India: Indian Botanical Garden, Howrah, Kolkatta
    - (iii) National Botanical Research Institute -Lucknow
    - (iv) Tropical Botanical Garden and Research Institute (TBGRI) - Trivandrum

**(iii) Zoological Park/ Zoo**

- These are places where wild animals are kept in protected environment under human care and control ie, ex-situ conservation strategy of wild animals
- All the animals in a zoo are provided the conditions similar to their natural habitat.  
Eg: National Zoological Park - Delhi

**Importance of Zoological park**

- 1) To learn about food habits and behaviour of wild animals
- 2) Tourism and aesthetic purposes etc.

**(iv) Museum**

- It is a collection of preserved plant and animal specimens for study and reference.
- Specimens are preserved in containers in preservatives, as dried specimens, collection of skeletons fossilised forms, stuffing
- Insects are preserved in insect boxes after collection, killing and pinning  
Eg: Natural History Museum - London, National Museums of Natural History - Delhi

**(v) Key**

- It is another taxonomical aid used for the identification and classification of plants and animals based on similarities and dissimilarities
- It is an analytical device used for the identification and classification of organisms found in a particular area
- The characters of organisms are arranged as contrasting pairs (tall×dwarf) of statements.

Each contrasting pairs is called couplet

Each character in the couplet is called lead

Separate taxonomic keys are required for each taxon/taxonomic category. Such as Kingdom, Phylum, Class, etc....

- There are some other recording descriptions, that also help in the correct identification of organisms

**(vi) Flora**

Flora containing an account of habit, habitat and distribution of plants seen in a particular area.

It provides an index to the plant species found in an area

**(vii) Fauna**

Description about animal species distributed in an area

**(viii) Monograph**

The book containing the description of any one taxon (Kingdom, Phylum, family, etc)

**(ix) Manual**

The index / book containing the description for the identification of names of species found in an area

**(x) Catalogue:**

It is a list or register that enumerate methodically all the species found in an area.

- Aristotle: Book - Historia Animalium, Father of Biology, Zoology
- Theophrastus: Historia Plantarum, Father of Botany
- John Ray: Historia generalis plantarum, Coined 'species'
- Carl Linnaeus: Books- Systema naturae, Species plantarum, Philosophia botanica
- Bentham and Hooker: Genera Plantarum