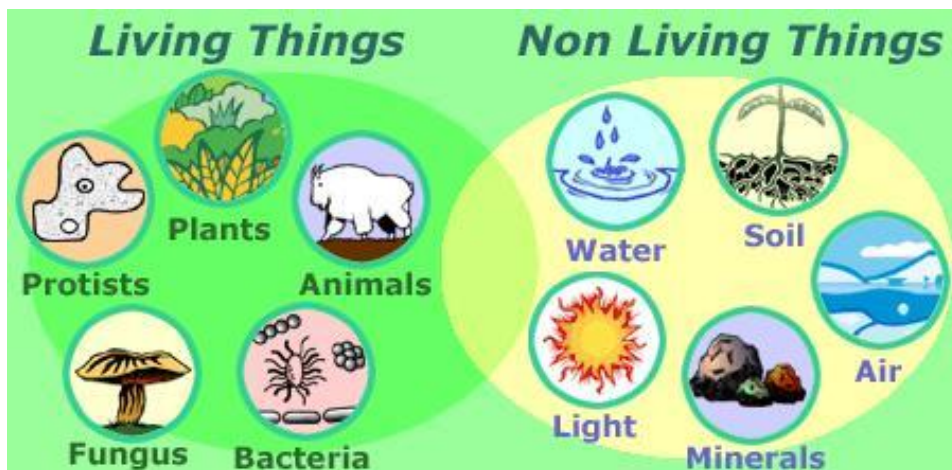


CHAPTER - 1

THE LIVING WORLD

INTRODUCTION

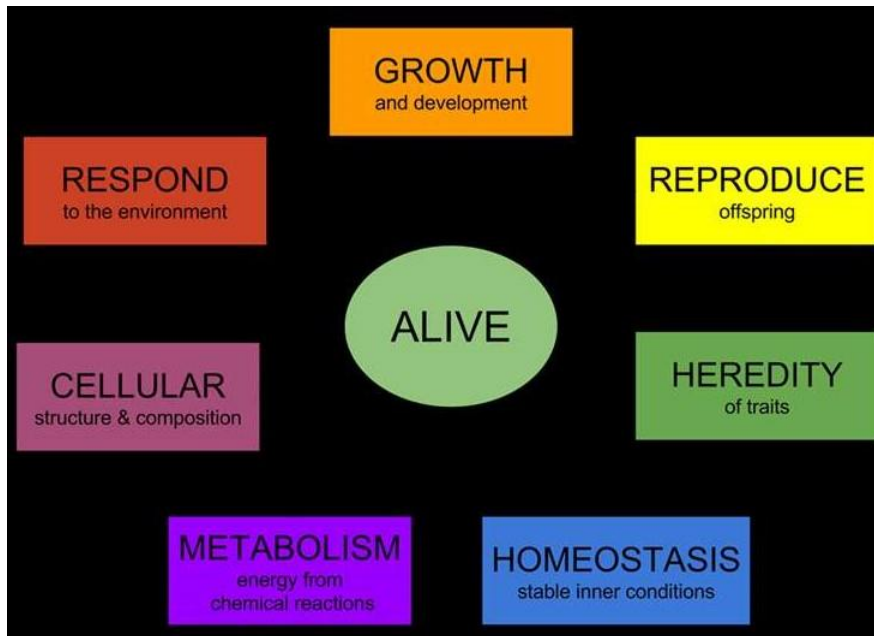
The world we are living contains both living and non living objects. In this chapter we will discuss about the characteristic features of living organisms and certain rules and principles for identification, nomenclature and classification of organisms



- BIOLOGY is the branch of science which deals with the life forms and living processes
- Greek word *bios* means life and *logos* means study
- ERNST MAYR is the scientist who pioneered the currently accepted definition of a biological species. He is known as ‘The Darwin of the 20th century’

❖ FEATURES OF LIVING ORGANISM are

- ✓ **GROWTH**
- ✓ **REPRODUCTION**
- ✓ **METABOLISM**
- ✓ **CELLULAR ORGANISATION**
- ✓ **CONSCIOUSNESS**



1. GROWTH

- Increase in mass and increase in number of individuals are the twin characteristics of growth.
- Growth is the irreversible permanent increase in size of an organism or its part or even of an individual cell.



➤ **INTRINSIC GROWTH**

- Intrinsic Growth is growth from inside
- **Intrinsic growth is a characteristic feature of living organism**

➤ **EXTRINSIC GROWTH**

- Extrinsic growth is the accumulation of material on the body surface
- That is the growth exhibited by non- living objects like mountains

✓ **HENCE, GROWTH CANNOT BE TAKEN AS A DEFINING PROPERTY OF LIVING ORGANISMS.**

INDETERMINATE TYPE

- In which growth takes place throughout their life span
- Example : plants

DETERMINATE TYPE

- Determinate type of Growth occurs only upto a certain age
- Example : Human and in animals.

➤ **MUTUALLY INCLUSIVE EVENTS :**

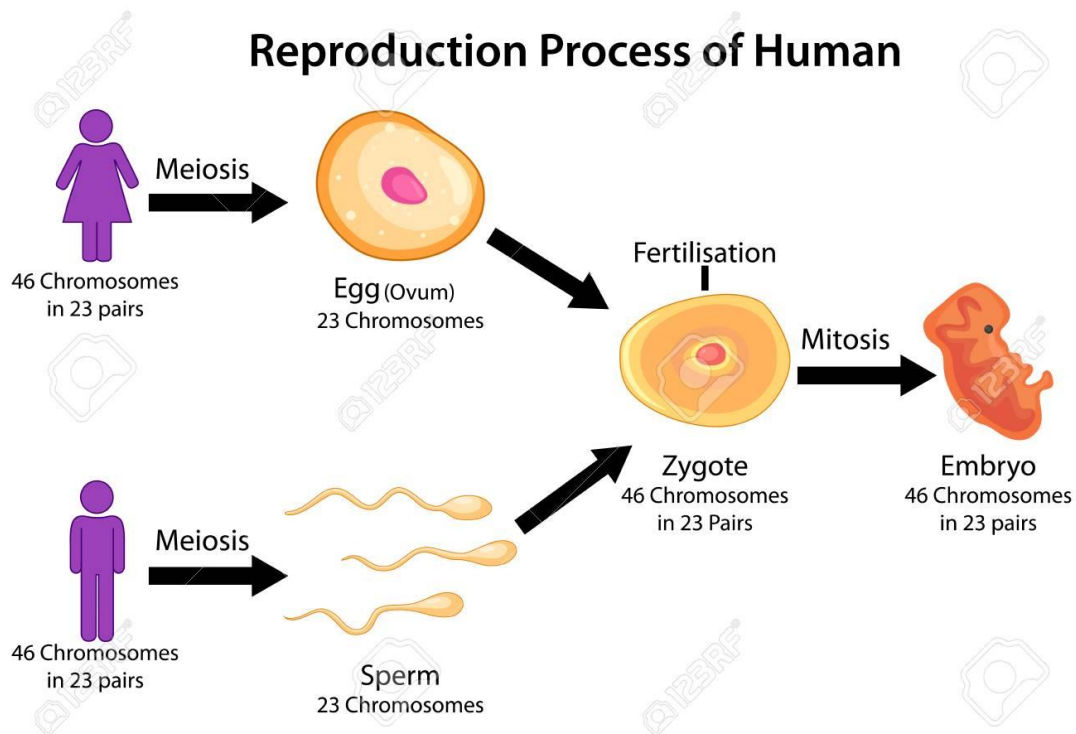
- Unicellular organism grow only when they reproduce
- Cell division is the means of reproduction
- Hence, in unicellular organisms like bacteria, growth & reproduction are mutually inclusive events

➤ **MUTUALLY EXCLUSIVE EVENTS:**

- In multicellular organisms the growth takes place because of enlargement of cells and cell division.
- In multicellular organisms growth and reproduction are separate events.
- So, in higher animals and plants growth & reproduction are mutually exclusive events.

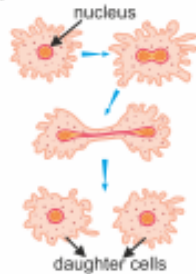
(2) REPRODUCTION

- **Reproduction** is the [biological process](#) by which new individual [organisms](#) – "offspring" – are produced from their "parents"
- Production of offspring by a sexual or asexual process.
- In unicellular organisms like bacteria, unicellular algae or amoeba, reproduction is synonymous with growth i.e., increase in number of cells.
- In multicellular organisms, production of progeny possessing features similar to those of parents is referred to as **sexual reproduction**.



- **Asexual reproduction** is through the following ways:

Binary fission: A single parent cell divides into two daughter cells .
e.g. Amoeba, paramecium, bacteria.



Budding: Parent cell produces bud, it gets detached and develops into new individual e.g. Yeast, Hydra



Spore Formation:
Reproduces by forming spores. Under favourable conditions spores develop into new individuals. E.g. Fern, fungi, bacteria.



Fragmentation: Organism with filamentous body, break into two or more fragments. Each fragment grows into a new individual.
e.g. Spirogyra



- ✓ By production of **Spores** – which is found in Algae & Fungi
- ✓ By **Budding** – which is found in Yeast & Hydra
- ✓ By **Fragmentation** – which is found in filamentous algae, fungi, and protonema of moss plant.
- ✓ **True Regeneration** – is a method of asexual reproduction in which fragmented organism regenerates the lost part of its body and becomes a new organism .

For Example – True regeneration can be found in *Planaria* or flat worms

- Regeneration is different from true regeneration
- In regeneration only lost part of the organism regenerates, not a new organism is produced. Regeneration is usually found in Lizard and Star fish.

Asexual reproduction	Sexual reproduction
Involves one parent only	Involves two organisms
Gametes are not produced	Gametes are produced by the organisms
Offspring are genetically identical to the parent	Offspring show genetic variation.
The cell division are only mitotic	Gametes are produced by meiotic divisions and zygote develops by mitotic division.
Large number of plants are produced in a very short time.	Comparatively the number produced is less.

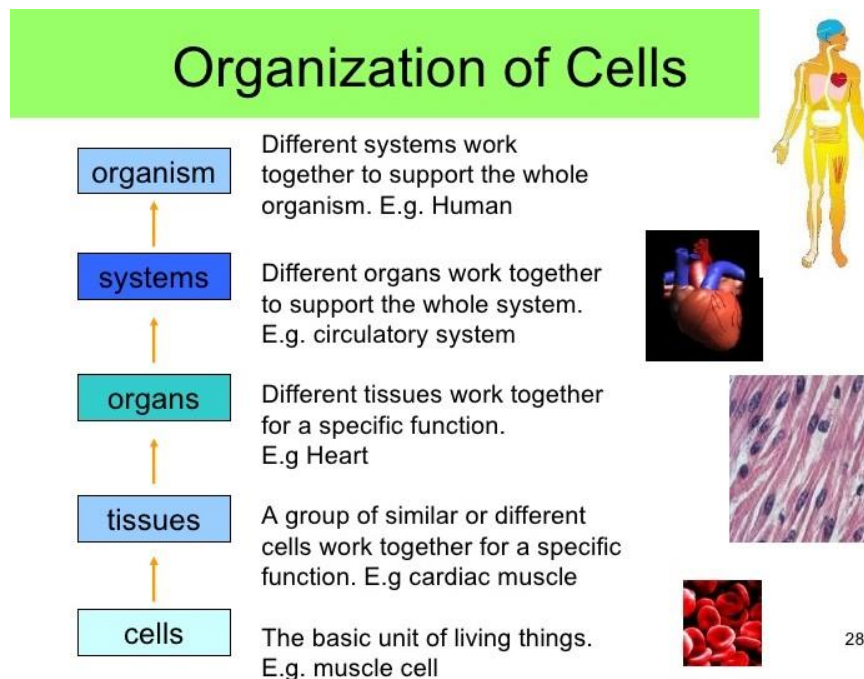
- Many living organisms do not reproduce like infertile human couples and sterile worker bees.
- **HENCE,REPRODUCTION CANNOT BE AN TAKEN AS A DEFINING FEATURE OF LIVING ORGANISMS**

(3) METABOLISM

- Metabolism is the sum total of all biochemical reactions taking place inside a living system.
 - All plants,animals, fungi and microbes exhibit metabolism.
 - non living object does not exhibits metabolism.
- Metabolic reactions can be performed outside the body in cell free system.An isolated metabolic reactions outside the body of an organism,performed in a test tube is neither living nor non- living.The isolated metabolic reactions in vitro are not living things but are living reactions.
- ✓ **HENCE,METABOLISM CAN BE CONSIDERED DEFINING FEATURE OF ALL LIVING ORGANISMS WITHOUT EXCEPTION.**

(4) CELLULAR ORGANIZATION

- Cell is the functional unit of an organism.
- Living organism is made up of cells, unicellular or multicellular
- Cells combine to form tissue. Tissues combine to form organ. Organs combine to form organ system and organ systems combine to form a Living Organism.
- **SO, CELLULAR ORGANIZATION OF THE BODY IS THE DEFINING FEATURE OF LIFE FORMS**



(5) CONSCIOUSNESS

- All living organisms has the ability to sense their surroundings or environment and respond to these environmental stimuli which could be physical, chemical or biological.
- We sense our environment through our sense organs
- Human being is the only organism that has ' self consciousness'
- ✓ **THE LIVING ORGANISM ARE SELF REPLICATING, EVOLVING AND SELF REGULATING INTERACTIVE SYSTEMS CAPABLE OF RESPONDING TO EXTERNAL STIMULI.**
- ✓ **HENCE, CONSCIOUSNESS IS THE DEFINING PROPERTY OF LIVING ORGANISM**

TAXONOMY

(B) DIVERSITY IN THE LIVING WORLD

1. BIODIVERSITY

So, what is biodiversity;

- Living organisms range from microscopic bacteria and algae to giant blue whale.
- **BIODIVERSITY** refers to the number and types of organisms present on earth



2. TAXONOMY

- TAXONOMY is the study of rules, principles and practices of characterisation, identification, classification and nomenclature of organisms.
- A Swedish naturalist, **CAROLUS LINNAEUS** is called as the father of taxonomy or father of systemic botany.
- ✓ The plants, animals, mammals, dogs, cats, wheat, rice etc are convenient categories used for the study of organisms. Each category is considered a taxonomic unit and represents a **TAXON** (Pl. **taxa**).
- ✓ Based on characteristics, all living organisms can be classified into different Taxa. This process of classification is called **TAXONOMY**.

FUNDAMENTAL COMPONENTS OF TAXONOMY

- Characterisation, identification, classification and nomenclature are the processes that are basic to taxonomy.
- Characterisation
 - The organism has to be described for its morphological and other characteristics. It is called characterization
- Identification
 - On the basis of its characteristics, it is decided whether it is similar or different to any known group of taxa
- Classification

It is the arrangement of organisms into categories or groups on the basis of their similar characteristics.
- Nomenclature
 - The process of giving scientific names to plants and animals is called nomenclature

BINOMIAL NOMENCLATURE

- Binomial nomenclature is a system of classification introduced by Carolus Linnaeus, in which each species is given two names.
 - The first is the **GENERIC NAME**, written with a capital letter, the second is the specific name or specific epithet, indicating the species and then the name of the discoverer in full or in abbreviation.
 - For Example : The scientific name of Mango is *Mangifera indica* Linn.
Mangifera – Genus or generic name
indica - Species or specific epithet
- ✓ **Who can give scientific name ?**

- Anyone can study, describe, identify and give a scientific name to an organism following certain universal rules. These rules are framed and standardized by ;
- **International Code for Botanical Nomenclature (ICBN)** for plants
- **International Code for Zoological Nomenclature (ICZN)** for animals

UNIVERSAL RULES OF NOMENCLATURE

1. Biological names are generally in **Latin** and written in italics.
2. The first word in the biological name represents the **genus** while the second component denotes the **specific epithet**.
3. Both the words in a biological name, **when handwritten, are separately underlined** or **printed in italics** to indicate their Latin origin.
4. The first word denoting the **genus** starts with a capital letter while the **specific epithet** starts with a small letter. Example: *Mangifera indica* Linn
5. **Name of the author** appears after the specific epithet ie, at the end of biological name and is written in an abbreviated form.

- Example: *Mangifera indica* Linn.
- It indicates that this species was first described by Linnaeus.

SYSTEMATICS

- Systematics is the branch of study that deals with classification of organisms based on their diversities and relationship among them.
- Systematics takes into account evolutionary relationships between organisms.
- The word systematic is derived from Latin word 'systema' which means systematic arrangement of organisms.
- 'Systema Naturae' is the book written by Carolus Linnaeus

TAXONOMY VERSUS SYSTEMATICS

Taxonomy refers to the classification of organisms in biology	Systematics refers to the study and classification of organisms for the determination of the evolutionary relationship of organisms
A branch of systematics	Studies the relationship of organisms
Involved in the classification and naming of organisms	Involved in the classification, naming, cladistics, and phylogenetics
Does not deal with the evolutionary history of organisms	Deals with the evolutionary history of organisms
Can change with further studies	Does not change with further studies

TAXONOMIC CATEGORIES

- **Classification** is a process in which closely resembling organisms are placed in a group. The groups which have similarities are placed into larger groups. The various grouping levels or ranks in **classification** are known as **TAXONOMIC CATEGORIES**.

TAXONOMIC HIERARCHY

- Taxonomic Hierarchy is the sequence of categories in a decreasing or increasing order from kingdom to species and vice versa. Kingdom is the highest **rank** followed by division, class, order, family, genus and species.
- Each category is considered a taxonomic unit and represents a **TAXON** (pl.taxa)

TAXONOMIC CATEGORIES SHOWING HIERARCHIAL ARRANGEMENT



TAXONOMIC HIERARCHY WITH EXAMPLES FROM PLANT KINGDOM AND ANIMAL KINGDOM



Animal Example	Taxonomic Rank	Plant Example
Animalia	Kingdom	Plantae
Chordata	Phylum	Angiospermophyta
Mammalia	Class	Eudicotidae
Primate	Order	Ranunculales
Hominidae	Family	Ranunculaceae
<i>Homo</i>	Genus	<i>Ranunculus</i>
<i>sapiens</i>	Species	<i>acris</i>
Human	Common Name	Buttercup



TAXONOMIC CATEGORIES

1. SPECIES

- Species is a group of individual organisms resembling one another in all morphological and reproductive features which can interbreed freely to produce fertile offsprings.
- Take the example of Mango (*Mangifera indica*) – In this case *indica* is the species of genera *Mangifera*.
- For the animal Lion (*Panthera leo*) – In this case *leo* is the species of genera *Panthera*



2. GENUS

- Genus is a group of related species which are presumed to have evolved from a common ancestor but with evolution became unable to interbreed
- For example ; potato and brinjal are two different species but belong to the genus *Solanum*.
- Leopard (*Panthera pardus*) and Tiger (*Panthera tigris*) with several common features are all species of the genus *Panthera*

3. FAMILY

- Family contains a group of related genera
- Families are characterized on the basis of both vegetative and reproductive features
- Family Felidae contains Genus *Panthera* and Genus *Felis*
- Family Solanaceae contains Genus *Solanum*, Genus *Petunia* and Genus *Datura*

4. ORDER

- Order is the next higher taxonomic category which includes related families.
- Plant families like Solanaceae, Convolvulaceae are include in the order Polymoniales mainly based on the floral characters

Species A group of individuals with similar morphological characters, which are able to breed among themselves and produce their own kind.

Genus Group of related species which resemble one another in certain correlated characters. Monotypic genus has only one species whereas polytypic genus may have more than one species.

Family It includes one or more related genera, differentiated from other related families by certain characteristic differences.

Order It includes one or more related families.

Class It includes one or more related orders.

Phylum It includes all organisms belonging to different classes having a few common characters. Botanists use the term Division for Phylum.

Kingdom It includes all organisms that share a set of distinguishing common characters. Plants are put in Plant Kingdom while animals are included in Animal Kingdom. This is the highest taxonomic category.

5. CLASS

- This category includes one or more related orders
- Class Mammalia of animals includes order Carnivore and order Primata

6. PHYLUM or DIVISION

- This category is based on the common features among different classes.
- The term phylum is used for animals while the term division is commonly employed for plants.
- The division Spermatophyta contains seven classes of gymnosperms and two classes of angiosperms
- The phylum Chordata of animals includes several classes like Amphibia, Reptilia, Aves and Mammalia.

7. KINGDOM

- Kingdom is the highest taxonomic category
- It includes one or more related divisions or phyla.
- In the Linnaeus system of classification all plants are included in kingdom Plantae and all animals are included in the kingdom Animalia

ORGANISMS WITH THEIR TAXONOMIC CATEGORIES

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

TAXONOMIC AIDS

- Taxonomic studies of various species of plants, animals and other organisms are useful in agriculture, forestry, industry and in general knowing our bio-resources and their diversity.
- Techniques, procedures and stored information that are useful in identification and classification of organisms are called taxonomic aids.

1. HERBARIUM

- Herbarium is a store house of collected plant specimens that are dried, pressed and preserved on sheets.

- The herbarium sheets also carry a label providing information about date and place of collection, English, local and botanical names, family, collector's name etc.

2. BOTANICAL GARDENS

- Botanical gardens have collections of living plants for reference.
- Plant species in these gardens are grown for identification purposes and each plant is labelled indicating its botanical/scientific name and its family.
- The famous botanical gardens are Kew garden in England and Indian Botanical Garden, Howrah in India and at National Botanical Research Institute, Lucknow in India.

3. MUSEUM

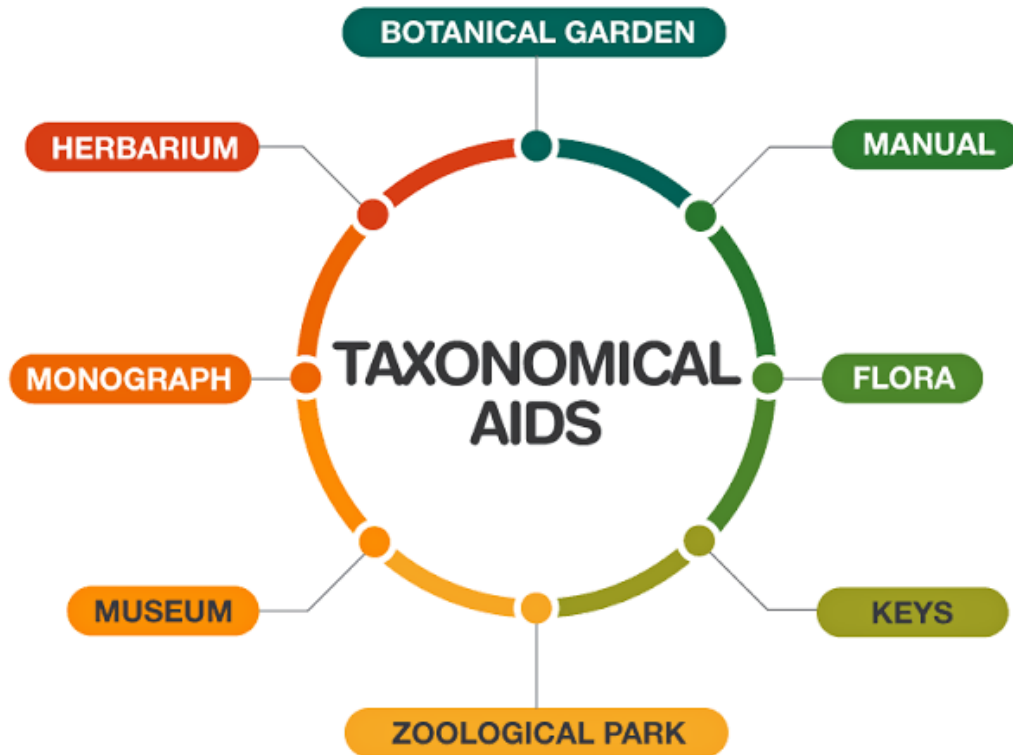
- Museums are collection of preserved plants and animals for study and reference.
- Specimens are preserved in the containers or jars in preservative solutions.
- Plant and animal specimens may also be preserved as dry specimens.

4. ZOOLOGICAL PARKS

- Zoological parks are places where wild animals are kept in protected environments under human care and which enable us to learn about their food habits and behavior.
- All animals in a zoo are provided as far as possible, the conditions similar to their natural habitats.

5. KEY

- Key is another taxonomical aid used for identification of plants and animals based on the similarities and dissimilarities.
- It is an artificial analytical device by which each type of taxonomic category can be identified.
- The Keys are based on the contrasting characters generally in a pair called couplet. It represents the choice made between two opposite options. This results in acceptance of only one and rejection of the other.
- Each statement in the key is called a Lead.
- Separate taxonomic keys are required for each taxonomic category such as family, genus and species for identification purposes.



OTHER TAXONOMIC AIDS

- Besides the above mentioned taxonomic aids; FLORA, MANUALS, MONOGRAPHS and CATALOGUES are some other means of recording descriptions.
- FLORA contains the actual account of habitat and distribution of plants of a given area.
- MANUALS are useful in providing information for identification of names of species found in an area.
- MONOGRAPHS contain information on any one taxon. Monograph give complete information about anyone family or genus at a given time.
- CATALOGUES is a database that provides the most comprehensive and authoritative index of known species of animals, plants, fungi and micro-organisms.