THE LIVING WORLD

Life can be defined as a unique aggregation of molecules. These molecules have the tendency to express themselves through various chemical reactions collectively called metabolic reactions. The basic purpose of these reactions is to transform or produce and utilize energy. The term used to define these reactions in a cumulative way is metabolism. Through metabolism, various biomolecules are synthesized resulting in growth, development, responsiveness, adaptations and reproduction. The forms that possess and express all these features are called living beings.

These living beings live in almost all possible habitats like forests, mountains, deserts, oceans, freshwater bodies, hot springs, polar regions etc.They are linked to one another by sharing the common genetic material.

All living beings share characteristics like organization, energy utilization, regulation or homeostasis, growth, development, reproduction and adaptation.

1.1 WHAT IS GROWING

Life has maintained certain fixed properties that life exhibits today and are very different from those that were present at its origin.

Characteristics of living organisms:

The most outstanding features that have arisen during life's history include

- Growth
- Reproduction
- Ability to sense environment
- Metabolism
- Cellular organization
- Consciousness.

1. GROWTH: **It is the increase in number & mass of cells by cell division.**

All living organisms have the capacity to grow.

Growth of an individual organism has two characteristics-

1. Increase in body mass

2. Increase in number.

In plants, growth occurs continuously throughout their lifespan. In animals, growth is only up to a certain age. However, cell division occurs to replace lost cells.

Unicellular organisms also grow by cell division.

Non-living objects grow by accumulation of material (increase in mass) on the surface.

For example: mountains, boulders, sand mounds etc. So growth cannot be taken as a defining property of living organisms alone. A dead organism does not grow.

2. REPRODUCTION:

In living organisms reproduction means the formation of new individuals from their parents.

Fungi multiply and spread easily by producing millions of asexual spores. Hydra and yeast multiply by budding. Planaria, a flat worm regenerates the lost part of its body and become a new one.

Filamentous algae, protonema of mosses and fungi also multiply by fragmentation.
In unicellular organisms reproduction is synonymous with growth, i.e., increase in number of cells. Therefore in unicellular organisms, there is no distinction in the usage of the terms growth and reproduction.
Many organisms do not reproduce - e.g. mules, worker bees, infertile human couples, etc. Hence, reproduction is not a perfect defining characteristic of living organisms.

3. METABOLISM:

A variety of biochemical changes are constantly occurring in a living organism leading to formation and interconversion of chemicals. All the chemical reactions taking place in our body come under metabolism. Non-living things do not metabolise. All living organisms show metabolism. However, metabolic reactions can be mimicked under *in vitro* conditions.

4. CELLULAR ORGANIZATION:

All living organisms are made up of cells. The cells perform all functions in the organism. Non-living things do not have a cellular organization. Therefore, it can be seen that a cellular organization gives rise to the functions of life-like metabolism, growth, reproduction, etc. Thus cellular organization is a defining characteristic of living organisms.

5. CONSCIOUSNESS:-

It is the awareness of one's environment, actions and intentions. It is present in living organisms. Human beings sense the environment through sense organs. Plants respond to external factors like light, temperature, water, pollutants, other organisms etc. In both plants and animals, photoperiod (duration of light) affects the reproduction in seasonal breeders.
Therefore, all organisms are 'aware' of their surroundings. So, it is the defining property of living organisms.
Human is the only organism having **self-consciousness i.e. aware of himself. Therefore consciousness is the defining property of living organisms.**
All living organisms are linked to one another by the sharing of common genetic material to varying degree.

1.2**DIVERSITY IN THE IVING WORLD**:

Earth provides the physical base for living beings. There are millions of varieties of living organisms in the world around us. There are also many organisms that we cannot see with our naked eye around us. They are found in varied habitats like mountains, oceans, forests, lakes, deserts and even hot water springs.
Number of species identified and studied is **1.7-1.8 million.**
All organisms which live on earth together make up the natural diversity of life in the world. This natural diversity of life on earth is generally called biological diversity or biodiversity.

Taxonomy: The systematic arrangement of organisms that includes characterization, identification, nomenclature, and classification of organisms is called taxonomy. Systematics is a branch of science that deals with identification, nomenclature, classification and evolutionary history of an organism. Thus systematics includes evolutionary history along with taxonomic characteristics of an organism. Systematics is as old as human civilization. **The term taxonomy was first introduced by A.P de Candolle in 1813.**

Systematics (Latin 'systema') means systematic arrangement of organisms.
Systema Naturae is the book written by Linnaeus.
Neosystematics is a concept of systematics that considers a species to be the product of evolution. This concept was developed by Julia Huxley in 1940.It takes into consideration all the known characteristics of organisms and all the known evidences from different fields of biology.

Identification: is to determine the exact place or position of an organism in the set plan of classification. It is carried out with the help of taxonomic keys.
Classification: It is the placing of an organism or a group of organisms in category according to a particular system and in conformity with a nomenclature system.
Characterization: The understanding of characters of organisms like external and internal structure (morphology and anatomy), the structure of the cell (cytology), developmental process (embryology) and ecological information (ecology) of organism.

Nomenclature (naming): The naming of living organisms is called nomenclature. The names are of two types-vernacular (common names) and scientific names.
Local names-Locally used names are called as local names. Local names are in local languages or common language. Local names are easy to use by local people, but these local names cannot be used by biologists due to the following draw backs.

- 1. A single local name is often used for many species.
- 2. The local names sometimes lead incorrect meaning about the organism.
- 3. Different local names are used to recognize an organism in different regions of country or world. These local names also vary with the language.

Scientific names: These are the names given to the organisms by biologists based on agreed principle and criteria. These are acceptable all over the world. To accomplish this, certain international codes have been established.
These codes are

- **ICBN-International Code of Botanical Nomenclature**
- **ICZN-International Code of Zoological Nomenclature**
- **ICVN-International Code of Viral Nomenclature**

ICBN/ICNB-International Code for Bacteriological Nomenclature or Nomenclature of Bacteria
BINOMIAL NOMENCLATURE:
Carolus Linnaeus used this nomenclature system for the first time and proposed scientific name of all the plants and animals. He is the founder of binomial system.
Linnaeus proposed scientific name of plants in his book" Species plantarum"
In binomial nomenclature, each scientific name has two components-generic name (genus) and specific name (species) E.g., *Mangifera indica* Linn. Mangifera is the genus name and indica is the species name. Linn indicates that this species was first described by Linnaeus
Who can give scientific names: Any one can study, describe, identify and give name to an organism provided certain universal rules are followed.
Rules:

1. A scientific name generally has two components (words) in Latin or derived from Latin irrespective of their origin.
2. First word of the biological name denotes the genus name where as the second one denotes for species.
3. Names are printed in italics or when hand written they are separately underlined to indicate their Latin origin.

4. Genus name starts with capital letter and specific name starts with small letter.
5. The name of the author is written in an abbreviated form after the species name and it is printed in Roman.
6. Each taxonomic group can have only one correct name.
7. The name should be short, precise and easy to pronounce.

Eg: *Mangifera indica*- Mangifera is the genus name and indica is the species name.

1.3 TAXONOMIC CATEGORIES:

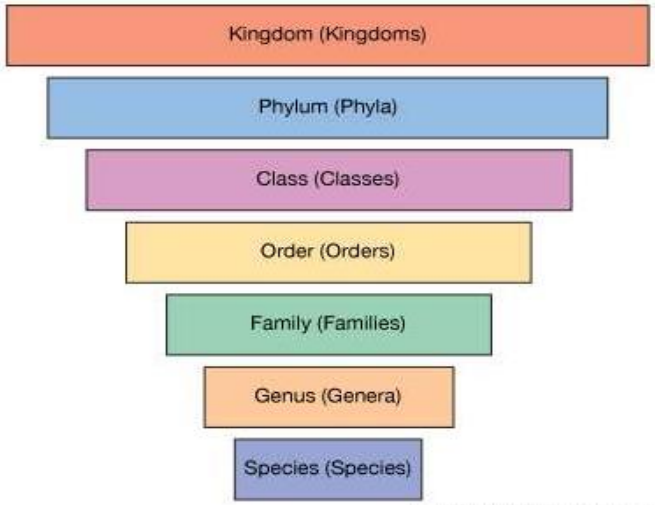
The term taxon was introduced for the first time by ICBN in 1956.**Mayr in 1964 defined Taxon as a taxonomic group of any rank that is sufficiently distinct to be worthy of being assigned a definite category.**

TAXONOMIC HIERARCHY:

The system of arranging organisms in a definite sequence of various taxonomic categories arranged in a proper descending order is called taxonomic hierarchy. It is also called Linnaean hierarchy as it was first proposed by **Carolus Linnaeus, the Father of Systematic Botany**. The hierarchy includes seven obligate categories.

They are as follows-

Kingdom - Animalia
↑
Phylum - Chordata
(Division in case of plants)
↑
Class - Mammalia
↑
Order - Primata
↑
Family - Hominidae
↑
Genus - Homo
↑
Species – sapiens



1.3.1 Species:

The lowest taxon or category in the biological classification is the species. So the basic unit of taxonomy is species. So the basic unit of taxonomy is species. **Species is a group of individuals resembling one another in all major vegetative and reproductive characteristics**. The individuals of a species resemble so closely

that they may be regarded as having been derived from the same parents. **In 1964, Ernst Mayr defined species as a group of potentially interbreeding populations that are reproductively isolated from other such groups.**
The term species was first introduced by **John Ray.**
Eg: sapiens

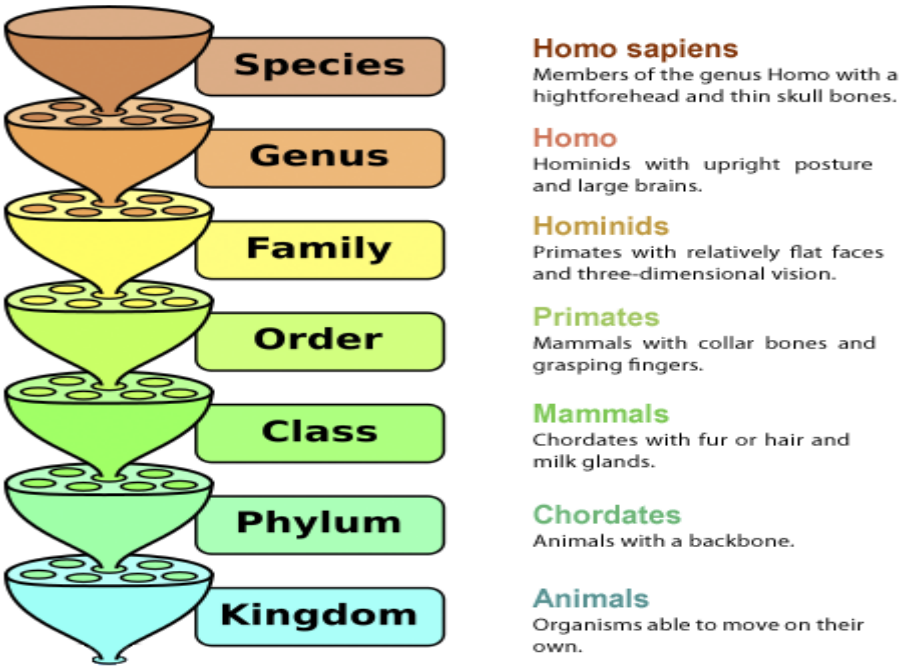
1.3.2Genus: A group of related species. All the species in a genus have many common characteristics and all have evolved from a common ancestor.
E.g.: Homo

1.3.3 Family: A family is an assemblage of related genera.
E.g.: Hominidae

1.3.4 Order or Cohort: An order is a group of related Families.
E.g.: Primata

1.3.5 Class: Several related orders having certain common characters form a higher category called the class.
E.g.: Mammalia
1.3.6 Phylum/Division:
Classes having same features in common constitute a Phylum. The term **phylum is used in the case of classification of animals and the term division is used in plant classification**.
E.g.: Chordata

1.3.7 Kingdom:
The highest taxon or category in biological classification is the Kingdom. It includes one or more related divisions or phyla. Plants are put in Kingdom Plantae and animals are put in the Kingdom Animalia.
E.g.: Plantae, Animalia.



Generic name	**Specific epithet**	**Common name**
Mangifera	*indica*	Mango

Solanum	*tuberosum*	Potato
Solanum	*nigrum*	Nightshade
Panthera	*leo*	Lion
Panthera	*tigris*	Tiger
Homo	*sapiens*	Man

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

1.4 Taxonomical Aids:

They are useful in agriculture, forestry and industry. These studies are essential for knowing our bioresources and biodiversity. Taxonomic work involves studies both in field and in laboratory.

Taxonomists have developed different types of taxonomic aids to help in identification, nomenclature and classification of organisms.

The important taxonomic aids are herbaria, botanical gardens, museums, zoological parks and keys.

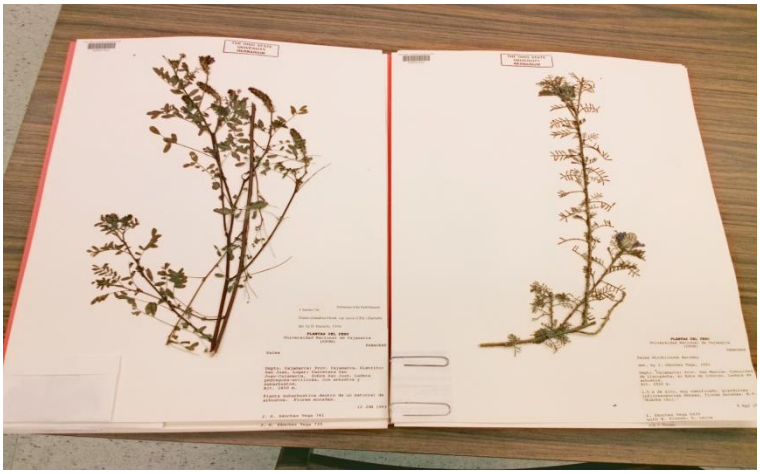
1.4.1 (A). Herbarium:

It is a depository of plant specimens in dry condition. The specimens are dried, mounted on a paper and properly labeled.

Procedure:

1. Collection of specimens
2. Pressing and drying: to remove moisture content
3. Sterilization or poisoning: to prevent fungal attack
4. Mounting: Pasting or stitching on a sheet
5. Labeling of specimens: Local name, Common English name, Binomial nomenclature, Family name, Place of collection, Date and time of collection, Collectors name.
6. Storage of herbarium sheets.

Each herbarium sheet is to be labeled properly to avoid confusion. The label should carry scientific name along with author's name, local name, name of family, locality, date of collection, name of collector etc. The label is pasted on the right hand corner at the bottom of the herbarium sheet.



Information about the collected specimens is published in the form of a book called flora.

It gives a list of total plant species in a particular region together with a brief description of the same.

Some important floras of India **are Flora of British India, Flora of Delhi, Flora of Madras, Flora of Travancore etc.**

The largest Herbarium of the world is **Herbarium of Royal Botanical Garden at Kew in England**.

The largest Herbarium in India is **Central National Herbarium in the Indian Botanical Garden at Kolkata established in 1787.**

1.4.2 (B).Botanical gardens: Botanical gardens are places or institutions that maintain the living plant specimens of different varieties of plants for reference.

A botanical garden contains plant species from various corners of the world. Plant species in botanical garden are grown for identification purpose. Each plant is labelled.The label should carry its botanical name and its family. Botanical garden has green houses, a library, a herbarium, research laboratory etc. It is, therefore, not merely a garden but a botanical institution. At present there are over 600 botanical gardens in the world**.**

The Hanging Gardens of Babylon are considered among the wonders of the ancient world.

The largest Botanical Garden of the world is Royal **botanical garden at Kew in England. It is called the botanical capital of the world**. Bentham and Hooker were associated with this garden.

The largest botanical garden of **India is Indian Botanical garden at Kolkata**. The largest tropical botanical garden in Asia is **Tropical Botanical Garden at Thiruvananthapuram** in Kerala.

KEW GARDEN

1.4.3 Museum:

It is the institution where artistic and educational plants or animals are preserved, stored and exhibited to public. There are natural science museum, Science museum and Zoological museum.

All colleges maintain museums in Botany and Zoology Departments. Animals are also preserved in museums. The specimens are fixed in the jars or containers in chemical solutions and are preserved for longer duration. The specimens are correctly identified and labeled. They are stored and a catalogue is prepared for future reference.

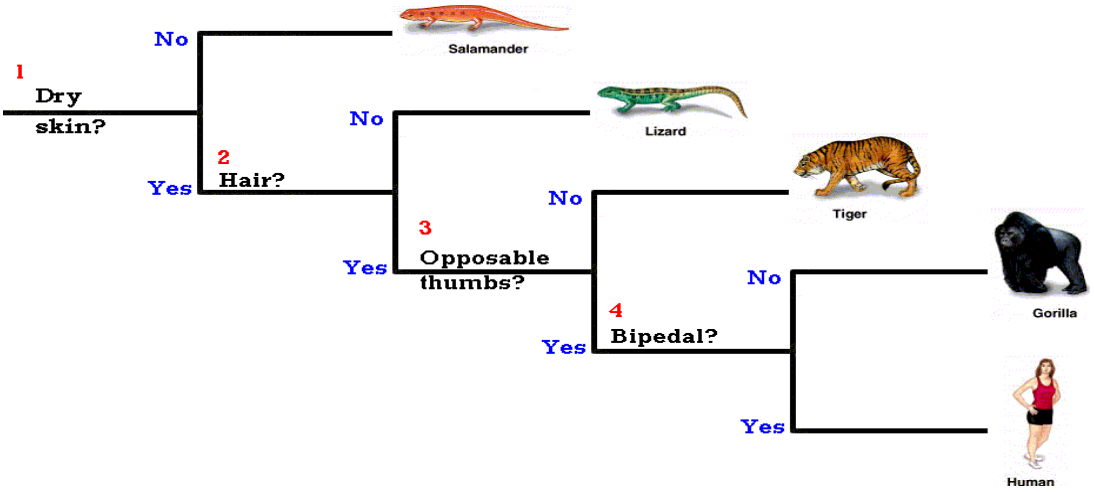
Plants and animal specimens are also preserved as dry specimens. Insects are preserved in insect boxes after collecting, killing and pinning. Birds and mammals are stuffed and preserved. Animal skeletons are also kept in museums.

1.4.5 (D).Keys: A key is a tool by which each species in a group of organisms may be identified. It is prepared by a taxonomist to help other biologists to identify the species. Taxonomic keys are based on contrasting characters. The characters are in a pair called couplet.

Key may be of two types-**indented key and bracketed key.**

If a key provides sequence of choices between two or more statements of characters of species, it is called **indented key**. Each statement in a key is called **a lead.**

If the pairs of contrasting characters are not repeated by subdividing characters and each character is given a number in bracket, it is called **bracketed key.**



(e).Zoological parks:

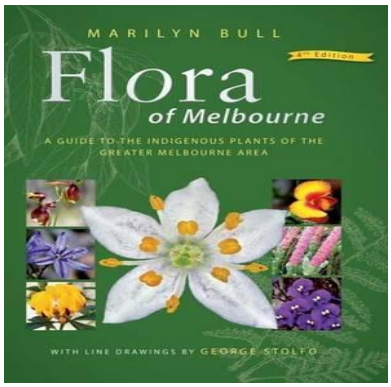
Zoological parks are the places where **animals are kept in protected environment under human care.** These enable us to learn about their food habits and behavior**.**

The largest zoo in the world is **the zoological park of Kruger in South Africa.**

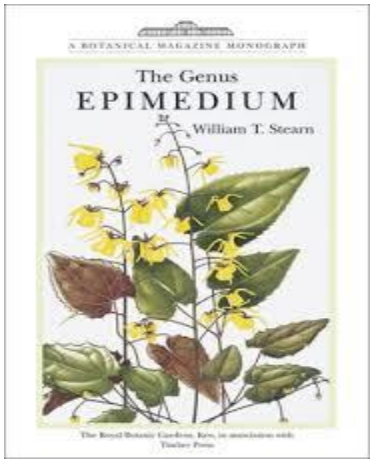
The largest zoo in India is **the Zoo of Kolkata.**

OTHER TAXONOMIC AIDS: Besides the above mentioned taxonomic aids**, flora, manuals, monographs and catalogues** also serve as taxonomic aids for correct identification.

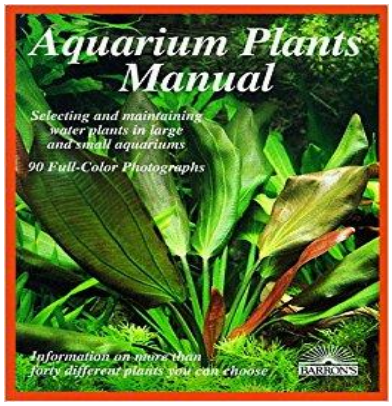
Flora: These contain the actual account of habitat and distribution of plant species of a given area. It provides the index to plants occurring in a particular area. Hooker compiled first complete flora of India.



Monograph: These are hand books which provide the available information of any one taxon (family or genus).



Manuals: These provide information for identification of names of species occurring in an area. They also help in correct identification.



Catalogue: These provide the list of publications. The publications publish the books, periodicals, and dictionaries which provide new information for taxonomic studies.

FAST TRACK REVISION:

1. The organisms exhibiting metabolism, cellular organization, homeostasis, growth, reproduction, development, responsiveness and other characteristics of life are designed as living things.

2. Growth is an irreversible increase in the mass of an individual.

3. Systematics deals with identification, nomenclature, classification and evolutionary history of an organism.

4. Identification is to determine the exact place or position of an organism in the set plan of classification.

5. Classification is an arrangement of organisms into groups on the basis of similarities.

6. Nomenclature deals with the determination of a scientific name of organisms using international code of nomenclature.

7. Binomial nomenclature- The system of naming with two components or epithets –generic and specific epithet and is proposed by Carolus Linnaeus.

8. The sequence of arrangement of these taxonomic categories in their order is known as taxonomical hierarchy and each level in the hierarchy is known as taxon.

9. Taxonomic hierarchy is the sequence of taxonomic categories in a descending order of number of species.

Kingdom → Phylum/Division → Class → Order → Family→ Genus→ Species

10. Taxonomical aids- Techniques and procedures to store information and specimens for identification and classification of organisms.

11. Herbarium is a storehouse of dried, pressed, and preserved plant specimens.

12. Museum has collection of preserved plant and animal specimens.

13. Botanical garden has collection of living plants.

14. Zoological parks are the places, where wild animals are kept in protected environment under human care.

15. Key is used for identification of plants and animals, based on similarities and differences.

16. Flora is a book or other work dealing the plants of a particular region or habit.

17. Monograph gives comprehensive information of a single taxon in biological studies.

18. Manual provides information for identification of name of species found in a particular area.