

UNIT 1

THE LIVING WORLD

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SYNOPSIS:

Characteristics of living organism, basic or fundamental elements of taxonomy, taxonomy, systematic and classification, nomenclature, rules for binomial nomenclature, Taxonomical hierarchy, tools for taxonomic studies- herbarium, botanical garden, museum, zoological parks, taxonomic keys, taxonomic literature, outline of five kingdom classification.

CHARACTERISTICS OF LIVING ORGANISM:

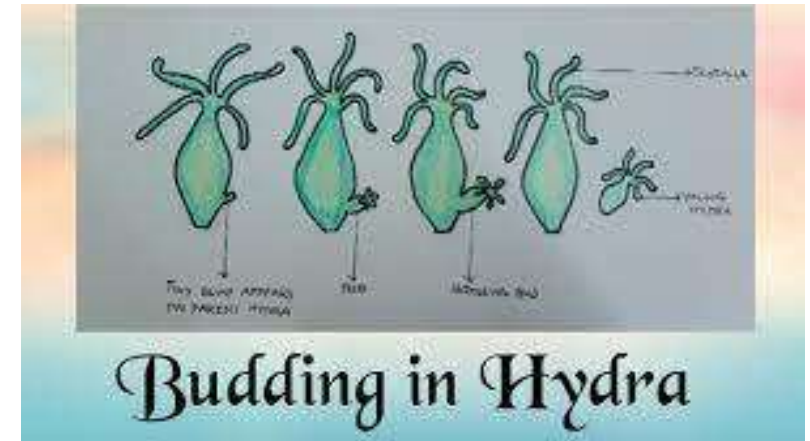
1. GROWTH
2. REPRODUCTION
3. METABOLISM
4. CELLULAR ORGANIZATION
5. CONSCIOUSNESS

GROWTH

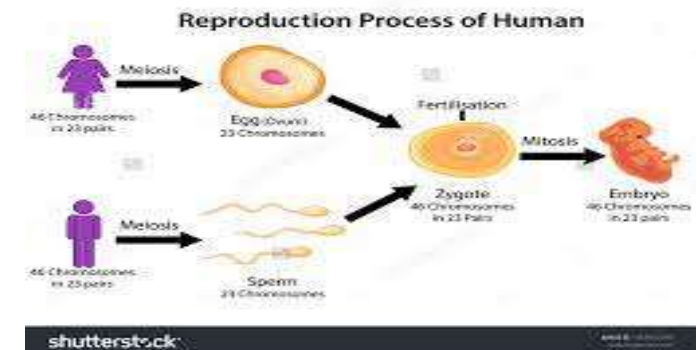
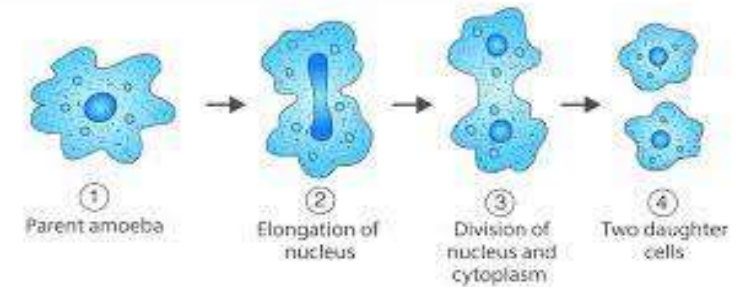
- Increase in mass and number
- Cell division
- Plants division occurs continuously and animals – certain age
- Division also enables to replace lost cells
- Unicellular- division to increase in number
- Body mass is increased
- Non living- grow with accumulation of material on surface, E.g mountains, sand mounds
- Conditions when it is observed in living organism when explained- characteristics of living.

REPRODUCTION

- Organism reproduce to progeny similar to them
- Asexual and sexual reproduction occurs
- Unicellular organism like Amoeba, bacteria- multiply and increase in number (cell division)
- Many organism do not reproduce like- mules, sterile worker bee, infertile human couple.
- Hence reproduction defines characteristic of living organism
- There are different process of reproduction.

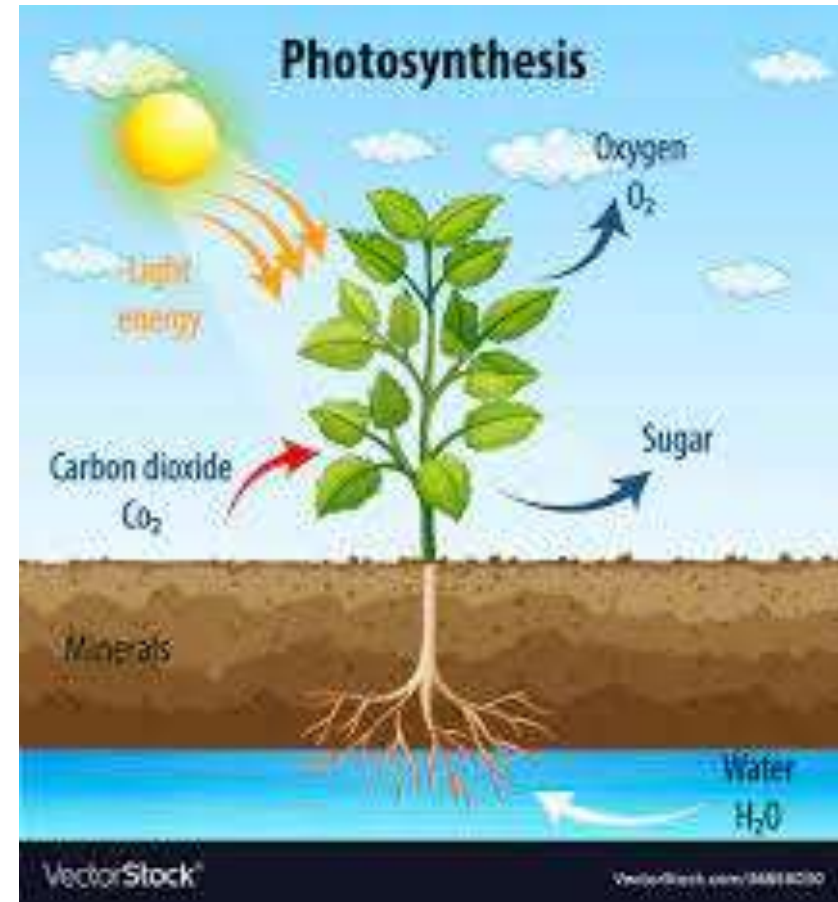


BINARY FISSION IN AMOeba



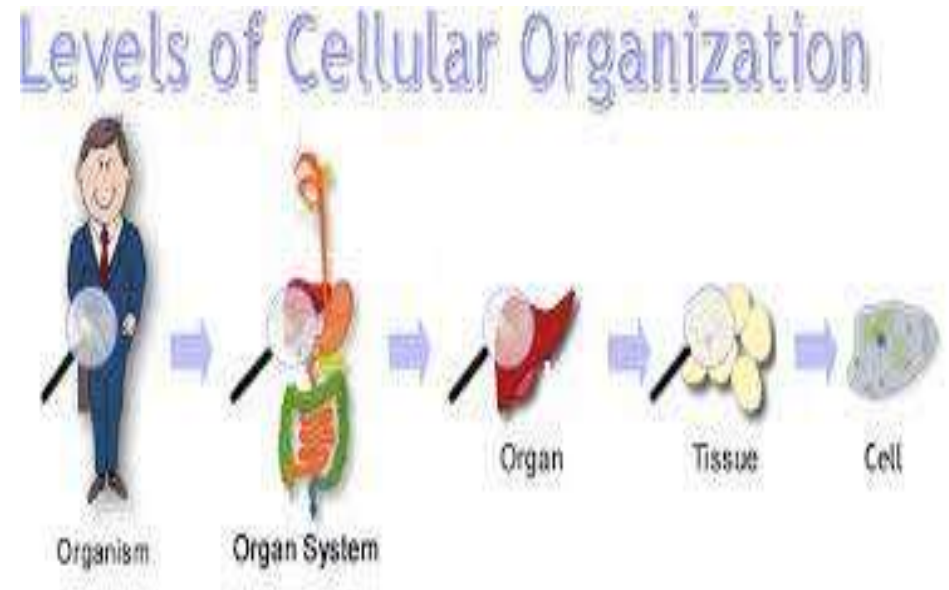
METABOLISM:

- All organism are made of chemicals- small and big
- Chemicals- biomolecules, which are made and changed to each other molecules
- Conversion reactions of these molecules are called **metabolic reactions**
- Sum total of all chemical reaction is termed as metabolism
- Metabolism – defining feature of living things and hence Cellular organization of the body is the defining feature of life form
- E.g Photosynthesis (anabolism), cellular respiration (catabolism)



Cellular organization

- Cellular organization is **the components that make up the cell and how they are arranged inside it.**
- Each component called an organelle, performs a specific function vital for the cell
- The basic level of organization for all living things is the cell. In unicellular (single-celled) organisms, a single cell performs all life functions. Multicellular (many-celled) organisms have various levels of organization within them. Examples: **blood cells, nerve cells, bone cells**, etc.
- Most organisms have functional parts with five levels: **cells, tissues, organs, organ systems and whole organisms.**



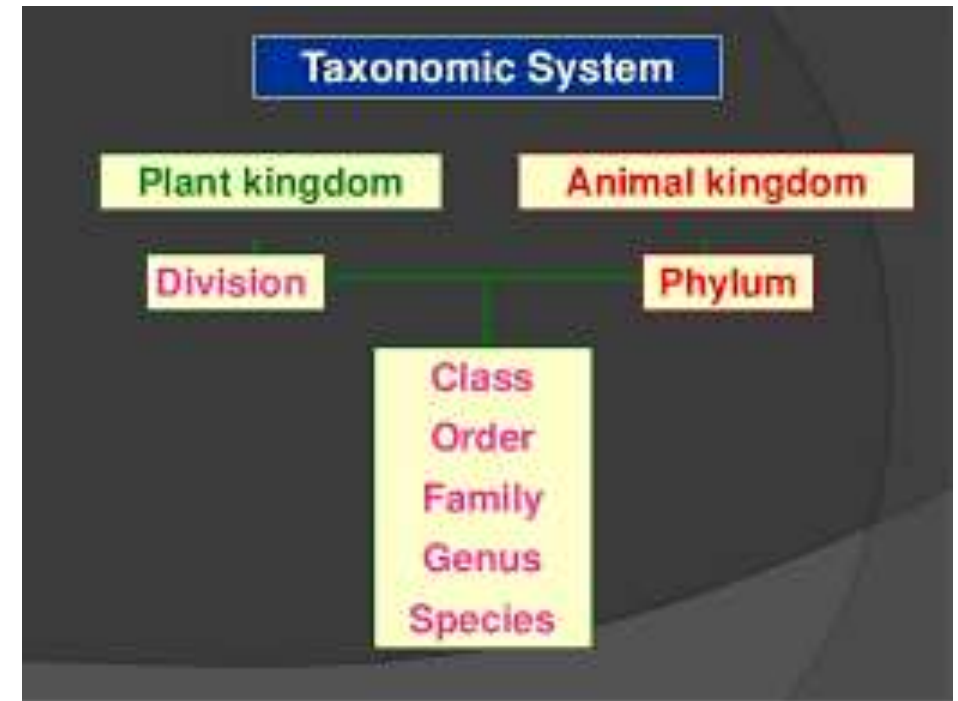
CONSCIOUSNESS

- Consciousness enables **an organism to respond to various external factors.**
- It is the ability of living organisms to respond to various physical, chemical and biological stimuli from their surroundings
- **Increases the likelihood that an organism will direct its attention, and ultimately its movements,** to whatever is most important for its survival and reproduction.



FUNDAMENTAL ELEMENTS OF TAXONOMY:

- **Identification**
It is the step of identifying an organism as plant ,animal, virus or microbe.
- **Characterization/ Description**
It is the study of characters of the newly found organism.
- **Classification**
It is the process of assigning various ranks in the hierarchy for classification.
- **Naming (nomenclature)**
It is the process of given scientific name to an organism. It is also called binomial nomenclature.



Taxonomy

- Taxonomy is the science of naming, describing and classifying organisms and includes all plants, animals and microorganisms of the world.
- Using morphological, behavioral, genetic and biochemical observations, taxonomists identify, describe and arrange species into classifications, including those that are new to science.
- In the past 250 years of research, taxonomists have named about 1.78 million species of animals, plants and microorganisms, yet the total number of species is unknown and probably between 5 and 30 million.
- The Swedish botanist Carl Linnaeus is regarded as the founder of the current system of taxonomy, as he developed a ranked system known as Linnaean taxonomy for categorizing organisms and binominal nomenclature for naming organisms.



Systematic and classification:

- The term **systematics** is derived from Latinized Greek word-systema-as applied to the systems of classification developed by early naturalists, notably Linnaeus.'
- Systematics includes taxonomy, identification, classification and nomenclature and all other aspects of dealing with different kinds of organisms and data accumulated about them is also included in systematics.
- The process of grouping together various organisms according to their similarities, dissimilarities and phylogenetic descent is known as **biological classification**.
- There have been various attempts to classify organisms. The earliest was by **Aristotle**, who classified plants into herbs shrubs and trees. He classified animals into two groups, based on the presence and absence of red blood.
- Linnaeus gave the Two Kingdom system of classification and divided living organisms into Plantae and Animalia.
- **R.H. Whittaker** proposed the Five Kingdom system of classification and classified organisms, based on cellular structure, complexity, mode of nutrition, phylogenetic relationship and ecological role performed by them.
- Whittaker divided organisms into Monera, Protista, Fungi, Plantae and Animalia

Five Kingdom Classification by Whittaker

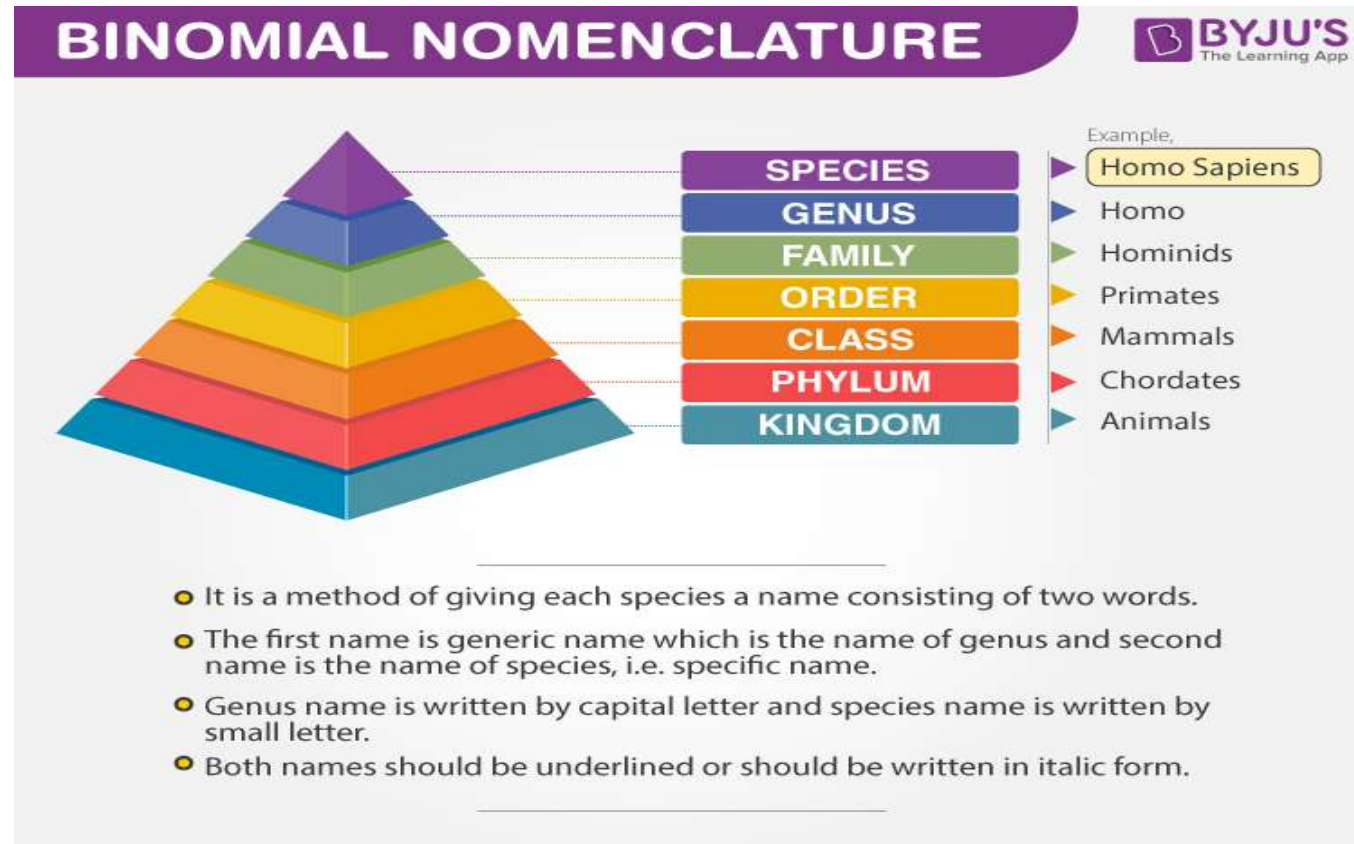
| Attributes | Monera | Protista | Fungi | Plantae | Animalia |
|-------------------|---|-------------------------------|-----------------------------|---------------|---------------------------|
| Cell type | Prokaryotic | Eukaryotic | Eukaryotic | Eukaryotic | Eukaryotic |
| Cell wall | Polysaccharide + amino acid | May be present | Chitin | Cellulose | Absent |
| Organ complexity | unicellular | Unicellular | Multicellular | Multicellular | Multicellular |
| Mode of Nutrition | Chemosynthetic Autotrophic/ heterotrophic | Autotrophic/ heterotrophic | Heterotrophic Absorption | Autotrophic | Heterotrophic Holozoic |

Nomenclature

- It is a system of names or terms, or the rules for forming these terms in a particular field of arts or sciences
- The word *nomenclature* is derived from the Latin *nomen* ('name'), and *calare* ('to call'). The Latin term *nomenclatura* refers to a list of names, as does the word *nomenclator*, which can also indicate a provider or announcer of names.
- The scientific need for simple, stable and internationally accepted systems for naming objects of the natural world has generated many formal nomenclatural systems.
- Nomenclature, in biological classification, **system of naming organisms**. The species to which the organism belongs is indicated by two words, the genus and species names, which are Latinized words derived from various sources.

Binomial nomenclature

- A system of nomenclature in which each species of animal or plant receives a name of two terms of which the first identifies the genus to which it belongs and the second the species itself.
- The **binomial** system of nomenclature was introduced by Carolus Linnaeus.



RULES FOR BINOMIAL NOMENCLATURE

Binomial Nomenclature

- Naming of Plants by two names
- It consists of two epithets [words] – Generic epithet and Species epithet
- It was first introduced by Linnaeus in 1751

How to write

- Genus comes first
- Species follows next
- Should be in Greek or Latin
- The name relates the plant
- Genus name should be capitalized
- Species name should be in small letter
- It should be italicized or underlined

TAXONOMICAL HEIRARCHY

- Taxonomic hierarchy is the process of arranging various organisms into successive levels of the biological classification either in a decreasing or an increasing order from kingdom to species and vice versa.

- Taxonomic Hierarchy Categories

Following are the important taxonomic hierarchies in which different organisms are classified:

Kingdom

The kingdom is the highest level of classification, which is divided into subgroups at various levels. There are 5 kingdoms in which the living organisms are classified, namely, Animalia, Plantae, Fungi, Protista, and Monera.

Phylum

This is the next level of classification and is more specific than the kingdom. There are 35 phyla in kingdom Animalia. For Example – Porifera, Chordata, Arthropoda, etc.

Class

Class was the most general rank in the taxonomic hierarchy until phyla were not introduced. Kingdom Animalia includes 108 classes including class mammalia, reptilia, aves, etc. However, the classes used today are different from those proposed by Linnaeus and are not used frequently.

Order

Order is a more specific rank than class. The order constitutes one or more than one similar families. There are around 26 orders in class mammalia such as primates, carnivora, etc.

Family

This category of taxonomic hierarchy includes various genera that share a few similarities. For eg., the families in the order Carnivora include Canidae, Felidae, Ursidae, etc.

Genus

A group of similar species forms a genus. Some genera have only one species and is known as monotypic, whereas, some have more than one species and is known as polytypic. For eg., lion and tiger are placed under the genus Panthera.

Species

It is the lowest level of taxonomic hierarchy. There are about 8.7 million different species on earth. It refers to a group of organisms that are similar in shape, form, reproductive features. Species can be further divided into sub-species.

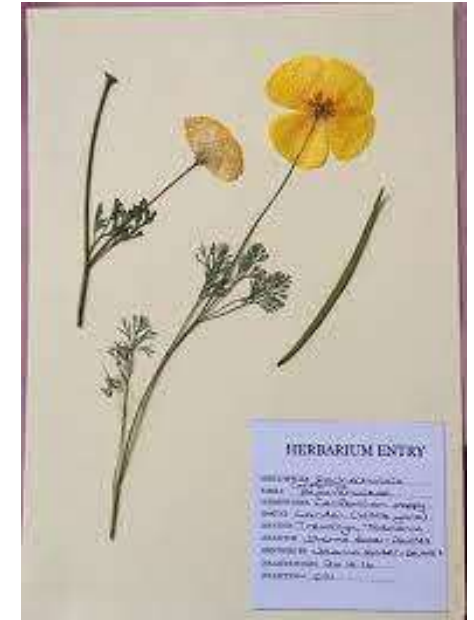
Example of taxonomical heirarchy

| Taxonomic Hierarchy | Examples |
|---------------------|----------------|
| Kingdom | Animalia |
| Phylum | Chordata |
| Class | Mammalia |
| Order | Primates |
| Family | Hominidae |
| Genus | <i>Homo</i> |
| Species | <i>sapiens</i> |

Tools for taxonomic studies

Herbarium

- It is a collection of dried **plant** specimens mounted on sheets of paper.
- The plants are usually **collected** in situ (e.g., where they were growing in nature), identified by experts, pressed, and then carefully mounted to archival paper in such a way that all major morphological characteristics are visible (i.e., both sides of the leaves and the floral structures).
- The mounted plants are labeled with their proper scientific names, the name of the collector, and, usually, information about where they were collected and how they grew and general observations.
- The specimens are commonly filed in cases according to families and genera and are available for ready reference.



Botanical Garden

- A botanical garden or botanic garden is a garden dedicated to the collection, cultivation, preservation and display of a wide range of plants labelled with their botanical names.
- Botanical gardens devote their resources to the study and conservation of plants, as well as making the world's plant species diversity known to the public.
- These gardens also play a central role in meeting human needs and providing well-being.

India's most famous botanical gardens

- Acharya Jagadish Chandra Bose Indian Botanic Garden, Howrah. ...
- Government Botanical Gardens, Udhagamandalam. ...
- Llyod's Botanical Garden, Darjeeling. ...
- Botanical Garden of Forest Research Institute, Dehradun. ...
- Lalbagh Botanical Garden, Bengaluru. ...
- National Botanic Garden, Lucknow.



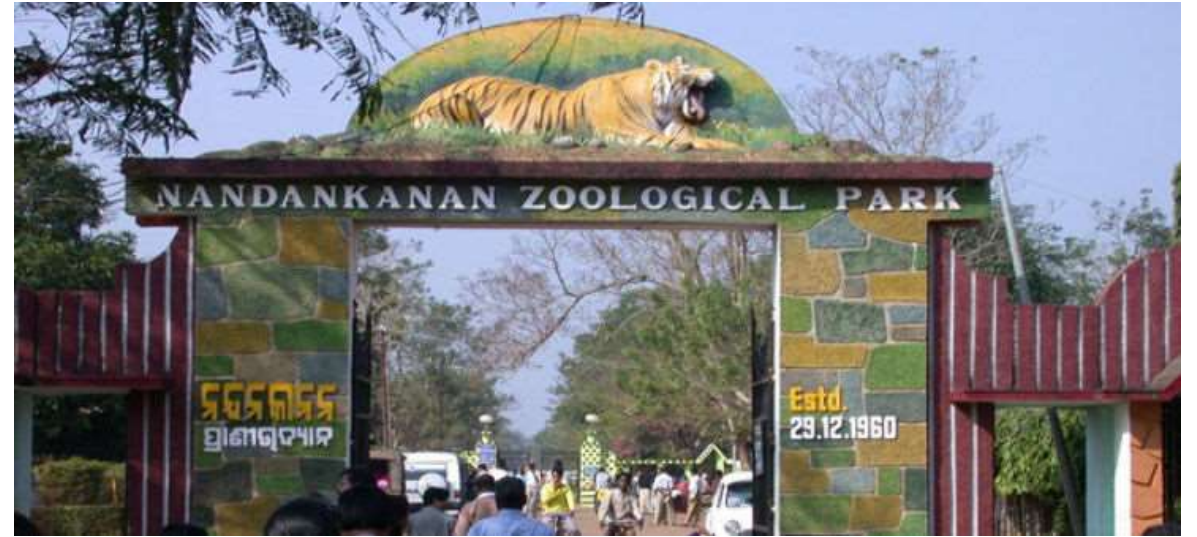
Museum

- MUSEUM is a building or institution that cares for and displays a collection of artifacts and other objects of artistic, cultural, historical, or scientific importance.
- The purpose of modern museums is to collect, preserve, interpret, and display objects of artistic, cultural, or scientific significance for the study and education of the public.



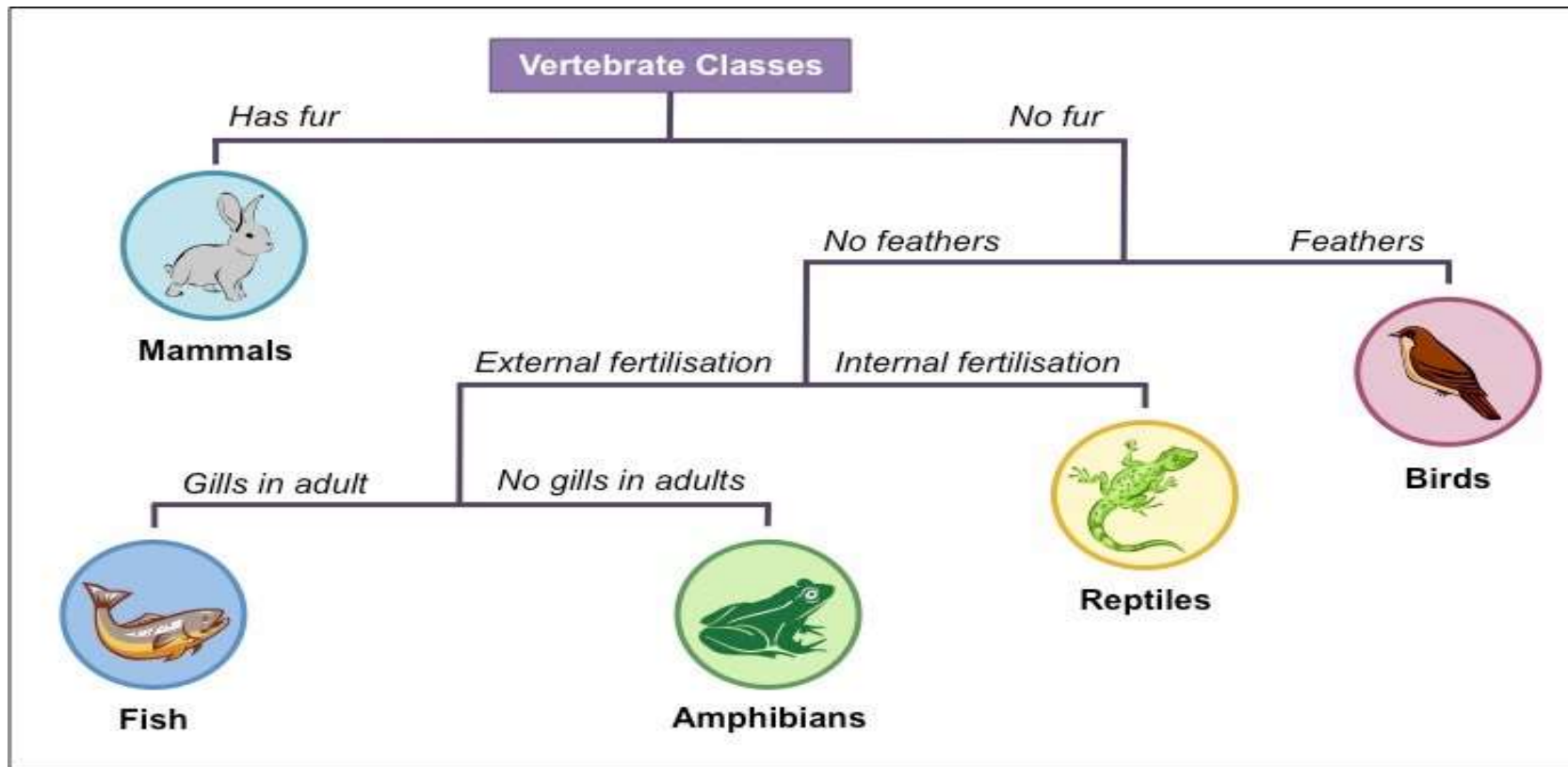
Zoological park

- Zoological park is a place where various living animals are kept within enclosures, displayed to public and may be used for study.
- For example, Alipore zoological gardens, Kolkata.
- The zoological park is involved in the rescue of many species threatened with extinction.
- The crocodile rehabilitation project is being run by FAO to rehabilitate crocodiles.
- Himalayan Musk Deer is bred at Kufri. Attempts have been made for the preservation of Blackbuck, Sambar and Spotted Deer



TAXONOMIC KEYS

- A taxonomic key is a **simple tool used to identify a specific object**.
- A taxonomic key is one of the most useful tools available to scientists trying to identify an unknown organism.
- Systematists rely on keys to help identify known organisms and determine whether they have discovered a new organism entirely.



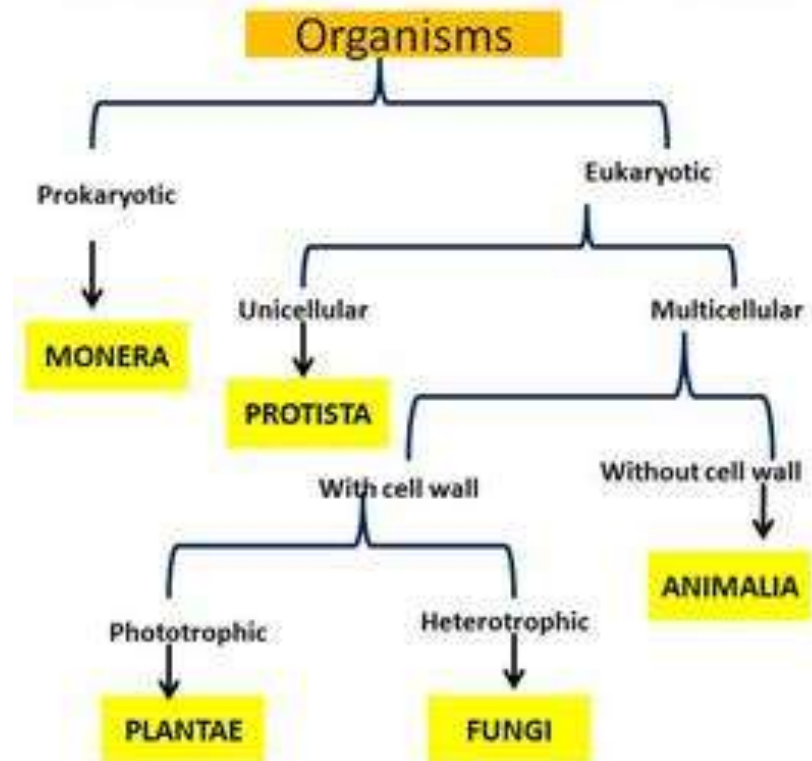
TAXONOMIC LITERATURE

- Taxonomic literature contains information about virtually ever known species on earth.
- In many cases, all that is known about a taxon is contained in this kind of literature, particularly for the most diverse and understudied groups.
- Various forms of literature incorporating description, illustrations and identification keys are useful for proper identification of unknown plants.
- The library is therefore as important as taxonomic work as a herbarium.

Outline of five kingdom classification

- R.H. Whittaker in 1969 introduced a Five Kingdom Classification.
- The kingdoms characterize by him were titled Monera, Protista, Fungi, Plantae, and Animalia.
- The main principle for analysis used by him include-
 - complexity of cell structure (it may be eukaryotic or prokaryotic), complexity of organisms (unicellular or multicellular), **thallus organisation, mode of nutrition (autotrophs or heterotrophs or acrophobic), reproduction (sexual or asexual) and phylogenetic relationships (prokaryotes to eukaryotes, unicellular to multicellular organism).**

Robert H. Whittaker (1969)



THANK YOU