THE LIVING WORLD

Life is a unique, complex organization of molecules, expressing through chemical reactions which lead to growth, development, responsiveness, adaptation & reproduction.
A **living organism** is self-replicating, evolving and self-regulating interactive system capable of responding to external stimuli.

PROPERTIES OF LIVING ORGANISMS

1. Growth

- It is the increase in number & mass of cells by cell division.
- In plants, growth continues throughout their lifespan.
- In animals, growth is only up to a certain age. However, cell division occurs to replace lost cells.
- Basically, growth is the increase in mass & size. Thus non-living objects also grow (surface accumulation of material). So growth is not a defining property of living organisms.
- In living organisms, growth is from inside.

2. Reproduction

- It is the production of progeny having features similar to those of parents.
- Organisms reproduce asexually and sexually.
- In unicellular organisms, growth & reproduction are same because they reproduce by cell division.
- Many organisms do not reproduce (e.g. mules, worker bees, infertile human couples, etc). Hence, reproduction is not a perfect defining property of living organisms.

3. Metabolism

- It is the sum total of all biochemical reactions taking place inside a living system.
- It is the defining feature of living organisms.
- Metabolic reactions can be demonstrated outside the body in cell-free systems. Isolated metabolic reactions *in vitro* are not living things but are living reactions.

4. Cellular organization

- Organisms are made up of one or more cells.
- It is the defining feature of living organisms.

5. Consciousness

- It is the ability of organisms to sense their environment and respond to environmental stimuli (like light, water, temperature, other organisms, chemicals, pollutants, etc).
- All organisms are 'aware' of their surroundings. So, it is the defining property of living organisms.
- Human is the only organism having **self-consciousness.**

DIVERSITY IN THE LIVING WORLD

- The number and types of organisms present on earth refer to **biodiversity**.
- Number of species described is **1.7-1.8 million.**
- **Taxonomy** is the study of **identification, classification** & **nomenclature** of organisms.
  Systematics (Latin '*systema'* = systematic arrangement) deals with evolutionary relationships among organisms.
- ***Systema Naturae*** is the book written by **Linnaeus.**

Basic processes of taxonomy

- **Characterization:** It is the understanding of characters of organisms such as external and internal structure, structure of cell, development process, ecological information etc.
- **Identification:** It is the correct description of the organism so that the naming is possible.
- **Classification:** It is the grouping of organisms into convenient categories (**taxa)** based on characters.
- **Nomenclature** (**naming):** It is the standardization of names of the organisms such that an organism is known by the same name all over the world.
  The system of naming with two components is called **Binomial nomenclature.** It is proposed by **Linnaeus.**
  Botanical names are based on the rules in **International Code for Botanical Nomenclature (ICBN).**
  Zoological names are based on **International Code for Zoological Nomenclature (ICZN).**

Universal rules of Binomial nomenclature

- Scientific names are in ***Latin*** or Latinised and written in ***italics.*** When handwritten, they are underlined separately.
- The first word is genus name (**Generic name)** and second word is the species name **(specific epithet)**.
  E.g. ***Homo sapiens***- *Homo* represents the genus name and *sapiens* represents the species name.
- The Genus name starts with capital letter and the species name starts with small letter.
- Name of the author (in abbreviated form) appears at the end of the biological name.
  E.g., *Mangifera indica* Linn. It indicates that this species was first described by Linnaeus.

TAXONOMIC CATEGORIES

- Classification involves hierarchy of steps in which each step represents a **taxonomic category (rank).**
- All categories together constitute a **taxonomic hierarchy**.
- A group of organisms occupying a particular category is called a **taxon (pl. taxa).** E.g. Class Mammalia.
- Each **category** or **taxon** represents a unit of classification.

	Category	Taxon
Taxonomic hierarchy in ascending order	Kingdom	Animalia
	↑ Phylum/Division	↑ Chordata
	↑ Class	↑ Mammalia
	↑ Order	↑ Primata
	↑ Family	↑ Hominidae
	↑ Genus	↑ Homo
	↑ Species	↑ Sapiens

Species: It is a group of closely related organisms capable of interbreeding to produce fertile offspring.
It is the lowest category. E.g.

Common name	Generic name	Specific epithet
Mango	*Mangifera*	*indica*
Potato	*Solanum*	*tuberosum*
Nightshade	*Solanum*	*nigrum*
Tomato	*Solanum*	*lycopersicum*
Brinjal	*Solanum*	*melongena*
Lion	*Panthera*	*leo*
Tiger	*Panthera*	*tigris*
Leopard	*Panthera*	*pardus*
Modern man	*Homo*	*sapiens*

Genus: It is the aggregates of closely related species.
E.g. Potato, tomato & brinjal are species of genus *Solanum.* Lion, leopard & tiger are species of genus *Panthera.* This genus differs from genus *Felis* (genus of cats).

Family: It is a group of closely related genera. E.g.
Family Solanaceae includes Genus *Solanum,* Genus *Petunia* and Genus *Datura.*
Family Felidae includes Genus *Panthera* and Genus *Felis.*

Order: It is the assemblage of related families. E.g.
Order *Polymoniales* includes Family *Convolvulaceae* and Family *Solanaceae.*
Order *Carnivora* includes Family *Felidae* & Family *Canidae.*

Class: It is the assemblage of related orders. E.g.
Order *Primata, Carnivora* etc. is placed in class *Mammalia.*

Phylum (Division in case of plants**):** It is the assemblage of related classes.
E.g. Classes *Amphibia, Reptilia, Aves, Mammalia* etc. come under phylum Chordata.

Kingdom: The assemblage of related phyla. It is the highest category. E.g. Kingdom Plantae, Kingdom Animalia etc.

Organisms with their taxonomic categories

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

TAXONOMICAL AIDS

a. Herbarium

- It is a store house (repository) of plant specimens that are dried, pressed and preserved on sheets and are arranged according to universally accepted classification.
- Herbarium sheets are labelled with information about date and place of collection, English, local and botanical names, family, collector's name etc.

b. Botanical gardens

- These are specialized gardens having collections of living plants for reference and identification.
- Each plant is labelled with its botanical name and family.
- **Famous botanical gardens:**
  - Royal Botanical Garden at Kew (England).
  - Indian Botanical Garden, Howrah (India).
  - At National Botanical Research Institute, Lucknow (India).

c. Biological Museum

- It is a collection of ***preserved plants and animals*** for study and reference.
- A museum contains
  - Specimens preserved in preservative solutions in containers or jars.
  - Preserved dry specimens of plants and animals.
  - Insects preserved in insect boxes after collecting, killing and pinning.
  - Stuffed larger animals like birds and mammals.
  - Collections of animal skeletons.

d. Zoological Parks (Zoos)

- These are the places where ***live wild animals*** are kept in protected environments under human care.
- It helps to learn about their food habits and behaviour.

e. Key

- It is an analytical method of identification of organisms based on similarities and dissimilarities.
- It is based on the contrasting characters generally in a pair called **couplet.**
- Each couplet has two opposite options. Of these, only relevant option is accepted and other is rejected.
- Each statement in the key is called a **lead.**

Flora, manuals, monographs & catalogues

- **Flora:** Actual account of habitat and distribution of plant species of a given area.
- **Manuals:** The record that contains information for identification of names of species found in an area.
- **Monographs:** The records that contain information on any one taxon.
- **Catalogue:** Alphabetical list of species.

MODEL QUESTIONS

1. "Consciousness is a defining property of living organisms". Comment.
2. Note the relationship between first two words and fill up the fourth place
   a. Monera: Kingdom Primata: ……
   b. Botanical nomenclature: ICBN Zoological nomenclature: ……
   c. Highest taxonomic rank: Kingdom Lowest taxonomic rank: ……..
3. Re-arrange the following in the descending order:
   Genus – order – kingdom – family – phylum – species – class
4. Analyze the following scientific names
   i. panthera Tigris ii. Mangifera Indica
   a. If there any mistake, correct them.
   b. Mention their common name.
5. Fill up the table

Common name	Housefly	Mango	Wheat
Family	**A**	Anacardiaceae	**B**
Order	Diptera	**C**	Poales
Class	**D**	Dicotyledonae	**E**
Phylum/Division	Arthropoda	**F**	Angiospermae

6. Compare museum and zoological park.
7. Complete the table

Taxonomical aid	**Plant/Animal**	**Live/Dead**
Herbarium		
Botanical garden		
Zoological park		
Biological museum		

8. Match the following

A	**B**
a. Herbarium	i. Contrast pair or couplet
b. Key	ii. Information on any one taxon
c. Monographs	iii. Habitat and distribution of plant species
d. Flora	iv. Storage of collected dried plant specimens