



MEDICAL Class Companion

BIOLOGY

For NEET and AIIMS

MODULE-1

Chapter 1 Diversity in the Living World

Chapter 2 Biological Classification

Chapter 3 Plant Kingdom

Chapter 4 Animal Kingdom

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NEET Syllabus :

- **Diversity in the living World** ; Biodiversity; Need for classification; Three domains of life; Taxonomy & Systematics; Concept of species and taxonomical hierarchy; Binomial nomenclature; Tools for study of Taxonomy - Museums, Zoos, Herbaria, Botanical gardens.
 - Five kingdom classification; salient features and classification of Monera; Protista and Fungi into major groups; Lichens; Viruses and Viroids.
 - Salient features and classification of plants into major groups-Algae, Bryophytes, Pteridophytes, Gymnosperms and Angiosperms (three to five salient and distinguishing features and at least two examples of each category); Angiosperms- classification up to class, characteristic features and examples).
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DIVERSITY IN THE LIVING WORLD

INTRODUCTION

Biology is the science of life forms and living processes. The living world comprises an amazing diversity of living organisms. Early man could easily perceive the difference between inanimate matter and living organisms. Early man deified some of the inanimate matter (wind, sea, fire etc.) and some among the animals and plants. A common feature of all such forms of inanimate and animate objects was the sense of awe or fear that they evoked. The description of living organisms including human beings began much later in human history. Societies which indulged in anthropocentric view of biology could register limited progress in biological knowledge. Systematic and monumental description of life forms brought in, out of necessity, detailed systems of identification, nomenclature and classification. The biggest spin off of such studies was the recognition of the sharing of similarities among living organisms both horizontally and vertically. That all present day living organisms are related to each other and also to all organisms that ever lived on this earth, was a revelation which humbled man and led to cultural movements for conservation of biodiversity.

1. WHAT IS LIVING

A. Definition

What is Living :- Following are the main characters of "living" -

B. Characteristics of living

- | | |
|--------------------------|--|
| 1. GROWTH | } Not the defining properties /characters/features |
| 2. REPRODUCTION | |
| 3. METABOLISM | |
| 4. CELLULAR ORGANISATION | } Defining properties/characters/features |
| 5. CONSCIOUSNESS | |

The character which has no exception is called as **defining property** of life.

I. Growth

- Increase in mass or overall size of a tissue or organism or its parts is called growth.
- Increase in mass and increase in number of individuals are twin characters of growth.
- Growth is an irreversible permanent increase in size of an organ or its parts or even of an individual cell.
- Growth is the result of metabolism, when the synthetic reactions or anabolism is more than that of the destructive processes or catabolism, growth occurs.
- In the reverse situation (Anabolism \downarrow catabolism \uparrow) there will be 'Degrowth' or negative growth.
- Growth is of two types :-
 - (a) **Intrinsic growth :-** This growth is from inside of the body of living organisms.
 - (b) **Extrinsic growth :-** This growth is from outside i.e. accumulation of material on any body surface Non living exhibits this type of growth.
- Growth is of two types _
 - (a) **Indeterminate growth = Unlimited growth :** Growth which occurs continuously throughout their life span is indeterminate growth or unlimited growth. It occurs in plants and not in animals.
 - (b) **Determinate growth = Limited growth :** Growth which occurs only upto a certain age is determinate growth or Limited growth It occurs in animals. However, cell division occurs in certain tissues to replace lost cells.
- In majority of higher plants and animals, growth and reproduction are mutually exclusive events.
- Because both living and nonliving exhibit growth so it can not be taken as **defining property**.
- Growth from inside (intrinsic growth) can be taken as defining property.



II. Reproduction:

Production of new individual or progeny is called as reproduction.

- Reproduction in case of multicellular organisms is production of progeny possessing features more or less similar to those of parents.
- Reproduction in case of unicellular organisms like bacteria, unicellular algae or Amoeba is increase in number of cells. Means in unicellular organisms the growth and reproduction are synonyms or same.
- Reproduction is not found in any non living object.
- There are many living organisms which can/do not reproduce like mules, sterile human couples, worker bees.
- So the reproduction also can not be taken as defining characteristic of living organisms.
- Reproduction is of two types.

(A) **Asexual Reproduction** :- Reproduction in which gametic fusion or fertilisation and meiosis are not involved is Asexual Reproduction. Many methods of asexual reproduction are there.

(a) **By Asexual spores** :- In algae and fungi

(b) **By Budding** :- In Yeast and Hydra

(c) **By Fragmentation** :- In Filamentous algae, fungi and the protonema of moss plants

(d) **True Regeneration** :- Fragmented organisms regenerate the lost part of its body and become a new organism, e.g. Planaria

Note: **Regeneration** is a process in which only the lost part of the body is repaired or regained e.g., Star fish, Lizard.

(B) **Sexual Reproduction** :- Reproduction in which gametes are formed by meiosis and fertilisation also takes place to form progeny is called as sexual reproduction.

III. Metabolism:

- The sum total of all the chemical reactions occurring in our body is metabolism.
- All living organisms, both unicellular and multicellular exhibit metabolism.
- No non-living object shows metabolism.

➤ In this way metabolism is a -defining character of living organisms because it has no exceptions.

➤ Now we have known most of the chemical or metabolic reactions occurring in our body So we can demonstrate many of them in a cell free medium or in a test tube in lab.

➤ The isolated metabolic reaction outside the body of an organism, performed in a test tube (in-vitro) is neither living nor nonliving.

➤ These isolated reactions can not be regarded as living things, but they are definitely living reactions because they are similar to the reactions performing in our body.

➤ Here we should not forget the fact that metabolism is the total sum of all the chemical reactions performing in our body, it is not the sum of few or more living reactions.

➤ All organisms are made of small or big chemicals. These chemicals perform thousands of reactions and form some other chemicals also in the bodies of living organisms.

➤ All plants, animals, fungi and microbes exhibit metabolism.

IV. Cellular Organisation:

➤ Cell is the basic unit of life.

➤ All living organisms are composed of cells. Some are composed of a single cell and are called as **Unicellular Organisms** while other like us composed of many cells, are called multicellular organisms.

➤ Unicellular organisms are capable of independent existence and performing essential functions of life

➤ Anything less than a complete structure of a cell, does not ensure independent living. Hence, cell is the **fundamental structural and functional unit** of all living organisms.

➤ In this way the **cellular organisation** is proved to be **defining property** of all living organisms.

V. Consciousness:

➤ Ability to sense the surrounding environments and respond to these environmental stimuli is called as **consciousness**.



- Consciousness is the most obvious and technically complicated feature of all living organisms.
- We sense these physical, chemical or biological stimuli through our sense organs.
- Plants also sense and respond to external factors like light, water, temperature, other organisms, pollutants etc.
- All organisms from the prokaryotes to complex eukaryotes show consciousness to environmental cues.
- Some common examples of consciousness can be seen in organisms, like -Plants performs flowering in a particular season (photoperiodism), Some animals perform breeding in a particular season only (seasonal breeders), and all organisms handle the chemicals entering their bodies etc.
- When human is concerned a very high level of consciousness is found in us because of our very well developed nervous system and supreme level of skill of communication which is called as self-consciousness.
- Human is very fast to respond towards the external stimuli and even it can think or predict about possible changes of surroundings also so it can prepare itself according to the surrounding situations. Further human can even change its surrounding situations upto a limit so this topmost or climax level of consciousness is regarded as self-consciousness, which can not be seen elsewhere.
- Self-consciousness is thought to be present only in human.
- The brain dead coma patient who is supported by machines which replace heart and lungs also has consciousness so it is living but it does not have self-consciousness because it has lost the co-ordination of organs of different body parts.
- Means all the living phenomena are due to underlying interactions between different components of an individual or organ or tissue or cell.
- Living organisms are self replicating, evolving, and self regulating interactive system capable of responding to external stimuli. Adaptations and homeostasis are also very important characters of living.

2. DIVERSITY IN THE LIVING WORLD

If you look around you will see a large variety of living organisms, be it potted plants, insects, birds, your pets or other animals and plants. There are also several organisms that you cannot see with your naked eye but they are all around you. If you were to increase the area that you make observations in, the range and variety of organisms that you see would increase. Obviously, if you were to visit a dense forest, you would probably see a much greater number and kinds of living organisms in it. Each different kind of plant, animal or organism that you see, represents a species. The number of species that are known and described range between 1.7-1.8 million. This refers to biodiversity or the number and types of organisms present on earth. We should remember here that as we explore new areas, and even old ones, new organisms are continuously being identified.

3. TAXONOMY

A. Definition & History

Taxonomy : Taxis = arrangement, nomos = law
→ Taxonomy is the study of principles and procedures of classification.

This word was proposed by **A.P. de Candolle** in his book "**Theories elementaire de la botanique**" (Theory of elementary botany)

B. Type of Taxonomy

- (a) **Alpha taxonomy or classical taxonomy** : It is based on **external** morphology characters of plants.
- (b) **Beta taxonomy** : Besides **external** morphology, it also includes **internal** characters like embryological, cytological, anatomical characters etc.
- (c) **Omega taxonomy** : Omega taxonomy has widest scope. It is based on **all the informations** or data available about plants.
- (d) **Cytotaxonomy** : The use of cytological characters of plants in classification or in solving taxonomic problems is called cytotaxonomy. Cytological characters constitute an important aid to plant taxonomy, especially in determining affinities at the generic and infrageneric levels.



- (e) **Chemotaxonomy** : The uses of chemical characters of plants in classification or in solving taxonomic problems is called chemotaxonomy or chemical taxonomy. It is based on the chemical constitution of plants. The fragrance and taste vary from species to species.

The basic chemical compounds used in chemotaxonomy are alkaloids, carotenoids, tannins, polysaccharide, nucleic acids, fatty acids, amino acids, aromatic compounds etc.

- (f) **Karyotaxonomy** : Based on characters of nucleus and chromosomes. Pattern of chromosomal bands (dark bands and light bands) is most specific characters.

C. Steps of Taxonomic Study

- (i) **Identification** - Identification of living organisms
- (ii) **Nomenclature** - Nomenclature of living organisms
- (iii) **Classification** - Classification of living organisms in groups
- (iv) **Affinities** - Study of inter relationship between living organisms

Systematics :- (Branch related with taxonomy)

- (1) The term "Systematics" was proposed by Linnaeus
- (2) Systematics, is the study of diversity of organisms and all their comparative and evolutionary relationship. It includes description of external morphological characters of plants or living organisms.

eg. Morphological characters of Root, Stem, Leaves, Flowers

New systematics or Neo systematics or Biosystematics :-

- (1) Neo - systematics - A new branch - Name given by Julian Huxley (1940)
- (2) It includes description of all the characters (internal) including morphological characters (external) of plants or living organism.
- (3) It is used to know the inter relationship among living organism.

Note : New systematics is mainly based on evolutionary as well as genetic relationship (experimental taxonomy) as compared to morphological characters.

Some Informations :

- Maximum diversity is found in tropical rain forests.
- Second maximum diversity is found in coral reefs
- Practical significance of taxonomy is → Identification of unknown organism.

NOMENCLATURE

(a) Polynomial system :

According to this system name of any plant consists of many words.

For eg. *Caryophyllum-Caryophyllum saxatilis folis gramineus umbellatis corymbis*

(b) Binomial system :

- (1) Binomial system was first proposed by **Gaspard Bauhin** in his book - "Pinax Theatree Botanica"
- (2) **Carolus Linnaeus** :- Linnaeus used this nomenclature system for the first time on large scale and proposed scientific name of all the plants and animals.
- Linnaeus is the founder of binomial system.
 - Linnaeus proposed scientific name of plants in his book "**Species plantarum**". It was published on 1 May 1753. So this was the initiation of binomial system for plants. So any name proposed (for plants) before this date is not accepted today.
 - Linnaeus proposed scientific name of animals in his book "Systema naturae" (10th edition).
 - This 10th edition of **Systema naturae** was published on 1 August 1758. So initiation of binomial system for animals is believed to be started on 1 Aug, 1758.

Principle of Priority :-

The nomenclature is done by principle of priority. If two names are proposed for any plant after the 1753, the valid name is the earlier name proposed just after 1 May, 1753.

ICBN

"International Code of Botanical Nomenclature"

ICBN - Book of rules of nomenclature

- Collection of rules regarding scientific - nomenclature of plants is known as ICBN.
- ICBN was firstly proposed by – **Sprague, Hitchcock, Green** (1930)
- ICBN was first accepted in **1961**.



4. TAXONOMIC CATEGORIES

A. Species:- Taxonomic studies consider a group of individual organism with fundamental similarities as a species. One should be able to distinguish one species from the other closely related species based on the distinct morphological differences.

SPECIES CONCEPT

John Ray :- Proposed the **term** and **concept of species**

To explain the species different concepts were proposed, which are as follows

(A) Biological concept of species :-

- (1) **Mayr** proposed the **biological concept of species**.
- (2) Mayr defined the "species" in the form of biological concept.
- (3) According to Mayr "All the members that can interbreed among themselves and can produce fertile offsprings are the members of same species"

But this definition of Mayr was incomplete because this definition is applicable to sexually reproducing living beings because there are many organisms that have only asexual mode of reproduction.

eg. Bacteria, Mycoplasma, BGA

- (4) The main character in determination of any species is interbreeding. But this character is not used in taxonomy. In taxonomy, the determination of species is based on other characters.

eg. - Mainly morphological characters

- (5) In higher plants, the determination of species is mainly based on the morphology of flower (floral morphology). Because floral (reproductive) characters are more conservative as compared to vegetative (Root, Stem, Leaf) characters i.e. they do not show major changes.

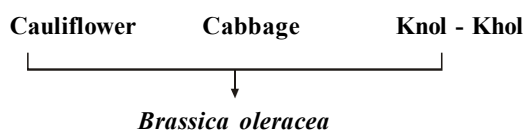
- (6) When the species is determined on the basis of interbreeding then it is called as biological species.

eg. All the humans in this world can interbreed among themselves.

So all the humans are the members of one biological species.

- (7) When the determination of species is based on other characters then it is called as **taxonomic species**.

eg.



These 3 have same morphological characters. Therefore they belong to same taxonomic species i.e. **one taxonomic species**. But these three can not interbreed among themselves. Therefore on the basis of interbreeding these are **three biological species**

B. Genus :- Genus comprises a group of related species which has more characters in common in comparison to species of other genera.

C. Family :- Family has a group of related genera with still less number of similarities as compared to genus and species. Families are characterised on the basis of both vegetative and reproductive feature of plant species.

D. Order:- Order being a higher category is the assemblage of

families which exhibit a few similar character.

E. Class:- Class includes organism of related orders having less similarities than orders.

Division:- Division includes all organisms belonging to different classes having a few common characters.

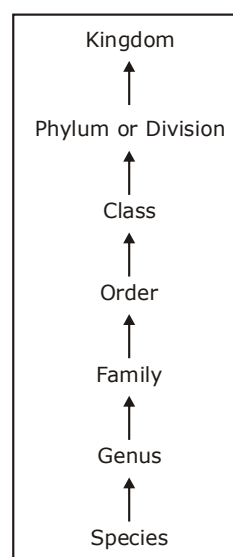


Fig.1.1 :- Taxonomic categories showing hierarchial arrangement in ascending order

Table :- Organisms with their Taxonomic Categories

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

There are 7 main taxonomic categories. They are obligate categories i.e. they are strictly used at the time of any plant classification.

There are some extra categories, like sub division, sub order, sub family, tribe, sub tribe, etc. They are not regularly used. They are used only when they are needed.

Classification of Radish :-

Categories	Kingdom	—	Plantae	Taxons
	Division	—	Spermatophyta	
	Class	—	Dicotyledonae	
	Order	—	Parietales	
	Family	—	Brassicaceae	
	Genus	—	<i>Raphanus</i>	
	Species	—	<i>R. sativus</i>	

- **Taxon** :- Plant groups or animal groups included in categories are called Taxon.
- **Adolf Mayer** - First proposed the term "Taxon" - for animals.
- **H.J. Lan** :- First proposed the term "Taxon" - for plants.
- The classification of any plant or animal is written in descending order.
- Hierarchy - Descending arrangement of taxonomic categories is known as hierarchy.
- **Species** :- Smallest taxonomic category → It is basic unit of classification

Suffix for taxa (Taxon)

Division	—	phyta
Sub div	—	phytina
Class	—	opsida, phyceae,ae

Order	—	ales
Sub- order	—	ineae
Family	—	aceae
Sub Family	—	oideae
Tribe	—	ea
Sub tribe	—	inae

Note : There is no suffix for Genus, Species and Kingdom

5. TAXONOMICAL AIDS

Biologists have established certain procedures and techniques to store and preserve the information as well as the specimens some of these are explained to help you understand the usage of these aids.

A. Herbarium :- Herbarium is a store house of collected plant specimens that are dried, pressed and preserved on sheet. Standard size of herbarium sheet in 11 .5 x 16.5 inches. The herbarium sheets also carry a label providing information about date and place of collection, English, local and botanical name, family, collector's name etc. Herbaria also serve as quick referral system in taxonomic studies.

B. Botanical Gardens :-Plant species in these gardens are grown for identification purposes and each plant is labelled indicating its botanical/scientific name and its family.

C. Museum :-Museum have collections of preserved plant and animal specimens for study and reference. Specimens are preserved in the containers or jars in preservative solutions.



- D. Zoological Parks:-** These are the places where wild animals are kept in protected environments under human care and which enable us to learn about their food habits and behaviour

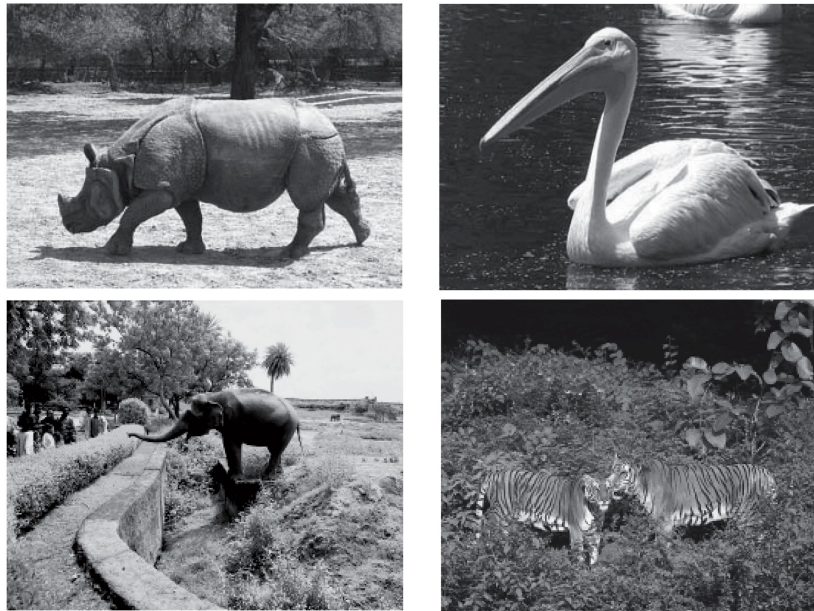


Fig. 1.2

**Pictures showing animals in different
zoological parks of India**

- E. Key :-** Keys is used for identification of plants and animals based on the similarities and dissimilarities
- The keys are based on the contrasting characters generally in a pair called couplet. It represents the choice made between the two opposite options. This result in acceptance of only one and rejection of the other.
 - Each statement in the key is called a lead.
 - Keys are generally analytical in nature.

Flora, Manuals, Monographs and Catalogues

These flora, manuals, monographs, etc. are recorded descriptions of plants, animals and other organisms. They provide correct identification and description of variety of living organisms.

- (i) **Flora :** It is a book containing information about plants found in a particular area. It gives the actual account of **habitat** and **distribution** of various plants of a given area. These provide the index to the plant species found in a particular area. For example, Flora of Delhi by J.K. Maheshwari.
- (ii) **Manual :** It is a book containing complete listing and description of the plants growing in a particular area. They provide useful information for identification of names of various species found in an area.
- (iii) **Monograph :** It contains information of any one taxon.
- (iv) **Catalogue :** It includes the alphabetical arrangement of species of a particular place describing their features.