

THE LIVING WORLD

What is Growth

To differentiate whether an organism is living or not, various characteristics need to be checked in the case of living organisms.

Growth: All living organisms can undergo the process of growth and development that results in an increase in the mass and number of cells. Multicellular organisms grow by cell division. The growth of plants and animals takes place with the help of cell division. In the case of plants, the cell division occurs throughout their life while in the case of animals the cell division occurs up to a certain age, and then the cells lose their capability to divide.

It results in an increase in body mass and increases in the number of cells.

Examples: Mountains, boulders, sand mounds, etc grow by the accumulation of the materials although they are non-living. So, growth cannot be taken as the factor which categorizes the organism as living.

Metabolism: As the body and organs are the constituents of different chemicals, they perform various metabolic functions that result in the conversion of chemicals into other biomolecules. All plants, animals, and microbes exhibit metabolism. It is absent in the case of non-living organisms but may be introduced through the in-vitro method.

Sensitivity: The living organisms whether prokaryotes or eukaryotes respond according to their surroundings and the stimuli present around them, it may be physical, chemical, or biological. The living organisms are sensitive about their surroundings and are responsive in accordance with their stimuli. The stimuli can either be biological, physical, or chemical.

Cellular Organization: It is the defining characteristic of living organisms since all living organisms are made up of cells that help in performing various cellular functions resulting in the growth and development, reproduction, metabolism, etc in the body. Since non-living organisms are not made up of cells so they do not have cellular organization.

Movement: The living organisms show movement and locomotion and more specifically plants move according to the movement of the sun.

Example: The flame of a candle and a crystal do not show movement while if we take mango trees then we can see they undergo movement, growth, and development along with reproduction and results in the production of more trees through their seeds. Thus mango trees are said to be alive as they show movement while candles flame and crystal are not alive.

Also, the organisms that are aware and are conscious of their surroundings will be living organisms.

What is Living?

We do know that all living organisms reproduce, grow and metabolize. But when we look at the microscopic realm, the actual definition of life is rather blurred. For instance, viruses are basically a nucleic acid that is protected by a protein coat. They exhibit no typical characteristics of living organisms such as reproduction, until and unless it is inside a host.

Another “organism” that borders between the living and non-living are Prions. These are essentially misfolded proteins can reproduce by making other healthy proteins to misfold. These entities are responsible for causing diseases such as Spongiform Encephalopathy, fatal familial insomnia, which are almost always fatal. In conclusion, the realm between the living and the non-living differs even now as the definition of “life” is ambiguous.

Characteristics of Life

Living organisms exhibit undisputable signs of life – such as growth, reproduction and metabolism. Higher organisms such as humans showcase consciousness – where we become aware of our surroundings. Similarly, consciousness may be observable in many lower forms of life such as bacteria and protozoa. When these organisms engulf food or react to their environment, it is done primarily to ensure survival.

Diversity in the Living World

In response to the sheer number of organisms discovered to date, a system of standardizing names was implemented. Binomial nomenclature assigns a two-part scientific name to an organism. Botanists and zoologists follow set principles and criteria when assigning a scientific name to an organism. For instance – plant names are assigned based on the principles and criteria set by the International Code for Botanical Nomenclature (ICBN). Similarly, animal names are assigned on the basis of the International Code of Zoological Nomenclature (ICZN).

Classification of organisms according to the aforementioned conventions involved a hierarchy of steps, with each step representing a category or a rank. The most basic unit of classification is species. A species is a group of individual organisms with fundamental similarities.

Reproduction

Reproduction, a characteristic of living organisms is the process of producing off springs, possessing features similar to those of parents. In multicellular organisms, the mode of reproduction is generally sexual. Living organisms also reproduce by asexual means.

Some examples are given below.

- Fungi spread and multiply fast by producing millions of asexual spores. Some fungi, the filamentous algae and the protonema of mosses multiply by fragmentation.

- In yeast and Hydra, budding occurs to produce new organisms. While, in Planaria (flatworm),
- regeneration of fragmented body parts occur. These parts in turn grow as a new organism.
- Unicellular organisms like bacteria, algae and Amoeba reproduce by increasing the number of cells, i.e., through cell division (growth is synonymous with reproduction).
- Some organisms like mules, sterile worker bees, infertile human couples, etc., do not reproduce. Hence, reproduction also cannot be an all-inclusive defining characteristic of living organisms.

Metabolism

Metabolism is another characteristic and defining feature of all living things. The sum total of anabolic or constructive reactions (anabolism) and catabolic or destructive reactions (catabolism) continuously occurring inside the body is called metabolism.

Metabolism: Anabolism + Catabolism Metabolism occurs in all unicellular and multicellular organisms. Its two stages include, i.e., anabolism, the process of building up or synthesis of complex substances from simpler ones, e.g., Photo synthesis and catabolism, the process of breakdown of complex substances into simpler substances, e.g., Respiration, releasing waste outside.

Metabolic reactions can also be demonstrated outside the body in cell free systems, which are neither living nor non-living. Thus, these reactions in vitro are surely living reactions not living things. Hence, metabolism can be considered as a defining feature of all living organisms without exception.

The important differences between anabolism and catabolism are:

Catabolism	Anabolism
Catabolism breaks down big complex molecules into smaller, easier to absorb molecules.	Anabolism builds molecules required for the body's functionality.
The process of catabolism releases energy.	Anabolic processes require energy.
Hormones involved in the processes are adrenaline, cytokine, glucagon, and cortisol.	Hormones involved in the process are estrogen, testosterone, growth hormones and insulin.
Examples of catabolic processes are proteins becoming amino acids, glycogen breaking down into glucose and triglycerides breaking up into fatty acids.	Examples include the formation of polypeptides from amino acids, glucose forming glycogen and fatty acids forming triglycerides.
In catabolism, potential energy is changed	In anabolism, kinetic energy is converted into

into kinetic energy.	potential energy.
It is required to perform different activities in living entities.	It is required for maintenance, growth, and storage.

Cellular Organization

The cells are the building blocks of all living things whether plants, animals or humans. The unicellular organisms are made of a single cell, while multi cellular organisms are formed by millions of cells. The cells contain protoplasm (living matter) and cell organelles (inside the cells) which perform several activities at the cellular level and result into various life processes.

Consciousness

All living organisms have excellent ability to sense their environment. They respond to various physical, chemical and biological stimuli.

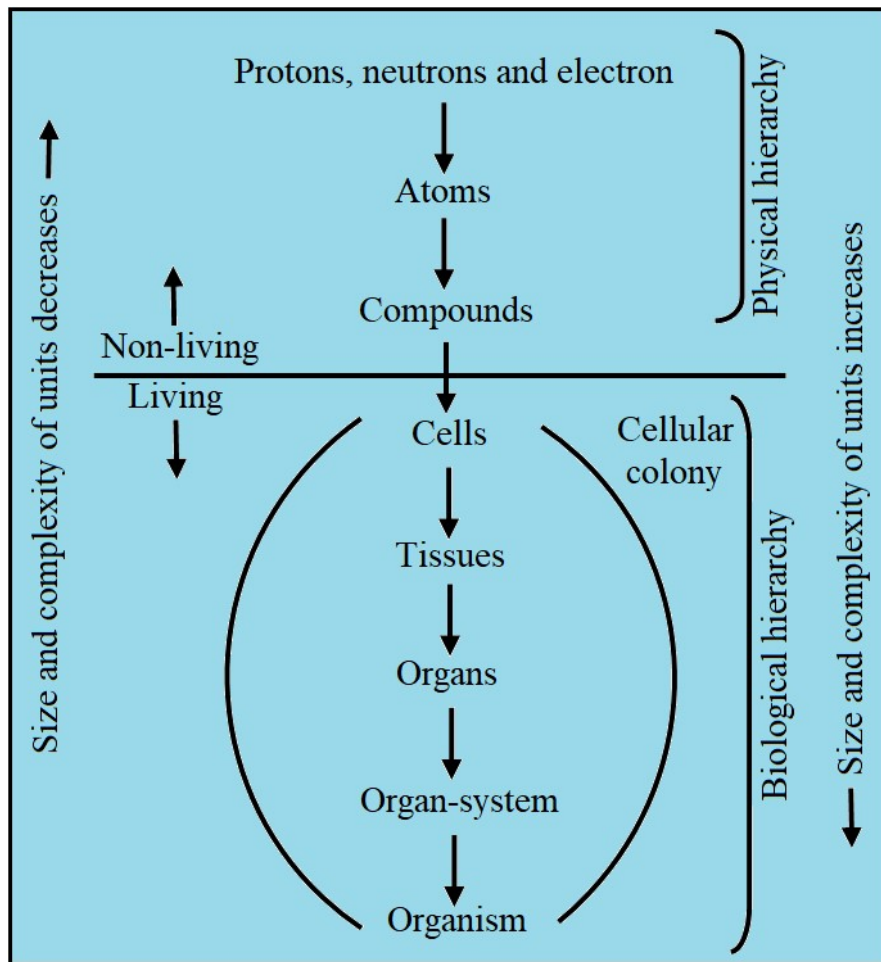
The various external factors to which living organisms respond are light, water, temperature, pollutants, other organisms, etc. Light duration or photo period affects many seasonal breeders, plants as well as animals. All living things respond to chemicals, entering their * bodies.

Humans are superior to all living things as they have an additional ability of self-consciousness. Therefore, consciousness can also said to be a defining property of living organisms.

However, in human beings, it is more difficult to define living state, e.g., Patients lying in coma supported by machines that replace heart and lungs, are brain-dead with no self-consciousness.

Body Organization

The body of living organisms is organized, i.e., several component and sub-components cooperate with each other for the functioning of whole body.



Physical and Biological Hierarchies

There is a physical (non-living) hierarchy and biological hierarchy in the organization of living body. In physical hierarchy, various non-living components aggregate to form compounds, which finally enter the living world in the form of cells. These cells organize to form tissues, that form organs and several organs combusive to form organ-systems. Finally, many organ systems organize and form a living organism.

The properties of tissues are not present in the constituent cells but arise as a result of interactions among the constituent cells. For example, bone is a hard tissue, which provides framework to the body. But the cells present inside it do not have this property. This phenomenon of interactions between various components of the body results in the hierarchy of organization.

The various life processes are the result of this interaction and coordination. The complexity in organization enables living organisms as to be self-replicating, evolving, self-regulating and responding to external stimuli. All living organisms along with their ancestors and descendants are linked to one another by sharing of common genetic material in the form of DNA in varying degrees. This DNA is responsible for the expression of specific traits in organisms. Thus, Biology is the story of life on earth. It is the story of evolution of living organisms on the

earth.

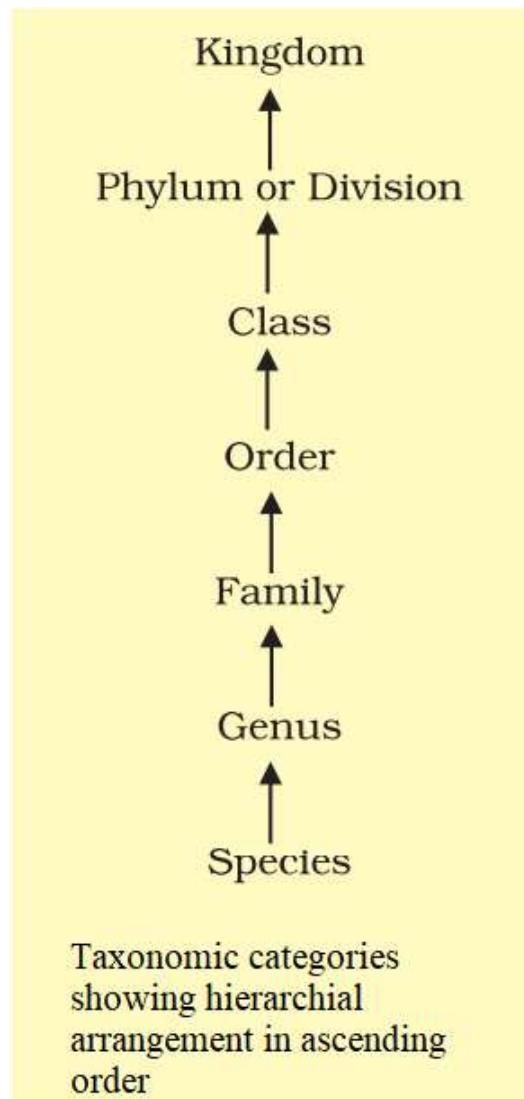
Taxonomic Categories

In 1956 the term Taxon was introduced and in 1964, Mayr defined taxon to be the various categories based on different characters of the organisms that consist of a taxonomic group of any rank.

Taxonomic Hierarchy

Various organisms in different categories depending upon their common characters to make classification easier. These groups together are called taxonomic hierarchies. The taxonomic hierarchy includes. Kingdom, division of the kingdom, phylum, class, order, family, genus, and species. Species are the lowest while the kingdom is the highest rank within the hierarchy. It is also called the 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:



Species: It is the lowest category of the taxonomic hierarchy. There are around 8.7 million species observed on earth till now while their rest are left undiscovered. It refers to a group of organisms that are similar in shape, form, generative options. Species may be more divided into subspecies. It was first defined by Ernst Mayr in 1964 that the species are the interbreeding populations that are reproductively isolated from other such groups. The term species was first introduced by the biologist John Ray. E.g., sapiens.

Genus: A category that is placed above species as they consist of a group of related species. Genus are of various types based on the number of species present like monotypic (one genus present), and polytypic (several species present). For e.g., the genus Panthera constitutes both lion and tiger.

Family: This taxonomic category consists of related genera having similar characteristics. For e.g., the families Canidae, Felidae, Ursidae, etc. come under one order Carnivora.

Order or Cohort: This taxonomic category is more specific than the class as it consists of one or more similar families. The class Mammalia consists of around twenty-six orders that include primates, Carnivora, etc.

Class: It was the most general taxonomic category before the introduction of phyla. In the animal kingdom, there are around 108 classes that include Pisces, reptilia, aves, etc. The categories used in classification now are different from those of the Linnaeus taxonomy.

Phylum: This category is more specific than the kingdom. In the animal kingdom, there are around thirty-five phyla that include phylum Arthropoda, Chordata, etc.

Kingdom: The highest level of classification is the kingdom which is further divided into various subgroups. The total kingdoms of the living organisms are five in number that includes Monera, Protista, Fungi, Plantae, and 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

Herbarium

A herbarium is a collection of preserved plant specimens that are dried and labelled. The plant species that are collected are first dried, pressed, mounted, and then labelled on the herbarium sheets.

The steps involved in the herbarium technique are as follows:

- Collecting various specimens from different areas.
- Drying the particular specimen by placing them in between the various folds of newspapers or by iron drying them.
- By dipping the specimens in mercuric chloride poisoning is done.
- With the help of a cello tape or glue, mounting the dried specimens on the herbarium sheets.
- Certain specimen parts that are difficult to attach to the sheet, like stems, are stitched so that they stick to their position on the sheet.
- To keep them for a longer time, preserves must be sprayed.
- The labeling for identification of all the specimens must be done at the left side of the bottom corner. The name, date of collection, area of collection, habit, etc must be written.
- Lastly, these herbarium sheets are deposited under the herbarium covers where the rest of the herbarium sheets are covered and packed.
- These herbarium sheets are stored in the cupboards named under their category.

To avoid any confusion each herbarium sheet is to be labeled properly on the right-hand corner at the bottom of the herbarium sheet which includes the scientific name along with author's name, local name, name of family, locality, date of collection, name of the collector, etc.

The book flora consists of information about the collected specimens, this book gives the

information regarding the number of plant species present in the various regions along with their brief description. is published in the form of a book called flora.

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

In England, the Royal Botanical Garden at Kew is the largest Herbarium in the world. Central National Herbarium is the largest Herbarium in India located in the Indian Botanical Garden at Kolkata established in 1787.

Botanical Gardens

They are those gardens that are responsible for the cultivation and preservation of a wide range of plants. These plants are reserved along with their botanical names that are tagged as a label. It is a collection of many species of plants such as succulent plants, garden herbs, and many more exotic plants. Visitors include educational displays, art exhibitions, and open-air theatre musical performances with tours and other entertainments. They are under the control of the universities or the scientific research organizations that relate both herbaria and the research programs together in the botanical sciences. There are more than 600 botanical gardens present all around the world.

The ancient Botanical Garden in the world is the Hanging Gardens of Babylon and comes under the Wonders of the world.

The Royal botanical garden at Kew in England is the largest Botanical Garden in the world and is known as the botanical capital of the world. It was discovered by Bentham and Hooker.

In India Indian Botanical Garden at Kolkata is the largest botanical garden while Tropical Botanical Garden at Thiruvananthapuram in Kerala is the largest tropical botanical garden in Asia.

Museum

The museum is the place where the artistic and educational plants or animals are preserved, stored, and exhibited to the public. Museums are of various types that include the natural science museum, Science Museum and Zoological Museum.

The Botany and Zoology Departments of all the college's museums are maintained. Animals can also be preserved as they are placed in jars or containers having chemical solutions which help them to preserve for a longer time. The specimens are then identified and labelled and are then stored after their catalog is prepared.

The plants and animal specimens are also preserved as dry specimens. Like insects after collecting, killing, and pinning are then preserved in insect boxes while in the case of the birds

and mammals they are first stuffed and then preserved. The skeletons of the animal are preserved in the museums.

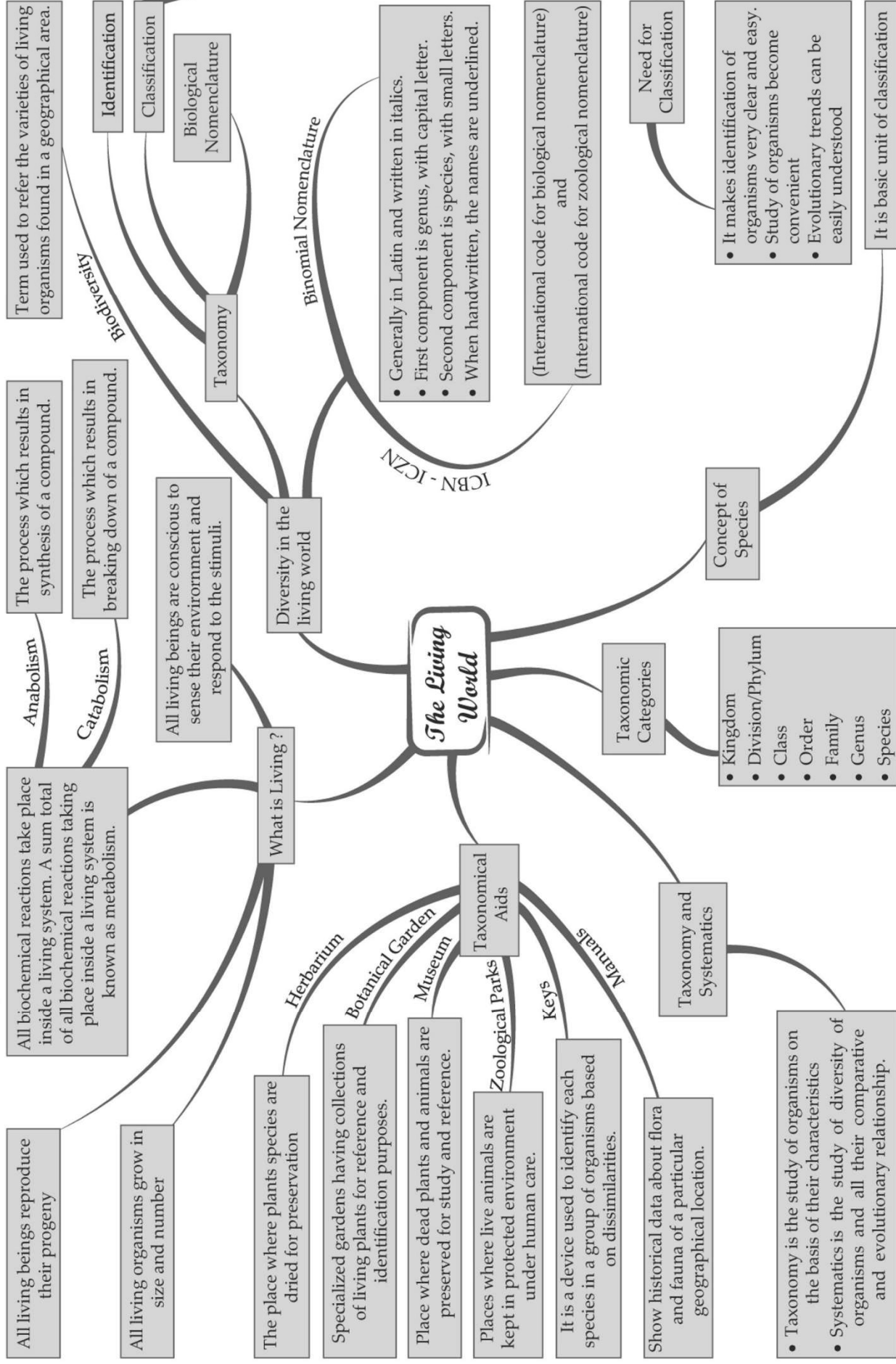
Zoological Parks

They are animal parks within enclosures that display to the public and replicate their natural habitats for behavioral patterns which benefit the animals and visitors. Special climatic conditions are created for the animals and the walkthrough exhibits are there for visitors for non-aggressive species. Visitors are how to avoid eating foods that animals might snatch or to keep their paths away.

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

The Zoo of Kolkata in India is the largest zoo.

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Important Questions

Multiple Choice questions-

1. Scientific name are drawn form
 - A. Latin
 - B. English
 - C. Sanskrit
 - D. Arabic
2. Binomial nomenclature was given by
 - A. Linnaeus
 - B. Pliny
 - C. Bentham and Hookes
 - D. Aristotle
3. Systematics is the study of
 - A. Diversity amongst groups
 - B. Grouping of organisms
 - C. Identification and grouping of organisms
 - D. Nomenclature and classification or organisms
4. Taxonomy refers to
 - A. Classification
 - B. Nomenclature
 - C. Identification
 - D. All of these
5. Which of the following has more characters In chtnmon?
 - A. Species
 - B. Genus
 - C. Class
 - D. Division
6. Any type of taxonomic group of the organisms is called
 - A. Taion

- B. Category
 - C. Classification
 - D. Rank of hierarchy
7. A rank or level in the hierarchial classification of organisms is a
- A. Taxon
 - B. Category
 - C. Key
 - D. All of these
8. Which of the following is not a correct hierarchial order?
- A. Phylum, order, family
 - B. Class, family, genus
 - C. Class, order, family
 - D. Family, class, order
9. Father of Taxonomy is
- A. Linnaeus
 - B. Aristotle
 - C. John Ray
 - D. None of the above
10. 'Systema Nature' is a book written by
- A. Linnaeus
 - B. Charak
 - C. John Roy
 - D. De Candole

Fill in the blanks

1. All living organisms _____ Increase in _____ and increase in _____ of individuals are twin characteristics of growth.
2. _____, this growth by cell division occurs continuously throughout their life.
3. _____, this growth is seen only up to a certain age.
4. The fungi, the filamentous algae, the protonema of mosses, all easily multiply by _____
5. All living organisms are made of _____
6. Cellular organisation of the body is the defining feature of life _____

7. We sense our environment through our _____
8. Plants respond to external factors like _____, _____, _____
9. Biology is the story of life on _____
10. Biology is the story of _____ of living organisms on earth.

True (T) or False (F)

1. There is a need to standardise the naming of living organisms such that a particular organism is known by the same name all over world. This process is called nomenclature.
2. Biologists follow universally accepted principles to provide scientific name to known organisms. Each name has two components-the Generic name and the specific epithet
3. System of providing a name with two components is called Binomical nomenclature.
4. Biological names are generally in Latin and written in italics.
5. Both the words in a biological name, when handwritten, are separately underlined, or printed in italics to indicate their Latin origin.
6. The first word denoting the genus starts with a capital letter while the specific epithet starts with a small letter.
7. All living organisms can be classified into different taxa. This process of classification is taxonomy.
8. Taxonomic categories and hierarchy can be illustrated by an example.
Taxonomical studies of all known organisms have led to the development of common categories such as kingdom, phylum or division (for plants), class order, family, genus and species
9. Herbarium is a store house of collected plant specimens that are dried, pressed and preserved on sheets.

Very Short Questions :

1. Name two organisms that do not reproduce?
2. Define 'living'?
3. Is regeneration a characteristic of living organisms?
4. What is biodiversity? or Define Biodiversity?
5. Name the International Authority who gives scientific name to the plants.
6. What is taxonomy?
7. How does taxonomy differ from systematics?
8. What is a species?

9. What is a taxon?

Short Questions :

1. How are zoological parks useful to biologists.
2. Write the universal rules of nomenclature.
3. Explain about taxonomical aids/tools?
4. "Consciousness is a defining property of living organisms." Explain.
5. Reproduction can't be an all-inclusive defining characteristic of living organisms? Illustrate the statement.

Long Answer Type

1. Explain two defining characteristics of living organisms.
2. Explain the utility of systematics for classification.

Assertion Reason Question-

1. In these questions, a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.
 - (a) If both Assertion and Reason are true and Reason is the correct explanation of Assertion.
 - (b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
 - (c) If Assertion is true but Reason is false.
 - (d) If both Assertion and Reason are false.

Assertion: Botany deals with the study of plants and zoology deals with the study of animals.

Reason: Biology is the study of living beings.

2. In these questions, a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.
 - (a) If both Assertion and Reason are true and Reason is the correct explanation of Assertion.
 - (b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
 - (c) If Assertion is true but Reason is false.
 - (d) If both Assertion and Reason are false.

Assertion: Study of internal structure is called anatomy.

Reason: It is useful for phylogenetic study.

Case Study Based Question-

1. Life is a unique process that is made from the aggregation of molecules. These molecules undergo various chemical reactions to perform their specific functions which are called

metabolism. This results in the production and utilization of energy. The metabolism will result in the growth, development, reproduction, adaptations, etc of the living organisms through the production of various biomolecules.

Living organisms contain certain important characteristics that include growth and development, body organization, homeostasis, reproduction, adaptation, and energy utilization.

The characteristic of living organisms is given below –

Growth – All living organisms can undergo the process of growth and development that results in an increase in the mass and number of cells. Multicellular organisms grow by cell division. The growth of plants and animals takes place with the help of cell division. In the case of plants, the cell division occurs throughout their life while in the case of animals the cell division occurs up to a certain age, and then the cells lose their capability to divide. It results in an increase in body mass and increases in the number of cells.

Metabolism– As the body and organs are the constituents of different chemicals, they perform various metabolic functions that result in the conversion of chemicals into other biomolecules. All plants, animals, and microbes exhibit metabolism. It is absent in the case of non-living organisms but may be introduced through the in-vitro method.

Sensitivity – The living organisms whether prokaryotes or eukaryotes respond according to their surroundings and the stimuli present around them, it may be physical, chemical, or biological. The living organisms are sensitive about their surroundings and are responsible in accordance with their stimuli. The stimuli can either be biological, physical, or chemical.

Reproduction – The ability to produce young ones is the process of reproduction which is observed only in the case of living organisms. In the case of fungi, reproduction occurs through asexual spores, while in the case of hydra budding occurs and in planaria regeneration occurs which are all the asexual methods of reproduction. Reproduction is the increase in the number of cells while in the case of mules, infertile human couples, etc reproduction is absent. So, reproduction is simply synonymous with growth which is not appropriate to distinguish the living organisms.

Cellular Organization: It is the defining characteristic of living organisms since all living organisms are made up of cells that help in performing various cellular functions resulting in the growth and development, reproduction, metabolism, etc in the body. Since non-living organisms are not made up of cells so they do not have cellular organization.

Movement: The living organisms show movement and locomotion and more specifically plants move according to the movement of the sun.

(1) Which among the following best describes the word “Growth” in living organisms?

- (a) Increase in mass either due to accumulation or due to changes that body undergoes internally

(b) Increase in mass due to internally cell division and increase in number due to replication are twin characteristic of growth

(c) All living organisms grow throughout their life

(d) Growth is a sufficient characteristic to determine whether an organism is living or non-living

(2) Reproduction in hydra takes place through _____

(a) Budding

(b) Binary Fission

(c) Asexual spores

(d) Fragmentation

(3) Consciousness and cellular organization of the body are the defining features of living organisms.

(a) True

(b) False

(4) Define metabolism.

(5) Write short note on growth?

2. Taxonomy is the study of the classification, characterization, nomenclature, and identification of organisms and it is a branch of science. Systematics is another branch of science that includes the study of the classification, nomenclature, identification, and evolutionary history of an organism. Thus, the taxonomic characteristics of an organism along with its evolutionary history come under systematics. In 1813, A.P de Candolle was the first to introduce the term taxonomy while systematics was introduced as the time of human civilization.

The term Systematics is derived from the Latin word 'systema' which means the systematic arrangement of organisms. Linnaeus (father of taxonomy) published his book *Systema Naturae* where the classification of plants, animals were based on taxonomy.

Neo-systematics is the branch of systematics that deals with the species to be the product of evolution. In 1940, Julia Huxley was the one who developed this concept. It involves the known characteristics of an organism and also the known evidence from different fields of biology.

Identification – It is the method of placing the organisms in their exact place based on their classification. The identification of organisms can be done with the help of taxonomic keys.

Classification – The classification is the process of grouping various living organisms based on the common features that they share. A single group consists of those organisms that have similar common features. To make classification easier various groups are formed in which different organisms are placed depending upon their characteristics.

Characterization – The studying and understanding of characters of organisms and categorizing them like external and internal structure (morphology and anatomy), the structure of the cell (cytology), developmental process (embryology), and ecological information (ecology) of the organism.

(1) Who is the Father of New Systematics?

- (a) Aristotle
- (b) Linnaeus
- (c) Theophrastus
- (d) Julian Huxley

(2) Which of the following takes into account evolutionary relationships between organisms?

- (a) Cladistics
- (b) Artificial System of Classification
- (c) Natural System of classification
- (d) Systematics

(3) Who is the father of taxonomy?

(4) Define taxonomy.

(5) What is mean by Systematics?

ANSWER KEY –

➤ Multiple Choice Answer:

1. Latin
2. Linnaeus
3. Diversity amongst groups
4. All of these
5. Species
6. Taxon
7. Category
8. Family, class, order
9. Linnaeus
10. Linnaeus

➤ Fill in the blanks :

1. grow, mass, number

2. In plants
3. In Animals
4. fragmentation
5. Chemical
6. Forms
7. sense organs
8. light, water, temperature
9. earth
10. evolution

➤ **Write true (T) or false (F) :**

1. True
2. True.
3. True
4. True
5. True
6. True
7. True
8. True
9. True
10. True

➤ **Very Short Answer :**

1. Mules, sterile worker bees.
2. Organisms exhibiting distinctive characters like growth, reproduction, etc. are called living.
3. Yes, because fragmented organisms regain the lost part of the body.
4. The number and variety of organisms present on earth are referred to as biodiversity.
5. International Code for Botanical Nomenclature (ICBN)
6. Taxonomy is the science of classification that is grouping them on the basis of certain similarities.
7. Systematics is the study of the diversity of plants. The study of systematics leads to their taxonomic grouping.
8. A population of identical individuals which can freely interbreed to produce fertile off-

springs.

9. A level of classification is called taxon e g., species, genus, family, etc. all are taxons.

➤ Short Answer:

1. Zoological parks are places where animals are maintained and allowed to breed in natural habitats.
 - a) It gives information about endangered animals.
 - b) Helps the biologists in developing hybrids with superior quality.
 - c) Support the workers of biotechnology.

2. Biological names are generally in Latin and written in Italics. They are Latinised or derived from Latin irrespective of their origi

the First word in a biological name represents the genus while the second component denotes a specific epithet.

Both the words in a Biological name when written in hand are separately underlined or printed in Italics to indicate their Latin origin.

First-world denoting genus starts with a capital letter while the specific epithet is written starting with a small word. It can be illustrated with the example of *Mangifera indica*.

The name of the author appears after a specific epithet i.e., the end of the biological name, and is written in the abbreviated form e.g. *Mangifera indica* (Linn). It indicates that species was first described by Linnaeus.

3. Identification of organisms requires intensive laboratory and field studies. The information about an organism is collected and analyzed. The collection of actual specimens of plant species is essential and is a prime source of taxonomic studies.

These are also fundamental not only to study but also to training in systematics. It is used for the classification of an organism and the information gathered is also stored along with even the specimens. In some cases, the specimen is preserved for future studies.

Biologists have established certain procedures and techniques to store and preserve the information as well as the specimens. These techniques are, in fact, aids available for the identification and classification of organisms. The knowledge of these aids is quite helpful in biological studies. Some of these are explained to help to understand the usage of these aids.

Some of the taxonomical aids are:

1. Herbarium,
2. Botanical Gardens
3. Museums

4. Zoological Parks

5. Keys.

4. Flora and fauna both respond to physical-chemical or biological environmental stimuli. Awareness of their surroundings makes organisms live. Mimosa pudica respond to touch. Photoperiodic affects flowering in plants. Thus unicellular microscopic to multicellular huge organisms show the property of consciousness
5. In nature, there are many organisms that can't reproduce. Mules, sterile worker bees are some examples of such organisms.

But the non-living object is strictly unable to reproduce.

Viruses are placed between living and non-living. They are crystallized like non-livings but replicate when enter inside living organisms.

➤ Long Answer :

1. Growth Unicellular and multicellular organisms increase their mass and number through cell-division. Non-livings increase their size by the accumulation of matter.
 - a) Cell has protoplasm which is living matter. Cell before division increases their mass through replication of genetic matter. It is absent in non-livings.
 - b) Metabolic Activity: Anabolic and catabolic reaction constantly occurs in living organisms, formation and conversion of biomolecules is metabolism.
- 'In Vitro, such reactions can be maintained. In non-living, there is the absence of metabolism.
2. For classification, systematic studies have to carried out.
 1. First, the organisms have to be described for all their morphological and other characteristics.
 2. Based on its characteristic, it is seen whether it is similar (or different) to any known group or taxa-identification is carried out.
 3. Based on its similar characteristic it is then placed in known taxa or the organism is classified. Sometimes organisms are very different from the ones already described anywhere in the world, then they are placed in a new group or 'taxa' and named.
 4. Once the organism has been placed in the right taxa-the last step is nomenclature or naming. If the organism is already known-its the correct name is determined. If an organism is not described before-it is given a new name.

Assertion Reason Answer-

1. (a) If both Assertion and Reason are true and Reason is the correct explanation of Assertion.

Explanation: Biology (Bio-living, logy-science). The study of living beings is called biology. Living beings on earth are mainly classified into two forms-plants and animals. Botany and zoology are

the fundamental branches of biology. Word botany has been derived from greek word botane which means pasture or plants and zoology has been derived from word zoo-animals, logosstudy. Theophrastus and Aristotle is called the father of botany and father of zoology respectively

2. (b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

Explanation: Anatomy is the study of internal structure which can be observed with unaided eye after dissection. By studying anatomy of large number of organisms, it is useful for knowing phylogenetic similarity (homology) and phylogenetic dissimilarity (analogy).

Case Study Answer-

1. Answer:

(1) B

(2) A

(3) True

(4) Metabolism refers to the sum total of all the reactions that occur in an organism. Conversions of chemicals in a living organism are called metabolic reaction.

(5) All living organisms can undergo the process of growth and development that results in an increase in the mass and number of cells. Multicellular organisms grow by cell division. The growth of plants and animals takes place with the help of cell division. In the case of plants, the cell division occurs throughout their life while in the case of animals the cell division occurs up to a certain age, and then the cells lose their capability to divide. It results in an increase in body mass and increases in the number of cells.

2. Answer:

(1) D

(2) D

(3) Carolus Linnaeus is the father of taxonomy.

(4) Taxonomy is the study of the classification, characterization, nomenclature, and identification of organisms and it is a branch of science.

(5) Systematics is another branch of science that includes the study of the classification, nomenclature, identification, and evolutionary history of an organism. Thus, the taxonomic characteristics of an organism along with its evolutionary history come under systematics.