

BOTANY

FOR
NEET AND OTHER MEDICAL
ENTRANCE EXAMINATIONS

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The Living World

Biology (Gr. *Bios*=life, *logos*=study) is a branch of science dealing with the study of living organisms. The term 'Biology' was coined by Jean Baptiste de Lamarck (1801).

Aristotle (384-322 B.C) is regarded as father of Biology.

Botany (Gr. *Botane*=herb) is study of plants.

Theophrastus (370-287 B.C) is regarded as Father of Botany.

Living organism is highly organised, structurally complicated, self replicating, evolving and self regulating interactive system. It is considered as an open system which has a constant flow of free energy. Even very simple single-celled organisms are remarkably complex. Inside each cell, atoms make up molecules which in turn form cell organelles. In multicellular organisms, similar cells form tissues which in turn form organ. The organs work together to form organ system.

Properties of living organisms

- 1. Growth:** It is irreversible quantitative increase in number (mass) and size (weight) of cells or tissues or organism or its parts. In nonliving objects, growth is extrinsic (increase in mass from outside). But in living organisms, growth is intrinsic (increase in mass of body from inside). Growth occurs slowly as well as rapidly.

In unicellular organisms, growth is due to increase in number of cells but in multicellular organisms, it is due to increase in number and size of cells.

In plants, growth is indefinite (continuous growth throughout life span) but in animals, it is definite (growth reaches a certain size and then stops).

Growth requires cell division, cell elongation and secretion of extracellular matrix or apoplasmic substances. Thus growth occurs due to synthesis of protoplasmic substances (living matter like cytoplasm and nucleus) and apoplasmic substances (nonliving materials formed by cells).

It is not a defining property because nonliving things present in living organisms show growth.

- 2. Reproduction:** It is production of new offspring (progeny) showing features more or less similar to their parents. The unicellular organisms divide to form two new cells by first duplicating their DNA but multicellular organisms produce specialised reproductive cells that will form new individuals.

In unicellular organisms, both growth and reproduction are mutually inclusive but in multicellular organisms, both are mutually exclusive (if growth occurs then it cannot be said that reproduction will take place). It occurs by following means:

- (a) **Vegetative:** It produces organisms by fragmentation of vegetative parts or budding.
- (b) **Asexual:** It produces organisms without the use of gametes by binary fission, spores, tissue culture, grafting etc.

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(c) Sexual: It produces organisms with the joining of gametes by isogamy, anisogamy and oogamy. It cannot be defining property because worker of honey bee; mule (hybrid of male ass and female horse), hinny (hybrid of female ass and male horse) and infertile human couple are sterile because they are unable to reproduce.

3. **Metabolism:** It is sum total of all chemical reactions taking place in the cells of a living organism. It is an organised process by which all living organisms release energy and utilise it for various functions such as growth, development, reproduction, movement etc. Metabolism can be demonstrated outside the body cell or in cell free system. An isolated metabolic reaction in a test tube (outside body) is neither living nor nonliving. The *in vitro* reactions are not living things but surely living reactions. It is a defining property because it occurs in all living organisms. It shows two types of mechanisms such as

- (a) Anabolism: It is synthesis of complex substance from simpler ones. It stores energy e.g., Photosynthesis.
(b) Catabolism: It is breakdown of complex substance into simpler ones. It releases energy e.g., Respiration.

There are three cases such as

- (a) If anabolism is equal catabolism, then there will be no growth.
(b) If anabolism is greater than catabolism, then there will be growth.
(c) If anabolism is lesser than catabolism, there will be degrowth.
4. **Consciousness:** It is response to external physical, chemical or biological stimuli. It is either positive if movement is towards a stimulus or negative if it is away from stimulus. All organisms from prokaryotes to eukaryotes sense their surroundings and show response. The plants respond to external factors like light, temperature, water, pollutants etc and animals perceive stimuli by their well developed sense organs (eyes, ears, taste buds).

It is most obvious and technically complicated feature.

5. **Homeostasis:** It is the maintenance (constancy) of favourable dynamic internal environment in spite of changes in external environment. It must be stable for smooth functioning of metabolic processes. The term 'Homeostasis' was coined by Cannon (1932). It occurs at all levels from cell level to the level of ecosystem.

The organisms that live in cold climates, have body structures (fur, feather, blubber, fat retaining energy) that help them withstand low temperatures and conserve body heat. The organisms of hot climate have methods (perspiration in humans or panting in dogs) that help them to shed excess body heat. It occurs through

- (a) Self regulatory mechanisms using genetic clock.
(b) Feedback system in which rate of formation of product is regulated by gathering information about the amount left out at anytime. It exhibits the process of thermoregulation by two modes such as **Poikilotherm** where the energy produced during metabolic reactions is lost to environment hence their body temperature varies with that of environment and **Homoiotherm** where the energy produced during reactions is not lost but retained by hairs, feathers, subcutaneous fat hence body temperature is kept constant.
6. **Protoplasm:** It is a distinctive and fundamental material of which all living organisms are composed. It is physical basis of life. It contains water, proteins, lipids, carbohydrates and inorganic materials. It is crystallo-colloidal, slightly alkaline and highly organised material which produces energy of life. It shows Brownian movement and Tyndall effect.

7. **Cellular organisation:** All living organisms possess cell which is the basic structural and functional unit of life. The cell will form tissue which develops organs. The living organisms may be unicellular and multicellular on the basis of number of the cell. The complexity of living organism begins with the cell. It is a defining feature.
8. **Genetic continuity:** All living organisms possess genetic material (DNA) for the expression of trait from generation to generation. It is the basis of inheritance and performs so many vital functions.
9. **Adaptation:** It is the condition in which living organisms cope with environmental stresses and pressure to lead successful life in given environment. It can be morphological (structural), physiological and behavioural. The living organisms show remarkable ability to adjust to their environment. These may be (i) short term in which changes are developed in response to particular condition for short time and later disappear and (ii) long term in which changes are inheritable and occur to adjust the environment permanently. If organism fails to adjust then it will perish or become extinct.
10. **Movement:** It is natural change of position. It is general tendency of all living organisms to change their location. The animals exhibit clear movement but sessile animals and plants in general show movement of parts.
11. **Death:** It is ultimate reality of all living organisms to die. It is necessary for the population to be checked and recycling of materials. Some organisms such as Bacteria and *Amoeba* are said to be immortal because they divide by binary fission hence they do not undergo natural death.

Diversity: The planet earth has a large number of living organisms such as plants, animals, fungi etc. Around 1.7 million species (1.2 million animals and 0.5 million plants) are found at different geographical areas. Due to diversity, it is very difficult to study each and every plants and animals so these are required to be classified for further study.

Taxonomy: It is the arrangement of different types of organisms on the basis of shared characteristics. It is study of characterisation (description), identification, nomenclature and classification of living organisms. The term 'Taxonomy' was coined by AP de Candolle (1813). He composed '*Theorie elementare de la botanique*'.

Father of Taxonomy is Carolus Linnaeus.

Father of Indian Taxonomy is Henry Santapau.

Linnaeus composed (i) *Philosophia Botanica* in 1751 in which principles of binomial nomenclature were mentioned. (ii) *Species Plantarum* in 1753 in which nomenclature of 5900 plants was given and (iii) *Systema Naturae* (10th ed) in 1758 in which description of 4326 animals was made.

Systematics: It was coined by Linnaeus. It is process of organising taxonomic information about organisms into a logical classification. It deals with kinds and diversity of all organisms and their existing relationship. It is taxonomy plus phylogeny (evolutionary history of organisms). It includes those areas of biology concerned primarily with similarities and differences between organisms.

Biosystematics

It provides information regarding habit, habitat, characters, affinities, and diversity of organisms.

- (a) It provides information of evolution.
- (b) It helps in identification of newly discovered organisms and fossils.

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Types of Taxonomy: Turril divided taxonomy into 3 types:

1. **Alpha taxonomy (Classical taxonomy):** It is based on morphological characters, compilation of flora and monograph. Classical taxonomists are Theophrastus, Aristotle.
2. **Beta Taxonomy (Modern or Explorative taxonomy):** It is based on morphological, anatomical, embryological, palynological, physiological, cytological and biochemical characters. It deals with identification of plants.

It is also known as Biosystematics.

3. **Omega taxonomy (Encyclopaedic taxonomy):** It is based on all available known information about plants. It deals with evolutionary patterns.

It is also known as Neosystematics (term coined by Julian Huxley).

New Branches of Taxonomy

- (a) **Chemotaxonomy:** It is based on studies of chemical constituents such as polysaccharides, amino acids, proteins, fatty acids, nucleic acids (DNA sequences), alkaloids, pigments (betacyanin in beet root), aromatic compounds, tannins, crystals in the form of cystolith (Calcium carbonates) and raphides (Calcium oxalates).
- (b) **Cytotaxonomy:** It is based on cytological studies such as number, structure and meiotic behaviour of chromosomes.
- (c) **Karyotaxonomy:** It is based on studies of chromosomal bands (light and dark band).
- (d) **Numerical Taxonomy (Phenetics/Taximetrics or computer aided taxonomy):** It was proposed by Adanson. It is based on numerical or statistical methods in which large number of characters are observed and recorded. It determines the similarities and dissimilarities or primitiveness and advancement of several characters at the same time. It has the following features:
 - (i) If content of information in taxa is increased then the classification will be better.
 - (ii) Every character is of equal weight in creating natural taxa.
 - (iii) Classification is based on percentage similarity coefficient for each operational taxonomic units (OTU).

Dendrogram: It is family tree of organisms based on numerical taxonomy.

Cladogram: It is family tree of organisms based on phylogeny (showing ancestry).

Taxonomic category: It is the position or status or level in a hierarchal classification of organisms.

Taxon: It was coined by Adolph Mayr. It is the scientific term of category. It is taxonomic group or unit of organisms of any rank in any category. It is group of genetically related individuals having distinct characters from those of other groups. It was introduced for the first time in 1956 by ICBN. All fishes or birds form taxon. Cats, mammals and animals represent taxa at different level or category.

Category	Taxon	Category	Taxon
Kingdom	Plantae	Kingdom	Animalia
Division	Angiospermae	Phylum	Chordata
Class	Dicotyledonae	Class	Mammalia
Order	Polemoniales	Order	Primata
Family	Solanaceae	Family	Hominoidea
Genus	<i>Solanum</i>	Genus	<i>Homo</i>
Species	<i>tuberosum</i>	Species	<i>sapiens</i>

Taxonomic hierarchy: It is classification of organisms in a definite but descending sequence of categories. Hence all categories constitute hierarchy.

Linnaeus firstly proposed hierarchy (Ranking system) in which 5 categories were mentioned. But he did not incorporate Division and Family.

Class----- Order----- Genus----- Species----- Variety

Later Taxonomic Hierarchy mentions 7 obligate categories.

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

(Phylum is used in place of Division in animals.)

1. **Kingdom:** It is the highest taxonomic category. It is a group of related divisions. All plants are placed in kingdom-Plantae.
2. **Division:** It is a group of related classes. It was coined by Eichler. It mentions suffix-phyta. In animals, the Phylum is equivalent to the Division. The term 'Phylum' was coined by Cuvier.
3. **Class:** It is a group of related orders. It was coined by Linnaeus. It mentions suffix-phyceae (algae) or -opsida (plants such as Bryophytes, Pteridophytes and Gymnosperms). If subclass exists then it will mention suffix -idea for plants. The orders such as Ranales, Polemoniales and Personales have been placed in class, Dicotyledonae.
4. **Order:** It is a group of related families having few similar features. It was coined by Linnaeus. It mentions suffix-ales. If suborder exists then it mentions suffix-inaeae. The families such as Solanaceae and Convolvulceae have been placed in the order, Polemoniales.
5. **Family:** It is a group of related genera having some similar or common features. It was coined by John Ray. It mentions suffix -aceae (plants) or -idea (animals). If there is sub-family then suffix will be -oideae. The three different genera such as *Solanum*, *Atropa* and *Nicotiana* have been placed in the family, Solanaceae.

Tribe: It is between family and genus. It mentions suffix -eae (plants) and -ini (animals)

6. **Genus:** It is a group of closely related species having many similar or common features. It was coined by Tournefort. It occupies a special position in classification hence species cannot be named without assigning it to a genus. The plants such as Potato (*Solanum tuberosum*) and Brinjal (*Solanum melongena*) are two species but both belong to same genus-*Solanum*. Genus is of two types:
 - (a) Monotypic genus: Some genera have only one species. e.g., *Ginkgo biloba*, *Homo sapiens*.
 - (b) Polytypic genus: Some genera have more than one species. e.g., *Solanum* has *tuberosum* and *melongena*; *Panthera* has *leo* and *tigris*.
7. **Species:** It is basic (smallest) unit of biological classification. It was coined by John Ray. It is group of naturally interbreeding population with the ability to produce fertile offspring but reproductively isolated. It is group of closely related individuals with similar morphological, anatomical, biochemical, and cytological characters. It is of two types:
 - (a) **Monotypic species** (Microspecies): The species without differentiation of sub-species or variety. It is the species in which variations are less but it reproduces asexually. e.g., Bacteria (*Escherichia coli*), Cyanobacteria (*Anabaena azollae*).
 - (b) **Polytypic species:** (Macrospecies): The species in which more than one varieties or subspecies are found. It is of three types:
 - (i) **Biotype:** The members of same species inhabit similar environment and they show some permanent genetic variations. The members cannot breed among themselves.e.g., *Brassica*

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oleracea var. *botrytis* (Cauliflower), *Brassica oleracea* var. *capitata* (Cabbage) and *Brassica oleracea* var. *pristis* (Knol kohl).

(iii) **Ecotype:** The members of same species inhabit different environment and they show some permanent genetic variations. The members can breed themselves but due to geographical barrier they cannot interbreed or it is genetically different population. e.g., *Corvus splendens splendens* (Indian crow), *Corvus splendens insolence* (Myanmarese crow) and *Corvus splendens perotegatus* (Srilankan crow).

(iii) **Ecades (Ecophenes):** The members of same species show some temporary non-genetic variations due to environment or It is a form of a plant modified by its habitat but not heritable. e.g., Money plant is dark green (in shade) and yellow (in sunlight).

Features of categories

Kingdom-----Division----- Class----- Order-----Family-----Genus-----Species
(Less) ←————— **Specific characters** —————→ (more)
(Less) ←————— **Common or Similar characters** —————→ (more)
(More) ←————— **Diversity** —————→ (less)

Types of species:

1. Morphospecies: The species which are based on morphological characters only.
2. Taxonomic species: The species which have definite binomial name.
3. Sympatric species: The species which live in same geographical area.
4. Allopatric species: The species which live in different geographical areas.
5. Parapatric species: The species which live in narrow overlap of two different areas.
6. Synchronic species: The species which belong to same period of time. e.g., *Archaeopteryx* and *Dinosaur*
7. Allochronic species: The species which belong to different period of time. e.g., Dinosaur and Man.
8. Sibling species (Cryptic species): True species which do not breed (reproductively isolated).
9. Palaeospecies: These species which are known from fossils only. e.g., Dinosaurs.
10. Neontological species: The species which are living.

Institutions for Nomenclature

1. International Code of Botanical Nomenclature (ICBN)
2. International Code of Zoological Nomenclature (ICZN)
3. International Code of Viral Nomenclature (ICVN)
4. International Code for Nomenclature of Bacteria (ICNB)
5. International Code of Nomenclature for Cultivated plants (ICNCP)

ICBN: It was established at 12th International Botanical congress held at Leningrad in 1975 to provide uniformity and to avoid confusion regarding nomenclature of plants. It came into existence in 1978. The latest 19th International Botanical Congress was held in Shenzhen, China in July 2017. It has three types of articles- Principles, Rules and Recommendations. The most important rule is principle of priority. The principles include

- (a) Botanical nomenclature is independent of zoological nomenclature.
- (b) The nomenclature of taxonomic group is based on priority of publication.

Now ICBN has been changed to International code of Nomenclature (ICN) in July, 2011.

Plant names became effective from 1st May, 1753 and animal names from 1st August, 1758.

Binomial Nomenclature: It was firstly introduced by Gaspard Bauhin in his book 'Pinax' (1623) but it was finally proposed by Linnaeus (1753). There are several **rules** which are as follows:

1. The name of organism should consist of genus and species.
2. The name of genus should be written first followed by species name.
3. The first letter of name of genus should be in capital and that of species in small.
4. The name of genus and species should consist of 3 to 12 letters.
5. The botanical name should be taken from Latin and Greek languages.
6. The botanical name (genus and species) should be printed in italics. If it is handwritten then it should be underlined separately.
7. The name of discoverer of plant should be written after species in last and in abbreviation. e.g., *Mangifera indica* Linn
8. The name of family and other categories should be based on type genus.
9. The name of family and other categories should not be printed in italics.
10. If a species name is transferred or revised then the name of original worker should be written but in parenthesis. e.g., *Syzygium cumini* (L) Skeels
11. If the name of species is compound (having two words) then a hyphen should be mentioned between these words.
12. In case of two or more names, the name given first is recognised as valid name and all other names will be called synonyms.

Trinomial Nomenclature: It was proposed by Lamarck. In case of plants, it includes name of genus, species and variety. e.g., *Brassica oleracea botrytis* (cauliflower), *Brassica oleracea capitata* (cabbage) but in case of animals, it includes name of genus, species and sub-species. e.g., *Homo sapiens sapiens* (Human being), *Corvus splendens splendens* (Indian crow)

Nomenclature Types: It acts as source for naming a certain taxonomic group. The ICBN recognised following several types:

1. Holotype: It is original description of type specimen by author.
2. Isotype: It is duplicate of holotype so this is other specimen collected at same place, same time by same author.
3. Neotype: It is new type specimen when original description (holotype) is missing.
4. Paratype: It is actual description of holotype with some additional information.
5. Syntype: It is two or more type specimen when original description (holotype) is missing.
6. Lectotype: It is used as substitute when holotype is lost.

Nomenclature terms

1. Autonym: It is name with same species and subspecies. e.g., *Corvus splendens splendens*
2. Synonym: It is more than one name of taxon. e.g., *Catharanthus roseus* (= *Vinca rosea*) for periwinkle and *Malus pumila* (= *Pyrus malus*) for apple.

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3. Homonym: It is same name for two different plants. e.g., *Prunus dulcis* for almond and plum.
4. Basionym: It is name on which new combination is based.
5. Tautonym: It is name with same genus and species. It is only for animals. e.g., *Bison bison*, *Rattus rattus*, *Naja naja*, *Gorilla gorilla*, *Catla catla*.

Taxonomic aids

These are meant for storing and preserving the specimens and their information.

1. **Herbarium:** It is storehouse of preserved plant specimens on sheet. It is arranged in the sequence based on accepted system of classification. Caesalpino prepared first herbarium of 768 plants. The international size of sheet is $11\frac{1}{2}'' \times 16\frac{1}{2}''$ or 29×41 cm. It mentions (a) Date of collection, (b) Place of collection. (c) Local (vernacular) name, (d) English name, (e) Botanical name, (f) Name of family and (g) Name of collector.

Procedure:

- (a) Collection: Specimen should contain roots, stem, leaf, flower and fruits.
- (b) Pressing: It is done by blotting paper.
- (c) Drying: It is done to remove moisture.
- (d) Poisoning: Dried specimen is sprayed with fungicides ($0.1\% \text{HgCl}_2$) to check the growth of fungus.
- (e) Mounting: Specimen is mounted on sheet except succulents.
- (f) Stitching: It is properly fixed on sheet.
- (g) Labelling: The parts of specimen were properly named.
- (h) Deposition: The specimen is now submitted.

Examples:

1. Herbarium of Royal Botanical Garden, Kew (England): It was established in 1841. It is the largest containing 60 lakh specimens.
2. Herbarium of Indian Botanical Garden, Kolkata (India): It was established in 1787 containing 10 lakh specimens.
3. Herbarium of National Botanical Research institute (NBRI), Lucknow (India): It was established in 1948 containing 40,000 specimens.

Importance:

- (a) It helps in identification of unknown plants.
 - (b) It is used to preserve specimens.
 - (c) It provides information regarding flora of different places.
 - (d) It is used as quick reference for alpha taxonomic studies and research.
2. **Botanical Garden:** It is large area of land where plants of different types and areas are grown.

Examples:

1. Royal Botanical Garden, Kew, (England)
2. Indian Botanical Garden, Kolkata
3. National Botanical Garden, Lucknow
4. Lloyd Botanical Garden, Darjeeling

Importance:

- (a) It helps in *ex situ* conservation of plants.
- (b) It helps in identification of local flora.
- (c) It helps in knowing the taxonomic affinities.

3. **Zoological Garden or Zoological Park or Zoo:** It is protected area or enclosed space where live wild animals are kept under human care.

Examples:

- 1. Kruger Zoo (South Africa): It is the largest zoo in the world.
- 2. National Zoological Park, New Delhi (India).

Importance:

- (a) It helps in *ex situ* conservation of animals.
 - (b) It is used in breeding of rare animal (fauna).
 - (c) It serves as recreation and education.
4. **Museum:** It is collection of preserved plants and animals in the container or jar in preservative solution. It is established to preserve algae, fungi, bryophytes (mosses), pteridophytes (ferns) and parts of gymnosperms since they cannot be kept in herbaria. Likewise different animals esp. lower ones are also preserved.

Importance:

- (a) It is used for study and reference.

Identification kits

1. **Flora:** It is a book which provides information esp. habitat and distribution of plants of a particular area.

Examples:

- 1. Flora Indica: It was written by William Roxburgh (Father of Indian Botany).
- 2. Flora of British India: It was written by Bentham and Hooker.
- 3. Flora of Delhi: It was written by Maheshwari.

2. **Manual:** It is a book containing complete listing and description of plants of a particular area for identification process.

Examples:

- 1. Manual of Mangroves
- 2. Manual of cultivated plants

3. **Monograph:** It is a printed material which has information of only one taxon.
4. **Catalogue:** It is alphabetical arrangement of species of a particular area describing their features.
5. **Key:** It is artificial and analytical device containing set of alternate (similar or dissimilar) characters of various plants and animals for easy and quick identification. It was developed by John Ray.

It is based on set of contrasting characters generally in a pair called couplet and each character of couplet or statement is called lead. It is used in preparing flora and monograph. It is of two types:

- (a) **Indented (Yoked) key:** It is a set of choice between two or more statements or characters of species. It is generally less followed.

(b) **Bracketed (Parallel) key:** It is a set of contrasting characters in pairs. It is most popular hence more followed.

SHORT ANSWER TYPE QUESTIONS

1. Define metabolism.
2. What do you mean by homeostasis?
3. Why growth and reproduction are not defining features?
4. Distinguish between taxonomy and systematic.
5. How alpha taxonomy differs from beta taxonomy?
6. What do you mean by numerical taxonomy?
7. What is difference between dendrogram and cladogram?
8. Explain species with examples.
9. Distinguish between sympatric and allopatric species.
10. Distinguish between taxon and category.
11. Explain Linnean hierarchy.
12. Explain monotypic genus and polytypic genus.
13. Distinguish between binomial and trinomial nomenclature.
14. Define botanical garden and mention its importance.
15. Discuss the types of key.

LONG ANSWER TYPE QUESTIONS

1. Describe the different properties of living organisms.
2. What is ICBN? Discuss the different rules of binomial nomenclature.
3. What is herbarium? Describe its procedure with examples.
4. Describe the all categories of taxonomic hierarchy.
5. Explain the different identification kits.

MULTIPLE CHOICE QUESTIONS

1. The growth and reproduction are mutually inclusive in

(a) <i>E. coli</i> and <i>Fucus</i>	(b) <i>E. coli</i> and <i>Chlamydomonas</i>
(c) <i>Chlamydomonas</i> and Moss	(d) Moss and Fern
2. The most obvious and technically complicated feature of living organism is

(a) Growth	(b) Metabolism	(c) Consciousness	(d) Homeostasis
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3. Reproduction is not exhibited by

(a) Worker bee	(b) Mule	(c) Hinny	(d) All of the above
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4. Systematics involve

(a) Taxonomy and ontogeny	(b) Taxonomy and phylogeny
(c) Numerical taxonomy and karyotaxonomy	(d) Cytotaxonomy and karyotaxonomy
5. The term 'Neosystematics' was coined by

(a) Linnaeus	(b) de Candolle	(c) Julian Huxley	(d) Adanson
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6. At which level of hierarchy homeostasis operate?

(a) Cell level	(b) Population level	(c) Ecosystem level	(d) All of above
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7. The family tree of organisms on the basis of phylogeny is called

(a) Dendrogram	(b) Histogram	(c) Karyogram	(d) Cladogram
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8. Linnean hierarchy does not include

(a) Class	(b) Order	(c) Family	(d) Variety
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9. Which of the following categories is used in place of 'Division' in animals?

(a) Domain	(b) Phylum	(c) Class	(d) Variety
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10. Which of the following categories is used in place of 'Subspecies' of plants?

(a) Form	(b) Section	(c) Series	(d) Variety
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11. The suffix of 'Family' is

(a) -ae	(b) -eae	(c) -ceae	(d) -aceae
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12. The suffix of 'Tribe' is

(a) -ae	(b) -eae	(c) -ceae	(d) -aceae
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13. The 'Tribe' is placed between

(a) Order and family	(b) Family and Genus
(c) Genus and Species	(d) Species and Variety
14. Which is not correct with respect to taxonomy?

(a) Numerical taxonomy is also known as phenetics	(b) Beta taxonomy is also known as biosystematics
(c) All birds form a taxon	(d) Taxonomy includes phylogeny
15. The exceptions to 'Biological species concept' in natural condition are

(a) Mule and Tigon	(b) Tigon and Liger	(c) Mule and Hinny	(d) Hinny and Tigon
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16. The specific characters are more in
(a) Class (b) Order (c) Family (d) Genus
17. The diversity is less in
(a) Class (b) Order (c) Family (d) Genus
18. The polytypic species is shown by the genus
(a) Solanum (b) Brassica (c) Lilium (d) All of the above
19. Dinosaur and *Archeopteryx* belong to
(a) Allochronic species (b) Synchronic species
(c) Allopatric species (d) Sympatric species
20. The name of plants became effective from
(a) 1-5-1751 (b) 1-5-1753 (c) 1-5-1758 (d) 1-5-1759
21. *Prunus dulcis* is homonym for
(a) Plum and Almond (b) Plum and Walnut
(c) Almond and Black berry (d) Cashew and Walnut
22. If a particular specimen was originally described by author, it is called
(a) Isotype (b) Holotype (c) Paratype (d) Lectotype
23. The botanical name of cauliflower is
(a) *Brassica oleracea* var. *botrytis* (b) *Brassica oleracea* var. *capitata*
(c) *Brassica oleracea* var. *pristis* (d) *Brassica oleracea* var. *glomerata*
24. Which of the following nomenclature terms is used especially for animals?
(a) Autonym (b) Basionym (c) Homonym (d) Tautonym
25. Which of the following processes is not used in the preparation of herbarium?
(a) Pressing (b) Cutting (c) Drying (d) Poisoning
26. The specimen for herbaria are treated to prevent any fungal attack by
(a) 0.1% mercuric chloride (b) 0.1% mercurous chloride
(c) Acetic acid (d) Phenol
27. Herbarium does not mention
(a) Local name of plant (b) Name of family of plant
(c) Name of collector (d) Name of order of plant
28. Which of the following taxonomic kits is used for actual identification of plants?
(a) Flora (b) Manual (c) Monograph (d) All of the above
29. Key is an artificial device coined by
(a) Linnaeus (b) John Ray (c) Eichler (d) Julian Huxley
30. The largest herbarium is found in
(a) USA (b) England (c) India (d) Russia
31. In India, the largest Botanical Garden is situated at
(a) Lucknow (b) Delhi (c) Kolkata (d) Mumbai

32. The *ex situ* conservation of organisms can be done at
(a) Herbarium and Botanical garden (b) Botanical garden and Zoological park
(c) Museum and Zoological park (d) Botanical garden and Museum
33. Which of the following taxonomic aids serves as a quick referral system in taxonomic studies?
(a) Botanical garden (b) Zoological park (c) Museum (d) Herbarium
34. Dinosaur and human being belong to
(a) Sympatric species (b) Allopatric species
(c) Synchronic species (d) Allochronic species
35. Biological epithet includes
(a) Generic name and specific name
(b) Specific name and variety name
(c) Generic name, specific name and author citation
(d) Specific name, variety name and author citation
36. Which of the following is incorrect regarding metabolism?
(a) It involves catabolism and anabolism
(b) It cannot be demonstrated outside the body cell
(c) It is an organised process
(d) It is a defining property.
37. The ICBN came into existence in the year
(a) 1975 (b) 1978 (c) 1981 (d) 1986
38. Potato and brinjal belong to
(a) Same genus but different species (b) Same species but different varieties
(c) Same families but different genus (d) Different families but same genus
39. Which of the following is incorrect regarding herbarium?
(a) It was first prepared by Caesalpino
(b) The size of sheet is 29×41 cm
(c) It mentions the local name
(d) It cannot be reference of alpha taxonomic studies
40. The species which live in same geographical are known as
(a) Allopatric species (b) Sympatric species
(c) Parapatric species (d) Synchronic species
41. The phylogenetic relationship can be established by
(a) Isoenzymes (b) Alkaloids
(c) Alcoholic dehydrogenase (d) Morphology
42. The phylogenetic relationship can be precisely established by
(a) Amino acid sequences (b) DNA
(c) rRNA (d) mRNA

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43. Molecular clock of evolution could be traced on the basis of
(a) Comparison of short arm of 16 S rRNA
(b) DNA finger printing
(c) Fossil study
(d) Substitution in amino acids of polypeptides due to mutation
44. When two species are morphologically almost identical but reproductively isolated, are termed as
(a) Taxonomic species (b) Ecotypes (c) Sibling species (d) Morphospecies
45. A group of species which are phylogenetically closer but they are lacking common ancestor. Such group is regarded as
(a) Monophyletic (b) Polyphyletic (c) Paraphyletic (d) Sympatric
46. Different hybrid forms of same parentage are termed as
(a) Apomicts (b) Nothomorphs (c) Race (d) Variety
47. Which of the following techniques is used among plants for genetic relationship?
(a) Amino acid sequence (b) Serological investigation
(c) Isoenzyme profiling (d) Chromosome morphology
48. ICBN is not applicable for
(a) Algae (b) Bryophytes (c) Angiosperms (d) Cultivated plants
49. Besides nomenclature of plants in wild, ICBN also gives binomial names for
(a) Fungi (b) Cultivated plants
(c) Bacteria and fungi (d) Fungi and cultivated plants
50. ICBN was established at
(a) 10th International Botanical congress
(b) 11th International Botanical congress
(c) 12th International Botanical congress
(d) 13th International Botanical congress
51. Which of the following is not a characteristic of a living organism?
(a) Reproduction (b) Complex chemical organisation
(c) Adaptation (d) Differentiation from cells to tissues
52. Which of the following is capitalised in printed scientific name?
(a) Species (b) Genus (c) Family (d) Order
53. Each category of taxonomic hierarchy refers to as a unit of
(a) Systematics (b) Nomenclature (c) Identification (d) Classification
54. The common characteristic between tomato and potato will be maximum at the level of
(a) Genus (b) Family (c) Order (d) Division
55. Each statement in the key is called
(a) Lead (b) Manual (c) Catalogue (d) Monograph
56. The true species are
(a) Interbreeding (b) Sharing the same niche
(c) Feeding on the same food (d) Reproductively isolated

57. Which of the following is 'Domain' taxon?
 (a) Bacteria (b) Eubacteria (c) Archaeobacteria (d) Protista
58. Which of the following types of honey bee is an exception to reproduction?
 (a) Worker (b) Queen (c) Drone (d) All of the above
59. Which of the following is incorrect about protoplasm?
 (a) It is crystallo-colloid (d) It is slightly alkaline
 (c) It shows Brownian movement (d) It includes cell wall
60. The diversity is maximum in
 (a) Class (b) Order (c) Family (d) Genus

ANSWERS

1. b	2. c	3. d	4. b	5. c	6. d	7. d	8. c	9. b	10. d
11. d	12. b	13. b	14. d	15. c	16. d	17. d	18. b	19. b	20. b
21. a	22. b	23. a	24. d	25. b	26. a	27. d	28. b	29. b	30. b
31. c	32. b	33. d	34. d	35. c	36. b	37. b	38. a	39. d	40. b
41. a	42. b	43. d	44. c	45. b	46. b	47. a	48. a	49. c	50. c
51. d	52. b	53. d	54. b	55. a	56. d	57. a	58. a	59. d	60. a