

Chapter 1.1

The Living World

1.1 Nature and Scope of Biology

Science : The term science is derived from Latin word *scientia* which means knowledge. So, the term 'science' is used for knowledge gained by actual observation, found correct on verification and put in a systematic manner or science provides us information based on facts. There are several branches of science, each dealing with a specific subject.

Biology : It is the combination of two Greek words *bios* and *logos*. *Bios* means life and *logos* means study. Thus, biology is the branch of science which deals with the study of life. The first major biological observations were made by ancient Greek naturalist Aristotle (384-322 B.C.). Aristotle has been designated as Father of biology. The term biology was given by French naturalist Lamarck and Gottfried Treviramus of Germany (1744-1829). Biology has been further classified into.

(1) Botany

(2) Zoology.

The science of plants is called Botany. The word botany has been derived from Greek word *botane* which means pasture or plants. Technically, botany is called Phytology (Gk. *phyto* = plants; *logos* = study). Theophrastus (370-287 B.C.) is known as Father of botany. Zoology is the study of animals (Gk. *zoon* = animals; *logos* = study). Aristotle is called Father of zoology. Being broad-based and with multi-disciplinary approach, the term biology has been replaced by Life Sciences or Biological Sciences.

Microbiology : It is the branch of biology which deals with different aspects of microorganisms. Leeuwenhoek (1632-1723) is called Father of microbiology.

Some Branches of Biology

Anatomy : Study of internal structures of plants and animals after dissection.

Biochemistry : Study of chemistry of living matter (i.e., chemical composition, nature, mode of formation, functioning) in relation to life activities.

Cytology : Study of the structure and functions of cells and their organelles.

Ecology : Study of relationship between organisms and environment.

Embryology : Study of developmental stages of organisms upto hatching or birth.

Endocrinology : Study of endocrine glands and hormones action in animals.

Evolution : Study of the origin of life and the gradual differentiation or descent of species.

Histology : Study of tissues by microscopy.

Immunology : Study of resistance of organisms to infection.

Limnobiology : Study of fresh water lakes, ponds and streams.

Morphology : Study of form and structure of animals.

Palaeozoology : Study of fossil animals.

Physiology : Study of functions of various parts within the organisms.

Radiobiology : Study of effects of radioactivity on life.

Taxonomy : Study of classification of organisms and their evolutionary relationships with other organisms.

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Zoogeography : Study of the distribution of animals over the earth.

Zoopathology : Study of diseases of animals.

Specified Branches of Biology

Acarology : Study of mites and ticks.

Agriculture : Science of farming, raising crops and animal husbandry.

Angiology : Study of blood vascular system including veins and arteries.

Anthology : Study of flowers.

Bacteriology : Study of bacteria.

Bryology : Study of mosses and liverworts.

Cardiology : Study of heart.

Dermatology : Study of skin covering the body.

Epidemiology : Study of infection of parasites or epidemic diseases.

Ethnology : Study of different races of mankind.

Etiology : Study of cause of disease.

Gerontology : Study of growing old.

Gynaecology : Study of female reproductive organs.

Haematology : Study of blood.

Hepatology : Study of liver.

Kalology : Study of human beauty.

Leprology : Study of leprosy.

Molecular biology : Study of life sciences on molecular level (e.g, nucleic acids i.e., RNA & DNA and proteins).

Myrmecology : Study of ants and anteaters.

Nematology : Study of nematodes.

Nephrology : Study of kidney.

Neurology : Study of nervous system including brain.

Oncology : Study of tumours.

Oology : Study of eggs of birds.

Ornithology : Study of birds.

Osteology : Study of bones.

Palaeontology : Study of fossils and their distribution.

Pomology : Study of fruit.

Rhinology : Study of nose and olfactory organs.

Serology : Study of serum, Study of antigen-antibody reactions.

Serpentology : Study of snakes.

Termitology : Study of termites.

Toxicology : Study of toxic effects of drugs and harmful compounds.

Therapeutics : Science of healing.

Trophology : Study of nutrition.

Virology : Study of viruses.

Zoophytology : Study of drifting organisms such as diatoms.

Zymology : Study of fermentation processes.

Fathers of Various Sciences

Father of Zoology and Biology and Founder of Embryology : **Aristotle**

Father of Botany : **Theophrastus**

Father of Genetics : **G.J. Mendel**

Father of Evolutionary ideas : **Empedocles**

Father of Eugenics : **Francis Galton**

Father of Mutation : **Hugo de Vries**

Father of Modern Embryology : **Karl Ernst Von Baer**

Father of Palaeontology : **Leonardo da Vinci**

Father of Taxonomy : **Carolus Linnaeus**

Father of Special Creation Theory : **Father Saurez**

Father of Blood groups : **K. Landsteiner**

Father of Blood circulation : **William Harvey**

Father of Comparative Anatomy : **G. Cuvier**

Father of Modern Genetics : **W. Bateson**

Father of human genetics : **Archibald Garrod**

Father of Medicine : **Hippocrates**

Father of Microbiology : **Leeuwenhoek**

Father of Immunology : **Edward Jenner**

Biology in Ancient India

About 740 plants and 250 animals have been mentioned in Vedic literature. Few significant references in old literature are,

(1) **Chandyoga Upanishad** : Here the animals have been classified into three categories –

(i) **Jivaja** (Viviparous) e.g. mammals.

(ii) **Andaja** (Oviparous) e.g. birds, reptiles, insects and worms.

(iii) **Udbhija** (Vegetal origin) e.g. small animals.

(2) **Susruta Samhita** (600 B.C.) : Here organisms were classified into,

(i) **Sthavara** in which immobile organisms like plants were kept.

(ii) **Jangama** in which mobile organisms like animals were placed.

Medical Science in Ancient India

Two Ashwini Kumars has been said to be practising medicine during Vedic times. Dhanvantari has been called as 'God of medicine'. Susruta has been called as 'Father of surgery'. Few important references are

(1) Susruta studied human anatomy on dead bodies.

(2) Susruta carried plastic surgery on human nose (rhinoplasty).

(3) **Ophthalmic surgery** : Susruta carried an eye surgery like extraction of cataracts.

(4) **Clotting of blood** : Susruta used non-poisonous live leeches for checking clotting of blood in post operative conditions. Now its clearly established that hirudin is released along saliva of leeches to produce this kind of effect.

(5) **Charaka Samhita** (100 B.C.) : It is said to be primarily written by Agnivesa under the guidance of Atreya (600 B.C.). Charaka was first to discuss the concepts of digestion, Metabolism and immunity.

Scope of Biology

Biology creates an awareness of vast array of forms of life which normally goes unseen. Biology offers a large scope and provides a large field for study.

(1) **Helps us to understand ourselves better :** It unfolds different queries of life alongwith its cultural, social, philosophical and economical aspects. So it helps in understanding the life better.

(2) **Biology and inter-relationship of living beings :** Study of biology helps us in understanding the wonderful phenomenon and laws of nature which finally tell us to predict the behaviour of different living beings under changed conditions.

(3) **Biology and resources :** Biology helps us to know how to trap and conserve the resources available to us e.g. fishes, birds, forests etc.

(4) **Biology and literature :** Knowledge of Natural Biology has greatly enriched the literature with their references in stories and poems etc. Poets and other authors have been inspired by the beautiful and interesting plants and animals and frequently figure them in stories, poems and dramas.

(5) **Study of nature is a rewarding experience :** Many plants like *Narcissus*, *Dahlia*, *Gloriosa*, Roses, Marigold, Aster, etc. are used for ornamental purposes. The variety available in animals is widely enjoyed in zoological parks.

(6) **Solving problems :** Biology makes us to understand the present day problems such as population growth, pollution, conservation of wildlife and survival of man etc. The future directions of biotechnology, conservation of biodiversity, maintenance of environment and human welfare remain in the hands of biologists.

(7) **Biology-Medicinal aspect :** Several plants like *Atropa belladonna*, *Cinchona* are sources of atropine, quinine etc. Many members of fungi such as *Penicillium* and *Streptomyces* give rise to antibiotics like penicillin and streptomycin. Plants are the major source of vitamins. Drugs are first tested on animals before being used for treating man. Animals provide scientific hints for the production and use of medicines. Many diseases like malaria are caused and transmitted by animals.

(8) **Solving approach of biology :** Knowledge for eradication of diseases like malaria, small pox, etc. have been achieved by scientists basically due to desire and determination to solve the problem.

(9) **Ecosystem and living organisms :** Biology helps us in understanding the various ecosystems. The living community and non-living environment interact with each other and exchange of material in them takes place.

(10) **Biotechnology :** Biotechnologists have produced many genetically modified (GM) crops. Plenty of studies are being made by geneticists, evolutionists and cytologists to fudge the efficacy of biotechnology.

1.2 Understanding Life

Basic Properties of Living Organisms

Living beings are called organisms. Living organisms are similar to non-living objects in being – formed of similar elements which combine in similar way to form similar molecules (called biomolecules in living organisms) and follow similar physical and chemical laws like gravitation, magnetism, action and reaction etc. living organisms show a great biodiversity and are classified into different kingdoms-Monera, Protista, Fungi, Plantae and Animalia. But all of these share the following properties –

(1) They have definite organisation.

(2) They always have cellular nature so are either unicellular (e.g. *Amoeba*, *Paramecium* etc.) or multicellular (e.g., *Hydra*, man etc.).

(3) They show co-ordination between different parts of body to maintain homeostasis (constant internal environment) inside the body.

(4) They have the ability of movements and locomotion.

(5) They show metabolic functions in the presence of energy.

(6) These have the ability of intussusceptional (internal) growth and development.

(7) These have specific receptors (e.g., sense organs to receive external and internal stimuli) and specific effectors (e.g., muscles and glands to give specific response).

(8) These have regulatory mechanisms (e.g., nerves and hormonal in animals, and only hormonal in plants) to maintain homeostasis inside the body.

(9) These show adaptations to their environment to increase their chances of survival.

(10) These show variations which help in speciation and evolution.

(11) These have reproductive powers for continuity of their race.

Levels of Biological Organization

(1) Levels of Organization common in both living and non-living

(i) **Atomic level :** The lowest level of organization in both living and non-living is the atom. All living organisms are basically made up of four chemical elements carbon (C), hydrogen (H), oxygen (O) and nitrogen (N) with only about 1% other elements. The non-living matter may possess other elements (such as silica, calcium, iron, etc.) in variable composition.

(ii) **Molecular level :** Atoms combine to form molecules, which undergo chemical reactions to form organelles.

Atoms → Molecules → Inorganic compounds → Simple organic compounds → Complex organic compound → Protoplasm → Cell.

(2) Levels of Organization found only in living organisms

(i) **Cellular level :** All multicellular organisms are made up of cells. The cell is considered as basic unit of life and constitutes the smallest level of organisation of the living organisms.

(ii) **Tissue level :** In multicellular organisms similar or dissimilar cells, having a common origin and a common function, combine to form a tissue. Each tissue performs a specific role (e.g., xylem conducts water and minerals in plants).

(iii) **Organ level :** Different tissue are organised to form distinct organs. For example, xylem, phloem chlorenchyma, parenchyma get organised to form a leaf.

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(iv) **Organs System level** : A group of organs that coordinates to perform a major function forms the organs system. For example, the brain works with the spinal cord and a network of nerves to form the nervous system.

(v) **Individual or Organismic level** : A multicellular individual, having many organ systems, forms an organismic level of organisation.

Cell → Tissue → Organ → Organ system → Individual.

(3) Levels of organization beyond the individual organism

(i) **Population level** : All the individuals of a species in a particular area, where they interact with each other, belong to a population. For example, there is a population of Oak trees in a temperate deciduous forest.

(ii) **Community level** : The populations of different species of plants and animals present in a particular area make up biotic community.

(iii) **Ecosystem level** : Populations of different plants and animals interact among themselves and with the non-living components of the area form as ecosystem.

(iv) **Biosphere level** : The different ecosystems (small or big) of all the geographical regions of the world form the biosphere or the entire livable part of the earth.

Building blocks of life and their function

Living organism is formed of many types of inorganic as well as organic biomolecules. Inorganic compounds include water, minerals etc. and are always micro-biomolecules (small sized, low molecular weight, readily soluble in water and diffusible) while organic molecules may be micro (e.g. monosugars, amino acids etc.) or macro-biomolecules (large sized, high molecular weight, insoluble or slightly soluble and non-diffusible e.g., proteins, fats, nucleic acids, etc.). These both types of biomolecules play important roles in metabolism :

(1) **Role of Water** : Water forms 70-90% of the cellular pool. It forms 65% (about two-thirds) of human body. It is formed of H and O in the ratio of 2:1. 95% of water is found in free state and 5% in combined form in the cell. Water helps in sustaining the life processes. So water is called elixir or cradle of life as life is not possible in the absence of water.

(2) **Role of Oxygen** : Oxygen is mainly utilized in aerobic cell respiration of the nutrients inside the mitochondria to produce energy-rich ATP molecules so is essential for life. In the absence of oxygen, only 5% of energy available is released.

(3) **Role of Sodium chloride (common salt-NaCl)** : Sodium chloride plays important roles in metabolic functions of body especially when in ionic form.

(4) **Role of Carbohydrates** : Carbohydrates are organic compounds formed of C, H and O generally in the ratio of 1:2:1. These are commonly called saccharides (Gk. *saccharon* = sugar) Carbohydrates are the main storage molecules and most organisms use carbohydrates as an important fuel, breaking these bonds and releasing energy to sustain life.

(5) **Role of Proteins** : Proteins are polymeric compounds formed by interlinking of amino acids (monomers) by peptide

bonds. Out of about 100 types of amino acids, only 20 types of amino acids are of biological importance, so are called Magic-20. Proteins play a vital role in the formation of structures in living organisms. Like carbohydrate and fat, protein can be broken down with the release of energy. Protein is not stored as such in the body and it is normally only used as a substantial source of energy in conditions of starvation.

(6) **Role of lipids** : Lipids comprise a major group of insoluble hydrocarbons having many functions. These are polymers of alcohols (e.g. glycerol) and fatty acids interlinked by ester bonds.

(7) **Role of Nucleic Acid** : These are polymers of nucleotides interlinked by phosphodiester bonds, so called polynucleotides. Each nucleotide is formed of 3 components : a pentose sugar (e.g. ribose in RNA and deoxyribose in DNA), a phosphate group and an inorganic nitrogen-base (a purine or a pyrimidine).

Matter and Energy

Technically speaking, matter and energy are interchangeable as expressed by Albert Einstein's famous equation $E = mc^2$: energy equals mass times the square of the speed of light (c^2).

For the chemical reactions that occur within living organisms, however, we can treat matter and energy as quite distinct from one another. Matter is the physical material of the universe; energy is the capacity to do work.

Close and Open system : A system is a portion of the universe that is selected within a definite boundary. The part other than the system is called surrounding.

As system is said to be closed if it can exchange energy but not matter, and in this energy can be gained or lost (through stainless walls) but not matter. A system said to be open if it can exchange matter and energy with surroundings. All living systems are open systems because they are continuously exchanging matter and energy with their surroundings.

Kinetic and Potential energy

Kinetic energy is the energy of movement and this include not only movement of large objects but also movements such as electrical energy (movement of electrons) and heat (movement of atoms and molecules).

Potential energy is stored energy that can be released as kinetic energy under right conditions.

The food which you eat has chemical potential energy, some of which is converted into kinetic energy.

Laws of Thermodynamics

The laws of thermodynamics describe the basic properties of energy. All interactions among pieces of matter are governed by the two laws of thermodynamics. The laws of thermodynamics deal with "isolated systems" which are any parts of the universe that cannot exchange either matter or energy with any other parts.

First Law of Thermodynamics : The first law of thermodynamics states that energy can neither be created nor destroyed; but energy can change from one form to another.

In other words, within an isolated system the total quantity of energy remains constant. The first law is therefore often called the law of conservation of energy.

Second law of Thermodynamics : The second law of thermodynamics states that the amount of useful energy always decreases when energy is converted from one form to another.

In other words, every transfer or transformation of energy makes the universe disordered; no physical process or chemical reaction is 100 per cent efficient.

Entropy is a measure of the disorder or randomness within a system.

Energy flow

(1) **Energy Transformation :** It is the phenomenon in which one form of energy is changed into another form of energy, e.g. in photosynthesis (anabolism), radiant (Kinetic) energy of sunlight is changed into chemical (potential) energy of glucose. All the living organisms depend upon this transformation.

(2) **Energy Transfer :** It involves the movement of energy from one source or area or substance to another in the same form. e.g. in cell respiration (catabolism), oxidative break down of glucose occurs inside the mitochondria of aerobic plants and animals.

The glucose is enzymatically catabolised by stepped breakdown into water and CO_2 and about 686 kcal of energy is released per mole of glucose. A part of released energy is stored as chemical energy in high energy bonds of ATP (adenosine triphosphate) formed by phosphorylation of ADP.

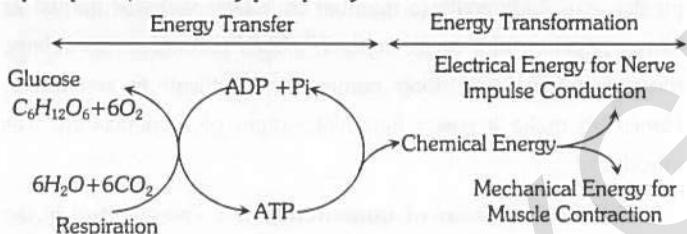


Table : 1.1-1 Some examples of Energy transformation.

Type of Energy Transformation	Example
Chemical to electrical	Nerve cell
Light to electrical	Retina of eye
Chemical to osmotic	Kidney
Chemical to mechanical	Muscles and cilia
Sound to electrical	Ear
Chemical to light	Bioluminescence
Chemical to heat	Homeothermy

Homeostasis

Homeostasis (Gk, *homoios* = same; *stasis* = standing) is the maintenance of a constant internal environment or steady state (blood plasma, haemolymph, extracellular fluid, etc.). The French physiologist Claude Bernard (1857) realized the importance of stability in the internal environment (*milieu interieur*). The term 'homeostasis' was first coined by the American physiologist Walter Bradford Cannon in 1929. Homeostasis is a fundamental property of life and is considered a good sign of life.

Thermoregulation

Regulation of body heat in response to the internal and external environment of the body is called thermoregulation.

As far as temperature regulation is concerned, animals can be divided into two groups: poikilothermic and homeothermic.

Poikilothermic means 'having a variable temperature'. Poikilothermic animals are described as 'cold-blooded', their body temperature changing with fluctuation in the environmental temperature. Homeothermic means 'having the same temperature'. Homeothermic animals (mammals, birds and a few fishes like tuna fish and sword fish) are popularly described as 'warm-blooded'; their body temperature is independent of environmental temperature.

Growth

Growth is one of the most important characteristics of living organisms. Growth is defined as a permanent increase in size or weight or volume of an organism or its body parts e.g. kittens grow into cats, puppies grow into dogs and a human baby grows to become adult.

At the molecular level, the growth involves,

(1) Increase in the size of cells due to synthesis of protoplasmic substances like cytoplasm and nucleus.

(2) Addition of non-living aprotoplastic materials like intercellular matrix, fibres of connective tissue, etc. These are secreted by the cells.

(3) Increase in the number of cells by cell division. It occurs through cell cycle which is formed of interphase and M-phase.

(4) Growth is the result of greater anabolic (synthetic) processes over the catabolic (destructive) processes in an organism.

The process in which reserve food material is utilized and exhibited negative growth is called degrowth.

Development

(1) In general, growth involves three processes or strategies namely cell proliferation, cell enlargement and secretion of large amount of extra cellular matrix.

(2) Growth is an important part of development, continuing throughout life.

(3) Early embryonic developmental stages constitute prefunctional state of life.

(4) The biological process of growth and differentiation enables the animal to enter the functional state of life.

(5) Morphogenesis refers to generation of form and structure during development of an individual organism.

(6) Morphogenesis produces new forms by involving cell movements.

(7) Morphogenetic movements of large number of cells during development is particularly noticed during gastrulation.

(8) Differentiation results in increasing diversity of cells.

Reproduction

(1) Reproduction is one of the most important life functions.

(2) Reproduction is the only way that living things can perpetuate themselves.

(3) There are a number of different ways that various kinds of organisms reproduce and compensate for the loss of life due to death.

(4) Some reproductive processes known as sexual reproduction involve two organisms and their sex cells.

(5) Asexual reproduction occurs when organisms make identical copies of themselves.

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Adaptation

(1) Adaptation may be defined as any characteristic of an organism which makes the organism better suited to its environment.

(2) In other words, an adaptation improves the performance and survival of the organism in its environment.

(3) Individuals with favourable characteristics replace those with less favourable characteristics.

(4) Adaptation improves the match between organisms and their environment.

(5) On the basis of their nature and role in evolution the adaptations are classified into short range or temporary and long range or permanent adaptation.

Life Span

The average longevity of an organism from birth to death is called life span. It is different in different living organisms.

Death

Death is the permanent breakdown and finally stopping of vital functions of body, especially heart beat and respiration.

Characteristics

(1) It is the last event in the degenerative processes of ageing.

(2) Death involves widespread cell breakdown and cell death.

(3) Death of an organism involves the death of body cells. But all the body cells do not die at same rate e.g. ciliated cells lining the respiratory tract of mammals continue to beat their cilia for long time even after clinical death.

(4) There is no natural death in some protists e.g. Amoeba and monerans like bacteria, etc.

Taxonomy

The art of identifying distinctions among organisms and placing them into groups that reflect their most significant features and relationship is called biological classification. Scientists who study and contribute to the classification of organisms are known as systematists or taxonomists, and their subject is called systematics (Gk. *Systema* = systems or order or sequence) or taxonomy (Gk. *Taxis* = arrangement; *nomos* = law).

Classical taxonomy : Taxonomy based on all available information and attempting to classify organisms, according to their origin, evolution and variations is called classical taxonomy. A taxonomist engaged in studying origin, evolution, variations and classification of organisms is called classical taxonomist.

History of classification

References of classification of organisms are available in **Upanishads** and **Vedas**. Our Vedic literature recorded about 740 plants and 250 animals. Few other significant contributions in the field of classification are :

Chandyogya upanishad : In this, animals are classified into three categories-viviparous *Jivaja*, oviparous *Andaja* and minute *Udbhija*.

Susruta samhita : It classified all 'substances' into **sthavara** (immobile) e.g., plants and **jangama** (mobile) e.g., animals.

Parasara : Here, angiosperms were classified into **dviyatruka** (dicotyledons) and **ekyatruka** (monocotyledons).

He was even able to find that dicotyledons bear **jalika parana** (reticulate veined leaves) and monocotyledons bear **maun laparna** (parallel veined leaves).

Hippocrates and Aristotle : They classified animals into four major groups like insects, birds, fishes and whales in his *Scala naturae*.

Nomenclature

Nomenclature is the assignment of a distinctive name to each species. Almost all plants (and animals too) are known by different common names in different parts of the world. Even within the same country people of different states and regions use different common names.

Ipomoea batatas, for example, is called **sweet potato** in English, **Shakarkandi** in Hindi, **Meetha alu** in Assamese and Bengali, **Kundmul** in Telugu, **Ratalu** in Marathi and **Jenasu** in Kannada. Similarly, the common house sparrow is called "Goraiya" in India, "Sparrow" in England and "Haussperling" in America. The common names are thus quite confusing.

The earliest scientific names were **polynomial**, i.e., they were composed of many words (which gave the characteristics of plants), e.g., *Sida acuta* (a member of Malvaceae) was named as *Chrysophyllum folis, ovalis superne glabris parallel striatis subtus, tomentosonitidis* such long names were difficult to remember. Hence, to make it easier binomial system of nomenclature was introduced.

Binomial system of nomenclature : The credit of giving binomial system of nomenclature goes to Swedish naturalist, **Carolus Linnaeus**. He employed this system in his book *Species Plantarum*, published in 1753. According to this system the name of a plant or animal is composed of two Latin (or Latinised) words, e.g., potato is *Solanum tuberosum* and house sparrow is *Passer domesticus*. The first word (i.e., *Solanum*) indicates the **name of the genus** (called **generic name**) and the second word (i.e., *tuberosum*) denotes the **name of the species (or a specific epithet)**. The generic name always begins with a capital letter and the specific name with a small letter and printed in italics.

The generic and specific names always have some meaning. They are based on some special characters of the plant and animals, on the name of any scientist or on some legend.

Usually the name of the author, who names a organism, is also written in full or in abbreviated form after the specific name. Thus, in case of *Mangifera indica L.*, the L. stands for **Linnaeus** and in *Lychnis alba Mill.*, the Mill. stands for **Miller**.

Sometimes a single species is described under different names by different authors. These names are called **synonyms**. In such cases, the name under which the species is first described, is considered to be valid.

Trinomial nomenclature : Certain species are divisible into smaller units, called subspecies or varieties, on the basis of finer differences. The name of the variety is written after the specific name. Thus, the name may become trinomial or three word name. e.g., *Homo sapiens europaeus* is the name of the man of European race. Trinomial nomenclature is simply an extension of the Linnaean system.

Code of biological nomenclature : Anyone can study, describe, identify and give a name to an organism provided certain universal rules are followed. These rules are framed and standardised by International Code of Botanical Nomenclature (ICBN) and International Code of Zoological Nomenclature (ICZN). The codes help in avoiding errors, duplication, confusion and ambiguity in scientific names. The codes are established and improved upon at International Botanical and Zoological Congress held from time to time. The names of bacteria and viruses are decided by International Code of Bacteriological Nomenclature (ICBN) and International Code of Viral Nomenclature (ICVN). Similarly, there is a separate International Code of Nomenclature for Cultivated Plants (ICNCP).

Valid name

- (1) It is not a tautonym (e.g., same generic and same specific name).
- (2) The name is new and given according to binomial nomenclature with abbreviation of author's name.
- (3) Its type specimen has been described in latin.
- (4) The type specimen is kept in a recognised herbarium/collection.
- (5) The new name has been published in a widely circulated scientific journal.
- (6) All the names previously given to the organism must be indicated.
- (7) If the new name is higher than species, the taxonomic category is indicated.

Type of specification

Holotype : The original type specimen from which the description of a new species is established.

Isotype : Duplicate of holotype, as another branch of the same tree.

Lectotype : Specimen selected from original material to serve as nomenclatural type where there is no holotype.

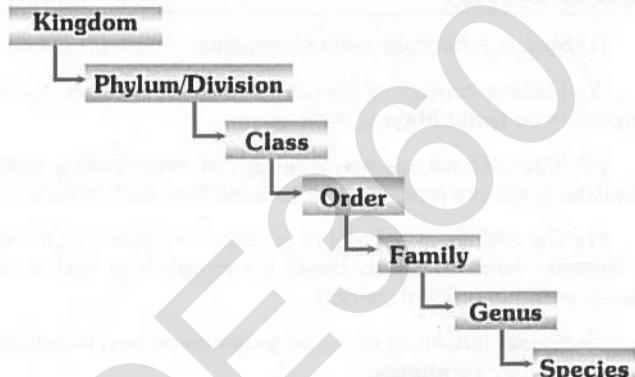
Neotype : New nomenclatural type when the original type is missing.

Paratype : Any other specimen described along with holotype.

Syntype : Any of two or more specimens cited by an author when there is no holotype.

The taxonomic hierarchy

It is the sequence of arrangement of taxonomic categories in a descending order during the classification of an organism. Hierarchy was first given by Linnaeus who used only five categories – class, order, genus, species and variety. The last one was discarded and three added so that now there are seven **obligate categories**. They are :



Some categories have been added to this list. They are called **intermediate categories**, e.g., Subkingdom, superphylum or superdivision, subdivision, superclass, subclass, superorder, suborder, superfamily, subfamily, tribe, subspecies, variety etc.

Taxon : Term taxon was introduced by ICBN during 1956 and defined by Mayr (1964). The term taxon is used to represent any unit of classification. The unit (i.e., taxon) may be large (e.g., Plant Kingdom) or small (e.g., Algae, Fungi, or a single species).

Category : Various sub-divisions of plant kingdom such as division, class, order, family, etc., are referred to as categories. In the hierarchy of categories, kingdom is the highest and species is the lowest category. The following is hierarchical series :

(1) **Kingdom** : It is the highest category in biological classification. e.g., all plants are included in plant kingdom.

(2) **Division (Eichler or phylum)** : It is a major group in the Linnaean hierarchy used in the classification of plants (equivalent to phylum in animal classification). It is a taxonomic category between kingdom and class. The subcategory of division is **subdivision**. The suffix of division is – phyta.

(3) **Class (Linnaeus, 1735)** : A division is divided into classes. It is a taxonomic category between the division and order. Its suffix is – ae. The subcategories of class are subclass and series. The class contains organism least similar to one another.

(4) **Order (Linnaeus, 1735)** : A class includes one or more orders. It is a taxonomic category between the class and family. Its suffix is – ales. The subcategory of order is **suborder**.

(5) **Family** : An order is divided into one or more families. It is the taxonomic category between the order and the genus. Its suffix is – aceae. The subcategories of family are **subfamily (Suffix-oideae), tribe** and **subtribe**.

(6) **Genus** : The plural of genus is genera. It comprises a group of related species which has more characters in common in comparison to species of other genera. The subcategories of genus are **subgenus, section** and **subsection**.

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(7) **Species (John Ray, 1693)** : It is the smallest rank and basic unit of taxonomic classification. The first letter of the species is denoted with small letter. The species is printed in Italics (It is underlined if hand written). A genus may include one or more species. The subcategories of species are **subspecies** or **varieties, subvarieties, form** and **subform**.

Species concept

(1) Species is the basic unit of taxonomy.

(2) Modern concept of species is biological species concept introduced by **Ernst Mayr** (1942).

(3) Mayr defined species as groups of interbreeding natural populations that are reproductively isolated from each other group.

(4) The traditional concept of species was given by Linnaeus in *Systema naturae*; this is based on morphology and is also known as 'Morphological concept'.

(5) Species inhabiting the same geographical area (identical or overlapping) are **sympatric**.

(6) Species inhabiting different geographical areas are **allopatric**.

(7) Related species which are reproductively isolated but morphologically similar are called **sibling species**.

(8) Classical systematic is based on the 'Typological concept' by **Plato** and **Aristotle**.

(9) Genetic species concept was given by **Lotsy** (1918), according to which, a species is a group of genetically identical individuals.

(10) Species that contain two or more subspecies are called **polytypic species**.

(11) Species that are not sub-divided into subspecies are called **monotypic species**.

(12) Normally breeding is possible only within a species.

(13) Two different species are reproductively isolated.

System of Biological Classification

Different systems of classification proposed from time to time have been divided into three basic categories viz., artificial systems, natural systems and phylogenetic system (However, Redford, (1986), included mechanical systems as a fourth category).

(1) **Artificial system of classifications** : These systems are more or less arbitrary as the plants are classified merely on the basis of gross morphology, habit and their importance to man. The main advocates of artificial system of classifications were :

Aristotle : He also classified animals on the basis of habitat into water, land and air.

Theophrastus (370 B.C. to 285 B.C.) : Theophrastus was a disciple of Plato and later Aristotle. In his book *De Historia plantarum*, he classified about 500 kinds of plants into four major group; trees, shrubs, subshrubs and herbs.

John Ray : He was a British botanist who published three volumes of his work *Historia Generalis Plantarum* consisting of improved classification originally proposed by him in *Methodus Plantarum Noven*. He was the first to divide the groups herbs,

shrubs and trees into Dicots and Monocots on the basis of the presence of two or one cotyledons respectively. He coined the term **species**.

Carolus Linnaeus : Father of taxonomy. A Swedish botanist, who published an artificial system of classification based exclusively on floral characters. Linnaeus published several manuscripts including *Hortus Cliffortianus* and *Genera plantarum* (1737). In his *Genera plantarum* he listed all the plant genera known to him. He published his best known *Species plantarum* in 1753. In this book he listed and described all species of plants known to him. He established binomial nomenclature.

(2) **Natural system of classifications** : These systems of classification are based not only on the characters of reproductive organs and structural morphology but used as many taxonomic characters or traits as possible to classify the organisms. The advocates of **natural** systems of classification are listed below :

Carolus Linnaeus : The first natural system of animal classification was developed by Linnaeus in his book "Systema Naturae" (10th edition 1758). Improvements were subsequently made by Haeckel (1864) and Lankester (1874).

George Bentham (1800-1884) and Joseph Dalton Hooker (1817-1911) : These two English botanists classified plants based on original studies of specimens. They published their well known scheme of classification in *Genera plantarum* (1862-83). This system of classification is still regarded as the best classification, especially from the practical point of view.

(3) **Phylogenetic system of classifications** : These systems of classifications are mainly the rearrangements of natural systems using as many taxonomic characters as possible in addition to the phylogenetic (evolutionary) informations. Some important phylogenetic systems of classifications were proposed by :

A.W. Eichler (1839-1887) : A German botanist who proposed phylogenetic system of classification and published in the third edition of *Syllabus der Vorlesungen* (1883).

Adolph Engler (1844-1930) and Karl Prantl (1849-1893) : These two German botanists classified plant kingdom on the basis of their evolutionary sequences. They started with simplest flowering plants and ended with plants of complex floral structures.

C.E. Bessey (1845-1915) : He classified flowering plants on the basis of their evolutionary relationships.

John Hutchinson (1884-1972) : A British botanist published his phylogenetic system of classification in 'The Families of Flowering Plants'.

Armen Takhtajan (1980) : A Russian botanist who published his system of classification in *Botanical Review*.

Arthur Cronquist (1981) : Published his classification in 'An Integrated System of Classification of Flowering Plants'.

Phylogenetic systems of classification for animals given by Dobzhansky and Mayr.

New Systematics or Biosystematics

The term new systematics was proposed by Sir Julian Huxley in 1940. In the new systematics, the species are considered related to one another, mutable and the work of gradual modification. This is in conformity with the facts of evolution.

Forms of new systematics : There are several forms of new systematics :

(1) **Morphotaxonomy** : It is based on the structural features of the organisms.

(2) **Cytotaxonomy** : It is based on cytological information of cell, chromosome number, structure and behaviour of chromosome during meiosis. **Karyotaxonomy** is a branch of cytotaxonomy which is based on banding pattern of chromosome.

(3) **Biochemical taxonomy or Chemotaxonomy** : It is based on the protein and serum analysis and on the chemical constituents of the organisms.

(4) **Numerical taxonomy** : It involves quantitative assessment of similarities and differences in order to make objective assessments. Characters of organisms are given equal weight and the relationships of the organisms are numerically determined, usually with the aid of a computer.

(5) **Experimental taxonomy** : It is based on the genetic relationship determined with the help of experiments.

Modern trends in systematics

Two kingdom system of classification : This system of classification is the oldest it was suggested by *Carolus Linnaeus* in 1758. He divided the living world (organism) into two kingdoms, Plantae (for all plants like tree, shrubs, climbers, creepers, moss and floating green algae) and Animalia (for animals).

Three kingdom system of classification : *Ernst Haeckel*, a German biologist and philosopher, suggested a third kingdom protista in 1866 for :

(1) Unicellular organisms such as bacteria, protozoans and acellular algae.

(2) Multicellular organisms without tissue such as algae and fungi.

Four kingdom system of classification : It was proposed by *Copeland* in 1956. The two additional kingdoms were Monera for the bacteria and blue green algae and Protista for protozoans, algae and fungi.

Five kingdom system of classification : *R.H. Whittaker*, an American taxonomist. He proposed five kingdom system of classification in 1969.

This system replaced the old, two-kingdom grouping of living organisms. As already discussed, a division of living world merely into plant and animal kingdoms is too simple. It does not take into account the **gradual** evolution of distinct plant and animal groups and it allows no place for those primitive organisms that even now are neither plants nor animals nor that are both. In this classification eukaryotes were assigned to only four of the five kingdom.

Five-kingdom classification is based on the following five criteria :

- (1) Complexity of cell structure.
- (2) Complexity of organism's body.
- (3) Mode of obtaining nutrition.
- (4) Phylogenetic relationship.
- (5) Ecological life style.

The five kingdoms are : Monera, Protista, Fungi, Plantae and Animalia.

Monera : It includes all prokaryotic organisms, which may have autotrophic or heterotrophic type of nutrition and are surrounded by a rigid cell wall. They are usually unicellular ranging from one to a few micron size. They are important decomposers and mineralizers. It include Bacteria, Actinomycetes, Cyanobacteria, etc.

Protista : They are mostly aquatic unicellular organisms, having eukaryotic organization. They generally have cilia or flagella and have diversified mode of life. Most of them are photosynthetic autotroph but some are holozoic, parasitic or even symbiotic. e.g., Euglena.

Fungi : They are diversified eukaryotic, heterotrophic organisms, body of which is made up of filamentous mycelium. They generally grow as saprophytes or parasites. They include moulds, mushrooms, puff balls etc.

Plantae : It includes all multicellular photosynthetic plants, which may have red, brown or green pigments except a few parasitic, saprophytic and insectivorous types. Most of the members are primary producers of land and water (Phaeophyta, chlorophyta, bryophyta, tracheophyta etc.).

Animalia : They are multicellular eukaryotic organisms having holozoic type of nutrition. They show muscular contractility and have a nervous system.

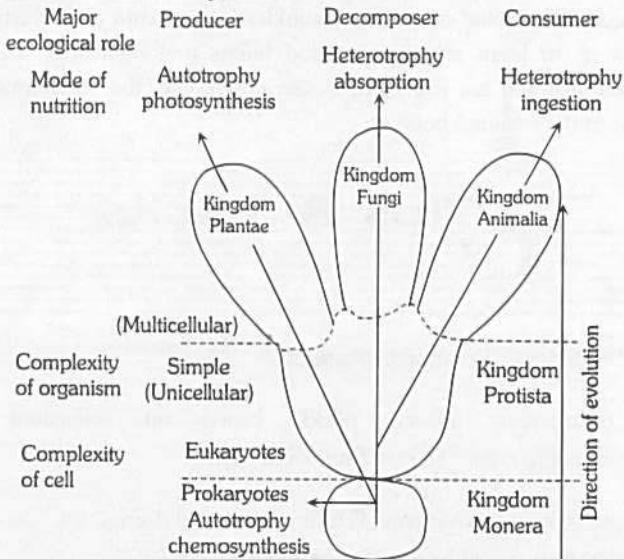


Fig : 1.1-1 Probable phylogenetic relationships among the kingdoms

Taxonomic Aids : Taxonomists collect specimens from the field, preserve and store the same for later verification and reference. Studies are carried out both in the field as well as inside the laboratory. Botanical gardens, herbaria, museums and zoological parks are important aids in taxonomic studies.

Monograph : It is a book or essay which gives comprehensive account of all the available information about a

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genus, family or higher category (or any other particular subject) of grouping at the time of its publication. It is a highly useful taxonomic aid.

Herbarium : Herbaria are collections of dry, pressed and preserved plant specimens mounted on sheets. Some plant parts are also kept in preservative liquids if they cannot be dried and pressed.

Botanical Gardens : These specialized gardens have collections of living plants for reference. Plant species in these gardens are grown for identification purposes and each plant is labelled indicating its botanical/scientific name and its family. The famous botanical gardens are at Kew (England), Indian Botanical Garden, Howrah (India) and at National Botanical Research Institute Lucknow (India).

Museum : Biological museums are generally set up in educational institutes such as schools and colleges. Museums have collections of preserved plant and animal specimens for study and reference. Plant and animal specimens may also be preserved as dry specimens. Specimens are preserved in the containers or jars in preservative solutions. Insects are preserved in insect boxes after collecting, killing and pinning. Larger animals like birds and mammals are usually stuffed and preserved. The largest museum in our country is Indian Museum at Kolkata.

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. All animals in a zoo are provided, as far as possible, the conditions similar to their natural habitats.

T Tips & Tricks

- ☛ Founder of Taxonomy : Aristotle.
- ☛ α -taxonomy (Turril, 1938) based on collections identification, compilation of fauna and flora.
- ☛ ω (omega) taxonomy (Turril, 1938) : It brings out the correct relationships as in new systematics.
- ☛ Cladistics is a method of classification (given by Willi Hennig) in which plants/animals are placed into taxonomic groups (called clades) according to their phylogenetic/ evolutionary relationships.
- ☛ Cladogram : Tree like graphic representation of evolutionary history of organism.
- ☛ Dendrogram : When cladogram is based on numerical taxonomy it is called dendrogram.

- ☛ Tribe : An intermediate category which is used in between genus and sub family.
- ☛ Cohort : Used differently by different authors as (i) Group of related species (ii) Group between order and class and (iii) Group above the rank of super-order.
- ☛ Taxonomic key : It is a set of alternate characters of different types arranged sequence wise in such manner that by selection and elimination one can quickly find out the same organism. It is of two type : (a) Bracketed key (b) Indented or Yorked key.
- ☛ Floral characters are used as basis of classification and for identifying new species because floral characters are conservative when compared with vegetative characters.
- ☛ In Bentham and Hooker's classification Dicotyledons have been kept before Monocotyledons. Seed plants have been divided into Dicots, Gymnospermae and Monocots.
- ☛ Among the vegetative characters, venation in leaf is one of highly acceptable character for classification of angiosperms.
- ☛ The correct sequence of taxa in Linnaean hierarchy is species → genus → family → order → class.
- ☛ Bauhin (1623) proposed the binary system of nomenclature which was elaborated by Linnaeus (1753) into binomial system.
- ☛ Monotypic genus : A genus having only one species, e.g., Homo.
- ☛ Polytypic genus : A genus containing more than one species, e.g., Panthera, Solanum.
- ☛ Engler and Prantl wrote 'Die natürlichen pflanzen familien' which contained the first phylogenetic classification.
- ☛ J.K. Maheswari described the plants of India in 'Flora of Delhi'.
- ☛ Camerarius was the person, who first recognized sexuality in plants.
- ☛ In Bentham and Hooker's system of classification, evolutionary criteria have not been followed hence not phylogenetic.
- ☛ Phylum covers the largest number of organisms.
- ☛ Hooker compiled first complete flora of India and wrote the book 'Flora of British India'.
- ☛ The prokaryotes and eukaryotes were distinguished by Dogherty (1957).

Q Ordinary Thinking

Objective Questions

Nature and Scope of Biology

1. A prediction made by a scientist based on his observations is known as [Kerala PMT 2003]
 - (a) Law
 - (b) Theory
 - (c) Principle
 - (d) Hypothesis
2. Melvin Calvin was professor of [AMU (Med.) 2012]
 - (a) Botany
 - (b) Plant physiology
 - (c) Chemistry
 - (d) Biochemistry
3. The study of trends in human population growth and the prediction of future development is known as [Kerala PMT 2000]
 - (a) Sociology
 - (b) Geography
 - (c) Demography
 - (d) Anthropology
4. Aquaculture does not include [BHU 2003]
 - (a) Pisces
 - (b) Prawns
 - (c) Silkworm
 - (d) Shell fishery
5. Edaphology is [KCET 2007]
 - (a) Study of elephants
 - (b) Study of snakes
 - (c) Study of amphibians
 - (d) None of these
6. Animals that rely on the heat from the environment, rather than of metabolism, to raise their body temperature are, in the strict sense, called [AMU (Med.) 2010]
 - (a) Ectothermic
 - (b) Poikilothermic
 - (c) Homeothermic
 - (d) Endothermic
7. Study of ecology of population is called [MP PMT 2007]
 - (a) Autecology
 - (b) Synecology
 - (c) Ecotype
 - (d) Demecology
8. Branch of Zoology dealing with the study of fishes is known as [KCET 1994, 99; Bihar MDAT 1995; BCECE 1995; Odisha JEE 2002; MP PMT 2009]
 - (a) Herpetology
 - (b) Ichthyology
 - (c) Mammalogy
 - (d) Ornithology
9. Science that deals with the study of external form, size, colour, structure and relative position of various parts of an organism is known as [Odisha JEE 2012]
 - (a) Ecology
 - (b) Taxonomy
 - (c) Anatomy
 - (d) Morphology
10. In which type of isolation, two species living in different habitats are prevented from interbreeding [J & K CET 2010]
 - (a) Temporal
 - (b) Ecological
 - (c) Behavioural
 - (d) Gametic
11. The study of action of drug is known as [MP PMT 2001]
 - (a) Physiology
 - (b) Pharmacology
 - (c) Phramacognosy
 - (d) Pharmaceutical chemistry
12. Study of periodical changes in plants in relation to seasonal changes [DPMT 2006, 10]
 - (a) Physiognomy
 - (b) Phycolgy
 - (c) Phenology
 - (d) Photoperiodism
13. Bioinformatics is an interdisciplinary branch which is concerned with the application of [KCET 2006]
 - (a) Engineering techniques in biological studies
 - (b) Chemistry in understanding the biological phenomenon
 - (c) Physics in understanding various life processes
 - (d) Information science in analyzing the biological data
14. In medical science, the study of structure as well as various disorders of nervous system is termed as [Odisha JEE 2012]
 - (a) Neurology
 - (b) Gynaecology
 - (c) Cardiology
 - (d) Endocrinology
15. The term "biology" was introduced by [MP PMT 1995]
 - (a) Aristotle
 - (b) Darwin
 - (c) Lamarck and Treviranus
 - (d) Linnaeus
16. The scientist who cut the tail of mouse in many generations but found that it is not inherited [CPMT 1995]
 - (a) Darwin
 - (b) Bateson
 - (c) Lamarck
 - (d) Weismann
17. Who is called 'Father of Zoology' [MP PMT 1999]
 - (a) Aristotle
 - (b) Darwin
 - (c) Hippocrates
 - (d) Theophrastus
18. Biometry refers to [AFMC 2012]
 - (a) Measurement of evolutionary rate in humans
 - (b) Measurement of living things and processes
 - (c) Measurement of fertility and mortality rate
 - (d) None of these
19. 'Father of Botany' is [Odisha JEE 2004, 11]
 - (a) Brunfels
 - (b) Aristotle
 - (c) Theophrastus
 - (d) Linnaeus
20. K. Esau dominated in the field of plant biology up to the age of 99 years. She contributed mainly in the field of [AMU (Med.) 2012]
 - (a) Morphology of flowering plants
 - (b) Anatomy of seed plants
 - (c) Classification of flowering plants
 - (d) Physiology of seed plants
21. Study of behaviour of animals is called [RPMT 1996; BHU 2004]
 - (a) Ethology
 - (b) Parapsychology
 - (c) Euphenics
 - (d) Etiology
22. William Harvey is known for the discovery of [HPMT 1993; Manipal 1996; AMU (Med.) 2000]
 - (a) Digestion
 - (b) Respiration
 - (c) Blood clotting
 - (d) Blood circulation
23. The statement 'Nothing in biology makes sense except in the light of evolution' was given by [Kerala PMT 2000]
 - (a) A.I. Oparin
 - (b) Th. Dobzhansky
 - (c) Joseph Hooker
 - (d) Charles Darwin
24. Study of fruit is known as [Odisha JEE 2010]
 - (a) Pomology
 - (b) Palynology
 - (c) Dendrology
 - (d) Anthology
25. In history of biology, human genome project led to the development of [NCERT; CBSE PMT (Mains) 2011]
 - (a) Bioinformatics
 - (b) Biosystematics
 - (c) Biotechnology
 - (d) Biomonitoring

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26. Hybridoma technology was developed by [MP PMT 2001]
 (a) Taggart, 1982 (b) Vitella *et al.*, 1982
 (c) Prie and Saxton, 1987 (d) Milstein and Kohier, 1975
27. Crick, one of the discoverer of DNA double helical structure, was the man of [NCERT]
 (a) Physics (b) Chemistry
 (c) Zoology (d) Botany
28. First experiment related to the method of hydroponics were done by [Kerala PMT 2000]
 (a) Knop (b) Hill
 (c) Arnon (d) Sachs
29. Which branch study about remains of plant life [Odisha JEE 1997; RPMT 2002; AFMC 2004]
 (a) Palaeontology (b) Palaeobotany
 (c) Eugenics (d) Palynology
30. Name the scientist who was awarded the Nobel Prize for his genetic studies on the linear arrangement of genes on the chromosomes in the fruitfly, *Drosophila melanogaster* [Kerala PMT 2001]
 (a) C.F. Wolff (b) T.A. Knight
 (c) J. Swammerdam (d) T. H. Morgan
31. Who wrote the book '*Genetics and Origin of Species'* [MP PMT 1999; Pb. PMT 1999]
 (a) R.A. Fisher (b) G.L. Stebbins
 (c) Th. Dobzhaansky (d) J.B.S. Haldane
32. Study of Ticks and Mites is called [MP PMT 2002; Odisha JEE 2005]
 (a) Acarology (b) Entomology
 (c) Malacology (d) Carcinology

Understanding Life

1. Which one of the following aspects is an exclusive characteristic of living things [NCERT; CBSE PMT (Mains) 2011]
 (a) Perception of events happening in the environment and their memory
 (b) Increase in mass by accumulation of material both on surface as well as internally
 (c) Isolated metabolic reactions occur *in vitro*
 (d) Increase in mass from inside only
2. Organisms which display properties of both living and nonliving [AFMC 2000]
 (a) Viruses (b) Diatoms
 (c) Lichens (d) Bacteria
3. When spontaneous process occurs then free energy of a system [DPMT 2003]
 (a) Decreases
 (b) Increases
 (c) Remains same
 (d) Either can decreases or increase
4. A molecule is reduced means it [Odisha JEE 2008, 09]
 (a) Loses electron
 (b) Gains proton
 (c) Loses proton and electrons
 (d) Gains electron
5. The type of bond involved in the formation of sodium chloride is [Kerala PMT 2009]
 (a) Ester bond (b) Peptide bond
 (c) Ionic bond (d) Covalent bond
 (e) Hydrogen bond
6. Animals spending winter in dormant conditions is referred as under [J & K CET 2005; RPMT 2005]
 (a) Hibernation (b) Aestivation
 (c) Mimicry (d) Camouflage
7. The type of linkage present in carbohydrates is [CPMT 2005]
 (a) Peptide (b) Glycosidic
 (c) Amide (d) Phosphate bonds
8. In ATP high energy bond is present [AMU (Med.) 2001; KCET 2002; CPMT 2005]
 (a) Between nucleoside and phosphate group
 (b) Between sugar and phosphate group
 (c) Between base (Adenine) and phosphate group
 (d) None of these
9. Anabolism is [BHU 2000]
 (a) Endergonic process (b) Exergonic process
 (c) Bidirectional process (d) Destructive process
10. Which of the following is a trace element required only in small amounts by most living things
 (a) Oxygen (b) Iron
 (c) Nitrogen (d) Hydrogen
11. The bond formed between the first phosphate group and adenosine in ATP is [KCET 2001]
 (a) Phosphoester bond (b) Adenophosphate bond
 (c) Nitrophosphate bond (d) Phosphoanhydride bond
12. Carbohydrates, the most abundant biomolecules on earth, are produced by [CBSE PMT 2005]
 (a) Some bacteria, algae and green plant cells
 (b) Fungi, algae and green plant cells
 (c) All bacteria, fungi and algae
 (d) Viruses, fungi and bacteria
13. Which of the following chemical characteristics is not common to all living beings [Manipal 2003]
 (a) Type of protein present in the body
 (b) Similar triple code for amino acids
 (c) Energy is stored by high phosphate bonds
 (d) Ribosomes are the sites of protein synthesis
14. Some plants having pleasant odour and attractive colours for [HPMT 2000]
 (a) Hydrophily (b) Anemophily
 (c) Entomophily (d) None of these
15. Metabolism comprises [NCERT]
 (a) Digestion of food
 (b) Elimination of wastes
 (c) Exchange of gases
 (d) Various energy exchanges in cell
16. Biological organisation starts with [NCERT; CBSE PMT 2007]
 (a) Submicroscopic molecular level
 (b) Cellular level
 (c) Organismic level
 (d) Atomic level

17. The total heat content of a system is [KCET 2002]
 (a) Entropy (b) Free energy
 (c) Enthalpy (d) Kinetic energy
18. Which of the following is the main adaptation for a plant to survive in xerophytic condition [HPMT 2000]
 (a) Spines (b) No stomata
 (c) Stipular leaves (d) None of the above
19. The energy transformation in the nervous system is [Kerala PMT 2002]
 (a) Chemical to radiant (b) Chemical to electrical
 (c) Chemical to mechanical (d) Mechanical to radiant
20. The most abundant compound in living cells is
 (a) Carbon (b) Water
 (c) Hydrogen (d) Oxygen
21. The amount of usable energy that is available for doing work in a system is
 (a) Mechanical energy (b) Free energy
 (c) Spontaneous energy (d) Light energy
22. Which statement is correct for biomolecules [RPMT 2001]
 (a) DNA is a polymer of ribonucleotides
 (b) All carbohydrates break down into glucose
 (c) RNA is single stranded and contain different purine base than DNA
 (d) Sequence of amino acids determine primary structure of proteins
23. Reproduction of immature or larval stage of animals caused by the acceleration of maturation is called
 (a) Cladogenesis (b) Paedogenesis
 (c) Morphogenesis (d) Parthenogenesis
24. Cause of mimicry is [CBSE PMT 2002]
 (a) Isolation (b) Attack
 (c) Protection (d) Both (b) and (c)
25. Which one is hexose sugar [BCECE 2001]
 (a) Mannose (b) Galactose
 (c) Both (a) and (b) (d) Cellulose
26. Maltose, lactose and sucrose are [BHU 2001]
 (a) Disaccharides (b) Trisaccharides
 (c) Monosaccharides (d) Polysaccharides
27. Glycogen is most structurally similar to
 (a) Glucose (b) Starch
 (c) Maltose (d) Cellulose
28. Which of the following is produced only by plants
 (a) Starch (b) Glycogen
 (c) Cholesterol (d) Triglycerides
29. The living organisms can be unexceptionally distinguished from the non-living things on the basis of their ability for [NCERT; CBSE PMT 2007]
 (a) Responsiveness to touch
 (b) Interaction with the environment and progressive evolution
 (c) Reproduction
 (d) Growth and movement
30. Which one of the following sequences is true [Pb. PMT 2000; VVMC Safdarjung 2001]
 (a) Observations, problem defining, hypothesis, experiment
 (b) Experiment, hypothesis, problem defining, observation
 (c) Observation hypothesis problem defining, experiment
 (d) Problem defining, observation, hypothesis, experiment
31. The process in which excess energy is lost by light waves is called [JIPMER 2002]
 (a) Photolysis (b) Fluorescence
 (c) Photo-oxidation (d) Photophosphorylation
32. Among the energy values or nutrients, 9.3 calories is that of [JIPMER 2002]
 (a) Fats (b) Proteins
 (c) Vitamins (d) Carbohydrates
33. Lipids are generally
 (a) A high energy source (b) Hydrophobic
 (c) Composed of fatty acids (d) All of the above
34. There is an exchange of materials and energy between living organisms and their surrounding. Such a system is called
 (a) Open system (b) Closed system
 (c) Isolated system (d) All of these
35. The basis of life (secret of life) is [AFMC 2002]
 (a) Lipid (b) Protein
 (c) Nucleic acid (d) Nucleoprotein
36. A coconut high in a palm tree has.....owing to its location
 (a) Free energy (b) Kinetic energy
 (c) Activation energy (d) Potential energy
37. Maintenance of internal favourable conditions, despite changes in external environment is [AFMC 1999; AMU (Med.) 2000; DPMT 2001; Kerala PMT 2001, 03]
 (a) Entropy (b) Steady state
 (c) Enthalpy (d) Homeostasis
38. Study the four statements (A – D) given below and select the two correct ones out of them
 (A) Definition of biological species was given by Ernst Mayr
 (B) Photoperiod does not affect reproduction in plants
 (C) Binomial nomenclature system was given by R. H. Whittaker
 (D) In unicellular organisms, reproduction is synonymous with growth
 The two correct statements are [NEET (Phase-II) 2016]
 (a) (A) and (B) (b) (B) and (C)
 (c) (C) and (D) (d) (A) and (D)

Systematics

1. The science of naming the plant is known as
 (a) Classification (b) Identification
 (c) Nomenclature (d) Taxonomy
2. The branch of Botany concerned with the classification, nomenclature and identification of plants is [NCERT]
 (a) Systematic Botany (b) Ecology
 (c) Morphology (d) Physiology

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3. Which one of the following is not a correct statements
[NEET 2013]
- (a) Key is taxonomic aid for identification of specimens
(b) Herbarium houses dried, pressed and preserved plant specimens
(c) Botanical gardens have collection of living plants for reference
(d) A museum has collection of photographs of plants and animals
4. A person who studies about the origin, evolution and variations in plants and also about the classification of plants, is called as
[NCERT; AIIMS 1992]
- (a) Classical taxonomist (b) Herbal taxonomist
(c) α -taxonomist (d) β -taxonomist
5. ICBN stands for
[INCERT; MP PMT 2003;
BVP 2004; CBSE PMT 2007]
- (a) International Council for Botanical Nature
(b) International Code of Botanical Nomenclature
(c) Indian Code of Botanical Nomenclature
(d) None of the above
6. Who amongst the following is regarded as the "Father of Taxonomy"
[INCERT; DPMT 1992; MP PMT 1997;
HPMT 1998; WB JEE 2012]
- (a) Takhtajan (b) Linnaeus
(c) Bentham and Hooker (d) Theophrastus
7. If a botanist has to nomenclate a similar species, he will use
[CPMT 1999; JIPMER 2001]
- (a) Syntype (b) Neotype
(c) Mesotype (d) Isotype
8. Which of the following taxonomical ranks contain organisms least similar to one another
[INCERT; DPMT 1999; Pb. PMT 2000]
- (a) Class (b) Genus
(c) Family (d) Species
9. In a hierarchical system of plant classification, which one of the following taxonomical ranks generally ends in 'cae'[AFMC 2003]
- (a) Family (b) Genus
(c) Order (d) Class
10. Which one of the following is a taxonomical aid for identification of plants and animals based on similarities and dissimilarities
[Kerala PMT 2012]
- (a) Flora (b) Keys
(c) Monographs (d) Catalogues
(e) Manuals
11. When organism is in same class but is not in same family, the taxonomic term is called as [INCERT; Odisha JEE 2008]
- (a) Order (b) Genus
(c) Species (d) Family
12. Which is a taxon [INCERT; CBSE PMT 1992; Pb. PMT 1998]
- (a) Genera (b) Family
(c) Class (d) None of these
13. A group of plants with similar traits of any rank is
[INCERT; CBSE PMT 1990, 92, 96, 97; AFMC 1994;
CPMT 1996; Chd. CET 2000; Pb. PMT 2002;
DPMT 2006; Odisha JEE 2009]
- (a) Species (b) Genus
(c) Order (d) Taxon
14. Animals are classified into hierarchical group, in which one of the following the largest number of species is found
[WB JEE 2012]
- (a) Genus (b) Order
(c) Family (d) Cohort
15. In Botanical nomenclature of plants [INCERT; MP PMT 1993]
- (a) Genus is written after the species
(b) Both in genus and species the first letter is a capital letter
(c) Genus and species may be same name
(d) Both genus and species are printed in italics
16. Match the following

(A) Genera Plantarum	(1) Aristotle
(B) Species Plantarum	(2) Linnaeus
(C) Historia Generalis Plantarum	(3) Bentham and Hooker
(D) Scala Naturae	(4) Pliny
	(5) John Ray
- [CBSE PMT 1999, 2001;
AIEEE Pharmacy 2004; Odisha JEE 2004;
WB JEE 2008; VITEEE 2008]
- (a) A - 4, B - 2, C - 5, D - 3
(b) A - 4, B - 2, C - 1, D - 3
(c) A - 4, B - 2, C - 3, D - 1
(d) A - 3, B - 2, C - 5, D - 1
17. The smallest taxon is called
[INCERT; J & K CET 2008; MP PMT 2010, 11]
- (a) Class (b) Order
(c) Genus (d) Species
18. A system of classification in which a large number of traits are considered is [INCERT; AIIMS 1996; CBSE PMT 1999]
- (a) Artifical system (b) Synthetic system
(c) Natural system (d) Phylogenetic system
19. In Bentham and Hooker's classification what was positioned in between dicots and monocots [AFMC 2008]
- (a) Gymnosperms (b) Bryophytes
(c) Algae (d) Pteridophytes
20. Who proposed the Binomial Nomenclature System
[INCERT; RPMT 1992, 98; CBSE PMT 1993, 94;
AMU (Med.) 1995, 98, 2000; Pb. PMT 1998, 99, 2000;
CPMT 1999, 2000; KCET 1999, 2000; J & K CET 2000;
Wardha 2000; AIIMS 2001; MHCET 2001, 02, 04;
BVP 2002; MP PMT 2003, 06; Odisha JEE 2004, 11;
DPMT 2004; BHU 2005, 06; AFMC 2010]
- (a) Whittaker (b) Mendel
(c) Carl Linnaeus (d) Tippo

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42. The meaning of taxon in the classification of animals
[CBSE PMT 1996]
- (a) A group of same species
(b) A group of animals on the basis of number of chromosomes
(c) A group of same type of animals
(d) A group of similar genera
43. Most important criteria used for the present day classification of living organisms is based on [CBSE PMT 1991]
- (a) Presence and absence of notochord
(b) Resemblances in external features
(c) Breeding habits
(d) Anatomical and physiological characteristics
44. The non-nucleated, unicellular organisms of Whittaker's (1969) classification are included in the kingdom
[NCERT; MP PMT 1994; BHU 1997, 2012; Kerala PMT 2000; J & K CET 2008; AMU (Med.) 2010]
- (a) Protista (b) Monera
(c) Animalia (d) Plantae
45. The suffix 'idae' refers to
(a) Family (b) Genus
(c) Order (d) Division
46. Read the statements given below and identify the incorrect statement [KCET 2012]
- (a) Scientific names are used all over the world
(b) Scientific names are often descriptive and tell us some important character of an organism
(c) Scientific names indicate relationship between species
(d) Scientific names favour multiple naming for the same kind of an organism
47. The term 'New systematics' was introduced in 1940 by
[AFMC 1993; AMU (Med.) 1999; BVP 2002]
- (a) Adolf Engler (b) Karl Prantl
(c) George Bentham (d) Julian Huxley
48. Taxonomic hierarchy refers to [DUMET 2009]
- (a) Stepwise arrangement of all categories for classification of plants and animals
(b) A group of senior taxonomists who decide the nomenclature of plants and animals
(c) A list of botanists or zoologists who have worked on taxonomy of a species or group
(d) Classification of a species based on fossil record
49. The third name of the trinomial nomenclature is of
[NCERT; JIPMER 1993; APME 2001]
- (a) Sub-genus (b) Species
(c) Sub-species (d) Type
50. In which book has "binomial nomenclature" been used for the first time [MP PMT 1999; Pb PMT 1999; Odisha JEE 2005]
- (a) Histoire naturelle (b) Systema naturae
(c) Historia naturalis (d) Historia plantarum
51. Who developed the "key" for identification of animals
[MP PMT 1999]
- (a) John Ray (b) Goethe
(c) Georges Cuvier (d) Theophrastus
52. What is the name of the book written by Aristotle
[MP PMT 1999; Pb PMT 1999]
- (a) Historia Animalium (b) Histoire Naturelle
(c) Systema Naturae (d) Philosophic Zoologique
53. The replacement of two kingdoms grouping by five kingdom classification was proposed in the year
[Kerala CET 2003]
- (a) 1859 (b) 1758
(c) 1919 (d) 1969
54. Engler and Prantl published a phylogenetic system in monograph
[Kerala CET 2005]
- (a) Die Naturlichen Pflanzen Familien
(b) Historia Plantarum
(c) Species Plantarum
(d) Genera Plantarum
(e) Origin of Species
55. In the five-kingdom classification, *Chlamydomonas* and *Chlorella* have been included in
[NCERT; CBSE PMT (Mains) 2012]
- (a) Protista (b) Algae
(c) Plantae (d) Monera
56. Which structure is present in both prokaryotic and eukaryotic plant cells
[WB JEE 2008]
- (a) Cell wall (b) Nucleus
(c) Chloroplast (d) Mitochondria
57. *Oryza sativa* is the binomial name of the rice plant, the sativa stands for
[NCERT; WB JEE 2008]
- (a) Specific name (b) Specific epithet
(c) Species name (d) Specific nomenclature
58. Which of the following is considered as neither prokaryotes nor eukaryotes
[J & K CET 2010]
- (a) Bacteriophages (b) Bacteria
(c) Monera (d) Fungi
59. Interbreeding natural population of animals are referred to as belonging to the same
[NCERT; AMU (Med.) 2002; J & K CET 2010]
- (a) Family (b) Species
(c) Genus (d) Variety
60. Natural system of classification is based on
[NCERT; DPMT 1993]
- (a) Morphology (b) Phylogeny
(c) Morphology and affinities (d) Ontogeny
61. Which one of the following organisms is scientifically correctly named, correctly printed according to the International Rules of Nomenclature and correctly described
[NCERT; CBSE PMT (Mains) 2012]
- (a) *Musca domestica* - The common house lizard, a reptile
(b) *Plasmodium falciparum* - A protozoan pathogen causing the most serious type of malaria
(c) *Felis tigris* - The Indian tiger, well protected in Gir forests
(d) *E. coli* - Full name *Entamoeba coli*, a commonly occurring bacterium in human intestine

- 62.** Consider the following statements with respect to characteristic features of the kingdom
 A. In animalia the mode of nutrition is autotrophic
 B. In monera the nuclear membrane is present
 C. In protista the cell type is prokaryotic
 D. In plantae the cell wall is present
 Of the above statements [Kerala PMT 2012]
 (a) A alone is correct (b) B alone is correct
 (c) C alone is correct (d) D alone is correct
 (e) A, B and C are correct
- 63.** Cohort is a group correlated with [MHCET 2004]
 (a) Species (b) Genera
 (c) Families (d) Order
- 64.** International code of "Biological nomenclature" is applicable to
 (a) Plants (b) Animals
 (c) Both animals and plants (d) None of the above
- 65.** The term "phylum" in animal classification was coined by [CBSE PMT 1992; MP PMT 1994, 2010]
 (a) E. Haeckel (b) John Ray
 (c) G.L. Cuvier (d) Carolus Linnaeus
- 66.** Family is placed between [Odisha JEE 2011]
 (a) Order and genus (b) Genus and species
 (c) Class and order (d) Phylum and class
- 67.** Four kingdom classification was proposed by [HPMT 1994; BHU 1994]
 (a) Whittaker (b) Copeland
 (c) Haeckel (d) Linnaeus
- 68.** Five kingdom system of classification suggested by R.H. Whittaker is not based on [CBSE PMT 2014]
 (a) Mode of nutrition
 (b) Complexity of body organization
 (c) Presence or absence of a well defined nucleus
 (d) Mode of reproduction
- 69.** Cytotaxonomy is connected with [NCERT]
 (a) Chemical composition of cytoplasm
 (b) Cell organelles
 (c) Cytochromes
 (d) Shape and size of cells
- 70.** 'Taxa' differs from 'taxon' due to [DUMET 2010]
 (a) This being a higher taxonomic category than taxon
 (b) This being lower taxonomic category than taxon
 (c) This being the plural of taxon
 (d) This being the singular of taxon
- 71.** The term 'biosystematics' was coined by [J & K CET 2010; MP PMT 2010, 12]
 (a) Gaspard Bauhin (b) Camp and Gilly
 (c) Karl Prantl (d) Robert Brown
- 72.** Which of the following statements regarding universal rules of nomenclature is wrong [Kerala PMT 2010; NEET (Phase-I) 2016]
 (a) The first word in a biological name represents the genus
 (b) The first word denoting the genus starts with a capital letter
 (c) Both the words in a biological name, when handwritten, are separately underlined
 (d) Biological names are generally in Greek and can be written in any language
 (e) The second component in a biological name denotes the specific epithet
- 73.** A scientist having made significant contribution in the field of classification is [CPMT 1990]
 (a) Pasteur (b) Oparin
 (c) Darwin (d) Linnaeus
- 74.** Classical systematics embodies/concept of classical taxonomist is [JIPMER 1997]
 (a) Biological concepts (b) Species concept
 (c) Typological concept (d) All the above
- 75.** Species is [CBSE PMT 1994]
 (a) Specific unit of evolution
 (b) Specific unit in the evolutionary history of a race
 (c) Specific class of evolution
 (d) Not related to evolution
- 76.** Two plants are taxonomically related if [NCERT]
 (a) They store carbohydrate in the same type of molecule
 (b) Both obtain energy from hydrolysis of ATP into ADP and inorganic phosphate
 (c) Both have similarly lobed palmate leaves
 (d) Both have pinnately veined leaves
- 77.** A group of related genera, with still less number of similarities as compared to the genus and species, constitutes [NCERT; AFMC 2009; DUMET 2010]
 (a) Order (b) Class
 (c) Family (d) Division
- 78.** Match the following and choose the correct combination from the options given
- | Column I
(Common name) | Column II
(Taxonomic category Order) |
|---------------------------|---|
| A. Wheat | 1. Primata |
| B. Mango | 2. Diptera |
| C. Housefly | 3. Sapindales |
| D. Man | 4. Poales |
- [Kerala PMT 2010]
- (a) A-1, B-2, C-4, D-3 (b) A-4, B-3, C-2, D-1
 (c) A-2, B-4, C-1, D-3 (d) A-3, B-4, C-2, D-1
 (e) A-4, B-2, C-3, D-1
- 79.** In the scientific name of *Mangifera indica L.*
 (a) Letter L. signifies latin language
 (b) The name is reverse with *Indica* preceding *mangifera*
 (c) Letter L. signifies taxonomist Linnaeus
 (d) Letter L. is superfluous
- 80.** Plant classification proposed by Carolus Linnaeus was artificial because it was based on [NCERT; RPMT 1990; CPMT 1995]
 (a) Only a few morphological characters
 (b) Evolutionary tendencies which are diverse
 (c) Anatomical characters which are adaptive in nature
 (d) Physiological traits alongwith morphological characters
- 81.** Classification of organisms based on evolutionary as well as genetic relationships is called [DUMET 2010]
 (a) Biosystematics (b) Phenetics
 (c) Numerical taxonomy (d) Cladistics

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82. Carolus Linnaeus (Carl Linne) was from [Manipal 1997]
 (a) Sweden (b) U.K.
 (c) Holland (d) France
83. First act in taxonomy is [NCERT; Wardha 2002]
 (a) Description (b) Identification
 (c) Naming (d) Classification
84. Taxonomy based on determination of genetic relationships is [INCERT; JIPMER 1997]
 (a) Cytotaxonomy (b) Numerical taxonomy
 (c) Biochemical taxonomy (d) Experimental taxonomy
85. Branch connected with nomenclature, identification and classification is [CPMT 1991; AMU (Med.) 2000; Kerala PMT 2002]
 Or
 The study of theory, practice and rules of classification of living and extinct organisms is called [Odisha JEE 2012]
 (a) Ecology (b) Taxonomy
 (c) Morphology (d) Physiology
86. Sequence of taxonomic categories is [INCERT; DPMT 1992; CBSE PMT 1992; AFMC 1992, 2001; HPMT 1994; Pb. PMT 1997; KCET 2001, 11; Kerala PMT 2007; AMU (Med.) 2012]
 (a) Class – phylum – tribe – order – family – genus – species
 (b) Division – class – family – tribe – order – genus – species
 (c) Division – class – order – family – tribe – genus – species
 (d) Phylum – order – class – tribe – family – genus – species
87. Phylogenetic system of classification is based on [INCERT; CBSE PMT 1994, 2006, 09; Pb. PMT 2000; Odisha JEE 2002; DPMT 2006]
 (a) Evolutionary relationships
 (b) Morphological features
 (c) Chemical constituents
 (d) Floral characters
88. An attribute found in plants but not animals is
 (a) Metabolism (b) Sexual reproduction
 (c) Autotrophy (d) Asexual reproduction
89. *Systema Naturae* was written by [CPMT 1991, 92, 93; Kerala PMT 2010; Odisha JEE 2010]
 (a) Lamarck (b) Cuvier
 (c) Aristotle (d) Linnaeus
90. Which of the following taxonomist described classification of plant kingdom in "Families of flowering plants" [CPMT 2004]
 (a) Cronquist (b) Takhtajan
 (c) Benson (d) Hutchinson
91. Mayr's biological concepts of species is mainly based on [NCERT; BVP 2004; BHU 2004, 08; CPMT 2009]
 (a) Morphological traits
 (b) Reproductive isolation
 (c) Modes of reproduction
 (d) Morphology and reproduction
92. Two morphologically similar populations are intersterile. They belong to [INCERT; BHU 1994, 97, 2000; Kerala PMT 2005]
 (a) One species
 (b) Two biospecies
 (c) Two sibling species
 (d) None of the above
93. Which one possess characters of both plants and animals [CBSE PMT 1995]
 Or
 A unicellular organism often considered connecting link between plants and animals is [AFMC 1997; JIPMER 1998]
 (a) Bacteria (b) Mycoplasma
 (c) Paramecium (d) Euglena
94. Distinction of prokaryota and eukaryota is mainly based on [INCERT; MP PMT 1995, 98]
 (a) Nucleus only (b) Cell organelles only
 (c) Chromosomes only (d) All the above
95. Algae with photosynthetic pigments possess nutrition [AMU (Med.) 1997; Manipal 1997]
 (a) Holozoic (b) Saprophytic
 (c) Holophytic (d) Parasitic
96. Select the incorrect statements
 (A) Lower the taxon, more are the characteristics that the members within the taxon share
 (B) Order is the assemblage of genera which exhibit a few similar characters
 (C) Cat and dog are included in the same family Felidae
 (D) Binomial nomenclature was introduced by Carolus Linnaeus [Kerala PMT 2011]
 (a) A, B and C (b) B, C and D
 (c) A and D (d) C and D
 (e) B and C
97. Phylogenetic system was given [DPMT 2007; Kerala PMT 2009; CPMT 2010]
 (a) Engler & Prantl (b) Pliny
 (c) John Ray (d) R.H. Whittaker
98. Huxley is father of [MP PMT 2007]
 (a) Classical taxonomy (b) Artificial taxonomy
 (c) Neo-taxonomy (d) Adansonian taxonomy
99. Species can be identified on the basis of [MP PMT 2007]
 (a) Interbreed (b) Species diversity
 (c) Reproductive isolation (d) None of these
100. In the five kingdom system of classification, which single kingdom out of the following can include blue-green algae, nitrogen fixing bacteria and methanogenic archaeabacteria [INCERT; CBSE PMT 1998; Pb. PMT 1998]
 (a) Monera (b) Fungi
 (c) Plantae (d) Protista
101. Floral features are commonly used for identification of angiosperms because [NCERT; CBSE PMT 1998]
 (a) Reproductive parts are more conservative
 (b) Flowers can be safely pressed
 (c) Flowers are nice to work with
 (d) Flowers have various colours and scents
102. Two similar holotypes are called [BHU 1997]
 (a) Mesotypes (b) Meotypes
 (c) Syntypes (d) Isotypes
103. Binomial system of nomenclature for plants is effective from [JIPMER 1997]
 (a) 5.8.1771 (b) 1.5.1753
 (c) 1.8.1758 (d) 6.7.1736

- 104.** A system of classification that is based on evolution, order and ancestry is known as [Pb. PMT 1998; MP PMT 1998]
 (a) Natural system (b) Analogous system
 (c) Phylogenetic system (d) Homologous system
- 105.** Characteristics which delimit a family are more general than those which delimit a [JIPMER 1999]
 (a) Cohort (b) Phylum
 (c) Class (d) Genus
- 106.** First great taxonomist was [BHU 1999]
 (a) Linnaeus (b) Hooker
 (c) Aristotle (d) Engler
- 107.** In the classification of plants, the term cladistics refers to the [Kerala PMT 2006; BHU 2008]
 (a) Phylogenetic classification (b) Sexual classification
 (c) Artificial classification (d) Natural classification
 (e) Binomial classification
- 108.** Five kingdom classification includes [DPMT 2006]
 (a) Monera, Protista, Fungi, Plantae Animalia
 (b) Algae, Fungi, Bryophyta, Pteridophyta, Gymnosperms
 (c) Virus, Prokaryota, Fungi, Plantae, Animalia
 (d) Monera, Protista, Animalia, Plantae, Alage
- 109.** Which of the following is less general in characters as compared to genus [NCERT; CBSE PMT 2001]
 (a) Species (b) Family
 (c) Class (d) Division
- 110.** What is correct [NCERT; Manipal 2001; Odisha JEE 2012; KCET 2012]
 (a) *Apis indica* (b) *trypanosoma gambiense*
 (c) *Ficus Bengalensis* (d) *Mangifera indica*
- 111.** Which covers the largest number of organisms [Kerala PMT 2001]
 (a) Genus (b) Family
 (c) Phylum (d) Class
 (e) Order
- 112.** Which of the following is not taxon but a category [MH CET 2000]
 (a) Division (b) Angiosperms
 (c) Polypetala (d) *Hibiscus*
- 113.** Chemotaxonomy is connected with [NCERT; MH CET 2001]
 (a) Classification of chemicals found in plants
 (b) Use of phytochemical data in systematic botany
 (c) Application of chemicals on herbarium sheets
 (d) Use of statistical methods in chemical yielding plants
- 114.** Descending arrangements of categories is called [NCERT; MH CET 2001]
 (a) Classification (b) Taxonomy
 (c) Hierarchy (d) Key
- 115.** Holotype is [Pb. PMT 2001]
 (a) Specimen used by author as nomenclature type
 (b) Specimen referred alongwith original description
 (c) Duplicate of nomenclature type
 (d) Specimen selected from original when nomenclature type is missing
- 116.** Keystone species are [Pb. PMT 2001]
 (a) Species belonging to same period
 (b) Species that determine structure of biotic community
 (c) Species reproducing sexually
 (d) Species recorded only in the fossil state
- 117.** *Nicotiana* is [NCERT; Haryana PMT 2001]
 (a) Variety (b) Subspecies
 (c) Species (d) Genus
- 118.** Barophilic prokaryotes [CBSE PMT 2005]
 (a) Grow slowly in highly alkaline frozen lakes at high altitudes
 (b) Occur in water containing high concentrations of barium hydroxide
 (c) Grow and multiply in very deep marine sediments
 (d) Readily grow and divide in sea water enriched in any soluble salt of barium
- 119.** In hierarchical classification class is interpolated between [NCERT; Chd. CET 2002]
 (a) Family and genus (b) Phylum and order
 (c) Order and family (d) Kingdom and phylum
- 120.** Binomial nomenclature is [MP PMT 1997; Chd. CET 2002]
 (a) Two words in name of a species
 (b) Two names local and specific
 (c) Two names of a species
 (d) Two phases, asexual and sexual, in the life cycle of a species
- 121.** A true species consists of a population [CBSE PMT 2002]
 (a) Sharing the same niche
 (b) Interbreeding
 (c) Feeding over the same food
 (d) Repproductively isolated
- 122.** Species are considered as [DPMT 1997; AIIMS 2000; BHU 2001; Kerala PMT 2002; CBSE PMT 2003; MP PMT 2009]
 (a) Real units of classification devised by taxonomists
 (b) Real basic units of classification
 (c) The lowest units of classification
 (d) Artificial concept of human mind which cannot be defined in absolute terms
- 123.** Biosystematics aims at [CBSE PMT 2003]
 (a) Identification and arrangement of organisms on the basis of their cytological characteristics
 (b) The classification of organisms based on broad morphological characters
 (c) Delimiting various taxa of organisms and establishing their relationships
 (d) The classification of organisms based on their evolutionary history and establishing their phylogeny on the totality of various parameters from all fields of study
- 124.** Phenetic classification of organisms is based on [NCERT; CBSE PMT 2004; WB JEE 2016]
 (a) Dendogram based on DNA characteristics
 (b) Sexual characteristics
 (c) Observable characteristics of existing organisms
 (d) The ancestral lineage of existing organisms

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125. Match the following and select the correct combination from the options given below

Column I (Kingdom)	Column II (Class)
A. Plantae	1. Archaeabacteria
B. Fungi	2. Euglenoids
C. Protista	3. Phycomycetes
D. Monera	4. Algae

[Kerala PMT 2011]

- (a) A-4, B-3, C-2, D-1
- (b) A-1, B-2, C-3, D-4
- (c) A-3, B-4, C-2, D-1
- (d) A-4, B-2, C-3, D-1
- (e) A-2, B-3, C-4, D-1

126. The term species was coined by [BVP 2002; KCET 2004]

- (a) Aristotle (b) Engler
- (c) John Ray (d) Linnaeus

127. The common characteristics between tomato and potato will be maximum at the level of their [NEET (Karnataka) 2013]

- (a) Family (b) Order
- (c) Division (d) Genus

128. The label of a herbarium sheet does not carry information on [NEET (Phase-II) 2016]

- (a) Height of the plant (b) Date of collection
- (c) Name of collector (d) Local names



Exemplar Questions

1. As we go from species to kingdom in a taxonomic hierarchy, the number of common characteristics [INCERT]

- (a) Will decrease (b) Will increase
- (c) Remain same (d) May increase or decrease

2. Which of the following 'suffixes' used for units of classification in plants indicates a taxonomic category of 'family' [INCERT]

- (a) -Ales (b) -Onae
- (c) -Aceae (d) -Ae

3. The term 'systematics' refers to [INCERT]

- (a) Identification and classification of plants and animals
- (b) Nomenclature and identification of plants and animals
- (c) Diversity of kinds of organisms and their relationship
- (d) Different kinds of organisms and their classification

4. Genus represents [INCERT]

- (a) An individual plant or animal
- (b) A collection of plants or animals
- (c) Group of closely related species of plants or animals
- (d) None of these

5. The taxonomic unit 'Phylum' in the classification of animals is equivalent to which hierarchical level in classification of plants [INCERT]

- (a) Class (b) Order
- (c) Division (d) Family

6. Botanical gardens and zoological parks have [INCERT]

- (a) Collection of endemic living species only
- (b) Collection of exotic living species only
- (c) Collection of endemic and exotic living species
- (d) Collection of only local plants and animals

7. Taxonomic key is one of the taxonomic tools in the identification and classification of plants and animals. It is used in the preparation of [INCERT]

- (a) Monographs (b) Flora
- (c) Both (a) and (b) (d) None of these

8. All living organisms are linked to one another because [INCERT]

- (a) They have common genetic material of the same type
- (b) They share common genetic material but to varying degrees
- (c) All have common cellular organization
- (d) All of above

9. Which of the following is a defining characteristic of living organisms [INCERT]

- (a) Growth (b) Ability to make sound
- (c) Reproduction (d) Response to external stimuli

10. Match the following and choose the correct option [INCERT]

- | | |
|---------------------------------|------------------------|
| A. Family | i. <i>tuberosum</i> |
| B. Kingdom | ii. <i>Polymniales</i> |
| C. Order | iii. <i>Solanum</i> |
| D. Species | iv. <i>Plantae</i> |
| E. Genus | v. <i>Solanaceae</i> |
| (a) i-D, ii-C, iii-E, iv-B, v-A | |
| (b) i-E, ii-D, iii-B, iv-A, v-C | |
| (c) i-D, ii-E, iii-B, iv-A, v-C | |
| (d) i-E, ii-C, iii-B, iv-A, v-D | |

Critical Thinking

Objective Questions

1. Karyotaxonomy is the modern branch of classification which is based on [INCERT; JIPMER 1998; MP PMT 1999]

- (a) Number of chromosomes
- (b) Bands found on chromosomes
- (c) Organic evolution
- (d) Trinomial nomenclature

2. Which of the following combinations is correct for wheat [DUMET 2010]

- (a) Genus : *Triticum*, Family : Anacardiaceae, Order : Poales, Class : Monocotyledonae
- (b) Genus : *Triticum*, Family : Poaceae, Order : Poales, Class : Dicotyledonae
- (c) Genus : *Triticum*, Family : Poaceae, Order : Sapindales, Class : Monocotyledonae
- (d) Genus : *Triticum*, Family : Poaceae, Order : Poales, Class : Monocotyledonae

3. Hutchinson's system of classification was revised in [DPMT 2003]
 (a) 1995 (b) 1959
 (c) 1954 (d) 1946
4. The total number of species included in the animal kingdom are about [CBSE PMT 1992; DUMET 2010]
 (a) 1 million (b) 2 million
 (c) 10 million (d) 1 billion
5. Which one of the taxonomic aids can give comprehensive account of complete compiled information of any one genus or family at a particular time [NCERT; Kerala PMT 2009]
 (a) Taxonomic key (b) Flora
 (c) Herbarium (d) Monograph
 (e) Dictionary
6. A species is defined as "the group of actually or potentially inter-breeding natural population producing fertile offspring and reproductively isolated from such other groups". The above statement is given by [MP PMT 1997]
 (a) Carolus Linnaeus (b) Mayr
 (c) J.B. Lamarck (d) Charles Darwin
7. Which of the following is required as equivalent to subspecies of classical Taxonomy [VITEEE 2006]
 (a) Ecospecies (b) Ecotype
 (c) Cenospecies (d) Comparium
8. Which one of the following statement correctly define the term homonym [WB JEE 2008]
 (a) Identical name of two different taxon
 (b) Two or more names belonging to the same taxon
 (c) When species name repeats the generic name
 (d) Other name of a taxon given in a language other than the language of zoological / botanical nomenclature
3. Assertion : Chemotaxonomy is classifying organisms at molecular level.
 Reason : Cytotaxonomy is classifying organisms at cellular level.
4. Assertion : Whittaker did not include unicellular green algae in protista.
 Reason : Distinction between unicellular and multicellular organisms is not possible in case of algae.
5. Assertion : Systematics is the branch of biology that deals with classification of living organisms.
 Reason : The aim of classification is to group the organisms. [AIIMS 2002]
6. Assertion : Acraniata is a group of organisms which do not have distinct cranium.
 Reason : It includes small marine forms without head. [AIIMS 1997]
7. Assertion : To give scientific name to plant, there is ICBN.
 Reason : It uses articles, photographs and recommendations to name a plant. [Haryana PMT 2000]
8. Assertion : Taxon and category are same things.
 Reason : Category shows hierarchical classification.
9. Assertion : The hierarchy includes seven obligate categories.
 Reason : Intermediate categories are used to make taxonomic positions more informative.
10. Assertion : The species is reproductively isolated natural population.
 Reason : Prokaryotes cannot be kept under different species on the basis of reproductive isolation.
11. Assertion : Bacteria, Protista do not have circulatory system.
 Reason : These organisms live in moist and watery environment. [AIIMS 2010]
12. Assertion : Living organisms possess specific individuality with the definite shape and size.
 Reason : Both living and non living entities resemble each other at the lower level of organization. [AIIMS 1999]

A Assertion & Reason

Read the assertion and reason carefully to mark the correct option out of the options given below :

- (a) If both the assertion and the reason are true and the reason is a correct explanation of the assertion
 (b) If both the assertion and reason are true but the reason is not a correct explanation of the assertion
 (c) If the assertion is true but the reason is false
 (d) If both the assertion and reason are false
 (e) If the assertion is false but reason is true

1. Assertion : Phylogeny is the developmental history of a species.
 Reason : Species is the basic unit of taxonomy.
2. Assertion : Whittaker's classification for algae is not acceptable.
 Reason : Whittaker grouped algae in different kingdoms.

Answers

Nature and Scope of Biology

1	d	2	c	3	c	4	c	5	d
6	a	7	d	8	b	9	d	10	b
11	b	12	c	13	d	14	a	15	c
16	d	17	a	18	b	19	c	20	b

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21	a	22	d	23	b	24	a	25	a
26	d	27	a	28	d	29	b	30	d
31	c	32	a						

Understanding Life

1	a	2	a	3	a	4	d	5	c
6	a	7	b	8	d	9	a	10	b
11	b	12	a	13	a	14	c	15	d
16	a	17	c	18	a	19	b	20	b
21	b	22	d	23	b	24	d	25	c
26	a	27	b	28	a	29	c	30	a
31	b	32	a	33	d	34	a	35	c
36	d	37	d	38	d				

Systematics

1	c	2	a	3	d	4	a	5	b
6	b	7	d	8	a	9	a	10	b
11	a	12	d	13	d	14	d	15	d
16	d	17	d	18	c	19	a	20	c
21	c	22	d	23	d	24	a	25	b
26	b	27	c	28	b	29	b	30	b
31	c	32	a	33	c	34	a	35	d
36	b	37	a	38	d	39	a	40	c
41	d	42	c	43	d	44	b	45	a
46	d	47	d	48	a	49	c	50	b
51	a	52	a	53	d	54	a	55	a
56	a	57	b	58	a	59	b	60	c
61	b	62	d	63	a	64	c	65	c
66	a	67	b	68	c	69	b	70	c
71	b	72	d	73	d	74	b	75	a
76	a	77	c	78	b	79	c	80	a
81	d	82	a	83	b	84	d	85	b
86	c	87	a	88	c	89	d	90	d
91	b	92	c	93	d	94	d	95	c
96	e	97	a	98	c	99	c	100	a
101	a	102	d	103	b	104	c	105	d
106	a	107	a	108	a	109	a	110	d
111	c	112	a	113	b	114	c	115	a
116	b	117	d	118	c	119	b	120	a
121	d	122	b	123	d	124	c	125	a
126	c	127	a	128	a				

NCERT Exemplar Questions

1	a	2	c	3	c	4	c	5	c
6	c	7	c	8	d	9	d	10	a

Critical Thinking Questions

1	b	2	d	3	a	4	a	5	d
6	b	7	c	8	a				

Assertion and Reason

1	b	2	a	3	b	4	a	5	b
6	b	7	a	8	e	9	b	10	b
11	b	12	b						

AS Answers and Solutions

Nature and Scope of Biology

5. (d) Edaphology is study of soil.
11. (b) Pharmacology is the branch of medicine and biology concerned with the study of drug action, where a drug can be broadly defined as any man made, natural or endogenous (with in the body) molecule which exerts a biochemical and/or physiological effect on the cell, tissue, organ or organism.
12. (c) **Phenology** is the scientific study of seasonal changes, i.e., periodic phenomena of organisms in relation to their climate.

Understanding Life

9. (a) In endergonic reactions, the product have more energy than the reactants, So the reaction requires an input of energy.
10. (b) Iron is component of haemoglobin of RBC of blood and helps in transportation of oxygen (about 97-99%) as well as carbon dioxide (about 23%).
16. (a) Submicroscopic particles such as Glucose amino acid, Nucleotides etc.
18. (a) Xerophytic plant of deserts, has a number of adaptation to reduce transpiration for water conservation e.g. stem is covered by thick cuticle and has high succulence while leaves are modified into spines.
20. (b) Water is the most abundant substance of living beings. In adult human body 20-22 litres (50% of the total) is present inside the cells as intracellular water.
22. (d) The shape, size, structure and biological functions of proteins are determined by the number type and arrangement of aminoacids.
24. (d) Animal imitate other animals, plants and natural objects in order to protect themselves from predators, called protective mimicry. Predatory animals mimic some natural object so that their prey get confused and is easily attacked or caught. This type of mimicry is called Aggressive mimicry.

27. (b) Starch common in plant and glycogen in animals are two food storage polysaccharides. Both of them can easily be hydrolysed into their glucose monomers.
29. (c) Reproduction capacity found only in living being.
31. (b) Fluorescence is the process in which excess energy is lost by light waves. Because of this energy loss, the wavelength of the light energy released in fluorescence is generally longer than that of originally absorbed.
32. (a) Maximum energy is provided by fats (9.45 K. cal).
34. (a) A living system which can exchange the matter and energy with the environment is called an open system.

Systematics

1. (c) Nomenclature (*Nomen* = name; *clature* = to call) is giving distinct scientific names to various structures, including living organisms, so they can be easily identified.
4. (a) Taxonomy based on all available information and attempting to classify organisms, according to their origin, evolution and variation is called classical taxonomy. A taxonomist engaged in studying origin, evolution, variations and classification of organisms is called classical taxonomist.
7. (d) Original specimen is called holotype and the duplicate of holotype is termed as isotype.
8. (a) The closely related orders are grouped into a class (named as a taxonomical rank in classification) which have least similar organisms to another.
9. (a) Family is a taxonomic category between the division and order. It includes one or more genera. Its suffix is 'aceae'.
15. (d) In botanical nomenclature of plants generic name always begin with capital letter and the specific name with a small letter and printed in italics.
18. (c) In the natural system of classification organisms are arranged according to their natural affinities through the use of all important characters. Characteristics such as structural, cytological, reproductive and biochemical are included. The characters are useful in bringing out homology.
20. (c) The 'Binomial system of nomenclature' was explained by Carl Linnaeus in his book 'species plantarum' in 1753. According to this system name of any organism/plant consist of two words. First represents its 'genera' and second its 'species'.
24. (a) Linnaeus system of classification is considered as artificial because it is based only on one or two character of plants.
31. (c) In five kingdom classification of Whittaker eukaryotes were assigned to only four of the five kingdom. Prokaryotes are included in kingdom – monera.
35. (d) Gymnosperms and angiosperms both are grouped under phanerogams because both are bearing seeds.
36. (b) Angiosperms flowering plants constitute the dominating terrestrial flora of the world is known as spermatophyta.

44. (b) Monera contains the most primitive living forms which are basically unicellular prokaryotes.
47. (d) The term new systematics was proposed by Sir Julian Huxley in 1940. In the new systematics, the species are considered related to one another mutable and the work of gradual modification. This is in conformity with the facts of evolution.
49. (c) Sometimes organisms of same species differ from each other as they are adapted for different kinds of environment. In such cases species are again divided into subspecies.
50. (b) Carolus Linnaeus introduced binomial nomenclature in his tenth edition of 'Systema naturae'.
53. (d) R.H. Whittaker (1969), an American ecologist, divide all the organisms into five kingdoms.
59. (b) An individual of a species can interbreed to produce fertile offspring.
60. (c) Natural system of classification is based on the large number of morphological characters and natural affinities of organism.
61. (b) *Plasmodium falciparum* - A protozoan pathogen causes the most serious type of malaria that is falciparum malaria.
67. (b) Four kingdom (Plantae, animalia, protista and monera) classification was developed by Copeland (1956). The main drawback of this system is that fungi are not properly placed.
68. (c) The main criteria of Whittaker's system are :- Cell type, Thallus organization, Nutrition, Reproduction and Phylogenetic relationship.
69. (b) Cytotaxonomy based on information about cytological structure, chromosomes numbers, structure and behaviour during meiosis and cell organelles.
83. (b) Identification is assigning an organism its correct name and placing it in its proper taxonomic category.
84. (d) Experimental taxonomy based on the experimental determination of the genetic relationship, environmental impact and evolutionary divergence within a group.
85. (b) Taxonomy is a branch of biology which deals with the study of principles and procedures of classification, nomenclature and identification. The term taxonomy was coined by De Candolle (1813).
87. (a) In phylogenetic system, the organisms are classified according to their evolution of genetic affinities. The system of classification proposed by Engler (1886) by Hutchinson (1926) and by Tippo (1942) are phylogenetic.
88. (c) Autotrophy is a characteristic of plants.
89. (d) In 1735, Carolus Linnaeus published the first edition of his classification of living things in his *Systema Naturae*.
90. (d) John Hutchinson put forward a classification on phylogenetic lines in the book "families of flowering plants".

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91. (b) Mayr defined species as group of interbreeding natural population that are reproductively isolated from each other group.
92. (c) Sibling species : True species which do not interbreed but are otherwise difficult to separate on the basis of morphological characters alone.
95. (c) Algae with photosynthetic pigment possess photosynthetic (holophytic) nutrition.
110. (d) Because *Mangifera indica* is a correct representation of scientific name. According to binomial nomenclature.
111. (c) Phylum includes one or more related classes. All the classes of a phylum possess some common correlated traits. So the phylum covers the largest numbers of organism.
126. (c) Term species was coined by John Ray in 1693.
128. (a) The herbarium sheets carry a label providing information about date and place of collection, english, local and botanical names, family, collector's name

Critical Thinking Questions

1. (b) Karyotaxonomy is based up on nucleus and band on chromosomes.
3. (a) Hutchinson's systems of classification (1884-1972) are the best known phylogenetic system. It was revised in 1995.
4. (a) Currently 1.7 million living organisms are known to science. Out of these 1.2 million are animals and about 0.5 million plants.

Assertion and Reason

1. (b) Phylogeny is the developmental history of a species or a group of species. Species is the basic unit of taxonomy. It is a natural population of individuals or group of population which resemble one another in all essential morphological and reproductive characters so that they are able to interbreed freely and produce fertile offspring.
2. (a) In Whittaker's classification, algae are grouped in three kingdoms – Monera (blue-green algae), Protista (dinoflagellates, diatoms, euglenoids) and Plantae (red algae, brown algae and green algae). Though plant kingdom of Whittaker is often called metaphyta or multicellular plants, the algae included in this kingdom also contain a number of unicellular and colonial forms. The most accepted classification of algae is given by Fritsch. He classified all algae into 11 classes.
3. (b) All the members of a species have similar karyotype (cytotaxonomy) – there is similarity in the number, size, shape and behaviour of chromosomes. At the molecular level there is similarity in the types of proteins, enzymes, hormones and other biochemicals.
4. (a) A distinction between unicellular and multicellular organisms is not possible in case of algae in Whittaker's system. It is because of this that unicellular green algae have not been included in kingdom protista.
5. (b) Systematics is related with classification of organisms. In classification the organisms are grouped on the basis of their characters or phylogeny, etc.
6. (b) Acraniata includes marine forms without head or cranium. They lack jaws, vertebral column, paired appendages.
7. (a) Anyone can study, describe, identify and give a name to an organism provide certain rules are followed. These rules are formed and standardised by International Code of Botanical Nomenclature (ICBN). It uses articles, photographs and recommendations.
8. (e) A category is a rank or level in the hierarchical classification of organisms. Taxon is a unit in classification which may represent any level of grouping of organisms based on certain common characteristics. There is some confusion in the use of taxon and category, for example Bryophyta is a taxon while division is a category.
9. (b) The hierarchy includes seven obligate categories – kingdom, division or phylum, class, order, family, genus and species. In order to make taxonomic position of species more precise, certain categories have been added to this list. They are called intermediate categories, e.g., subkingdom, superphylum or superdivision, superclass, subclass, superorder, suborder, superfamily, subfamily, tribe, subspecies, variety etc.
10. (b) The species is genetically distinct and reproductively isolated natural population. Sexual reproduction is absent in prokaryotes and some protists. In such cases morphological differences, cytotaxonomy and chemotaxonomy are resorted to.
11. (b) Bacteria, Protista are single-celled organisms. They do not have circulatory systems and live in moist and watery environments so that all their cells are close enough to the external environments for the direct exchange of substances such as water and gases.
12. (b) All living organisms have definite shape and size and all show specific individuality with a orderly mannered organization whereas at the lower level of organization, both the living and non living made up of atoms.

The Living World**SET Self Evaluation Test**

1. When generic name is repeated in specific name of a plant it is called
[NCERT]

Or

In fish, *Catla catla* the specific name is identical with the generic name, thus it is an example of

[AMU (Med.) 2012; WB-JEE 2016]

- (a) Synonyms (b) Antonyms
(c) Tautonyms (d) None of the above
2. Specimen used for original publication by the author is
[AIIMS 1996]

- (a) Holotype (b) Isotype
(c) Syntype (d) Lactotype

3. Number of criteria used in classifying organisms in five-kingdom classification is
[NCERT; MP PMT 2001]

- (a) 5 (b) 4
(c) 3 (d) 2

4. Artificial system of classification was first used by
(a) Linnaeus (b) De Candolle
(c) Theophrastus (d) Bentham and Hooker

5. Archegoniatae include
(a) Algae, fungi and viruses
(b) Algae, lichens and bryophytes
(c) Bryophytes, pteridophytes and gymnosperms
(d) Pteridophytes, gymnosperms and angiosperms

6. Institution which encourages publication of local flora is
[APMEE 2001]

- (a) NBRI (b) FRI
(c) BSI (d) IARI

7. "Taxonomy without phylogeny is similar to bones without flesh" is the statement of
(a) Oswald Tippo (b) John Hutchinson
(c) Takhtajan (d) Bentham and Hooker

8. The scientist who created the group Protista for both unicellular plants and animals is
(a) Haeckel (b) Pasteur
(c) Lister (d) Koch

9. In a scientific name, the name of author is printed in
(a) Italics (b) Bold (antics)
(c) Roman (d) Capital letters

10. The generic name of Mango is
[MP PMT 2011]

- (a) *Mangifera indica* (b) *Indica*
(c) *Mangifera* (d) *Indica Mangifera*

11. Static concept of species was put forward by
(a) De Candolle (b) Linnaeus
(c) Theophrastus (d) Darwin

AS Answers and Solutions

1	c	2	a	3	a	4	c	5	c
6	c	7	c	8	a	9	c	10	c
11	b								

1. (c) If both generic and specific names are same, these are called tautonyms.
 2. (a) Holotype is a original type specimen from which the description of a species is established.
 3. (a) The main criteria for classifying organisms into five kingdoms are complexity of cell structure, body organisation, the mode of nutrition, life style and the phylogenetic relationships.
 4. (c) Artificial system of classification was first used by Theophrastus. A classification based on one or a few superficial similarities is called an artificial system of classification.
 5. (c) Archegoniatae is a group of embryophytes having archegonia. Its include bryophytes, pteridophytes and gymnosperm.
 6. (c) Botanical Survey of India at Kolkata explores the plant wealth of India.
 8. (a) A German biologist Ernst Haeckel created a third kingdom protista in 1866 for unicellular organism such as bacteria, protozoans, algae and fungi.
 9. (c) In a scientific name, the name of author is printed in Roman. e.g., *Mangifera indica* linn, the linn. stand for Linnaeus.
 11. (b) The static concept of species was given by Linnaeus in *systema naturae*.

* * *