Chapter: Biological Classification

Exercise

Question 1: Discuss how classification systems have undergone several changes over a period of time?

Answer: The classification systems have undergone several changes with time as follows: -

1. Aristotle made the first attempt to classify organisms. He classified plants into three categories: herbs, shrubs, and trees. Animals, on the other hand, were classified primarily based on the presence or absence of red blood cells (RBC). This system of classification was unable to classify all of the known organisms.
2. Linnaeus proposed a two-kingdom system of classification. It consists of the kingdoms of Plantae and Animalia. However, this system of classification failed to differentiate between unicellular and multicellular organisms, photosynthetic (green algae) and non-photosynthetic (fungi) organisms and eukaryotes and prokaryotes. As a result, a huge number of organisms could not be classified using the two-kingdom classification system. So, it is an inadequate system of classification.
3. The two-kingdom classification was then replaced by the three-kingdom classification. Ernst Haeckel proposed a three-kingdom classification to overcome the drawback of the two-kingdom classification. Haeckel's three-kingdom were Animalia, Plantae and Protista (protozoa, fungi, bacteria, and other microorganisms).
4. Herbert F. Copeland (1938) gave a four-kingdom classification by creating the novel Kingdom Monera (prokaryotic organisms). The four-kingdom system of classification was Monera, Protista, Plantae, and Animalia.
5. To solve these problems, a Five-Kingdom Classification was proposed by R.H. Whittaker (1969). Based on characteristics such as cell structure, mode of nutrition, presence of cell wall, etc., five kingdom classifications were proposed. The five kingdoms were Monera (prokaryotes, particularly bacteria), Protista, Fungi, Plantae (Plants), and Animalia (Animals). This is the most accepted system of biological classification of living organisms.

Question 2: State two economically important uses of :

(a) Heterotrophic bacteria

(b) Archaebacteria

Answer:

(a) Heterotrophic bacteria: - Heterotrophic bacteria are a group of microorganisms that derive energy from organic compounds.

- Some heterotrophic bacteria are decomposers, and they help in the formation of humus.
- Heterotrophic bacteria like Rhizobium help in the fixation of atmospheric nitrogen.

- Heterotrophic bacteria like Lactobacillus help in the formation of curd from milk.

(b) Archaebacteria: - Archaebacteria are the oldest living organisms on earth that have one cell and live in extreme environments.

- Archaebacteria such as *Methanobacterium* are used in the production of biogas or gobar gas that is used as fuel.
- Some archaebacteria are also utilised in mineral bioleaching.
- The Taq polymerase enzyme, which is employed in recombinant DNA technology, is obtained from archaebacteria such as *Thermus aquaticus*.
- Some archaebacteria, like *methanogens*, are also involved in sewage treatment.

Question 3: What is the nature of cell - walls in diatoms?

Answer: The cell walls of diatoms are made of silica and are indestructible. Their cell wall construction is known as frustules, which are made up of two thin, overlapping shells that fit together in the shape of a soapbox. The silica in diatoms' cell walls is deposited as diatomaceous earth when they die. This diatomaceous earth is a soft, inert substance. It is used to filter oils, sugars, and other industrial materials.

Question 4: Find out what do the terms ' algal bloom ' and 'red tides' signify.

Answer:

Algal bloom: - Algal bloom is a term that refers to the excessive growth of algae or blue-green algae over a water body due to the enrichment of the water body with mineral nutrients from fields, resulting in discolouration of the water body. This raises the biological oxygen demand (BOD), leading to the death of fish and other aquatic species.

Red tides: - Red tides, sometimes also called harmful algal blooms, are caused by red dinoflagellates like *Gonyaulax* that multiply rapidly. Due to the large population of dinoflagellates, the sea appears red. These dinoflagellates release powerful toxins into the water, leading to the deaths of fish, shellfish, mammals, and birds.

Both algal bloom and red tides signify the population of the water bodies.

Question 5: How are viroids different from viruses?

Answer: Viroids were discovered in T.O. Denier in 1917. They cause potato spindle tuber disease. Viroids differ from viruses in the following ways :

- Viroids are smaller in size than viruses.
- Viroids exist inside the cells as RNA particles only.
- They lack capsids (protein coats) and envelopes.
- They have only one circular RNA strand of very low molecular weight, which contains very few nucleotides.

- The RNA of viroids does not code for any protein.
- Viroids, unlike some viruses, do not require the help of another virus to infect a cell.
- Unlike viruses, which can copy their RNA in both the cytoplasm and the nucleus, viroids' RNA is only copied in the nucleus.
- To identify their existence in the tissues of plants, special techniques must be employed.

Question 6: Describe briefly the four major groups of Protozoa.

Answer: Protozoa are unicellular, eukaryotic organisms with the heterotrophic mode of nutrition. They may be holozoic, saprobic, or parasitic. They are divided into four major groups on the basis of their mode of locomotion or organ of motility: -

(1) Amoeboid protozoa or sarcodines: -

- They are unicellular, jelly-like protozoa found in fresh, seawater, or moist soil.
- There is no definite shape to their bodies as they lack pellicle.
- They might be either naked or completely covered by a calcareous shell.
- They reproduce asexually by binary fission and cyst formation.
- They usually lack flagella and have temporary protoplasmic outgrowths called "podia," or "false feet," that help in movement and capturing prey.
- They include free-living or parasitic forms such as *Amoeba* and *Entamoeba*.

(2) Flagellated protozoa or zooflagellates: -

- They are parasitic or free-living, non-photosynthetic flagellates without a cell wall.
- Their body is covered by either a cuticle or pellicle.
- They have flagella for locomotion and capturing prey.
- They reproduce asexually by longitudinal binary fission.
- They include parasitic forms that cause certain diseases, such as Trypanosoma, which causes sleeping sickness in human beings.
- Examples: *Giardia, Leishmania, Trichomonas, Trypanosoma* etc.

(3) Ciliated protozoa or ciliates: -

- They are aquatic that form a large group of protozoa.
- They have a fixed shape due to the covering of the pellicle.
- They are characterised by the presence of numerous cilia on the entire body surface, as well as two types of nuclei.
- To transport water-laden food through a cavity called the gullet, all of the cilia beat in the same direction.
- They possess contractile vacuole.

- They reproduce asexually by transverse division and formation of the cyst
- Example: *Paramoecium*, *Vorticella*, etc.

(4) Sporozoans: -

- They are one-celled, parasitic non-motile protozoans that have an infectious spore-like stage in their life cycle
- They are uninucleate and their body is covered by a pellicle, which has subpellicular microtubules that help in movement.
- They do not possess cilia or flagella for locomotion .
- They reproduce by sporozoite formation.
- Examples: *Plasmodium*, *Myxidium* etc.

Question 7: Plants are autotrophic. Can you think of some plants that are partially heterotrophic?

Answer: Plants have an autotrophic (auto=self; trophos=nourishment) mode of nutrition due to the presence of a green pigment called chlorophyll. They have the ability to synthesise their own food by using simple inorganic substances such as carbon dioxide and water in the presence of sunlight and chlorophyll through the process of photosynthesis. But in nature, there are some plants that are partially heterotrophic, meaning they depend on others for their nutritional requirements. Examples of some heterotrophic plants are:

- *Loranthus* and *Viscium* are partial stem parasites that grow as parasitic epiphytes on host plants. They can perform photosynthesis and manufacture their own food.
- Insectivorous plants such as *Venus flytrap, pitcher plants (Nepenthe), butterworts, sundews,* etc., derive some of their nutrients from trapping and consuming animals or protozoans.
- Parasitic plants such as *Cascuta* derive some or all of their nutritional requirements from other living plants. They have special organs called haustoria through which they extract water and nutrients from hosts.

Question 8: What do the terms phycobiont and mycobiont signify?

Answer: The term "phycobiont" refers to the algal component of lichens, whereas the term "mycobiont" refers to the fungal component. Algae is autotroph as it contains chlorophyll and supplies food to fungi, which is prepared by photosynthesis. The fungus is a saprophyte that provides shelter to algae and absorbs water and nutrients from the soil. This type of relationship between phycobiont and mycobiont is referred to as symbiotic.

Question 9: Give a comparative account of the classes of Kingdom Fungi under the following:

(i) Mode of nutrition

(ii) Mode of reproduction

Answer:

(a) Phycomycetes (lower fungi): - This group of fungi includes members such as *Rhizopus*, *Albugo*, *mucor*, *saprolegnia*, *soham* etc.

(i) Mode of nutrition: - They are obligate parasites or saprophytes found on dead and decaying matter such as wood.

(ii) Mode of reproduction: -

- They reproduce asexually through motile zoospores or non-motile aplanospores that are produced endogenously in sporangium (a structure within which spores are produced).
- Sexual reproduction may be of isogamous (fusion of gametes in similar sizes), anisogamous (fusion of gametes in dissimilar size) , or oogamous type (fusion of large non-motilefemale gamete with small motile male gamete). It leads to the formation of thick-walled zygospore.

(B) Ascomycetes (sac fungi): This group of fungi includes members such as *Penicillium*, *Aspergillus*, *Claviceps* and *Neurospora* etc.

(i) Mode of nutrition: - They can be sporophytic (obtain nutrition from dead and decaying organic matter), parasitic, decomposers, or coprophilous (that is, they grow on dung).

(ii) Mode of reproduction: -

- Asexual reproduction occurs employing exogenously produced asexual spores, such as conidia produced on conidiophores (a specialized hyphal branch).
- Sexual reproduction takes place through endogenously ascospores produced in sac-like asci and arranged inside ascocarps (the mature fruiting body).

(C) Basidiomycetes (club fungi): This group of fungi includes members such as Mushroom, *Puff balls* or *Bracket Fungi*, *Ustilago*, *Agaricus* and *Puccinia*.

(i) Mode of nutrition: - They are saprophytes and obtain nutrition from dead and decaying organic matter including wood and leaf litter. They also occur as parasites in plants causing diseases such as rusts (*Puccinia triticina Eriks*) and smuts (*Ustilago maydis*).

(ii) Mode of reproduction: -

- Asexual reproduction takes place commonly by conidia, budding or fragmentation.
- Sex organs are absent however, sexual reproduction occurs through plasmogamy. It involves fusion of hyphae of two distinct strains and the resulting dikaryon gives rise to a basidium. Inside a basidium, four basidiospores are produced.

(D) Deuteromycetes (imperfect fungi): This group of fungi includes members such as *Alternaria*, *Fusarium*, *Trichoderma*, *Cercospora* and *Colletotrichum*.

(i) Mode of nutrition: - They are either saprophytes, parasites or decomposers.

(ii) Mode of reproduction: -

- They reproduce asexually through asexual spores called conidia.
- Sexual reproduction is absent.

Question 10: What are the characteristic features of Euglenoids?

Answer: Characteristic features of Euglenoids are as follows:

- Euglenoids are a group of unicellular protists commonly found in freshwater.
- Euglenoids lack a cell wall, but their bodies are covered by a protein-rich cell membrane known as a pellicle.
- They bear two flagella at the anterior end of the body.
- They have a small light-sensitive eyespot.
- They contain photosynthetic pigments called chlorophyll and can prepare their food. However, in the absence of light, they behave like heterotrophs by capturing other small aquatic organisms. Hence, euglenoids have mixotrophic nutrition.
- They have both plant-like and animal-like features. For example, the presence of chlorophyll signifies plant features, whereas the lack of cell walls signifies animal features.

Question 11: Give a brief account of viruses concerning their structure and nature of genetic material. Also, name four common viral diseases.

Answer:

Structure of viruses: - Viruses is non-cellular ultramicroscopic infectious agents that can infect all living organisms. They are made up of an envelope, protein coat (capsid), and a nucleoid. Viruses possess an outer, thin layer of covering called an envelope. The nucleic acid of viruses is known as the nucleoid. The central portion of the nucleoid is surrounded by capsids, made up of smaller subunits called capsomeres. These capsomers are organised in helical or polyhedral geometric forms. A virus consists of genetic material (DNA or RNA) which is surrounded by a protein coat (capsid).

Nature of genetic material of viruses: - The genetic material of viruses is of the following four types: -

1. Double-stranded DNA (dsDNA): - Hepatitis-B virus, Herpes virus, pox virus.
2. Single-stranded DNA (ssDNA): - Coliphage fd
3. Double-stranded RNA (dsRNA): - Reovirus, Rotavirus.
4. Single-stranded RNA (ssRNA): - Retrovirus, TMV virus, Polio virus.

The genetic material of most viruses that infect plants is single-stranded RNA (ssRNA). Viruses that infect animals, on the other hand, have single-stranded RNA (ssRNA) or double-stranded RNA (dsRNA) or double-stranded DNA (dsDNA).

Four common viral diseases: -

1. A.I.D.S
2. Polio
3. Mumps
4. Influenza

Question 12: Organize a discussion in your class on the topic- Are viruses living or non - living?

Answer: Viruses are non-cellular, microscopic infectious organisms that have characteristics of both living and nonliving organisms. Viruses act as a connecting link between the living and nonliving organisms.

Some properties of viruses, such as non-cellular organisation, inactivity outside the host organism, lack of respiration, and cellular metabolism, suggest that viruses are non-living. Viruses can also be crystallised and precipitated, much like non-living objects.

They possess genetic material (DNA or RNA), the property of mutation, irritability, and can grow and multiply inside the host cell, suggesting that viruses are living. Moreover, they have a limited ability to respond to their surroundings (inside the host cell). They are obligate intracellular parasites that attack only specific types of hosts. With these considerations in mind, determining whether viruses are living or non-living remains a mystery to modern scientists.