



TOPIC 1

1. Biological classification is the scientific procedure of arranging organisms in a hierarchical series of groups and sub-groups on the basis of their similarities and dissimilarities. Scientists have proposed different systems of classification which have undergone several changes from time to time. Earlier Aristotle proposed artificial system of classification, which divided organisms into animals and plants on the basis of habitat. *E.g.*, aquatic (fish, whale), terrestrial (reptiles, cattle) and aerial (bat, birds). Then, natural system of classification was based on morphology, anatomy, physiology, reproduction, ontogeny, cytochemistry, etc. After natural system, organisms were classified on the basis of evolutionary relationships called phylogenetic system.

TOPIC 2

1. The cell walls of diatoms are called frustules. The cell wall is chiefly composed of cellulose impregnated with glass-like silica. It is composed of two overlapping halves (or theca) that fit together like two parts of a soap box or petri dish. The upper half (lid) is called epitheca and the lower half (case) is called hypotheca. The outer covering possesses very fine markings, pits, pores and ridges. The siliceous frustules of diatoms do not decay easily. They pile up at the bottom of water reservoirs and form big heaps called diatomite or diatomaceous earth. It may extend for several hundred metres in certain areas from where the same can be mined.

2. (a) Heterotrophic bacteria: They include saprotrophic, symbiotic and parasitic bacteria. They act as natural scavengers as they dispose off the dead bodies, organic wastes, release raw materials for reutilisation. They also help in sewage disposal, manure production, etc. Symbiotic bacteria help in nitrogen fixation. Some bacteria are employed in the production of a number of industrial products like lactic acid, curd, cheese, butter, vinegar, etc. Some bacteria are used in preparation of serum, vaccines, vitamins, enzymes, antibiotics, etc.

(b) Archaeobacteria : Archaeobacteria are employed in the production of gobar gas from dung and sewage and in ruminants, they cause fermentation of cellulose.

3. The rapid increase in populations of algae and other phytoplanktons, in particular cyanobacteria, in water bodies rich in organic matter is called algal bloom. The density of the

organisms may be such that it may prevent light from passing to lower depths in the water body. Algal blooms are caused by an increase in levels of nitrate, a mineral ion essential for algal and bacterial growth. The source of increased nitrate may be from agricultural fertilisers, which are leached into water systems from the land, or sewage effluent.

Red tides are caused by a sudden, often toxic proliferation of marine phytoplankton, notably dinoflagellates, that colour the sea red, brown, or yellowish due to the high concentration of the photosynthetic accessory pigments. Some dinoflagellates, such as *Gonyaulax*, produce potent toxins, which may kill fish and invertebrates outright or accumulate in the food chain, posing a hazard to humans eating shellfish and other seafood. These phytoplanktonic blooms may be related to nutrient-rich inputs from the land, or upwelling oceanic waters, and are initiated by the activation of cyst-like forms lying on the sea bed.

4. All protozoans are heterotrophs and live as predators or parasites. They are believed to be primitive relatives of animals. They are classified into four groups on the basis of locomotory organelles.

(i) Amoeboid protozoans : These organisms live in freshwater, sea water or moist soil. They move and capture their prey by developing pseudopodia (false feet) as in *Amoeba*. Some of them such as *Entamoeba* are parasites.

(ii) Flagellated protozoans : The members of this group are either free-living or parasitic. They have flagella for locomotion. The parasitic forms cause diseases such as sleeping sickness, *e.g.*, *Trypanosoma*.

(iii) Ciliated protozoans : These are aquatic, actively moving organisms because of the presence of thousands of cilia. They have a cavity (gullet) that opens to the outside of the cell surface. The coordinated movement of rows of cilia causes the water laden with food to be steered into the gullet, *e.g.*, *Paramecium*.

(iv) Sporozoans : This includes diverse parasitic organisms that have an infectious spore-like stage in their life cycle. Locomotory organs are absent. The most notorious is *Plasmodium* (malarial parasite) which causes malaria which has a staggering effect on human population.

5. The euglenoid flagellates are the most interesting organisms having a mixture of animal and plant characteristics. The characteristic features are :

(i) They are unicellular flagellates.

- (ii) These protists lack a definite cellulose cell wall. Instead the cells are covered by a thin membrane known as pellicle. The pellicle is composed of protein, lipid and carbohydrates.
- (iii) One or two flagella which help these protists in active swimming are present. If two flagella are present, then one is long and other is short. They are tinsel-shaped, *i.e.*, with two longitudinal rows of fine hairs.
- (iv) Cell at the anterior end possesses an eccentric mouth or cytostome which leads into a flask-shaped cavity, *viz.* gullet or cytopharynx. Gullet opens into a large basal reservoir.
- (v) At one end of the reservoir, the cytoplasm contains an orange red stigma (eye spot).
- (vi) Just below the reservoir is found a contractile vacuole having many feeding canals. The contractile vacuole takes part in osmoregulation. It expands and pumps its fluid contents in the reservoir.
- (vii) The mode of nutrition in euglenoids is holophytic or photoautotrophic. Some euglenoids show mixotrophic nutrition (both holophytic as well as saprobic mode).
- (viii) Cytoplasm is differentiated into ectoplasm and endoplasm. Nucleus is large and occurs roughly in middle. The envelope and nucleolus persist during cell division.
- (ix) Each chloroplast is composed of a granular matrix traversed by 10-45 dense bands and is covered by 3-membraned envelope. They contain the photosynthetic pigments, chlorophyll-*a*, *b*. They store carbohydrates as paramylon bodies, scattered throughout the cytoplasm.
- (x) Asexual reproduction occurs by longitudinal binary fission. The flagellum is duplicated before cell division.
- (xi) Under unfavourable condition the euglenoids form cysts or perennate the dry period.
- (xii) Sexual reproduction is not observed.

TOPIC 3

1. Some insectivorous plants like *Drosera*, *Nepenthes*, and *Utricularia* are partially heterotrophic plants. These plants are deficient in nitrogen content but are otherwise autotrophic. They trap various insects to obtain nitrogen from them. Rest, the food, *i.e.*, carbohydrate is manufactured by themselves.
2. Viroids are the smallest known agents of infectious diseases that contain small single-stranded RNA molecule. They lack capsid and have no proteins associated with them. Viroids infect only plants. Whereas, viruses have genetic material surrounded by a protective coat of protein or lipoprotein. The genetic material of viruses are of 4 types-double-stranded DNA, double-stranded RNA, single-stranded DNA and single-stranded RNA. They infect both plants and animals.
3. A lichen is structurally organised entity consisting of the permanent association of a fungus and an alga. The

fungus component of a lichen is called mycobiont and the algal component is called phycobiont. Both mycobiont and phycobiont are associated in symbiotic union in which the fungus is predominant and alga is subordinate partner. Fungus provides the structural covering that protects alga from unfavourable conditions, *i.e.*, drought, heat, etc. It also traps moisture from the atmosphere and anchors the lichen to a rock, tree bark, leaves and other similar supports. The alga prepares organic food by the process of photosynthesis from carbon dioxide. If the algal component is cyanobacteria (blue-green alga), they fix atmospheric nitrogen in addition to preparation of food.

4. Virus (*L. poisonous fluid*) is a group of ultramicroscopic, non-cellular, highly infectious agents that multiply only intracellularly inside the living host cells without involving growth and division. Outside the host cells, they are inert particles. They are nucleoproteins having one or more nucleic acid molecule, either DNA or RNA, encased in a protective coat of protein or lipoprotein. A virus consist of two parts - nucleoid (genome) and capsid. An envelope and few enzymes are present in some cases.

(i) Nucleoid : The nucleic acid present in the virus is called nucleoid and it represents viral chromosome. It is made up of a single molecule of nucleic acid. It may be linear or circular and nucleic acid can be DNA or RNA. It is the infective part of virus which utilises the metabolic machinery of the host cell for synthesis and assembly of viral components. The genetic material of viruses are of 4 types - (a) Double stranded DNA (ds DNA) *e.g.*, Pox virus, Hepatitis-B virus; (b) Single stranded DNA (ss DNA) *e.g.*, Coliphage $\phi \times 174$ (cyclic); (c) Double stranded RNA (ds RNA) *e.g.*, Reovirus; (d) Single stranded RNA (ssRNA) *e.g.*, Tobacco Mosaic Virus.

(ii) Capsid : It is a protein covering around genetic material. Capsid have protein subunits called capsomeres. Capsid protects nucleoid from damage from physical and chemical agents.

(iii) Envelope : It is the outer loose covering present in certain viruses like animal viruses (*e.g.*, HIV) but rarely present in plant and bacterial viruses and made of protein of viral origin and, lipid and carbohydrate of host. Outgrowths called spikes may be present. Envelope proteins have subunits called peplomers. A virus without envelope is naked virus.

(iv) Enzymes : Rarely, lysozymes are found in bacteriophages. Reverse transcriptase enzyme (catalyses RNA to DNA synthesis) is found in some RNA viruses like HIV.

Some common viral diseases are - influenza, polio, measles, chickenpox, hepatitis, AIDS, bird flu, SARS (Severe Acute Respiratory Syndrome), etc.

5. A comparative account of the classes of kingdom fungi are as follows:

Class of fungi	Mode of nutrition	Mode of reproduction
Phycomycetes (Includes oomycetes and zygomycetes)	<p>Oomycetes are mostly parasitic (obtain their nourishment from the protoplasm of living plants or animals, e.g., <i>Phytophthora infestans</i>).</p> <p>Zygomycetes are mostly saprophytes (absorb food from dead or decaying organic matters e.g., <i>Rhizopus</i>), parasitic (<i>Absidia cornealis</i>), some are coprophilous (fungi which grow on dung, e.g., <i>Mucor</i>).</p>	<p>In oomycetes asexual reproduction is by zoospores (aquatic form), aplanospore (terrestrial form). Sexual reproduction may be isogamous or oogamous, sexual fusion is of gametangial contact type. Male sex organ is antheridium and female sex organ is oogonium. Plasmogamy is followed by karyogamy and meiosis (oospore formation).</p> <p>In zygomycetes, asexual reproduction occurs by thin walled non motile sporangiospores inside sporangia. Sexual reproduction takes place by gametangial copulation (two identical gametangia) known as conjugation. Sexual reproduction forms diploid zygospore.</p>
Ascomycetes (Sac fungi)	Most are terrestrial and occur as saprophytes (e.g., <i>Aspergillus</i>), parasitic (<i>Claviceps</i>). Some grow in deciduous forests on humus rich soil (<i>Morchella</i>).	<p>Asexual reproduction by conidia or conidiospores (<i>Aspergillus</i>), budding (<i>Saccharomyces</i>), fission (<i>Schizosaccharomyces</i>). Sexual reproduction by gametic copulation (e.g., yeast), gametangial contact (e.g., <i>Pyronema</i>), spermatization (<i>Ascobolus</i>), somatogamy (<i>Peziza</i>).</p> <p>Sexual reproduction takes place in three stages plasmogamy (fusion of protoplast), karyogamy (fusion of nucleus) and meiosis. Ascospores are formed in ascus. Generally each ascus consists of eight ascospores. Fructification are known as, ascocarp (cleistothecium, e.g., <i>Penicilium</i>, perithecium, e.g., <i>Neurospora</i>, and apothecium, e.g., <i>Peziza</i>).</p>
Basidiomycetes (Club fungi)	Mostly saprophytes (<i>Agaricus</i>), on humus, bark, decaying wood, etc. Some are obligate parasites (e.g., rusts, powdery mildews, which live entirely on the living protoplasm of their hosts and can never grow on dead tissue), some are facultative saprophytes (some smuts, which are usually parasitic in their mode of life but later may pass their mode of life as saprophytes).	<p>The asexual spores are generally not found, but vegetative reproduction by fragmentation is common.</p> <p>The sex organs are absent, but plasmogamy is brought about by fusion of two vegetative or somatic cells of different strains or genotypes. The resultant structure is dikaryotic which ultimately gives rise to basidium. Karyogamy and meiosis take place in the basidium producing four basidiospores. The basidiospores are exogenously produced on the basidium. The basidia are arranged in fruiting bodies called basidiocarps.</p>
Deuteromycetes (Fungi Imperfecti)	Mostly parasitic.	Asexual reproduction by conidia and some other spores. Sexual reproduction is either absent or yet to be discovered.

