

## CHAPTER 2

### BIOLOGICAL CLASSIFICATION

Classification is the arrangement of organisms in specific groups or categories based on certain characters.

#### Systems of classification:

**1. Artificial system:** In this system, morphological characters like habit, habitat, number of stamens etc. are considered to classify organisms. e.g.:- Linnaean system

**2. Natural system:** In this system, natural relationships are considered to classify organisms e.g.:- George Bentham and Joseph Dalton Hooker's system

**3. Phylogenetic system:** In this system, evolutionary relationships are taken into account to classify the organisms. eg:-Engler and Prantl's system.

Recently classification of organisms is done based on the following criteria- a) **Type of cell structure**- prokaryotic or eukaryotic, b) **Complexity of organism's body**- unicellular or multicellular, c) **Mode of nutrition**- autotrophs or heterotrophs, d) **Major ecological role**- Producer, consumer or decomposer, e) **Phylogenetic relationship**- evolutionary relationship- simple to complex.

**R.H. Whittaker** (1969) proposed a **Five Kingdom** system of classification where the organisms are classified into Five Kingdoms namely **Monera, Protista, Fungi, Plantae and Animalia**.

A comparative account of different characteristics of 5 Kingdoms are given in Table 2.1

Table 2.1. Comparison of characteristics of the 5 Kingdoms

Characters	Kingdoms				
	Monera	Protista	Fungi	Plantae	Animalia
Type of cell	Prokaryotic	Eukaryotic	Eukaryotic	Eukaryotic	Eukaryotic
Cell wall	Non cellulose ( polysaccharide + amino acid )	Present in some	Present(chitin)	Present (cellulose)	Absent
Nuclear envelope	Absent	Present	Present	Present	Present
Cellular organization	Cellular	Cellular	Multicellular/ loose tissue	Tissue/organ	Tissue/organ/ organ system
Mode of nutrition	Autotrophic (chemosynthetic and photosynthetic) and Heterotrophic (saprophytic/ parasitic)	Autotrophic (photosynthetic) and Heterotrophic	Heterotrophic (saprophytic/ parasitic)	Autotrophic (photosynthetic)	Heterotrophic (holozoic/ saprophytic)

In this chapter let us study the characteristics of Kingdoms-Monera, Protista and Fungi. Other two Kingdoms-Plantae and Animalia will be dealt in chapter 3 and 4.

Table 2.2 Major groups under Kingdom Monera , Protista and Fungi

Kingdom	Major groups
Monera	Archaeobacteria, Eubacteria, Cyanobacteria.
Protista	Chrysophyta, Pyrrophyta, Euglenophyta, Slimemoulds,Protozoa.
Fungi	Phycomycetes, Ascomycetes, Basidiomycetes, Deuteromycetes.

### 2.1 KINGDOM MONERA

The members of this Kingdom are found everywhere in large numbers. Some live in extreme environmental conditions like hot springs, deserts, snow etc. e.g. Archaeobacteria. They have a **prokaryotic cell structure**. Their mode of nutrition is autotrophic (photosynthetic or chemosynthetic) or heterotrophic (saprophytic or parasitic).

Table 2.3 Major groups of Kingdom Monera and their examples

Major group	Examples
Archaeobacteria	Methanogens( <i>Methenobacterium</i> ) Halophiles ( <i>Halobacterium</i> ) Thermoacidophiles( <i>Thermoplasma</i> )
Eubacteria	Bacteria- ( <i>Vibrio comma</i> , <i>Mycobacterium tuberculosis</i> , <i>Xanthomonas citri</i> )
Cyanobacteria	<i>Nostoc</i> , <i>Anabaena</i>

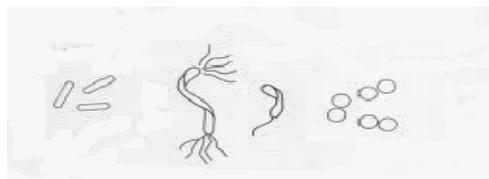


Fig. 2.1. Bacteria

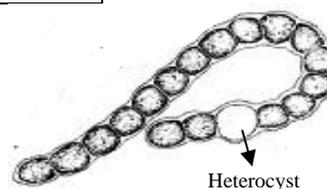


Fig.2.2 Cyanobacteria- *Nostoc*

### 2.2 KINGDOM PROTISTA

These are unicellular eukaryotes. Some are photosynthetic and others are non-photosynthetic. Some possess cilia or flagella. They reproduce asexually and sexually.

Table 2.4 Major groups of Kingdom Protista and their examples.

Major group	Examples
Chrysophyta (Golden brown algae)	<i>Pinnularia</i> , <i>Navicula</i> , <i>Cyclotella</i> .
Pyrrophyta- (Dinoflagellates)	<i>Gonyaulax</i> , <i>Noctiluca</i> .
Euglenophyta (Euglenoids)	<i>Euglena</i> , <i>Paranema</i> .
Slime moulds	<i>Stemonitis</i> , <i>Physarum</i> .
Protozoa	<i>Paramecium</i> , <i>Trypanosoma</i> , <i>Amoeba</i> , <i>Entamoeba</i> , <i>Plasmodium</i> .

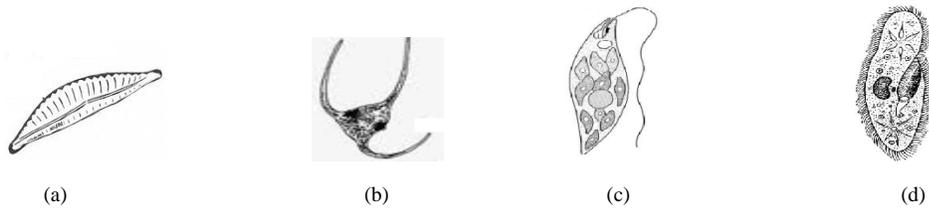


Fig. 2.3. Kingdom Protista – a) Diatom ,b) Dinoflagellate, c) *Euglena*, d) *Paramoecium*

### 2.3 KINGDOM FUNGI

They are unicellular (e.g.:- yeast) or multicellular eukaryotes. Their body (except yeast) is made up of thin thread-like hyphae which form a network called **mycelium**. Some hyphae have cross walls, others have continuous cytoplasm with many nuclei and they are called coenocytic hyphae. The cell wall of fungi contains **chitin**. The mode of nutrition is heterotrophic. Most of them are saprophytes e.g. yeast, *Agaricus* and others are parasites e.g. *Puccinia*. They reproduce by vegetative, asexual and sexual methods. Vegetative reproduction is by fragmentation, fission and budding. Asexual reproduction is by the formation of spores like sporangiospores, conidia or zoospores. During sexual reproduction, plasmogamy (fusion of cytoplasm of gametes) and karyogamy (fusion of nuclei) take place to produce zygote. The zygotes divides by meiosis and produces haploid spores. The spores are produced in fruiting bodies. The fruiting bodies produce oospores, ascospores or basidiospores.

Table. 2.5. Major groups of Kingdom Fungi and their examples

Major groups	Examples
Phycomycetes	<i>Mucor, Rhizopus</i> (bread mould).
Acomycetes (Sac fungi)	<i>Saccharomyces</i> (yeast), <i>Aspergillus, Penicillium, Claviceps, Neurospora</i> .
Basidiomycetes (Club fungi)	<i>Agaricus</i> (mushroom), <i>Puccinia</i> (rust fungus), <i>Ustilago</i> (smut fungus), <i>Lycoperdon</i> ( puff ball)
Deuteromycetes (Imperfect fungi)	<i>Colleterium, Alternaria, Trichoderma, Cercospora</i> .

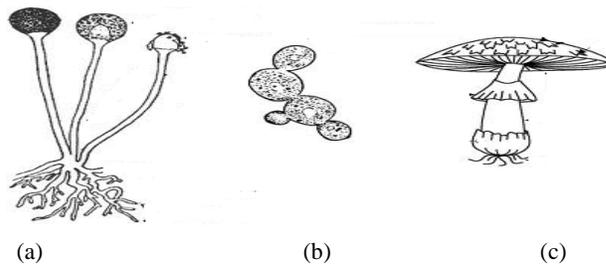


Fig. 2.4. Kingdom Fungi:(a) *Rhizopus*, (b) Yeast, (c) *Agaricus*.

## 2.4 VIRUSES, VIROIDS, PRIONS AND LICHENS

In five Kingdom System of classification by Whittaker Viruses, Viroids, Prions and Lichens is not mentioned.

**Viruses:** Viruses did not find a place in classification since they do not have a cell structure and are not true living beings. Viruses are noncellular, obligate, intracellular parasites. They show some living characters like- a) They have a genetic material b) They can multiply (inside host cells) c) They exhibit heredity and the genetic material can undergo mutation. The viruses contain **DNA** or **RNA** as a genetic material but not both. Apart from nucleic acid viruses contain protein coat called **capsid** which is made of subunits called capsomeres.

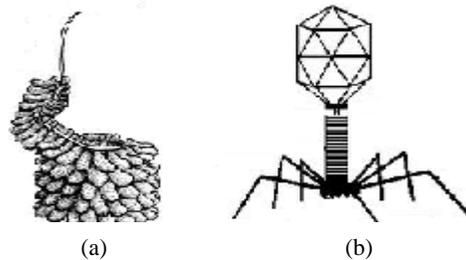


Fig. 2.5. (a) Tobacco Mosaic Virus, (b) Bacteriophage.

**Viroids:** The causative agent of potato spindle tuber disease was discovered by Diener and Raymer. It was found to be short strands of RNA without protein coat. Such infectious pathogenic agent of plant that contains only RNA is called viroid.

**Prions:** These are proteinaceous infectious particles, first observed by Stanley Prusiner. Prions do not possess nucleic acid. They cause diseases in animals. Eg:- Creutzfeldt-Jacob disease in humans, Mad cow disease etc.

**Lichens:** They are the symbiotic associations (mutually beneficial associations) between algae and fungi. The algae component is called **phycobiont** (autotrophic) and fungal component is called **mycobiont** (heterotrophic). Phycobiont synthesizes food for fungi and mycobiont absorbs minerals, water etc for the algae. The association is so close that lichen never appears to have two organisms. Lichens are pollution indicators. E.g. *Cladonia*, *Parmelia*.

### SUMMARY

There are three systems of classification of organisms – Artificial system, Natural system and Phylogenetic system. Recent system of classification is based on certain criteria like type of cell structure, complexity of organism's body, mode of nutrition, major ecological role, evolutionary relationships etc. Whittaker proposed five Kingdom system-Monera, Protista, Fungi, Plantae and Animalia.

In five Kingdom system, Kingdom Monera includes archaeobacteria, eubacteria and cyanobacteria. They are autotrophic or heterotrophic prokaryotes. Kingdom Protista includes single celled eukaryotes like Chrysophytes, Dinoflagellates, Euglenoids, slime moulds and Protozoans. Kingdom Fungi includes organisms with diverse nature and habitat. They have cell wall with chitin and heterotrophic in nutrition. They include Phycomycetes, Ascomycetes, basidiomycetes and Deutermycetes. In the five Kingdom System of classification non cellular Viruses, viroids, Prions and lichens are not included.

### EXERCISES

1. Name the systems of classification of organisms.
2. Based on which criteria the living beings are classified in five kingdom system of classification?
3. The members of which kingdom have prokaryotic cell structure?
4. Which group of protista is called golden brown algae?
5. What is mycelium?
6. Name the chemical present in the cell walls of fungi?
7. What is plasmogamy?
8. Why viruses are not included in 5 Kingdom system of classification by Whittaker?
9. Define viroids.
10. Describe the functions of phycobiont and mycobiont in lichens