Biological Classification

2 Chapter

1 INTRODUCTION

There have been many attempts to classify living organisms since the dawn of civilisation. Aristotle was the earliest to attempt a more scientific basis for classification. He used simple morphological characters to classify plants into trees, shrubs and herbs. He also divided animals into two gropus, with RBCs and without RBCs.

2 TWO KINGDOM CLASSIFICATION SYSTEM

- Given by Linnaeus.
- Organisms were divided into two kingdoms Plantae and Animalia.

Disadvantages: This system did not distinguish between eukaryotes and prokaryotes, unicellular and multicellular organism & photosynthetic & non photo-synthetic organisms.

3 FIVE KINGDOM CLASSIFICATION SYSTEM

- Given by R.H. Whittaker.
- All organisms were divided into five kingdoms Monera, Protista, Fungi, Plantae and Animalia.
- Fungi were placed in separate kingdom called kingdom fungi.

Characters	Five Kingdoms				
	Monera	Protista	Fungi	Plantae	Animalia
Cell type	Prokaryotic	Eukaryotic	Eukaryotic	Eukaryotic	Eukaryotic
Cell wall	Noncellulosic (Polysaccharide+ amino acid)	Present in some	Present with chitin	Present (cellulose)	Absent
Nuclear membrane	Absent	Present	Present	Present	Present
Body organisation	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 etc.

- Earlier classification systems included bacteria, blue green algae, fungi, mosses, ferns, gymnosperms and angiosperms under plants due to presence of cell wall.
- *Chlamydomonas* and *Spirogyra* were placed under algae.
- Kingdom Protista put together *Chalamydomonas*, *Chlorella* with *Paramoecium* and *Amoeba*.
- Over time, an attempt has been made to evolve a classification system which reflects not only the morphological, physiological and reproductive similarities but also phylogenetic i.e. is based on evolutionary relationships.

4 KINGDOM MONERA

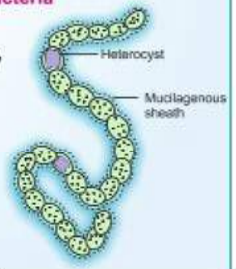
- Sole members of the kingdom are bacteria which occur almost everywhere.
- Many of them live in or on other organisms as parasites.
- They are grouped under four categories based on their shapes, spherical (*Coccus*), rod shaped (*Bacillus*), comma shaped (*Vibrio*) and spiral shaped (*Spirillum*).

ARCHAEBACTERIA

- Are special bacteria since they live in some of the harsh habitats such as extreme salty areas (halophiles) hot springs (thermoacidophiles) and marshy areas (methanogens).
- Have different cell wall structure than other bacteria. This feature is responsible for their survival in extreme conditions.
- Methanogens produce methane and found in gut of ruminant animals.

EUBACTERIA or True Bacteria

- **Cyanobacteria** (Blue green algae)
  - May be unicellular, colonial or filamentous, fresh water/marine or terrestrial.
  - Have chlorophyll a similar to green plants.
  - Are photosynthetic autotrophs.
- **Mycoplasma**
  - Smallest living known cells.
  - Can survive without oxygen.
  - Completely lack cell wall.
  - Are pathogenic to both plants and animals.



- Bacteria are simple in structure but very complex in behaviour.
- Show most extensive metabolic diversity.
- Majority of bacteria are heterotrophic but can be photo or chemoautotrophic.
- Chemosynthetic autotrophs oxidise various inorganic substances and play great role in recycling nutrients like nitrogen.
- **Heterotrophic bacteria:** Majority are decomposers and are helpful in making curd from milk, production of antibiotics, fixing nitrogen in legumes etc.
- Some are parasites, cause disease like cholera, typhoid, tetanus, citrus canker etc.

(5) KINGDOM PROTISTA

- All single celled eukaryotes are placed in kingdom protista.
- Members are primarily aquatic.
- Boundaries of this kingdom are not well defined.
- Reproduce sexually and asexually both.

KINGDOM PROTISTA

Chrysophytes

- Includes diatoms and golden algae (desmids).
- Microscopic and floats passively in water currents.
- Most of them are photosynthetic.
- Cell wall has silica and thus indestructible.
- Body look likes soap box.
- Form diatomaceous earth.
- Are chief producers in the oceans.

Dinoflagellates

- Mostly marine and photosynthetic.
- Appear in various colours depending on main pigments present in their walls.
- Biflagellated.
- Cell wall has stiff cellulosic plates on the outer surface.
- Responsible for red tides.
- Toxins released by organisms may kill other marine animals (fishes) *Gonyaulax*.

Euglenoids

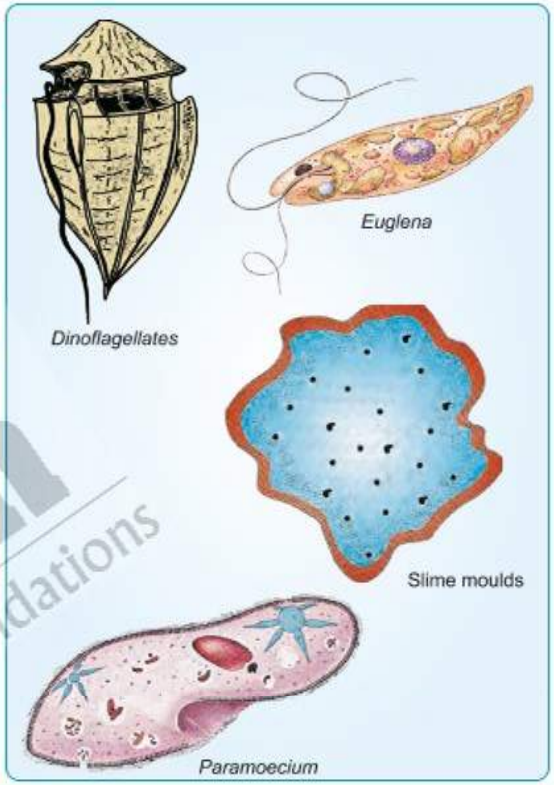
- Are fresh water forms found in stagnant water.
- Photosynthetic in presence of sunlight and predators in absence of sunlight.
- Biflagellated, has one short and one long flagella.
- Cell wall absent but proteinaceous pellicle present. Eg. *Euglena*.

Slime Moulds

- Are saprophytic protists.
- Body moves along decaying twigs and leaves engulfing organic material.
- Under favourable conditions form plasmodium and under unfavourable conditions they form fruiting bodies.
- Spores have true walls, resistant to adverse conditions and dispersed by air currents.

Protozoans

- Are heterotrophs and believed to be primitive relatives of animals.
- **Amoeboid:** have pseudopodia for capturing prey. Many have silica shells on their surface. Some are parasites Eg. *Entamoeba, Amoeba*.
- **Flagellated:** have flagella. Parasitic forms many cause disease as sleeping sickness. Eg. *Trypanosoma*.
- **Ciliated:** have cilia, gullet. Eg. *Paramoecium*.
- **Sporozoans:** have inflectious spore like stage in their life-cycle. Eg. *Plasmodium* (malarial parasite).



(6) KINGDOM FUNGI

- Constitute a unique kingdom of heterotrophic organisms.
- Show great diversity in morphology and habitat.
- Unicellular forms such as yeast is used in bread and beer making.
- Most of them are saprophytes but they can be parasitic or symbionts such as lichens and mycorrhiza associations.
- Reproduction can take place by vegetative, asexual or sexual means.
- Vegetative reproduction by fragmentation, fission or budding.
- Asexual reproduction by spore formation such as conidia, sporangiospores or zoospores.
- Sexual reproduction involves oospores, ascospores and basidiospore formation.
- The sexual cycle involves three steps
  - Plasmogyamy – Fusion of protoplasm between two motile or non-motile gametes.
  - Karyogamy – Fusion of two nuclei.
  - Meiosis – In zygote results in haploid spores.
- The morphology of mycelium, mode of spore formation and fruiting bodies form the basis for the division of kingdom fungi into various classes.

- In some fungi (ascomycetes and basidiomycetes) an intervening dikaryotic stage (n + n) occurs. Such condition is called a dikaryon and the phase is called dikaryophase.

Comments	Phycomycetes	Ascomycetes (Sac fungi)	Basidiomycetes (Club fungi)	Deuteromycetes (Imperfect fungi)
Habitat	Aquatic habitats and on decaying wood or as obligate parasites on plant.	Coprophilous, saparophytic decomposers or parasitic.	Grow in soil, on logs and tree stumps or as parasites e.g. rust and smuts.	Saprophytes, parasites and some of them are decomposers and help in mineral recycling.
Mycelium	Aseptate and coenocytic.	Are multicellular, rarely uni-cellular, branched and septate.	Branched and septate	Branched and septate
Asexual Reproduction	By endogenously produced zoospores (motile) or aplanospores	Conidia, produced exogenously	Generally not found but vegetatively by fragmentation	Conidia
Sexual Reproduction	Zygospore is formed by fusion of two gametes.	Ascospores produced in asci, which is turn are arranged in fruiting bodies called ascocarp.	Sex organs are absent. Sexual spores are basidiospores formed on basidium inside basidiocarps	Absent
Examples	*Mucor, Rhizopus* (bread mould) and *Albugo* (the parasitic fungi on mustard)	*Aspergillus, Claviceps, Neurospora* (used in biochemical & genetic work), Morels and truffles (edible), *Penicillium* (source of antibiotics)	*Agaricus, Ustilago, Puccinia* (Parasitic), Bracket fungi & Puffballs.	*Alternaria, Colletotrichum, Trichoderma*

(7) KINGDOM PLANTAE

- Includes all eukaryotic chlorophyll containing organisms called plants.
- Some are partially heterotrophic such as insectivorous plants *e.g. Cuscuta*, Bladderwort and Venus fly trap.
- Life cycle has two distinct phases - diploid sporophytic and haploid gametophytic, phenomenon called alternation of generation.

(8) KINGDOM ANIMALIA

- Includes heterotrophic eukaryotic organisms called animals.
- These are multicellular and lack cell walls.
- Mode of nutrition is holozoic.
- Store food as glycogen or fat.
- Are capable of locomotion.
- Higher forms show elaborate sensory and neuromotor mechanism.

(9) VIRUSES, VIROIDS, PRIONS AND LICHENS

- In R.H. Whittaker's system, there is no mention of lichens, viruses, viroids and prions.
- Viruses are non-cellular that are characterised by having an inert crystalline structure outside the living cell.
- Viruses contain either RNA or DNA.
- Bacterial viruses usually have dsDNA, viruses that infect plants generally have ss-RNA.
- Protein coat is called capsid made up of capsomeres, which protect the nucleic acid.
- Virus name given by Pasteur, recognized by D.J. Ivanowsky, demonstrated by M.W. Beijerinek.
- Viruses causes diseases in animals as well as plants. They cause mumps, small pox, herpes & influenza in animals.

VIROIDS

- Discovered by T.O Diener.
- Was found to be free RNA, devoid of protein coat, hence named viroid.
- Cause potato spindle tuber disease.

PRIONS

Is abnormally folded protein. Similar in size to viruses. Cause Bovine spongiform encephalopathy (BSE) commonly called mad cow disease in cattle and its analogous variant Cr-jacob disease CJD humans.

LICHENS

- Symbiotic association between algae & fungi.
- The algal component is phycobiont (autotrophic) and fungal component is mycobiont (heterotrophic)
- Lichens are good pollution indicators, they do not grow in polluted areas.

- In plants symptoms of viral diseases can be mosaic formation, leaf rolling and curling, yellowing and vein clearing, dwarfing and stunted growth.

Sharpen Your Understanding

1. Two kingdom system of classification did not distinguish between all of the given, **except** [NCERT Pg. 16]
   (1) Photosynthetic and non-photosynthetic
   (2) Eukaryotes and prokaryotes
   (3) Plants and animals
   (4) Unicellular and multicellular
2. In which kingdom, chemosynthetic organisms are seen out of five kingdoms proposed by Whittaker? [NCERT Pg. 17]
   (1) Protista (2) Monera
   (3) Fungi (4) Plantae
3. Select the **incorrect** statement. [NCERT Pg. 17]
   (1) In three domain system, all eukaryotes are placed in single domain
   (2) Plants have cellulosic cell wall
   (3) Cell type is prokaryotic in kingdom Monera
   (4) Mode of nutrition was not the criteria to classify organisms in five kingdom classification
4. The composition of fungal cell wall is [NCERT Pg. 17]
   (1) Cellulose
   (2) Non-cellulose (Polysaccharides + lipid)
   (3) Chitin
   (4) Lignin
5. Kingdom Protista has brought together *Chlamydomonas*, *Chlorella* with *Paramecium* and *Amoeba* as they all [NCERT Pg. 18]
   (1) Are heterotrophic
   (2) Have cell wall
   (3) Lack cell wall
   (4) Are unicellular and eukaryotic
6. Select the **incorrect** statement about kingdom Monera. [NCERT Pg. 18]
   (1) Bacteria are the sole members of kingdom Monera
   (2) They are most abundant micro-organisms
   (3) They can live in extreme habitats
   (4) They cannot be parasites
7. Find the **incorrect** match w.r.t. shapes of bacteria. [NCERT Pg. 18]
   (1) *Coccus* : Spherical shaped
   (2) *Bacillus* : Rod shaped
   (3) *Vibrium* : Circular shaped
   (4) *Spirillum* : Spiral shaped
8. Read the following statements and select the **correct** option. [NCERT Pg. 19]

   Statement-A: Bacteria as a group show most extensive metabolic diversity.

   Statement-B: Bacteria may be photo-synthetic autotropic or chemosynthetic autotrophic.
   (1) Only statement A is correct
   (2) Only statement B is correct
   (3) Both statements A and B are correct
   (4) Both statements A and B are incorrect
9. Mark the **odd** one w.r.t. methanogens. [NCERT Pg. 19]
   (1) Found in the guts of ruminants
   (2) Responsible for production of methane
   (3) Live in some of the most harsh habitats
   (4) Have cell wall structure same as other bacteria
10. Cyanobacteria are also referred to as [NCERT Pg. 19]
    (1) Red algae
    (2) Green algae
    (3) Brown algae
    (4) Blue green algae
11. All of the following are functions of heterotrophic bacteria, **except**. [NCERT Pg. 19]
    (1) Making curd from milk
    (2) Fixing nitrogen in legumes
    (3) Production of antibiotics
    (4) Fixing atmospheric carbon

NCERT Based MCQs

12. Select the **wrong** for mycoplasma. [NCERT Pg. 20]

(1) Can survive without oxygen

(2) Completely lack cell wall

(3) Pathogenic to plants and animals

(4) Are largest monerans

13. Select the **incorrect** one about Kingdom Protista. [NCERT Pg. 20]

(1) Being eukaryotes, the protistan cell body contains a well-defined nucleus and other membrane bound organelles

(2) They reproduce asexually only

(3) Boundaries of this kingdom are not well defined

(4) Members are primarily aquatic

14. Which statement is **wrong** about chrysophytes? [NCERT Pg. 20]

(1) They are microscopic

(2) Most of them are photosynthetic

(3) In diatoms the cell walls forms two thin overlapping shells, which fit together as in a soap box

(4) They are found in terrestrial habitats only

15. Which of the following is responsible for red tide? [NCERT Pg. 21]

(1) Diatoms (2) Desmids

(3) *Gonyaulax* (4) Slime moulds

16. Which of the following statements is **incorrect**? [NCERT Pg. 21]

(1) Dinoflagellates have two flagella

(2) Euglenoids are fresh water organisms

(3) Slime moulds are saprophytic protists

(4) The spores of slime moulds lack cell wall

17. The basis for division of the kingdom fungi into various classes is all, **except** [NCERT Pg. 23]

(1) Morphology of mycelium

(2) Mode of nutrition

(3) Mode of spore formation

(4) Type of fruiting bodies

18. Select the **incorrect** match [NCERT Pg. 23-24]

(1) *Rhizopus* : Sac fungi

(2) *Penicillium* : Multicellular

(3) Morels and truffles : Edible fungi

(4) *Ustilago* : Smut

19. Select the **incorrect** statement. [NCERT Pg. 25]

(1) Kingdom plantae includes all eukaryotic chlorophyll-containing organisms

(2) Life cycle of plants has two distinct phases

(3) Kingdom animalia includes multicellular organisms

(4) Animals store glycogen or starch

20. Mark the **wrong** statement. [NCERT Pg. 27]

(1) Viruses, viroids and prions are acellular

(2) Lichens are symbiotic associations between algae and fungi

(3) Viruses contain genetic material

(4) Prions are abnormally folded RNA molecules

Thinking in Context

1. _____ proposed five kingdom classification. [NCERT Pg. 17]

2. _____ are sole members of kingdom monera. [NCERT Pg. 18]

3. Bacterial ___A___ is very simple, but they are very complex in ___B___. [NCERT Pg. 19]

4. Archaebacteria found in salty areas are called _____. [NCERT Pg. 19]

5. Cyanobacteria have _____ similar to green plants. [NCERT Pg. 19]

6. _____ bacteria oxidise various inorganic substances such as nitrates, nitrites and ammonia and use the released energy for their ATP production. [NCERT Pg. 19]
7. Bacteria mainly reproduce by _____. [NCERT Pg. 20]
8. All single-celled eukaryotes are placed under _____. [NCERT Pg. ??]
9. Chrysophytes includes __A__ and __B__. [NCERT Pg. 20]
10. _____ are chief 'producers' in the ocean. [NCERT Pg. 20]
11. Euglenoids lack cell wall, they have _____ rich layer called pellicle. [NCERT Pg. 21]
12. During unfavourable conditions, the plasmodium of slime moulds differentiates and forms _____. [NCERT Pg. 21]
13. Protozoans are believed to be primitive relatives of _____. [NCERT Pg. 21]
14. Fungi that depend on living plants and animals are called _____. [NCERT Pg. 22]
15. Fusion of two nuclei is called _____. [NCERT Pg. 23]
16. In phycomycetes, asexual reproduction takes place by __A__ or by __B__. [NCERT Pg. 23]
17. Coprophilous fungi grow on _____ [NCERT Pg. 23]
18. The sex organs are generally absent in fungi called _____. [NCERT Pg. 24]
19. _____ is an example of insectivorous plant. [NCERT Pg. 25]
20. The viruses are _____ organisms that are characterized by having inert crystalline structure outside the living cell. [NCERT Pg. 25]

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