

## Chapter 2

# Biological Classification

### INTRODUCTION

- Biological classification is the scientific method to classify the organism into different group on the basis of their similarity or dissimilarity.
- Criteria for classification has been changed with time because knowledge regarding organism is increasing.
- **Aristotle** was the earliest to attempt a more scientific basis of classification. He used simple morphological characters to classify plants into trees, shrubs and herbs.
- Aristotle also divided animals into two groups, those which had red blood (Enaima) and those without red blood (Anaima).

### Classification of living organisms

#### Two kingdom classification

- Given by **Carolus Linnaeus**.
- Linnaeus gave two kingdom classifications. He classified all organisms into two kingdoms – **Kingdom Plantae** and **Kingdom Animalia**.
- Kingdom Plantae includes all plants while Kingdom Animalia includes all animals.
- This system did not distinguish between the eukaryotes and prokaryotes, unicellular and multicellular organisms and photosynthetic (green algae) and non-photosynthetic (fungi) organisms.
- Classification of organisms into plants and animals was easily done and was easy to understand, inspite, a large number of organisms did not fall into either category. Hence the two kingdom classification used for a long time was found inadequate.
- Besides, gross morphology a need was also felt for including other characteristics like cell structure, nature of wall, mode of nutrition, habitat, methods of reproduction, evolutionary relationship, etc., Classification systems for the living organisms have hence, undergone several changes over the time.

#### Three kingdom classification

- In 1866 **Ernst Haeckel** separated all unicellular eukaryotic organisms and named it as **Protista**. The 3 kingdoms were Animalia, Plantae and Protists.

#### Four kingdom classification

- In 1956, **Copeland** created a new Kingdom Monera for prokaryotes and 4 kingdoms were Monera, Protista, Plantae and Animalia.

#### Five kingdom classification

- **R. H. Whittaker** (1969) proposed a five kingdom classification.
- He grouped all organisms into five kingdoms namely **Kingdom Monera**, **Protista**, **Mycota (fungi)**, **Plantae (Metaphyta)**, **Animalia (Metazoa)**.
- The main criteria used by him for making classification are:



- (i) Cell Structure (Complexity of cell)
- (ii) Thallus Organisation (Complexity of organism)/Body organization.
- (iii) Mode of nutrition.
- (iv) Reproduction.
- (v) Phylogenetic relationship.
- Viruses, Prions, Viroids have not assigned to any of these five kingdoms since they have highly unique characters or some uniquely absent characters which will be dealt in later chapters.

Characters	Five kingdoms				
	Monera	Protista	Fungi	Plantae	Animalia
Cell type	Prokaryotic	Eukaryotic	Eukaryotic	Eukaryotic	Eukaryotic
Cell wall	Non-cellulosic (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.)

Characteristics of the five kingdoms

### Three domain system (Six kingdom classification/system)

- In 1977, **Carl Woese** introduced a biological classification with **three domain system**. A domain level was added above the Kingdom level.
- According to this, life forms on the earth come under three domains: **Archaea, Bacteria and Eukarya**.
- In this, prokaryotes are separated into **Archaea** (includes Kingdom Bacteria) while Eukaryotes formed **Eukarya** (includes four Kingdoms i.e., Protista, Mycota, Plantae and Animalia) hence three domain system is also called **six kingdom** classification.

### Five kingdoms

1. **Monera**: All the Prokaryotes (Eubacteria, Rickettsia, Chlamydia, Actinomycetes, Blue green algae, Archaeobacteria, Mycoplasma)
2. **Protista**: All the unicellular eukaryotes (Dinoflagellates, Diatoms, Euglenoids, Slime moulds (false fungi) and Protozoans.
3. **Mycota (Fungi)**: True fungi
4. **Plantae**: All the multicellular plants – Algae, Bryophyta, Pteridophyta, Gymnosperm, Angiosperm.
5. **Animalia**: All the multicellular animals.

### Some drawbacks of earlier classification systems

- It is brought together the prokaryotic bacteria and the blue green algae with other groups which are eukaryotic.
- It grouped together the unicellular organisms and the multicellular ones, for **example**, *Chlamydomonas* and *Spirogyra* were placed together under algae.



- The classification did not differentiate between the heterotrophic group-fungi and the autotrophic green plants, though they also showed a characteristic difference, in their walls while the green plants had a cellulosic cell wall.
- All prokaryotic organisms were grouped together under Kingdom Monera and the unicellular eukaryotic organisms were placed in Kingdom Protista.
- Kingdom Protista has brought together *Chlamydomonas*, *Chlorella* (earlier placed in Algae within plants and both having cell walls) with *Paramecium* and *Amoeba* (Which were earlier placed in the animal kingdom which lack cell wall).
- An Attempt has been made to evolve a classification system which reflects not only the morphological, physiological and reproductive similarities, but is also phylogenetic, i.e., is based on evolutionary relationships.

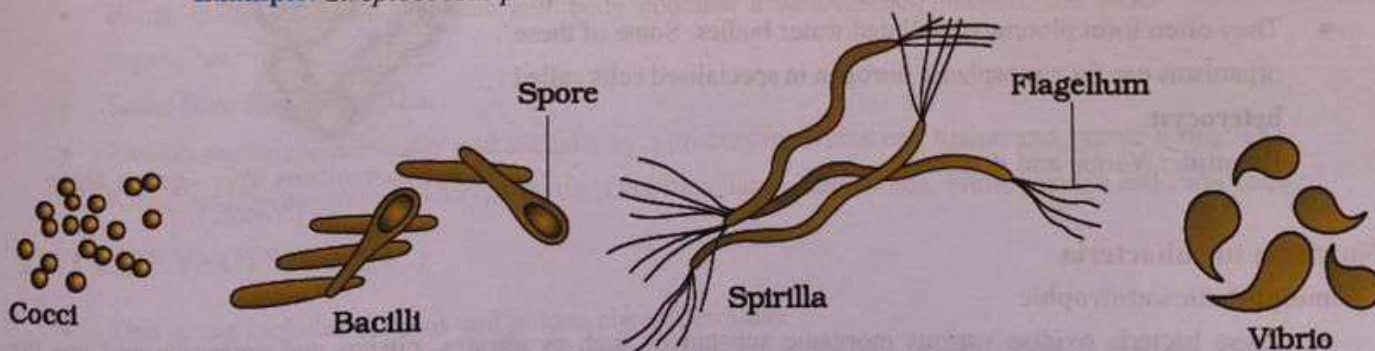
## 2.1 KINGDOM MONERA

- Bacteria are the sole members of the Kingdom Monera. They are the most abundant micro-organisms.
- **Habitat:** Bacteria live in extreme habitats such as hot springs, deserts, snow and deep oceans where very few other life forms can survive.
- Many of them live in or on other organisms as parasites.
- **Shape of Bacteria:** Bacteria show large variations in their shape. On the basis of their shape bacteria are of different types.

### 1. Coccus/ Cocci

- These Bacteria are spherical
- These are smallest bacteria
- Maximum resistant bacteria

**Example:** *Streptococcus pneumoniae*



**Bacteria of different shapes**

### 2. Bacillus / Bacilli

- This group includes most of the bacteria.
- These are rod shaped.

**Example:** *E.coli*, *Bacillus anthracis*.

### 3. Spirillum / Spirilla

- These are spiral shaped bacteria

**Example:** *Spirillum voluntans*, *Treponema*

### 4. Comma / Vibrio

- These are comma shaped bacteria.

**Example:** *Vibrio cholerae*



**Nutrition in bacteria**

- The bacterial structure is very simple, they are very complex in behaviour.
- Bacteria as a group show the most extensive metabolic diversity.
- Some of the bacteria are autotrophic, i.e., they synthesise their own food from inorganic substrates.
- They may be photosynthetic autotrophic or chemosynthetic autotrophic.
- The vast majority of bacteria are heterotrophs, i.e., they depend on other organisms or on dead organic matter for food.

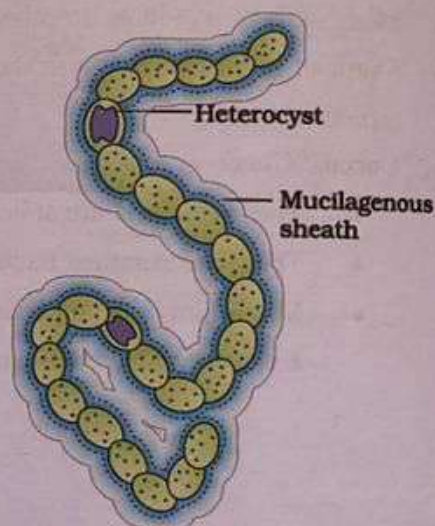
**2.1.1 ARCHAEABACTERIA**

- These bacteria live in some of the most harsh habitats such as extreme salty areas (halophiles), hot springs (thermoacidophiles) and marshy areas (methanogens).
- It differs from other bacteria in having a different cell wall structure and this feature is responsible for their survival in extreme conditions.
- Methanogens are responsible for the production of methane (biogas) from the dung of these animals.

**2.1.2 EUBACTERIA**

- They are characterised by the presence of a rigid cell wall, and if motile, a flagellum.
- The cyanobacteria (also referred to as blue-green algae) have chlorophyll a similar to green plants and are photosynthetic autotrophs.
- The cyanobacteria are unicellular, colonial or filamentous, fresh water/marine or terrestrial algae.
- The colonies are generally surrounded by gelatinous sheath.
- They often form blooms in polluted water bodies. Some of these organisms can fix atmospheric nitrogen in specialised cells called **heterocyst**.

**Example:** *Nostoc* and *Anabaena*



**A Filamentous blue - green algae (*Nostoc*)**

**Nutrition in eubacteria****Chemosynthetic autotrophic**

- These bacteria oxidise various inorganic substances such as nitrates, nitrites and ammonia and use the released energy for their ATP production.
- They play a great role in recycling nutrients like nitrogen, phosphorous, iron and sulphur.

**Heterotrophic bacteria**

- These are most abundant in nature.
- The majority are important decomposers.
- Many of them have a significant impact on human affairs.
- They are helpful in making curd from milk, production of antibiotics, fixing nitrogen in legume roots, etc.,

**Disease caused by Eubacteria**

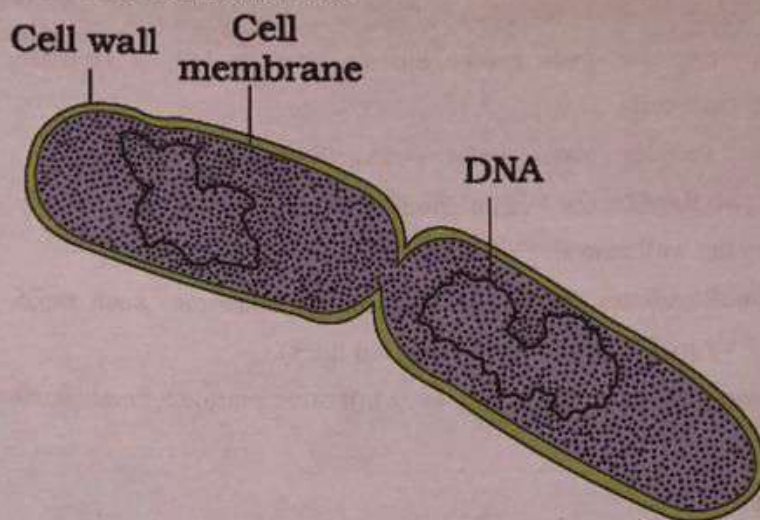
Cholera, typhoid, tetanus, citrus canker are well known diseases caused by different bacteria.

**Reproduction in Eubacteria**

- **By Binary Fission:** It takes place during favourable conditions.
- **By Spore - Formation:** It takes place in unfavourable conditions, spores are thick walled and highly resistant.



- **By Sexual Reproduction:** They also reproduce by a sort of sexual reproduction by adopting a primitive type DNA transfer from one bacterium to the other.



A dividing bacterium

### Mycoplasma

- Mycoplasma are organisms that completely lack a cell wall
- Mycoplasma are the smallest living cells known and can survive without oxygen.
- Many mycoplasma are pathogenic in animals and plants.

## 2.2 KINGDOM PROTISTA

- Kingdom Protista contains all single-celled eukaryotes.
- Members of Protista are primarily aquatic
- This kingdom forms a link with the others dealing with plants, animals and fungi
- Being eukaryotes, the protistan cell body contains a well-defined nucleus and other membrane-bound organelles.
- Some have flagella or cilia.
- Protists reproduce asexually and sexually by a process involving cell fusion and zygote formation.
- Kingdom Protista include Chrysophytes, Dinoflagellates, Euglenoids, Slime moulds and Protozoans.

### 2.2.1 CHRYSOPHYTES

- This group includes diatoms and golden algae (desmids).
- They are found in fresh water as well as in marine environment.
- They are microscopic and float passively in water current (Plankton)
- Most of them are photosynthetic.
- In diatoms the cell walls form two thin overlapping shells, which fit together as in a soap box.
- The walls of diatoms are embedded with silica and thus the walls are indestructible.
- Diatoms have left behind large amount of cell wall deposits in their habitat; this accumulation over billions of years is referred to as '**diatomaceous earth**'

#### Uses of Diatomaceous earth

- Stone polishing
- Filtration of oils and syrups
- Sound proofing.
- Diatoms are the chief 'Producers' in the oceans.



### 2.2.2 DINOFLAGELLATES

- Dinoflagellates are mostly marine and photosynthetic.
- Dinoflagellates appear yellow, green, brown, blue or red depending on the main pigments present in their cells.
- The cell wall has stiff cellulose plates on the outer surface.
- Most of them have two flagella; one lies longitudinally and the other transversally in a furrow between the wall plates.
- Very often, red dinoflagellates (**Example:** *Gonyaulax*) undergoes such rapid multiplication that they make the sea appear red (red tides).
- Toxins released by such large numbers may even kill other marine animals such as fishes.



*Dinoflagellates*

### 2.2.3 EUGLENOIDS

- Majority of Euglenoids are fresh water organisms found in stagnant water.
- Instead of a cell wall, Euglenoids have a protein rich layer called **pellicle** which makes their body flexible.
- Euglenoids have two flagella, a short and a long one.
- Euglenoids are photosynthetic in the presence of sunlight, when deprived of sunlight they behave like heterotrophs by predating on other smaller organisms.
- The pigments of euglenoids are identical to those present in higher plants.

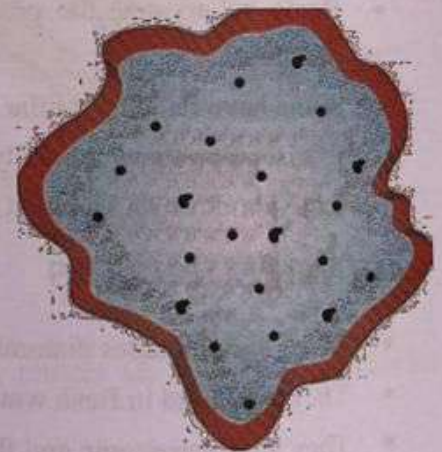
**Example:** *Euglena*



*Euglena*

### 2.2.4 SLIME MOULDS

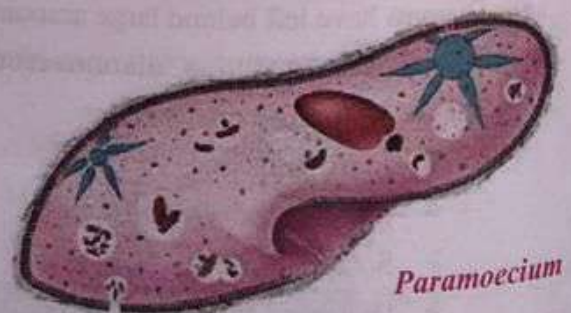
- Slime moulds are saprophytic protists.
- The body moves along decaying twigs and leaves engulfing organic material.
- Under suitable conditions, they form an aggregation called plasmodium which may grow and spread over several feet.
- During unfavourable conditions, the plasmodium differentiates and forms fruiting bodies bearing spores at their tips.
- The spores possess true walls.
- They are extremely resistant and survive for many years, even under adverse conditions. The spores are dispersed by air currents.



*Slime mould*

### 2.2.5 PROTOZOANS

- All protozoans are heterotrophs and live as predators or parasites.
- They are believed to be primitive relatives of animals.



*Paramoecium*



### There are four major groups of protozoans

Classified into groups	Locomotory Organelles	Features	Examples
Amoeboid Protozoans	Pseudopodia	<ul style="list-style-type: none"> <li>These are found in fresh water or moist soil.</li> <li>They move and capture their prey by putting out pseudopodia.</li> <li>Marine forms may have silica shells.</li> </ul>	<i>Amoeba</i> (Free living), <i>Entamoeba</i> (Parasitic)
Flagellated Protozoans	Flagella	<ul style="list-style-type: none"> <li>Free living (aquatic) or parasitic</li> </ul>	<i>Trypanosoma</i> (Disease-African sleeping sickness)
Ciliated Protozoans	Cilia	<ul style="list-style-type: none"> <li>Aquatic</li> <li>Numerous cilia are present over the body.</li> <li>They have a cavity (gullet) that opens to the outside of the cell surface.</li> </ul>	<i>Paramecium</i>
Sporozoans	Absent	<ul style="list-style-type: none"> <li>These possess spore like infectious stage</li> <li>The most notorious is <i>Plasmodium</i></li> </ul>	<i>Plasmodium</i> (Malarial Parasite)

## 2.3 KINGDOM FUNGI

- The fungi constitute a unique kingdom of heterotrophic organisms.
- Fungi show a great diversity in morphology and habitat.

### Habitat

- Fungi are cosmopolitan and occur in air, water, soil and on animals and plants.
- Fungi prefer to grow in warm and humid places.
- Fungi can be observed on moist bread and rotten fruits.

### Characteristic features

- The cell walls of fungi are composed of chitin and polysaccharides.
- With the exception of yeasts which are unicellular, fungi are filamentous.
- Fungi bodies consist of long, slender thread-like structures called hyphae. The network of hyphae is known as mycelium.
- Some hyphae are continuous tubes filled with multinucleated cytoplasm – these are called coenocytic hyphae. Others have septae or cross walls in their hyphae.
- Most fungi are heterotrophic and absorb soluble organic matter from dead substrates and hence called **saprophytes**.
- Those that depend on living plants and animals are called **parasites**.
- They can also live as symbionts – in association with algae as lichens and with roots of higher plants as **mycorrhiza**.

### Reproduction

#### (1) Vegetative reproduction.

- In fungi vegetative reproduction takes place mainly by 3 methods.
  - Fragmentation:** Example: Moulds, Mushrooms
  - Budding:** Example: *Saccharomyces* (yeast)
  - Fission:** Example: *Schizosaccharomyces* (yeast)



### Note

- Reproduction through bud formation and fission takes place only in non-mycelial form.

### (2) Asexual reproduction

- Asexual reproduction takes place by the formation of different types of spores.
- These spores are formed by mitotic division.
- Asexual reproduction is by spores called conidia or sporangiospores or zoospores.

### (3) Sexual reproduction

- Sexual reproduction is by oospores, ascospores and basidiospores.
- The various spores are produced in distinct structures called fruiting bodies.
- Sexual reproduction in fungi gets completed in three steps.

(A) **Plasmogamy**: It is the fusion of protoplasm between two motile or non-motile gametes.

(B) **Karyogamy**: It is the fusion of two nuclei.

(C) **Meiosis**: Meiosis in zygote resulting in haploid spores.

- The morphology of the mycelium, mode of spore formation and fruiting bodies form the basis for the division of the kingdom into various classes.

### Classification of fungi

Fungi are divided into four classes on the basis of

- Morphology of the mycelium.
- Mode of spore formation.
- Fruiting bodies.

#### 2.3.1 PHYCOMYCETES

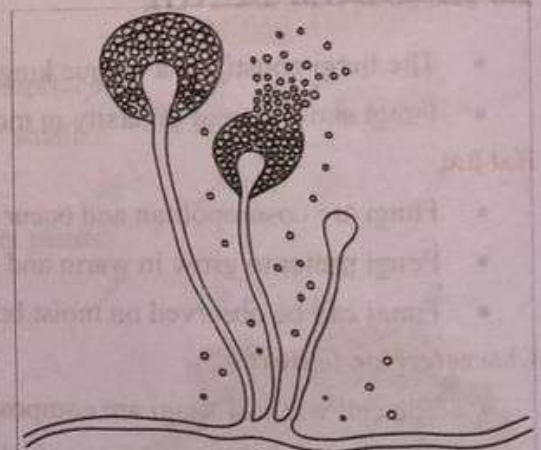
[Gr., phyco = algae; mycetes = fungi]

- **Habitat**: Found in aquatic habitats, on decaying wood in moist and damp places or as obligate parasites on plants.
- **Mycelium**: Aseptate and coenocytic
- **Asexual reproduction**: Takes place by zoospores (motile) or by aplanospores (non-motile). These spores are endogenously produced in sporangium.
- **Sexual reproduction**: In some members is by fusion of similar gametes (Isogamous) or dissimilar gametes (anisogamy/oogamy).
- A zygospore is formed by fusion of two gametes.

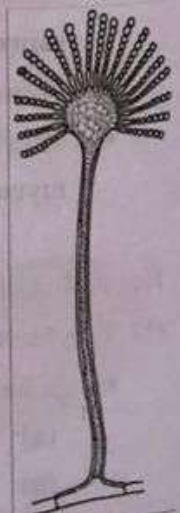
**Examples**: *Albugo* (parasitic on mustard), *Rhizopus* (bread mould) and *Mucor* (cause spoilage of bread, pickles etc.,)

#### 2.3.2 ASCOMYCETES (SAC FUNGI)

- **Habitat**: Saprophytic, decomposers, parasitic or coprophilous (growing on dung).
- **Mycelium**: Branched and septate.
- **Asexual Reproduction**: The asexual spores are conidia produced exogenously on the special mycelium called **Conidiophores**.
- Conidia on germination produce mycelium.



*Mucor*



*Aspergillus*



- **Sexual reproduction:** Sexual spores are called ascospores which are produced endogenously in sac like asci (singular ascus).
- These asci are arranged in different types of fruiting bodies called ascocarps.

**Example:** *Aspergillus*, *Neurospora*, *Claviceps* and members like morels and truffles.

### 2.3.3 BASIDIOMYCETES (BRACKET FUNGI, PUFFBALLS OR MUSHROOMS)

- **Habitat:** Grow in soil, on logs and tree stumps and in living plant bodies as parasites.

**Example:** rusts and smuts.

- **Mycelium:** Branched and septate.

- **Asexual reproduction:** Absent and vegetative reproduction is by fragmentation of the thallus.

- **Sexual reproduction:** 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 takes place in the basidium producing four basidiospores.
- The basidiospores are exogenously produced on the basidium.
- The basidia are arranged in fruiting bodies called basidiocarps.

**Examples:** *Agaricus* (mushroom), *Ustilago* (smut), *Puccinia* (rust fungus).



*Agaricus*

### 2.3.4 DEUTEROMYCETES (IMPERFECT FUNGI)

- Commonly known as imperfect fungi because only the asexual or vegetative phases of these fungi are known.
- Once perfect (sexual) stages of members of deuteromycetes were discovered they were often moved to ascomycetes and basidiomycetes.

- **Habitat:** Mostly decomposers, some are saprophytes or parasites.

- **Mycelium:** Branched and septate.

- **Reproduction:** Reproduce only by asexual spores known as conidia.

**Examples:** *Alternaria*, *Colletotrichum* and *Trichoderma*.

#### Importance of Fungi

- Some unicellular fungi, e.g., yeast are used to make bread and beer.
- Some are the source of antibiotics, e.g., *Penicillium*.
- *Neurospora* (Ascomycetes) is used extensively in biochemical and genetic work.
- Many members of class ascomycetes like morels and truffles are edible and are considered delicacies.
- A large number of deuteromycetes are decomposers of litter and help in mineral cycling.

#### Harmful activities of Fungi

- White spots seen on mustard leaves are due to a parasitic fungus.
- Fungal infections spoil fruits and the food stored in refrigerators.
- Fungi cause diseases in plants and animals like wheat rust caused by *Puccinia*.

### 2.4 KINGDOM PLANTAE

- All eukaryotic chlorophyll containing organisms commonly called plants are included under Kingdom Plantae.
- Few of them are partially heterotrophic such as insectivorous plants (e.g., Bladderwort and Venus fly trap) or parasites (e.g., *Cuscuta*)



## BIOLOGICAL CLASSIFICATION

- The plant cells have an eukaryotic structure with prominent chloroplasts and cell wall which is mainly made up of cellulose.
- Kingdom Plantae includes Algae, Bryophytes, Pteridophytes, Gymnosperms and Angiosperms.
- In plants, life cycle has two distinct phases i.e., the diploid sporophytic and haploid gametophytic that alternate with each other. This phenomenon is called alternation of generation.

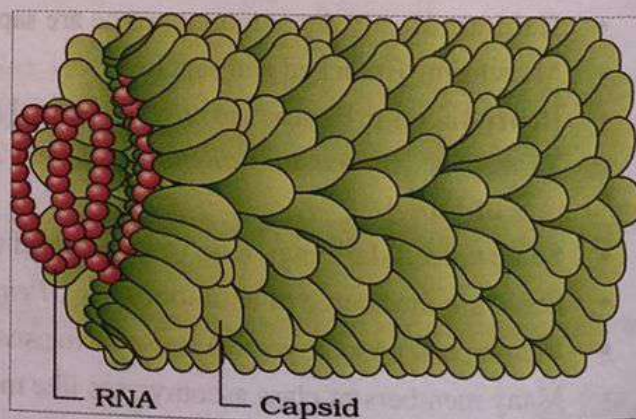
## 2.5 KINGDOM ANIMALIA

- Kingdom Animalia is characterised by heterotrophic eukaryotic organisms that are multicellular and their cells lack cell walls.
- They directly or indirectly depend on plants (autotrophs) for nutrition.
- In these members, the digestion of food takes place in an internal cavity and they store their food reserves in the form of glycogen or fat.
- Their mode of nutrition is holozoic by ingestion of food. They follow a definite growth pattern and grow into adults that have a definite shape and size.
- Most of them are capable of locomotion.
- Higher forms of kingdom animalia show elaborate sensory and neuromotor mechanism.
- The sexual reproduction is by copulation of male and female followed by embryological development.

## 2.6 VIRUSES, VIROIDS, PRIONS AND LICHENS

## Virus

- The viruses are non-cellular organisms that are characterized by having an inert crystalline structure outside the living cell. Once they infect a cell they take over the machinery of the host cell to replicate themselves killing the host.
- **Dmitri Ivanowsky (1892):** Ivanowsky recognised certain microbes as causal organism of the mosaic disease of tobacco.
- These were found to be smaller than bacteria because they passed through bacteria-proof filters.
- **M.W Beijerinck (1898):** He demonstrated that the extract of the infected plants of tobacco could cause infection in healthy plants and called the fluid as *contagium vivum fluidum* (infectious living fluid)
- **W.M Stanley (1935):** He showed that Viruses could be crystallized and crystals consist largely of proteins.
- They are inert outside their specific host cell. Viruses are obligate parasites.
- In addition to proteins, viruses also contain genetic material that could be either DNA or RNA. No virus contains both RNA and DNA.
- A virus is a nucleoprotein and the genetic material is infectious.
- In general, viruses that infect plants have single stranded RNA and Viruses that infect animals have either single or double stranded RNA or double stranded DNA.
- Bacterial viruses or bacteriophage (Viruses that infect the bacteria) are usually double stranded DNA Viruses.



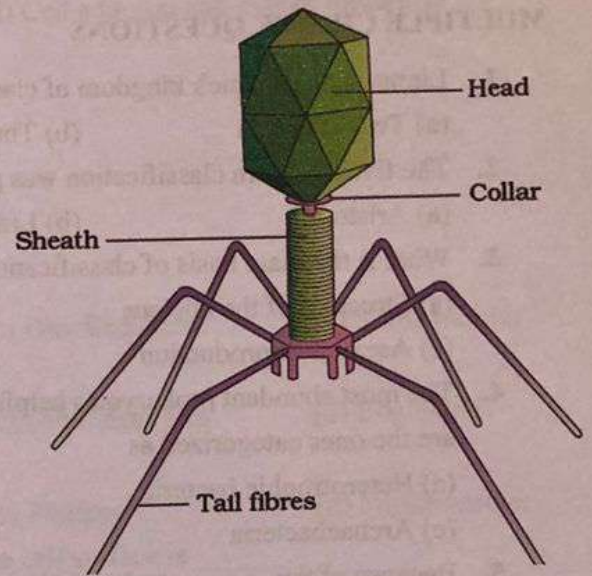
Tobacco Mosaic Virus (TMV)



- The protein coat called capsid made of small subunits called capsomeres protects the nucleic acid.
- These capsomeres are arranged in helical or polyhedral geometric forms.
- Viruses cause diseases like mumps, small pox, herpes, measles, polio, swine flu, common cold, yellow fever and influenza.
- AIDS in humans is also caused by a virus.
- In plants, the symptoms can be mosaic formation, leaf rolling and curling, yellowing and vein clearing, dwarfing and stunted growth.

### Viroids

- In 1971, T.O. Diener discovered a new infectious agent that was smaller than viruses and caused potato spindle tuber disease.
- It was found to be a free RNA.
- It lacks the protein coat that is found in viruses, hence the name viroid.
- The RNA of the viroid was of low molecular weight.



**Bacteriophage**

### Prions

- In modern medicine certain infectious neurological diseases were found to be transmitted by an agent consisting of abnormally folded protein.
- The agent was similar in size to viruses. These agents were called prions.
- The most notable diseases caused by prions are bovine spongiform encephalopathy (BSE) commonly called mad cow disease in cattle and its analogous variant Cr-Jacob disease (CJD) in humans.

### Lichens

- Lichens are symbiotic associations, i.e., mutually useful associations, between algae and fungi.
- The algal component is known as phycobiont (Chlorophyceae) and fungal component as mycobiont (Ascomycetes), which are autotrophic and heterotrophic respectively.
- Algae prepare food for fungi and fungi provide shelter and absorb mineral nutrients and water for its partner.
- Lichens are very good indicators of pollution. They do not grow in polluted areas as they are sensitive to sulphur dioxide.



## EXERCISE

## MULTIPLE CHOICE QUESTIONS

- Linnaeus used which kingdom of classification?  
 (a) Two kingdom (b) Three Kingdom (c) Four Kingdom (d) Five Kingdom
- The five kingdom classification was proposed by  
 (a) Aristotle (b) Linnaeus (c) R.H. Whittaker (d) T.O. Diener
- What is the main basis of classification in the five-kingdom system?  
 (a) Structure of the nucleus (b) Structure of cell wall  
 (c) Asexual Reproduction (d) Mode of Nutrition
- The most abundant prokaryotes helpful to humans in making curd from milk and in production of antibiotics are the ones categorized as  
 (a) Heterotrophic bacteria (b) Chemosynthetic autotrophs  
 (c) Archaeobacteria (d) Cyanobacteria
- Because of the \_\_\_\_\_ archaeobacteria can endure harsh environments.  
 (a) They are the oldest living organisms on Earth  
 (b) They have complicated metabolic processes in their bodies  
 (c) Rigid cell walls  
 (d) Double membrane nuclei
- Methanogens are found in the \_\_\_\_\_ of a ruminant.  
 (a) Mouth (b) Guts  
 (c) Cow's respiratory system (d) Cow's ribs
- Choose the incorrect statement  
 (a) Methanogens are archaeobacteria that produce methane in marshy areas.  
 (b) *Nostoc* is a filamentous blue green alga which fixes atmospheric nitrogen.  
 (c) Chemosynthetic autotrophic bacteria synthesize cellulose from glucose.  
 (d) *Mycoplasma* lacks a cell wall and can survive without oxygen.
- Which of the following organisms can be found in extreme saline conditions?  
 (a) Eubacteria (b) Archaeobacteria (c) Cyanobacteria (d) *Mycobacteria*
- Which of the following statements regarding cyanobacteria is false?  
 (a) Also referred as blue green algae. (b) Are chemosynthetic autotrophs.  
 (c) Have chlorophyll a similar to green plants. (d) Form blooms in polluted water bodies.
- Which statement regarding *Mycoplasma* is false?  
 (a) Has a stiff cell wall (b) Smallest living cell known  
 (c) Can survive without oxygen (d) Pathogenic in animals and plants
- In which of the following kingdom are Archaea and Nitrogen-fixing organisms classified?  
 (a) Animalia (b) Plantae (c) Monera (d) Fungi
- Blue-green algae belong to \_\_\_\_\_.  
 (a) Protista (b) Monera (c) Fungi (d) Plantae
- All Prokaryotes are placed under \_\_\_\_\_.  
 (a) Monera (b) Protista (c) Fungi (d) Mycota
- All single celled eukaryotes are placed under \_\_\_\_\_.  
 (a) Monera (b) Protista (c) Fungi (d) Archaea



15. Protists reproduce asexually and sexually by a process involving \_\_\_\_\_.
  - (a) Cell fission and zygote formation
  - (b) Cell fusion and zygote formation
  - (c) Cell lysis and zygote formation
  - (d) Cell addition and zygote formation
16. Identify the incorrect statement
  - (a) Diatoms are microscopic and float in water passively
  - (b) Diatoms are chief producers in oceans
  - (c) Diatomaceous earth is formed by the cell walls of diatoms
  - (d) Walls of diatoms are easily destructible
17. Which of the following groups of protists resemble animals?
  - (a) Chrysophytes
  - (b) Protozoa
  - (c) Dinoflagellates
  - (d) Slime moulds
18. Diatoms belong to the following classifications: \_\_\_\_\_.
  - (a) Chrysophytes
  - (b) Protozoans
  - (c) Dinoflagellates
  - (d) Euglenoids
19. African sleeping sickness is caused by \_\_\_\_\_.
  - (a) *Trypanosoma*
  - (b) *Plasmodium*
  - (c) *Euglena*
  - (d) *Paramoecium*
20. The protozoan that has a gullet that opens to the outside of the cell surface is \_\_\_\_\_.
  - (a) Amoeboid
  - (b) Flagellated
  - (c) Ciliated
  - (d) Sporozoan
21. The most notorious sporozoan that has a staggering effect on human population is \_\_\_\_\_.
  - (a) *Entamoeba*
  - (b) *Trypanosoma*
  - (c) *Paramoecium*
  - (d) *Plasmodium*
22. The imperfect fungi that are decomposers of litter and help in mineral cycling belong to
  - (a) Basidiomycetes
  - (b) Deuteromycetes
  - (c) Ascomycetes
  - (d) Phycomycetes
23. Identify the incorrect statement
  - (a) *Neurospora* is used in the study of biochemical genetics
  - (b) *Penicillium* is a source of antibiotics
  - (c) Yeast is unicellular and used to make bread and beer
  - (d) Morels and truffles are poisonous mushrooms
24. Which of the following statements is false about the fungi?
  - (a) They are eukaryotes
  - (b) They are heterotrophs
  - (c) Yeast is unicellular
  - (d) Cell wall is purely cellulosic
25. The parasitic fungi on mustard is \_\_\_\_\_.
  - (a) *Puccinia*
  - (b) *Albugo*
  - (c) *Rhizopus*
  - (d) *Mucor*
26. Who discovered causal organisms of the mosaic disease of tobacco?
  - (a) Dmitri Ivanowsky
  - (b) M.W. Beijerinck
  - (c) W.M. Stanley
  - (d) T.O. Diener
27. The infectious fluid was called *Contagium vivum fluidum* by \_\_\_\_\_.
  - (a) Dmitri Ivanowsky
  - (b) M.W. Beijerinck
  - (c) W.M. Stanley
  - (d) T.O. Diener
28. Who showed that viruses can be crystallised?
  - (a) Dmitri Ivanowsky
  - (b) M.W. Beijerinck
  - (c) W.M. Stanley
  - (d) T.O. Diener
29. T.O. Diener discovered \_\_\_\_\_.
  - (a) Bacteriophage
  - (b) Infectious protein
  - (c) Free infectious DNA
  - (d) Free infectious RNA
30. CJD in humans is caused by
  - (a) Viruses
  - (b) Viroids
  - (c) Prions
  - (d) Lichens
31. Bacteriophages are viruses that have
  - (a) Single stranded RNA
  - (b) Single stranded DNA
  - (c) Double stranded RNA
  - (d) Double stranded DNA



FILL IN THE BLANKS

[Cyanobacteria, Bacteria, Heterocysts, Halophiles, Desmids, Phylogenetic, Diatoms, Methanogens, Gelatinous, Cell wall, *Gonyaulax*, *Plasmodium*, *Puccinia*, Prions, Thermoacidophiles]

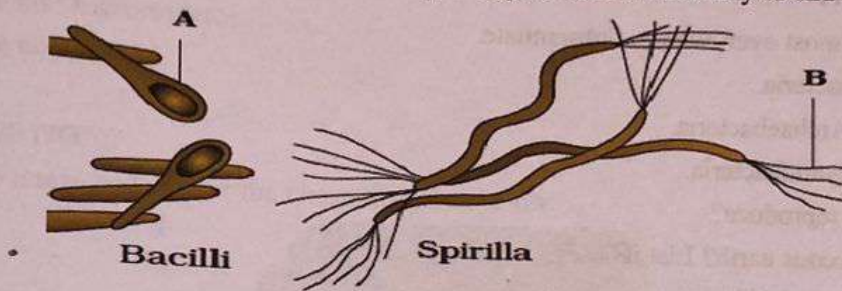
1. Earlier classification system included Bacteria, blue green algae, fungi, mosses, ferns, gymnosperms and angiosperms under plants because of the presence of \_\_\_\_\_ in their cells.
2. The \_\_\_\_\_ system of classification is based on evolutionary relationship.
3. \_\_\_\_\_ are the sole members of the kingdom Monera.
4. Archaeobacteria found in marshy areas are \_\_\_\_\_.
5. Archaeobacteria found in hot springs are \_\_\_\_\_.
6. Archaeobacteria found in salty areas are \_\_\_\_\_.
7. The colonies of cyanobacteria are generally surrounded by \_\_\_\_\_ sheath.
8. \_\_\_\_\_ often form blooms in polluted water bodies.
9. *Nostoc* and *Anabaena* can fix atmospheric nitrogen in specialised cells called \_\_\_\_\_.
10. Chrysophytes include \_\_\_\_\_.
11. The chief producers in the oceans are \_\_\_\_\_.
12. Red tides are caused by \_\_\_\_\_.
13. Under suitable conditions, slime moulds form an aggregation called \_\_\_\_\_.
14. Wheat rust is caused by \_\_\_\_\_.
15. The abnormally folded proteins causing neurological diseases are \_\_\_\_\_.

TWO MARK QUESTIONS

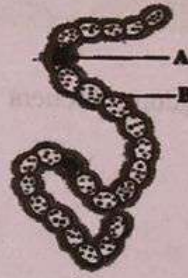
1. Two kingdom classification used for a long time was found inadequate. Substantiate.
2. List the main criteria for the five kingdom classification.
3. Classify bacteria based on their shape.
4. Dung of cows and buffaloes are used for biogas production. Why?
5. Write a note on chemosynthetic autotrophic bacteria.
6. List the economic importance of heterotrophic bacteria.
7. List the uses of heterotrophic bacteria.
8. Differentiate between chemosynthetic and photosynthetic forms of eubacteria.
9. Mention any four diseases caused by bacteria.
10. Draw a neat labelled diagram of a dividing bacterium.
11. How do Protists reproduce?
12. Mention the economic importance of diatoms.
13. Mention the four major groups of Protozoans.
14. List the four classes of kingdom Fungi.
15. Name the fruiting bodies of
  - (a) Ascomycetes
  - (b) Basidiomycetes.
16. List any four importances of fungi in our life.
17. Give two examples of fungal symbiotic associations.
18. What is the basis for the division of kingdom fungi into various classes?
19. List any four importances of fungi in our life.



20. Observe the picture of bacteria of different shapes is given below. Identify A and B



21. Observe the filamentous blue green algae *Nostoc*. Identify A and B



22. What do the following terms mean
- Coenocytic hyphae
  - Dikaryophase
23. Name the
- asexual motile spores of Phycomycetes
  - asexual spores in Ascomycetes
24. What do the following terms mean
- Coenocytic hyphae
  - Dikaryophase
25. Name the
- asexual motile spores of Phycomycetes
  - asexual spores in Ascomycetes
26. Give two examples of fungal symbiotic associations.
27. What is the basis for the division of kingdom fungi into various classes?
28. Identify the fungus that causes
- Wheat rust
  - Bread mould
29. Draw a labelled diagram of Bacteriophage.
30. Mention any two living and nonliving characters of viruses.
31. List four diseases caused by viruses in animals.
32. Classify the viruses with respect to the nature of genetic material.
33. Write any two differences between Viruses and viroids.
34. List two neurological diseases caused by prions.
35. Write the algal and fungal components of lichens.
36. Differentiate between phycobiont and mycobiont.
37. When observed under the microscope, the organism appeared unicellular, with well-defined nucleus, Biflagellate with one flagellum longitudinally and the other transversely. Identify the organism and mention the kingdom to which it belongs.
38. What do the terms algal blooms and red tides signify?



### THREE MARK QUESTIONS

1. Bacteria occur almost everywhere. Substantiate.
2. Classify Archaeobacteria.
3. Write a note on Archaeobacteria.
4. Write a note on cyanobacteria.
5. How do bacteria reproduce?
6. What is diatomaceous earth? List its uses.
7. Write a note on amoeboid protozoans.
8. Write a note on flagellated protozoans.
9. Write a note on ciliated protozoans.
10. Write a note on sporozoans.
11. Give a comparative account of the kingdoms Monera and Protista with respect to cell type, cell wall, body organization.
12. Describe the structure of fungal body.
13. Fungi are heterotrophic. Justify.
14. Explain the sexual cycle of fungi.
15. List six symptoms of viral diseases in plants.
16. Explain the structure of a virus.
17. Write a note on viroids.
18. Write a note on prions.
19. Write a note on Lichens.
20. Identify the following:
  - (a) Pollution indicators
  - (b) Low molecular weight free infectious RNA
  - (c) Abnormally folded protein causing neurological diseases.
21. Name a disease caused by the following: (a) Viroids (b) Viruses (c) Prions.
22. Cyanobacteria and heterotrophic bacteria though vastly different have been clubbed together in eubacteria of kingdom Monera according to five kingdom classification. Is the grouping of the two types of taxa in the same kingdom justified?

### FIVE MARK QUESTIONS

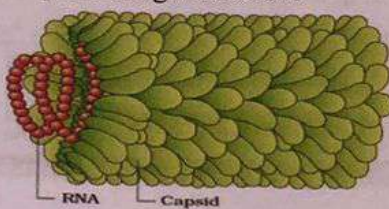
1. Explain the salient features of kingdom Monera.
2. Write a note on Eubacteria.
3. Explain the modes of Nutrition in Bacteria.
4. Write the salient features of kingdom Protista.
5. Write a note on Chrysophytes.
6. Write a note on Dinoflagellates.
7. Write a note on Euglenoids.
8. Write a note on Slime moulds.
9. Write a note on Protozoans.
10. List the economic importance of fungi.
11. Explain the various modes of reproduction seen in fungi.
12. Write a note on Phycomycetes.
13. Write a note on Ascomycetes.



14. Write a note on Basidiomycetes.
15. Write a note on Deutromycetes.
16. Write a note on viruses.

### FIVE MARK QUESTIONS

1. Observe the image and answer the questions given below.



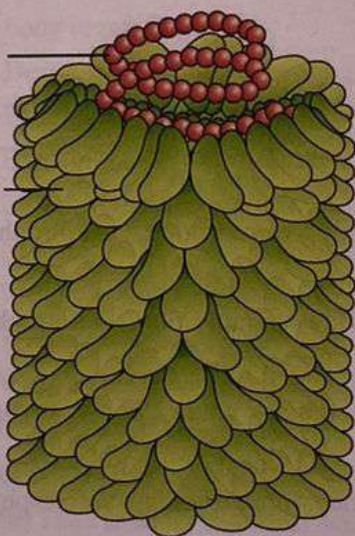
- (a) Identify the virus.
  - (b) What is a capsid?
  - (c) What is the function of the capsid?
  - (d) What are the subunits of capsid called?
  - (e) How are the subunits arranged?
2. Identify the kingdom:
    - (a) Prokaryotic, non cellulosic cell wall, cellular grade body organisation, autotrophic and heterotrophic mode of nutrition.
    - (b) Eukaryotic, cell wall present in some, cellular grade body organisation, autotrophic and heterotrophic mode of nutrition.
    - (c) Eukaryotic, chitinous cell wall, multicellular or loose tissue grade body organisation, heterotrophic mode of nutrition.
    - (d) Eukaryotic, cellulosic cell wall, tissue or organ grade body organisation, autotrophic mode of nutrition.
    - (e) Eukaryotic, cell wall absent, tissue or organ or organ system grade of body organisation, heterotrophic mode of nutrition.
  3. (a) Identify the class of fungi based on the examples given.
    - i. *Alternaria*, *Colletotrichum*, *Trichoderma*
    - ii. *Agaricus*, *Ustilago*, *Puccinia*
    - iii. *Aspergillus*, *Claviceps*, *Neurospora*
    - iv. *Mucor*, *Rhizopus*, *Albugo*
  - (b) Deuteromycetes are known as imperfect fungi. Why?
  4. Identify the following:
    - (a) Causes wheat rust disease.
    - (b) Found on bread mould.
    - (c) Extensively used in biochemical and genetic work.
    - (d) Parasitic fungi on mustard
    - (e) Used to make bread and beer.
  5. (a) Identify the classes of fungi based on the characters:
    - i. Mycelium is aseptate and coenocytic. Asexual spores are endogenously produced.
    - ii. Mycelium is branched and septate. Asexual spores are exogenously produced.
    - iii. Mycelium is branched and septate. Asexual spores are generally not found.
    - iv. Mycelium is branched and septate. Only asexual or vegetative phases are known.
  - (b) Name the class of coprophilous fungus.



6. Identify the type of Protist based on the characters given below:
- Microscopic planktons found both in fresh water as well as marine water, cell wall embedded with silica.
  - Marine, photosynthetic, two flagella, cell wall with stiff cellulose plates on outer surface.
  - Found in stagnant water, two flagella, protein rich pellicle, photosynthetic.
  - Saprophytic, forms plasmodium, spores are extremely resistant.
  - Predators or parasites, primitive relatives of animals.

## Diagram Based Questions

1. Observe the image and answer the questions given below.



- Identify the virus.
- What is a capsid?
- What is the function of the capsid?
- What are the subunits of capsid called?
- How are the subunits arranged?

\* \* \*