CHAPTER-2

BIOLOGICAL CLASSIFICATION

Facts that Matter

Artificial Classification System: it was used by Linneaus.The artificial classification system was based on Vegetative characters or on the androecium structure.Both vegetative and sexual characters, were given equal weightage.

Natural Classification System. It was based on natural affinities among organisms.BothExernal and internal features were into account.It was used by GeorgeBenthan and Joseph Dalton Hooker.

Phylogenetic Classification System: This system is currently In use. It is based evolutionary relationships among organisms.

Two Kingdom Classification Proposed by Linnaeus

-Animal Kingdom

-Plant Kingdom

Five Kingdom Classification as proposed by RH. Whittaker (1969):

-Monera

-Protista

-Fungi

-Plantae and

-Animalia.

The main criteria for classification used by Whittaker:

-Cell Structure
-Thallus Organization
-Mode of Nutrition
-Reproduction and
-phylogenetic Relationships

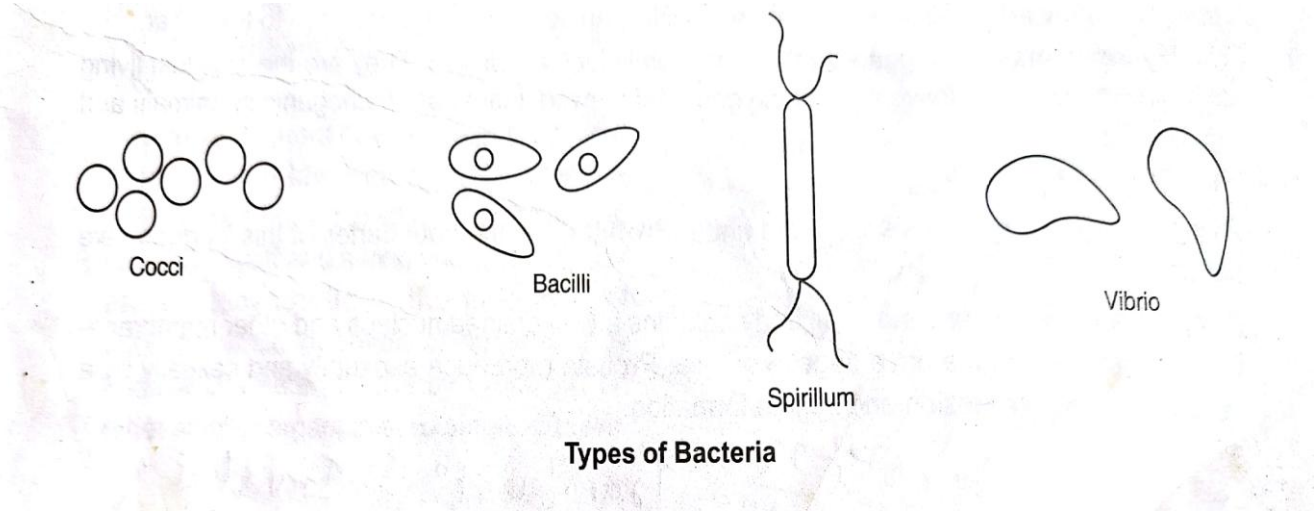
characters	Five Kingdoms				
	monera	protista	fungi	plantae	Animalia
Cell type	Prokaryotic	Eukaryotic	Eukaryotic	Eukaryotic	Eukaryotic
Cell wall	Non cellular (polysaccharides + amino acids)	Present in some	Present (without cellulose)	Present (with cellulose)	Absent
Nuclear Membrane	Absent	Present	Present	present	Present
Body organization	Cellular	Cellular	Multicellular + loose tissue	Tissue/ organ	Tissue organs organ system
Mode of nutrition	Autotrophic (chemo-synthetic and photosynthetic) Heterotrophic (saprophyte and parasite)	Autotrophic (photosynthetic) Heterotrophic	Heterotrophic (saprophyte and parasite)	Autotrophic (photosynthetic)	Heterotrophic (holozoic,saprophyte,etc)

Three domains of life. Domains are a relatively new grouping. The three-domain system was first invented in 1990, but not generally accepted until later. One main characteristic of the three domain method is the separation of Archaea and bacteria, previously, grouped into the single kingdom Bacteria (a kingdom also referred to as Monera). The three domains of life are as follows:

* Archaea
*Bacteria
*Eukaryota

KINGDOM MONERA

Bacteria are grouped under four categories based on their shape:
1. The spherical Coccus (pl.: cocci)
2. The rod-shaped Bacillus (pl.: bacilli)
3. The comma-shaped Vibrium (pl.: vibrio)
4. The spiral Spirillum (pl.: spirilla)



Types of Bacteria

Simple but Complex Organism. Though the bacterial structure is very simple, they are very complex in behaviour. Compared to many other organisms, bacteria is a group that shows 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.

Archaebacteria

Habit and Habitat. These bacteria are special since they live in some of the most harsh habitats and are named according to their habitats as follows:

1. Halophiles live in extreme salty areas

2. Thermoacidophiles live in hot springs

3. Methanogens live in marshy areas

Archaebacteria differ from other bacteria in having a different cell wall structure and this feature is responsible for their survival in extreme conditions. Methanogens are present in the. guts of several ruminant animals such as cows and buffaloes and they are responsible for the production of methane (biogas) from the dung of these animals.

Eubacteria

Structure. There are thousands of different eubacteria or 'true bacteria'. 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 similar to green plants and are photosynthetic autotrophs. The cyanobacteria are unicellular, colonial or filament, marine or terrestrial algae. The colonies are generally surrounded by gelatinous sheath.

Habit and Habitat. They often form blooms in polluted water bodies. Some of these organisms can fix atmospheric nitrogen in specialised cells called heterocysts, e. g. Nostoc and Anabaena.

Chemosynthetic autotrophic 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.

Most Abundant Bacteria. Heterotrophic bacteria are the most abundant In nature. The majority are Important decomposers .

Economic Importance of Bacteria. Bacteria have a significant impact on human affairs. They are helpful in making curd from milk, production of antibiotics, fixing nitrogen in legume roots,, etc. Some are pathogens causing damage to human beings, crops, farm animals and pets. Cholera, typhoid, tetanus, citrus canker are well known diseases caused by different bacteria.

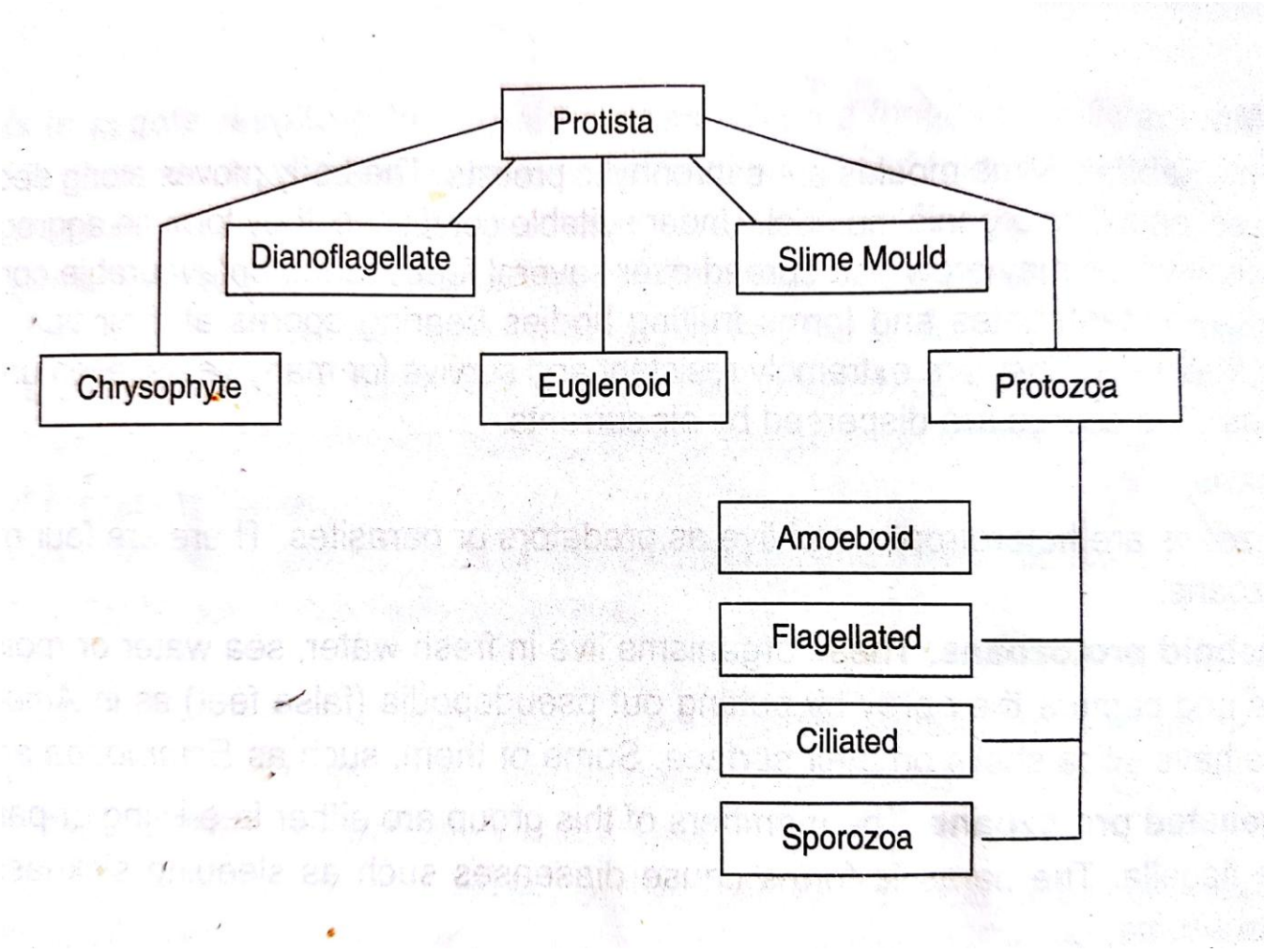
Reproduction in Bacteria. Bacteria reproduce mainly by fission Sometimes, under unfavourable conditions, they produce spores. They also reproduce by a method which is similar to sexual reproduction by adopting a primitive type of DNAtransfer from one bacterium to the other.

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

KINGDOM PROTISTA

All single-celled eukaryotes are placed under Protista, but the boundaries of this kingdom are not well defined.

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.



Chrysophytes

Habit and Habitat. This group includes diatoms and golden algae (desmids). They are found in fresh water as well as in marine environments.

Structure. They are microscopic and float passively in water currents (plankton). Most of them are photosynthetic. ln diatoms the cell walls form two thin overlapping shells, which fit together, as in a soap box. The walls are embedded with silica and thus the walls are indestructible. Thus, 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’. Being gritty this soil is used in polishing, filtration of oils and syrups. Diatoms are the chief ‘producers’ in the oceans.

Dianoflagellates

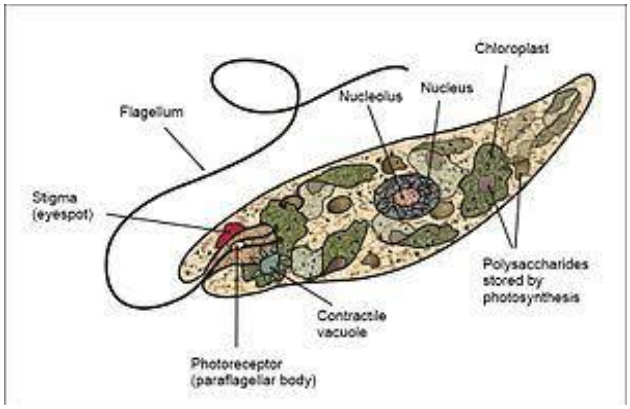
Habit and Habitat. These organisms are mostly marine and photosynthetic.

Structure. They 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 anther transversely in a furrow between the wall plates.

Euglenoids

Habit and Habitat. Majority of them are fresh water organisms found in stagnant water.

Structure. Instead of a cell wall, they have a protein rich layer called pellicle which makes their body flexible. They have two flagella, a short and along one. Though they are photosynthetic in the presence of ' sunlight, when deprived of sunlight they behave like heterotrophs by predating on other smaller organisms. Example: Euglena.



Slime Moulds

Habit and Habitat. 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.

Protozoans

All protozoans are heterotrophs and live as predators or parasites. There are four major groups of protozoans.

1. Amoeboid protozoans. These organisms live in fresh water, sea water or moist soil. They move and capture their prey by putting out pseudopodia (false feet) as in Amoeba. Marine forms have silica shells on their surface. Some of them, such as Entamoeba are parasiteskq

2. Flagellated protozoans. The members of this group are either free-living or parasitic. They have flagella. The parasitic forms cause diaseases such as sleeping sickness. Example: Trypanosoma.

3. 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. Example: Paramoecium.

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

KINGDOM FUNGI

Habit and Habitat. Most fungi are heterotrophic and absorb soluble organic matter from dead substrates and hence are 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. ,

Structure. With the exception of yeasts which are unicellular, fungi are filamentous. Their 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. The cell walls of fungi are composed of chitin and polysaccharides.

Reproduction in Fungi

(a) Vegetative Reproduction. Reproduction in fungi can take place by vegetative means - fragmentation, fission and budding.

(b) Asexual Reproduction. Asexual reproduction Is by spores called conidia or sporangiospores or zoospores.

(c) Sexual Reproduction. Sexual reproduction is by oospores, ascospores and basidiospores. The various spores are produced in distinct structures called fruiting bodies.

The sexual cycle involves the following three steps.

(i) **Plasmogamy**. Fusion of protoplasms between two motile or non-motile gametes called plasmogamy.

(ii) **Karyogamy**. Fusion of two nuclei is called karyogamy.

(iii) **Meiosis in zygote resulting in haploid spores.** When a fungus reproduces sexually, two haploid hyphae of compatible mating types come together and fuse. In some fungi the fusion of two haploid cells immediately results in diploid cells (2n). However, in other fungi (ascomycetes and basidiomycetes), an intervening dikarybtic Stage (n + n, i.e. two nuclei per cell) occurs; such a cendition is called a dikaryon and the phase is called dikaryophase of fungus. Later, the parental nuclei fuse and the cells become diploid. The fungi form fruiting bodies in which reduction division occurs, leading to formation of haploid spores.

Division of Kingdom Fungi

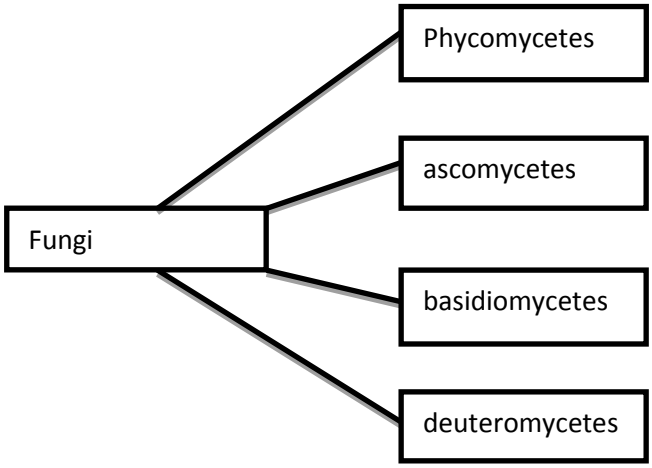
The morphology of the mycelium, mode of spore formation and fruiting bodies form the basis for the division of the kingdom into various classes.

Phycomycetes

Habit and Habitat. Members of phycomycetes are found in aquatic habitats and on decaying wood In moist and damp places or as obligate parasites on plants.

Mycelium.The mycelium ls aseptate and coenocytic.

Reproduction. Asexual reproduction takes place by zoospores (motile) or by aplanospores (nonmotile). These spores are endogeneously produced in sporangium. Zygospores are formed by fusion of two gametes. These gametes are similar in morphology (isogamous) or dissimilar (anisogamous or oogamous). Some common examples are Mucor, Rhizopus (the bread mould mentioned earlier) and Albugo (the parasitic fungi on mustard).



Ascomycetes

Habit and Habitat. Commonly known as sac-fungi, the ascomycetes are unicellular, e.g., yeast (Sacharomyces) or multicellular, e.g., Penicillium. They are saprophytic, decomposers, parasitic or coprophilous (growing on dung). Mycelium. Mycelium is branched and septate.

Reproduction. The asexual spores are conidia produced exogenously on the special mycelium, called conidiophores. Conidia on germination produce mycelium. 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. Some examples are Aspergillus ,Claviceps and Neurospora. Neurospora is used extensively in biochemical and genetic work. Many members like horas-End buffles are edible and are considered delicacies.

Basidiomycetes

Habit and Habitat. Commonly known forms of basidiomycetes are mushrooms, bracket fungi or Puffballs. They grow in soil, on logs and tree stumps and in living plant bodies as parasites..example rusts and smuts.

Mycelium. The mycelium is branched and septate.

Reproduction. The asexual spores are generally not found, but vegetative reproduction by fragmentation is common. 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 (pl.: basidia). The basidia are arranged in fruiting bodies called basidiocarps. Some common members are Agaricus (mushroom), Ustilago (smut) and Puccinia (rust fungus).

Deuteromycetes

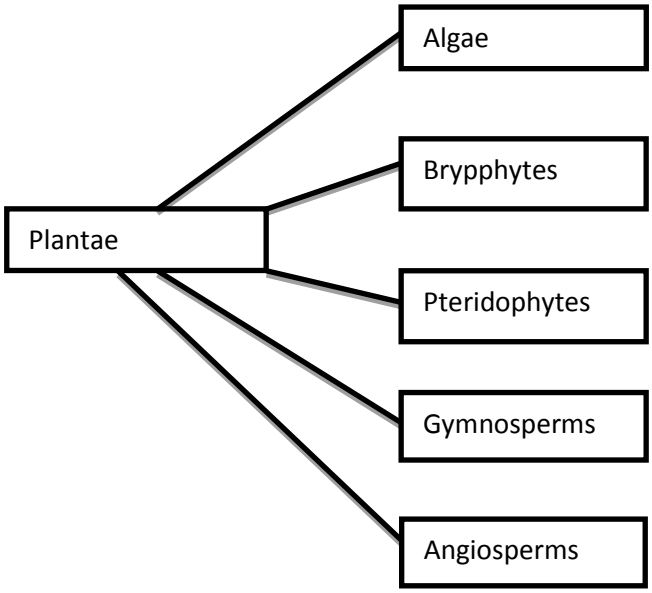
Habit and Habitat. Some members are saprophytes or parasites while a large number of them are decomposers of litter and help in mineral cycling. Some examples are Alternaria, Colletortrichum and Trichoderma.

Reproduction. The deuteromycetes reproduce only by asexual spores which are known as oonidia. The mycelium is septate and branched.

Commonly known as imperfect fungi because, only the asexual or vegetative phases of these fungi are known. When the sexual forms of these fungi were discovered they were moved into classes they rightly belong to.

KINGDOM PLANTAE

Kingdom Plantae includes all eukaryotic chlorophyll-containing organisms, commonly called plants. Afew members are partially heterotrophic such as the insectivorous plants or parasites. Bladderwort and Venus fly trap are examples of insectivorous plants andCuscuta is a parasite. The plant cells have an eukaryotic structure with prominent chloroplasts and cell wall mainly made of cellulose.



Plantae includes algae, bryophytes, pteridophytes, gymnosperms and angiosperms.

Alternation of Generation. Life cycle of plants has two distinct phases the diploid sporophytic and the haploid gametophytic that alternate with each other. The lengths of the haploid and diploid phases, and whether these phases are free-living or dependent on others, vary among different groups in plants. This phenomenon is called **alternation of generation**.

KINGDOM ANIMALIA

This kingdom is characterised by heterotrophic eukaryotic organisms that are multicellular and their cells lack cell walls. They directly or indirectly depend on plants for food. They digest their food in an internal cavity and store food reserves as 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. Higher forms show elaborate sensory and neuromotor mechanism. Most of them are capable of locomotion. The sexual reproduction is by copulation of male and female followed by embryological development.

VIRUSES, VIROIDS AND LICHENS

Viruses did net find a place in classification since they are not truly ‘living’, if we understand living as those organisms that have a cell structure. 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.

History of Discovery of Virus:

The name virus that means venom or poisonous fluid was given by Pasteur. D.J. Ivanowsky (1892) 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. Beijerinek (1898) demonstrated that the extract of the infected plants of tobacco could cause infection in healthy plants and called the fluid as Contagiumvivumfluidum (infectious living fluid).
W.M. Stanley (1935) showed that viruses could be crystallised 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 RNA or DNA. 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.

Bacteriophage. Bacterial viruses or bacteriophages (viruses that infect the bacteria) are usually double stranded DNA viruses.

Structure of Virus. 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.

Economic Importance of Virus. Viruses cause diseases like mumps, small pox, herpes 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 TO.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 lacked the protein coat that is found in viruses, hence the name viroid. The RNA of the viroid was of low molecular weight.

Lichens

Lichens are symbiotic associations, i.e. mutually useful associations, between algae and fungi. The algal component is known as phycobiontand fungal component as mycobiont, 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 pollution indicators , they do not grow in polluted areas.