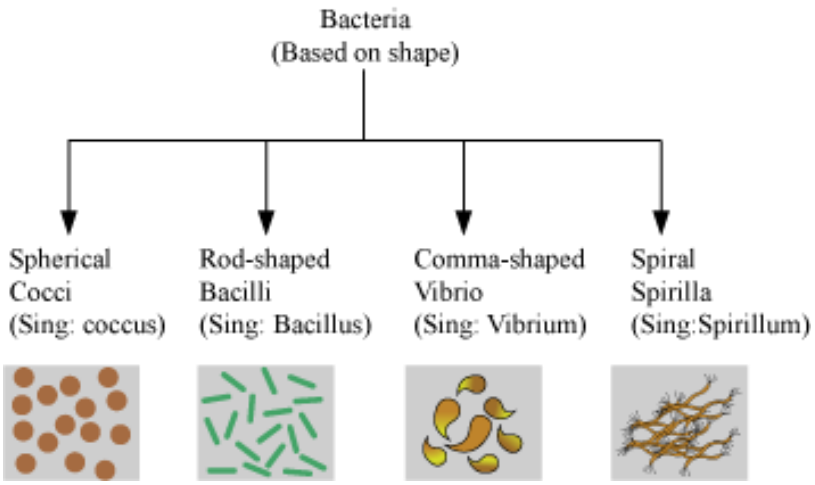
Biological Classification

Kingdom Monera (Including Virus and Viroids)

Kingdom Monera

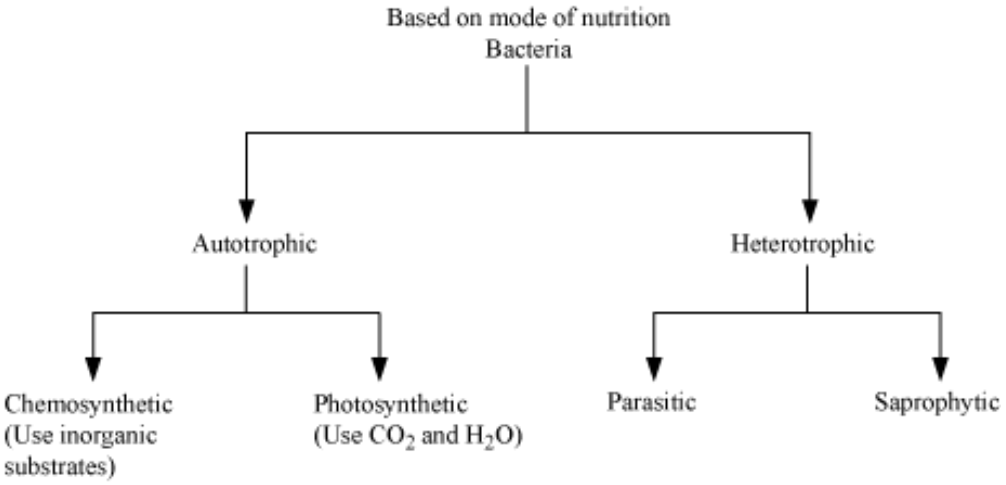
Bacteria

- Sole members of this kingdom
- Most abundant microorganisms
- Occur almost everywhere including extreme environments such as hot springs, deep oceans, snow, and deserts
- Many live in or on other organisms as parasites
- Can be classified in four groups based on shape



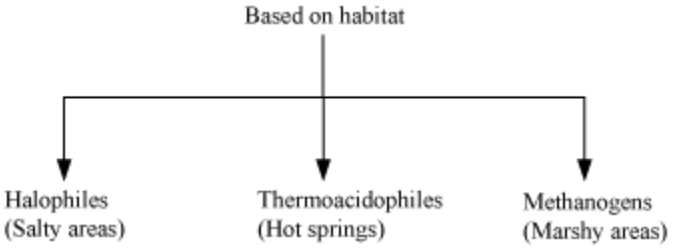
- Cell structure is very simple but complex in behaviour

- Exhibit the most extensive metabolic diversity as shown below



Archaebacteria

- Unique since they live in the most harsh habitats
- Bacteria based on habitat can be named as



- Different from other bacteria in having a different cell wall structure which makes them capable to survive in these extreme conditions
- Methanogens present in the guts of ruminants are responsible for methane (biogas) production from their dung.

Eubacteria (True Bacteria)

- Characteristic feature − presence of rigid cell wall and if motile, a flagellum

Cyanobacteria (Blue green Algae)

- Have chlorophyll *a* similar to green plants; hence, they are photosynthetic autotrophs
- Unicellular, colonial or filamentous, marine or terrestrial algae
- Colonies surrounded by gelatinous sheath

- Some can fix atmospheric nitrogen in specialized cells called heterocysts. Example − *Nostoc and Anabaena*

- Some cyanobacteria contain pigment in the membranous extensions called **chromatophores**. These structures contain chlorophyll pigment which helps in the process of photosynthesis
- Few cyanobacteria has specialised structures called **hormocysts**. These structures contain a row of granulated cells which is surrounded by a thick sheath.

Chemosynthetic Autotrophs

- Oxidize various inorganic substances such as nitrites, nitrates, ammonia, etc.

- Play key role in recycling nutrients such as nitrogen, sulphur, iron, etc.

Heterotrophic Bacteria

- Most abundant in nature

- Important decomposers

- Helpful in making curd from milk, production of antibiotics, fixing nitrogen in legume roots, etc.

- Some are pathogens, causing damage to humans, crops, cattles, and pets.

- In humans, they cause diseases such as cholera, typhoid while they cause citrus canker in crop plants and anthrax in cattle.

Mycoplasma

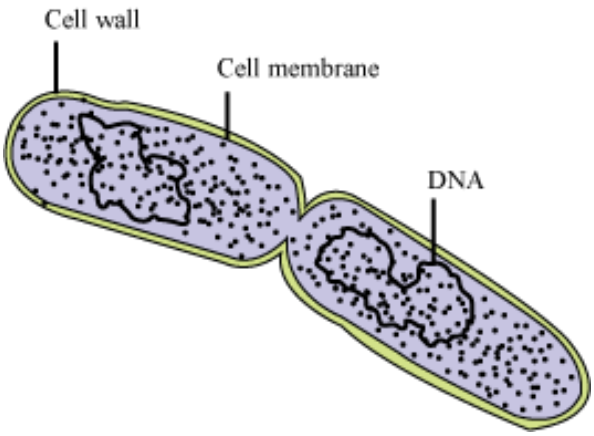
- Smallest known living creatures

- Devoid of cell wall

- Can survive without oxygen

- Many are pathogens of humans, animals, and plants.

Reproduction in Bacteria



- Reproduce asexually mainly by fission
- Under unfavourable conditions − reproduction through spores
- Sexual reproduction may also take place in a primitive way by DNA transfer from one bacterium to another.

Prions

- The term prion "proteinaceous infective particles" was first coined by **Stanley B.Prusiner**.
- It is a stable structure of abnormally folded proteins.
- It affects the central nervous system.
- It is responsible for causing Bovine spongiform encephalopathy (mad cow disease) in cattles and Creutzfeldt-Jakob disease in humans.

Viruses and Viroids

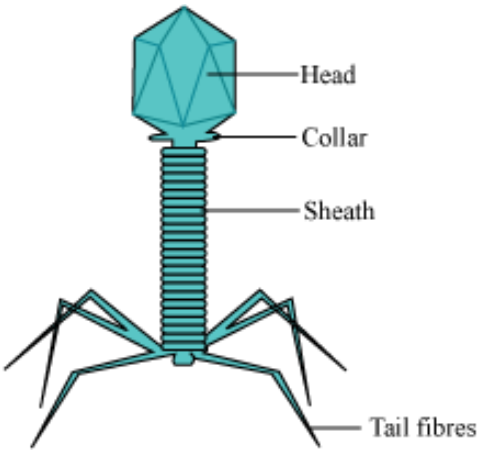
Viruses

- Being acellular, they are not placed anywhere in Whittaker's five kingdom classification.
- Viruses are not truly 'living' as they are living only inside the host body, else inert.
- They are non-cellular organisms characterized by inert crystalline structure outside the living cells.
- Obligate (compulsory) parasites
- Once inside a living cell, they take over the host cell machinery to replicate themselves, killing the host.
- Meaning of virus - venom or poisonous fluid

- D. J. Ivanowsky (1892) led the foundation of discovery of virus. He identified causative agent of Mosaic disease of tobacco, which are smaller than bacteria as they can pass through bacteria-proof filters.

- M. W. Beijerinek (1898) found that the extract of infected plant causes disease in healthy plants.
  He called the fluid as *Contagium vivum fluidum* (infectious living fluid).

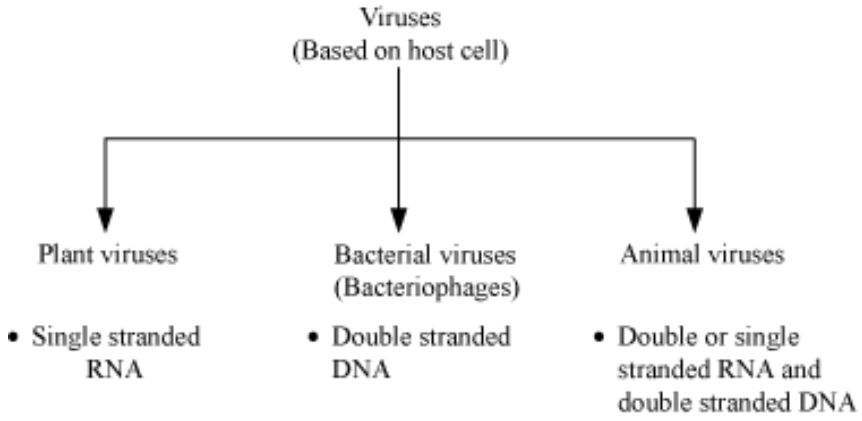
- W. M. Stanley (1935) crystallized viruses and demonstrated that crystals contain largely proteins, inert outside the host cell.



Structure of Viruses

- In addition to proteins, viruses also contain genetic material, either DNA or RNA, never both.

- It is a nucleoprotein and the genetic material is infectious.



- The protein coat is called capsid. It protects the nucleic acid and is made up of small subunits called capsomeres, which are arranged in helical or polyhedral geometric forms.

- Viruses cause diseases such as mumps, small pox, herpes influenza, and AIDS in humans.
- In plants, they cause mosaic, leaf rolling and curling, yellowing, vein clearing, dwarfing and stunted growth.

Viroids

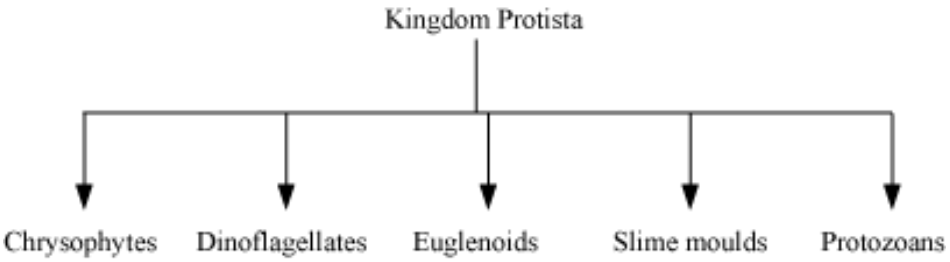
- Discovered by T.O. Diener in 1971
- Smaller than viruses and responsible for spindle tuber disease in potato
- Unlike viruses, they lack protein coat and exist as free RNA, hence named viroids.
- Viroid RNA is of low molecular weight.

Kingdom Protista

General Characteristics

- Contains all unicellular eukaryotes
- Primarily aquatic
- Cell body contains well-defined nucleus and other membrane-bound organelles
- Reproduce asexually and sexually, by a process involving cell fusion and zygote formation

Classes of Protista

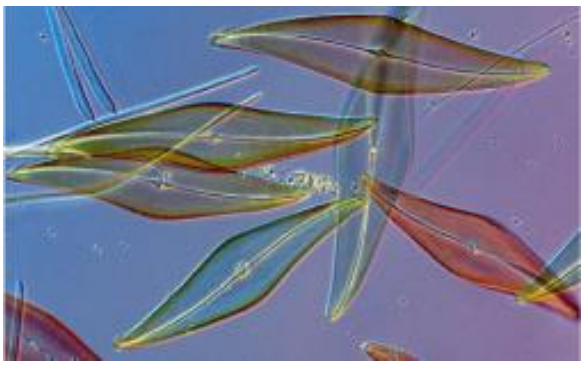


Chrysophytes (Planktons)

- Includes diatoms and golden algae (desmids)
- Found in fresh water as well as marine environments

- Microscopic; float passively in water currents
- Mostly photosynthetic

Diatoms



- Cell wall forms two thin overlapping shells
- Walls embedded with silica, and thus, indestructible
- Fossilised remains of diatoms are referred to as ‘diatomaceous earth’
- Chief producers of the ocean
- Specialised cells called **auxospores** are present which helps in growth and sexual reproduction

Dinoflagellates

- Mostly marine and photosynthetic
- Appear yellow, green, brown, blue or red, depending on pigments present in their cells
- Cell wall has stiff cellulosic plates on the outer surface
- Most of these have two flagella—one lies longitudinally and the other transversely, in a furrow between the wall plates
- Red dinoflagellates (Example − *Gonyaulax*) rapidly multiply and make the sea appear red (red tides)
- Toxins released by these organisms may kill other marine animals

Euglenoids

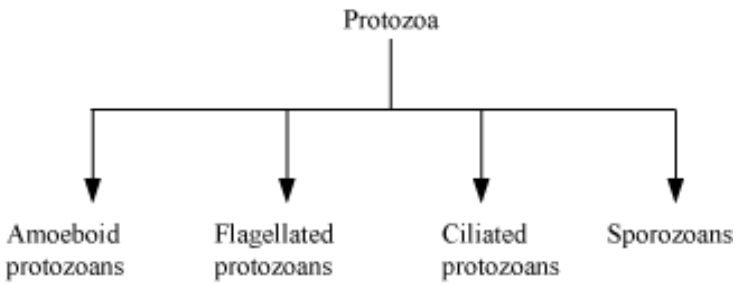
- Majority are fresh-water organisms
- Found in stagnant water
- Have protein-rich layer called pellicle, instead of cell wall, which makes their body flexible
- In the presence of sunlight, they behave like autotrophs; in the absence of sunlight, they behave like heterotrophs, predating on smaller organisms
- Pigments are identical to those present in higher plants

Slime Moulds

- Saprophytic protists
- Move along decaying twigs and leaves
- Under suitable conditions, they form an aggregation called plasmodium, which grows and spreads over several feet.
- Under unfavourable conditions, plasmodia differentiate to form fruiting bodies bearing spores at their tips.
- Spores possess extremely resistant true walls, which make them capable of survival for a long time under adverse conditions.
- Spores disperse by air currents.

Protozoans

- All are heterotrophs
- Live as predators or parasites
- Believed to be the primitive relatives of animals



Amoeboid Protozoans

- Live in freshwater, sea water or in moist soil
- Move and capture their prey by putting out pseudopodia (false foot); Example: *Amoeba*
- Marine forms have silica shells on their surface
- Some of them, such as *Entamoeba*, are parasites
- Some protozoans such as *Amoeba* possess **contractile vacuole** in its cytoplasm. This structure helps in excretion and osmoregulation.

Flagellated Protozoans

- Either free-living or parasitic
- Bear flagella
- The parasitic forms cause diseases such as sleeping sickness;
  Example: *Trypanosoma*

Ciliated Protozoans

- Aquatic and actively moving
- Show presence of thousands of cilia
- Have a cavity (gullet) which opens on the outside
- Movement of cilia causes food-laden water to enter the gullet. Example: *Paramoecium*
- Some ciliated protozoans (such as *Paramoecium*) possess **dimorphic** nucleus -

  (i) macronucleus - controls the metabolic activities of the organism.
  (ii) micronucleus - controls the reproduction.

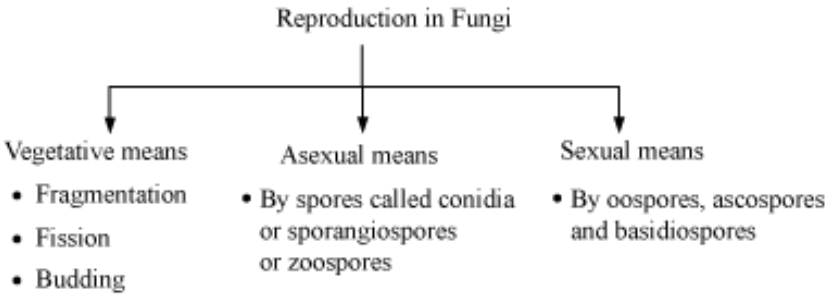
Sporozoans

- Include diverse organisms with spore-like infectious stage in their life cycle
- Example: *Plasmodium*, which causes malaria

Kingdom Fungi

General Characters

- Constitute a unique kingdom of heterotrophic organisms
- Show great diversity in morphology and habitat
- Some are parasitic while most are saprophytic (feed on dead organisms).
- Except *Yeasts* (which are unicellular), other are multicellular and filamentous.
- The body consists of long, slender, thread-like structures called hyphae.
- A network of hyphae is known as mycelium.
- Some hyphae are continuous and multinucleate known as coenocytic hyphae while others have septae (cross walls).
- Cell wall is composed of chitin and polysaccharides.
- Shows symbiotic association
- with algae in lichens
- with roots of higher plants in mycorrhiza



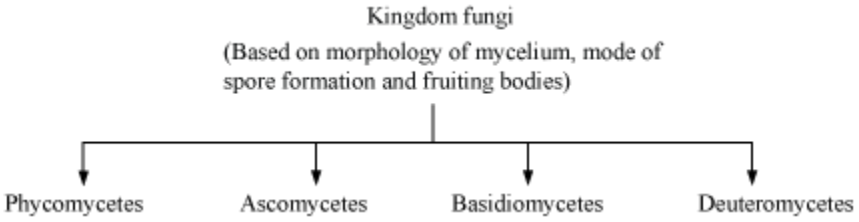
- Sexual reproduction involves
- plasmogamy − fusion of protoplasm of two gametes
- karyogamy − fusion of two nuclei
- meiosis in zygote resulting in haploid spores
- During sexual reproduction in fungus,
- fusion of two haploid hyphae of compatible mating types takes place which may result
- in a diploid cell (2*n*) in some fungi or

- in an intervening dikaryotic stage (*n* + *n*) called dikaryon and a phase called dikaryophase - mainly in classes Ascomycetes and Basidiomycetes

> The dikaryotic phase of the fungal life cycle is unique. During this unusual phase, which is common in many species of fungi, cells contain two distinct nuclei. These two nuclei divide simultaneously as the mycelium grows; growth continues until fusion occurs during karyogamy resulting in diploid condition.

- Formation of fruiting bodies takes place
- Production of haploid spores occurs in fruiting bodies as a result of meiosis

Classes of Fungi



Phycomycetes

- Found in aquatic as well as damp habitats
- Some are obligate parasites on plants
- Mycelium − aseptate and coenocytic
- Asexual reproduction − by motile zoospores or non-motile aplanospores
- Spores produced endogenously in sporangium
- Zygospores formed by fusion of two gametes which may be isogamous, anisogamous, or oogamous
  Example: *Mucor, Rhizopus* (Bread mould), *Albugo* (Plant parasite)

Ascomycetes

- Commonly called sac-fungi
- Unicellular (*Yeast*) or multicellular

- They are saprophytic, decomposers, parasitic or coprophilous (growing on dung)
- Mycelium − branched and septate
- Asexual spores (conidia) produced exogenously on special mycelium called conidiophores
- Sexual spores (Ascospores) produced endogenously in sac-like asci, arranged in different types of fruiting bodies called ascocarps
- Example: *Aspergillus, Claviceps,*
  Neurospora − Used extensively in biochemical and genetic work
- Several members such as morels and buffles are edible (considered as delicacies).

Basidiomycetes

- Commonly known members are mushrooms, puffballs, or bracket fungi
- Grow in soil, on logs and tree stumps, or as plant-parasites (rusts and smuts)
- Mycelium − branched and septate
- Asexual spores absent and most common means of vegetative reproduction is fragmentation
- Sex organs absent, but plasmogamy takes place through fusion of vegetative cells of different strains
- Resultant structure is dikaryotic which gives rise to basidium
- Basidia are arranged in fruiting bodies called basidiocarps
  Example: *Agaricus* (mushroom), *Ustilago* (smut), *Puccinia* (rust)

Deuteromycetes

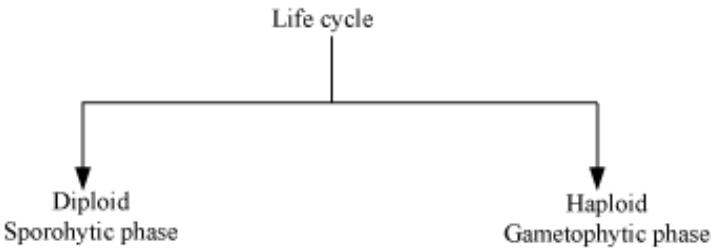
- Known as imperfect fungi because sexual phase is absent
- On recognition of sexual phase, the member is shifted to either class Ascomycetes or class Basidiomycetes
- Reproduce only by asexual spores (conidia)
- Mycelium is septate and branched.

- Some are saprophytic while others are parasitic.
- Being decomposers, they help in mineral cycling.
  Example: *Alternaria, Colletotrichum, Trichoderma*

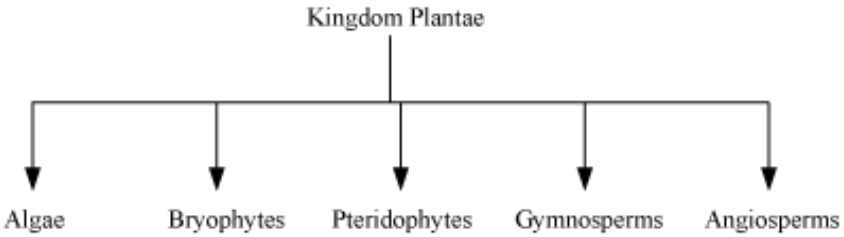
Kingdom Plantae (Including Lichens) and Animalia

Kingdom Plantae

- Contains all eukaryotic-photosynthetic organisms
- Few are partially heterotrophic (insectivorous plants such as Venus flytrap) or parasites (*Cuscuta*).
- Plant cells − eukaryotic with prominent chloroplasts and cellulosic cell wall
- Exhibit alternation of generation



- Major divisions included are



Kingdom Animalia

- Heterotrophic, eukaryotic, multicellular organisms
- Animal cells lack cell wall.
- Directly or indirectly depend on plants for food
- Digestion is internal and store food reserve as glycogen or fat.

- Follow definite growth pattern, grow into adults having definite shape and size
- Higher forms show elaborate sensory and neuromotor mechanism.
- Most capable of locomotion
- Sexual reproduction is by copulation of male and female followed by embryological development.

Lichens

- Symbiotic associations between fungi and algae
- Algal component − phycobiont (autotrophic)
- Fungal component − mycobiont (heterotrophic)
- Algae prepare food for fungi; in return, fungi absorb water and minerals and provide shelter to the algae
- Very good pollution indicators − do not grow in polluted areas