



BIOLOGICAL CLASSIFICATION

THE EARLY APPROACHES

Aristotle classified animals in groups like enaima (having red blood) & anima (the one not having red blood).

Linnaeus gave 2 kingdom classification i.e. plantae (bacteria, BGA, Fungi, mosses, ferns, gymnosperms, angiosperms) & animals on basis of presence or absence of cell wall.

Aristotle was first to give scientific classification by classifying plants into tree, herbs, and shrubs (based on morphological characters) and animals into anima & enaima.

RH WHITTAKER in 1969 gave 5 kingdom classification i.e. Monera, Protista, Fungi, Plantae, Animalia.

ISSUES IN THE EARLY APPROACHES

- It brought together prokaryotic bacteria & higher plants
- Unicellular (eg- *Chlamydomonas*) & multicellular (eg- *Spirogyra*) were placed together.
- Organisms with different cell wall were placed together like fungi having chitinous cell wall was placed with plants having cellulosic cell wall.
- No differentiation between mode of nutrition i.e., heterotrophic fungi were placed with autotrophic plants.

BASIS OF 5 KINGDOM CLASSIFICATION

- Cell structure
- Thallus organization
- Mode of nutrition
- Reproduction
- Phylogenetic relationships

KINGDOM MONERA

INTRODUCTION

- They live in all type of habitat, even the extreme ones.
- Bacterial structure is simple but they are complex in behaviour.
- Some are autotrophic (chemosynthetic or photosynthetic) but majority are heterotrophic (saprophytic and parasitic).
- On basis of shape bacteria may be:-
 - **Spherical – coccus**
 - **Rod shaped – bacillus**
 - **Comma shaped – vibrio**
 - **Spiral – spirillum**

ARCHAEBACTERIA (PRIMITIVE/ANCIENT)

- Live in most harsh habitat eg. Halophiles (salty areas), Thermoacidophiles (hot springs) have well defined cell wall. Methanogens found in most ruminant gut & produce methane (biogas) from animal dung.

EUBACTERIA

- Characterised by presence of rigid cell wall, and presence of flagella if they are motile.

REPRODUCTION IN BACTERIA

- Mainly by fission, in unfavourable conditions, they make spores & also reproduce sexually by a primitive type of DNA transfer from one cell to other.

CHEMOSYNTHETIC AUTOTROPH

- Oxidise inorganic substance like nitrates, nitrites, ammonia & use released energy for ATP production play role in recycling N, P, Fe, S.

HETEROTROPHS

- Mostly decomposers; help in making curd, antibiotic, fixing N_2 in legume roots & some are pathogens causing damage. Eg., of bacterial diseases- cholera, typhoid, tetanus, citrus canker

CYANOBACTERIA

- Also called BGA & have chl a & are photosynthetic autotrophs unicellular, colonial, filamentous, marine or terrestrial in habitat. Colonies are surrounded by gelatinous sheath & forms blooms in water bodies. N_2 fixing bacteria Fix atmospheric N_2 in specialised cells called heterocysts, Eg – *Nostoc*, *Anabaena*. Heterocyst provides anaerobic condition required for N_2 fixation.

MYCOPLASMA

- Lack cell wall & are smallest living cells and can live without O_2 .



KINGDOM PROTISTA

All single cell eukaryotes; some have flagella or cilia & reproduces asexually & sexually involving zygote formation and cell fusion

Crysophytes: Diatoms and desmids

Fresh water as well as marine water; Float passively in water; photosynthetic; In diatoms cell walls form two thin overlapping shells, which fit together as in a soap box; walls are embedded with silica & are indestructible thus they left behind large amount of cell deposits in their habitat over billions of years which are called as diatomaceous earth used in polishing, filtration of oil & syrup, for being being gritty in nature; diatoms are chief producers of ocean.

Dinoflagellates: Mostly marine & photosynthetic; Appear yellow, green, brown, blue, red depending upon pigments they carry. Cell wall have stiff cellulosic plates on outer surface. Most have 2 flagella (one longitudinal other transversely in furrow between plates). Red dinoflagellate (*Gonyaulax*) multiplies rapidly & cause red tide; Toxins released by them may kill fishes.

Euglenoids: Most are fresh water dwelling found in stagnant water; Instead of cell wall they have a protein rich layer called pellicle (makes body flexible); Have a short & a long flagella; They are photosynthetic in presence of sunlight and heterotrophs in absence of sunlight and they predate small organisms. They are connecting link between plants & animals; The pigments in them are identical to those of higher plants. Eg- *Euglena*.

Slime moulds: Saprophytic Body moves along decaying twigs & leaves engulfing organic material; Under suitable condition they form aggregation called plasmodium (may grow over several feet) in unfavourable condition; Plasmodium differentiates & forms fruiting bodies bearing spores at their tips; spores bear true wall, extremely resistant & survive for many years; Spores are dispersed by air currents.

Protozoans: All are heterotrophs & live as predators or parasites. 4 main groups:-

- A) Amoeboid: Move & capture prey by pseudopodia (*amoeba*), Marine forms have silica shells on surface. Eg- *Entamoeba*
- B) Flagellated: Either free living or parasite; Have flagella; The parasitic forms causes disease like sleeping sickness. Eg- *Trypanosoma*
- C) Ciliated: Aquatic, actively moving, have thousands of cilia, have cavity (gullet) that opens to outside of cell surface; The coordinated movement of rows of cilia cause the water laden with food to be steered into the gullet. Eg- *paramecium*
- D) Sporozoans: Have an infectious spore like stage in life cycle. Eg- *plasmodium* (Malarial parasite)

KINGDOM FUNGI

INTRODUCTION

NUTRITION

- Mostly heterotrophs & absorb soluble organic matter from dead substrate (saprophytes), some are parasites too.
- They can also live as symbionts in association with algae as lichens and with roots of higher plants like Pinus as mycorrhiza.

REPRODUCTION

- By vegetative mode- fragmentation, fission, budding.
- Asexual- spores (conidia, sporangiospores, zoospores, aplanospores).
- Sexual- oospore, ascospore, basidiospore.

Spores are produced in fruiting bodies.

The sexual cycle involves-

Plasmogamy → karyogamy → meiosis

- Fusion of protoplasm b/w 2 motile or non mobile gametes Fusion of 2 nuclei
- Zygote results in making haploid spores meiosis
- Haploid spores → fusion begin →

dikaryophase → nuclei fuse →

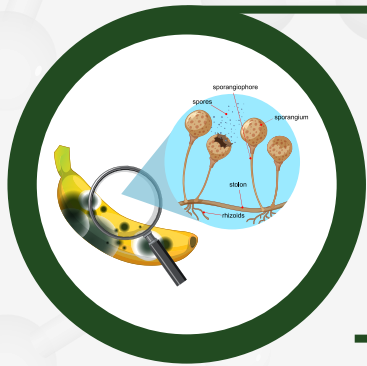
diploid body → meiosis → haploid spores

STRUCTURE

- They are filamentous except yeast which is unicellular. Body consists of long slender thread like Hyphae & it's network called mycelium.
- The continuous hyphae with multinuclear situation are called coenocytic & others have septae or cross walls (non-coenocytic).
- The cell wall contains chitin and polysaccharides.



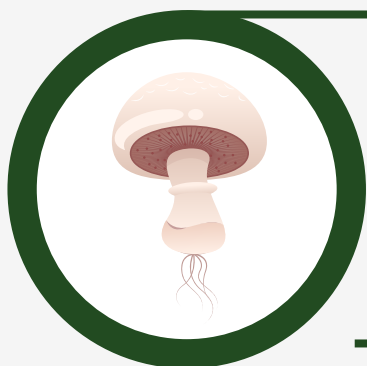
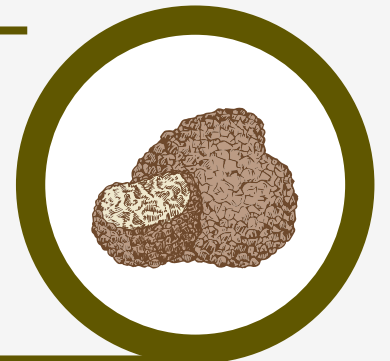
FOURS GROUPS OF FUNGI



Phycomycetes : Found in aquatic habitat & on decaying wood in moist & damp places or as obligate parasites on plants. Mycelium is aseptate/ coenocytic. Asexual reproduction by zoospores (motile) or aplanospores (non motile). These are produced endogenously in sporangium. Zygosporangia are formed by fusion of two gametes, if similar-isogamous or if dissimilar-anisogamous or oogamous. Eg- *mucor*, *rhizopus* (bread mould) and *albugo* (parasitic fungi on mustard).

Ascomycetes: (Sac fungi)

Multicellular (except yeast); Mycelium is branched & septate. The asexual spores are conidia produced exogenously on the special mycelium called conidiophores. Sexual spores are ascospores which are produced endogenously in sac like asci which are arranged in ascocarps (fruiting bodies). *Neurospora* is used in genetic & biochemical work. Many members like morels & truffles are edible & are considered delicacies. Eg- yeast, *Aspergillus*, *Penicillium*, *Claviceps*, *Neurospora*



Basidiomycetes: Mushrooms, bracket fungi & puff balls

Grow in soil, logs, tree stumps, living on plants as parasites Eg-rust & smut. Mycelium is branched & septate. Asexual spores are absent. Vegetative reproduction by fragmentation. Sex organs are absent but plasmogamy takes place. Dikaryotic stage is found which gives rise to basidium. Karyogamy and meiosis takes place in basidium producing 4 basidiospores (exogenously). Fruiting body is called basidiocarp. Eg- *Agaricus* (mushroom), *Ustilago* (smut), *Puccinia* (rust)

Deuteromycetes: (Imperfect fungi)

- Sexual phase is absent, they produce only asexual spores members are called conidia.
- Mycelium is septate and branched
- Many are decomposers & help in mineral cycling.
- Eg- *Colletotrichum*, *Trichoderma*, *Alternaria*



VIRUSES, VIROIDS, PRIONS & LICHENS

These acellular organisms were not included in Whittaker's classification

VIRUS

Introduction

- They are not truly living & are acellular having inert crystalline structure outside living cell.
- Once they infect a cell they take over the machinery to replicate themselves, killing the host. They are obligate parasites.

History of virus

- The name virus meaning venom or poison was given by Dmitri Ivanowsky (1892) recognised certain microbes as caused organism of the mosaic disease of tobacco.
- These were found to be smaller than bacteria-proof filters. MW Beijerinck (1898) demonstrated that the extract of the infected plants of tobacco could cause infection in healthy plants called the fluid as (*contagium vivum fluidum* i.e. infectious living fluid)
- WM Stanley (1935) showed that viruses could be crystallised and crystals consist largely of proteins.

Important points

- In addition to proteins viruses also have genetic material that could either be RNA or DNA. No virus contain both RNA & DNA.
- A Virus is a nucleoprotein and the genetic material is infectious.
- In general viruses that infect plants have ssRNA & Viruses infecting animals have either ssRNA or dsRNA or dsDNA. Bacterial viruses or bacteriophage are usually dsDNA virus.
- In plants symptom may be mosaic formation, leaf rolling & curling, yellowing & vein clearing, dwarfing & stunted growth.



IMPORTANT POINTS

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 lacked the protein coat that is found in viruses, hence the name viroid.
- The RNA of the viroid was of low molecular weight.

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** and 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.
- So close is their association that if one saw a lichen in nature one would never imagine that they had two different organisms within them.
- Lichens are very good pollution indicators- they do not grow in polluted areas.

