

BIOLOGICAL CLASSIFICATION

EVOLUTION OF CLASSIFICATION

1 ARISTOTLE

- First major attempt at scientific classification.
- Plants → Trees, Shrubs, Herbs based on morphology.
- Animals → Red-blooded and non-red-blooded.

PLANTS



Trees

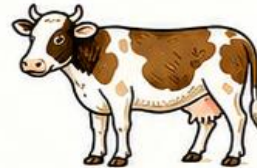


Shrubs



Herbs

ANIMALS



Red-blooded



Non-red-blooded

2 LINNAEUS — TWO KINGDOM SYSTEM



PLANTAE

+



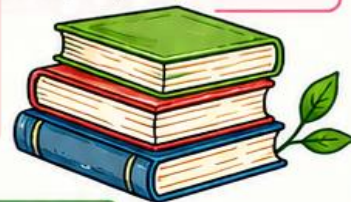
ANIMALIA

LIMITATIONS

- Did not distinguish prokaryotes/eukaryotes.
- Did not distinguish unicellular/multicellular organisms.
- Did not separate autotrophs/heterotrophs such as green algae and fungi.
- Many organisms could not be placed properly.



Therefore, classification later considered cell structure, cell wall, nutrition, habitat, reproduction and evolutionary relationships.



3 WHITTAKER — FIVE KINGDOM CLASSIFICATION (1969)



MONERA



PROTISTA



FUNGI



PLANTAE



ANIMALIA

MAIN CRITERIA CONSIDERED



Cell Structure



Body Organisation



Mode of Nutrition



Reproduction



Phylogenetic / Evolutionary Relationships

★ EXAM FACT

Three-domain system divides Monera into two domains and places the remaining eukaryotic kingdoms in the third domain → six-kingdom concept.

DOMAIN BACTERIA

+

DOMAIN ARCHAEA

+

DOMAIN EUKARYA

Protista

Fungi

Plantae

Animalia

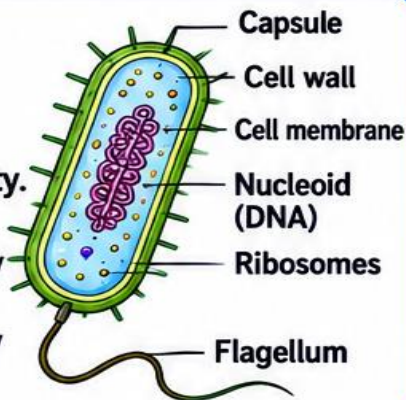


3. KINGDOM MONERA

ONLY MEMBERS →
BACTERIA

GENERAL FEATURES

- Prokaryotic, mostly unicellular.
- Found almost everywhere, including **extreme habitats**.
- Show enormous metabolic diversity.
- **Nutrition:**
 - **Autotrophic** → photosynthetic / chemosynthetic
 - **Heterotrophic** → saprophytic / parasitic



BACTERIAL SHAPES

Coccus

→ Spherical



Bacillus

→ Rod-shaped



Vibrio

→ Comma-shaped



Spirillum

→ Spiral-shaped



ARCHAEBACTERIA

- Live in extreme environments:
- **Halophiles** → extremely salty areas
- **Thermoacidophiles** → hot springs
- **Methanogens** → marshy areas



Methanogens occur in the gut of ruminants such as cows and buffaloes and produce methane/biogas from dung.

★ **Key feature:** distinctive cell wall helps them survive extreme conditions.

IMPORTANT BACTERIAL DISEASES



Cholera



Typhoid



Tetanus



Citrus canker

EUBACTERIA

- "True bacteria".
- Rigid cell wall; motile forms have flagella.

Cyanobacteria (blue-green algae):

- Chlorophyll-a
- Photosynthetic autotrophs
- Unicellular, colonial or filamentous
- May contain heterocysts for nitrogen fixation
- Examples: **Nostoc**, **Anabaena**



- Chemosynthetic bacteria oxidise inorganic substances and help recycle N, P, Fe and S.



Heterotrophic bacteria:

- Major decomposers
- Help in curd formation, antibiotics and nitrogen fixation
- Some cause diseases



REPRODUCTION

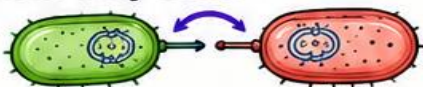
- Mainly binary fission.



- Spores under unfavourable conditions.

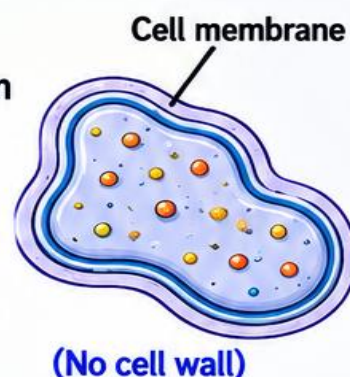


- Primitive DNA transfer may occur between bacteria.



MYCOPLASMA ★

- No cell wall
- Smallest known living cells
- Can survive without oxygen
- Many are pathogenic



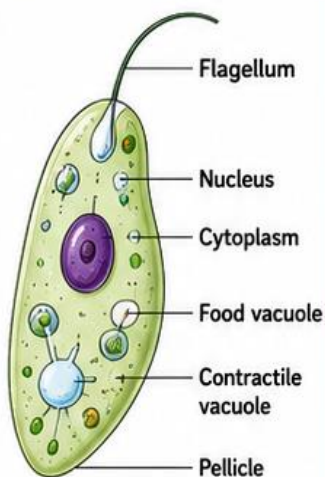


4. KINGDOM PROTISTA



GENERAL FEATURES

- All unicellular eukaryotes.
- Primarily aquatic.
- Well-defined nucleus + membrane-bound organelles.
- Some possess cilia/flagella.
- Reproduce asexually and sexually.
- **Five major groups in NCERT:** Chrysophytes, Dinoflagellates, Euglenoids, Slime moulds, Protozoans.



A. CHRYSOPHYTES

Includes:

- Diatoms
- Golden algae / desmids
- Freshwater + marine
- Microscopic and planktonic
- Mostly photosynthetic
- Diatom wall → two overlapping silica shells
- Silica walls are indestructible
- Deposits → diatomaceous earth
- Uses → polishing, filtration
- Diatoms are chief producers in oceans.



B. DINOFLAGELLATES

- Mostly marine + photosynthetic
- Colours: yellow, green, brown, blue, red
- Cell wall → stiff cellulose plates
- Usually two flagella
- **Gonyaulax** → rapid multiplication → **red tide**
- Toxins can kill marine animals.



C. EUGLENIDS ★

- Mostly freshwater, especially stagnant water.
- No cell wall
- Have protein-rich pellicle → flexibility.
- Two flagella → one short and one long.
- Sunlight → photosynthetic
- No sunlight → heterotrophic
- Pigments similar to higher plants.
- Example → **Euglena**.



D. SLIME MOULDS

- Saprophytic protists
- Feed on decaying organic matter.
- Form plasmodium under favourable conditions.
- Unfavourable conditions → fruiting bodies + spores.
- Spores have resistant walls and are dispersed by air.



E. PROTOZOANS

All are heterotrophic, predators or parasites.

GROUP	KEY FEATURE	EXAMPLE	ILLUSTRATION
Amoeboid	Pseudopodia	<i>Amoeba</i> , <i>Entamoeba</i>	
Flagellated	Flagella	<i>Trypanosoma</i>	
Ciliated	Numerous cilia	<i>Paramecium</i>	
Sporozoans	Infectious spore-like stage	<i>Plasmodium</i>	

Trypanosoma → sleeping sickness



Plasmodium → malaria

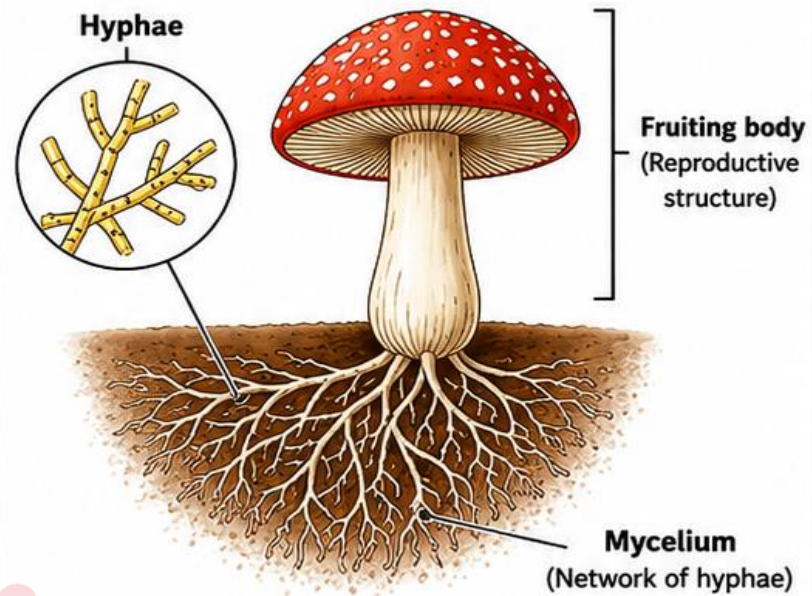


5. KINGDOM FUNGI ★

GENERAL FEATURES

- Eukaryotic and heterotrophic organisms.
- Mostly multicellular; **yeast** is unicellular.
- Prefer warm and humid conditions.
- Filamentous body made up of **hyphae**.
- Network of hyphae is called **mycelium**.
- Hyphae may be:
 - **Septate** (having cross walls)
 - **Coenocytic / aseptate** (without cross walls)
- Cell wall is made of **chitin** and **polysaccharides**.
- Nutrition:
 - **Saprophytic**: obtain nutrients from dead organic matter.
 - **Parasitic**: obtain nutrients from living organisms.
 - **Symbiotic**: live in association with other organisms (e.g., lichens, mycorrhiza).

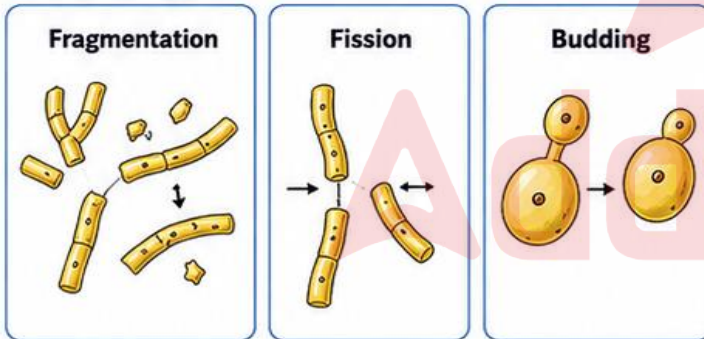
STRUCTURAL ORGANIZATION



REPRODUCTION

A. VEGETATIVE REPRODUCTION

Occurs through:



B. SPORE FORMATION

ASEXUAL SPORES

• Conidia

• Sporangiospores

• Zoospores



SEXUAL SPORES

• Oospores

• Ascospores

• Basidiospores

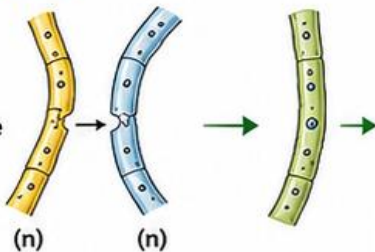


SEXUAL REPRODUCTION – 3 STEPS ★

Sexual reproduction in fungi occurs in three main steps:

1 PLASMOGAMY

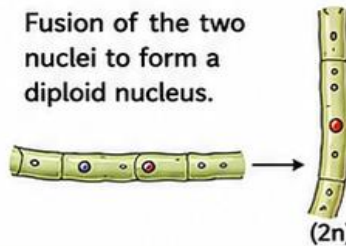
Fusion of protoplasts (cytoplasm) of two compatible hyphae.



Result: Cell with two nuclei ($n + n$) in common cytoplasm

2 KARYOGAMY

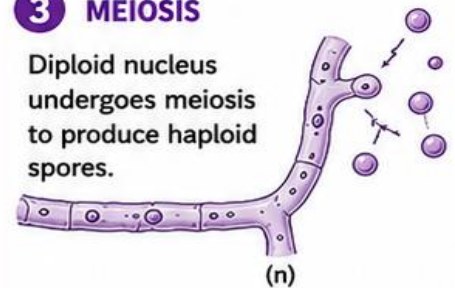
Fusion of the two nuclei to form a diploid nucleus.



Result: Diploid nucleus ($2n$) is formed

3 MEIOSIS

Diploid nucleus undergoes meiosis to produce haploid spores.



Result: Haploid spores (n) are formed



In Ascomycetes and Basidiomycetes, after plasmogamy, a **dikaryotic stage ($n + n$)** occurs, where two nuclei remain in the cell together before karyogamy.

7. Kingdom Plantae

- Eukaryotic + **chlorophyll**-containing
- Mainly **autotrophic**.
- Some partially heterotrophic:
 - **Bladderwort, Venus flytrap** → insectivorous
 - **Cuscuta** → parasite
- Cell wall mainly **cellulose**.
- Includes:



**Algae → Bryophytes → Pteridophytes
→ Gymnosperms → Angiosperms**

- Life cycle has:
 - **Gametophytic phase** → haploid
 - **Sporophytic phase** → diploid
- Alternation between these generations =
Alternation of Generations

8. Kingdom Animalia

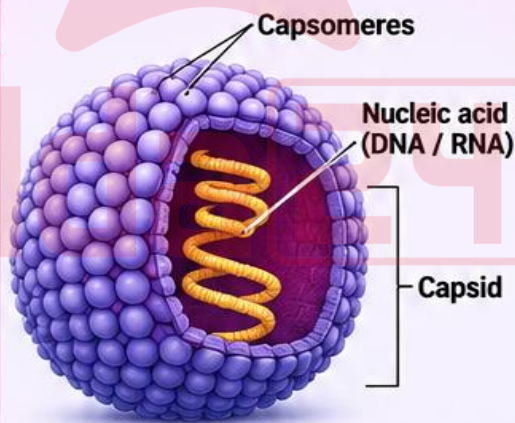
- Eukaryotic
- Multicellular
- Heterotrophic
- Cell wall **absent**
- Mostly depend directly/indirectly on plants.
- Nutrition → **holozoic / ingestion**
- Food stored as **glycogen or fat**.
- Internal digestion.
- Definite growth pattern and body shape.
- Higher forms → developed **sensory and neuromotor systems**.
- Most capable of **locomotion**.
- Sexual reproduction → male + female gametes followed by **embryonic development**.



9. Viruses

Why Not in Five Kingdoms?

- **Acellular**
- Not considered truly living because they **lack cellular organisation**.
- Outside host → **inert / crystalline**
- Inside host → take over host machinery and reproduce.
- Therefore, they show **both living and non-living characteristics**.



Important Scientists

- **Dmitri Ivanowsky** (1892) → identified infectious agent causing tobacco mosaic disease.
- **M.W. Beijerinck** (1898) → called the pathogen virus; *Contagium vivum fluidum*.
- **W.M. Stanley** (1935) → crystallised viruses; crystals largely protein.

Structure

Virus = Nucleic acid + Protein coat

- Genetic material → either **DNA or RNA**, never both.
- Protein coat → **Capsid**
- Capsid subunits → **Capsomeres**
- Capsomeres arranged in **helical / polyhedral forms**.
- Viruses are **obligate parasites**.

Genetic Material

- Plant viruses → generally **ssRNA**
- Animal viruses → **ssRNA / dsRNA / dsDNA**
- Bacteriophages → usually **dsDNA**



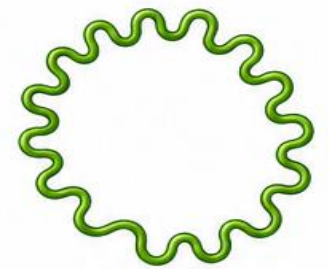
Diseases

- Mumps
- Smallpox
- Herpes
- Influenza
- AIDS
- **Plant viral diseases** → mosaic formation, leaf curling / rolling, yellowing, vein clearing, dwarfing and stunted growth.



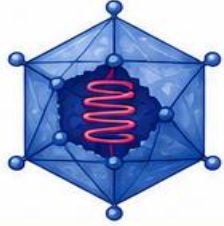
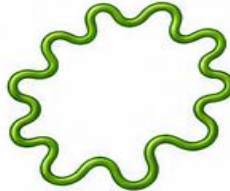
10. VIROIDS

- Discovered by T.O. Diener (1971).
- Smaller than viruses.
- Cause **potato spindle tuber disease**.
- Made only of **free RNA**.
- **No protein coat**.
- RNA has low molecular weight.



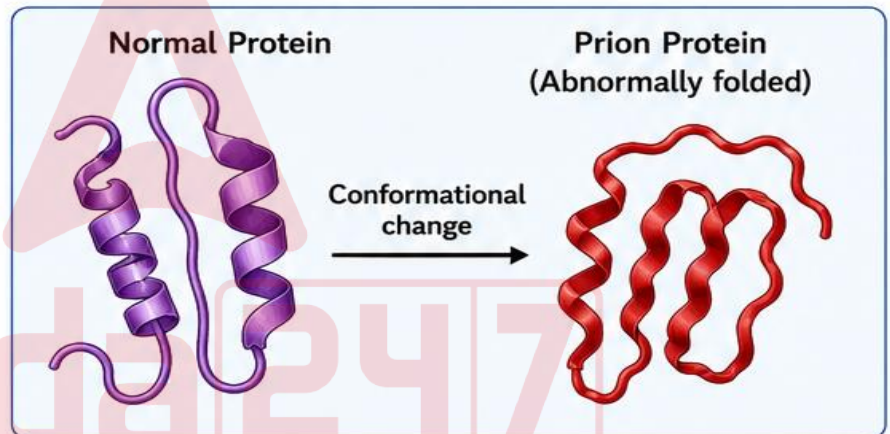
Viroid (RNA only)

VIRUS vs VIROID

VIRUS	VIROID
 Nucleic acid + protein coat	 RNA only, no protein coat

11. PRIONS

- Infectious agents made of **abnormally folded proteins**.
- Associated with **neurological diseases**.
- Important examples:
 - **BSE** → Mad cow disease
 - **CJD** → Creutzfeldt–Jacob disease in humans.



12. LICHENS ★

Lichen = Alga + Fungus in symbiotic association

ALGAL COMPONENT (PHYCOBIONT)



- Autotrophic
- Produces food



FUNGAL COMPONENT (MYCOBIONT)



- Heterotrophic
- Provides shelter, water and minerals



Lichens are **good pollution indicators** because they generally do not grow in polluted areas.