The University of Burdwan
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Paper ZOOL1011

Classification of Subkingdom Protozoa

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Learning Objectives

- Understand the general characteristics of subkingdom Protozoa
- Learn the classification system proposed by Levine et al. (1980)
- Identify the seven phyla and their distinguishing features
- Recognize examples of each phylum

Kingdom Protista & Subkingdom Protozoa

- Protista re eukaryotic, unicellular, heterotrophic or autotrophic organisms.
- The term ***Protista*** was first suggested by German scientist Ernst Haeckel in 1866.
- The earliest fossils of the protists date back to 1.4 billion years ago, i.e., *radiolarians* and *foraminiferans*.
- Protozoans are heterotrophic eukaryotic unicellular animals.
- The word "protozoa" (singular protozoon) was coined in 1818 by zoologist Georg August Goldfuss.
- The term Protozoa is formed from the Greek words πρῶτος (prôtos), meaning "first", and ζῷα (zôia), plural of ζῷον (zôion), meaning "animal".
- Found in diverse habitats: freshwater, marine, soil, and as parasites.
- About 50,000 known species.

Protozoan classification

- Earlier classifications were based mainly on locomotory organelles:
  - Sarcodina (pseudopodia)
  - Mastigophora (flagella)
  - Ciliata (cilia)
  - Sporozoa (no locomotory organelles).
- Later, electron microscopy and molecular biology revealed more complexity.
- Basis of Classification (Levine et al., 1980):
  - Mode of locomotion
  - Ultrastructural features
  - Life cycle and reproduction
- Widely adopted in zoology curricula for clarity and systematic grouping.

General Characters

- Microscopic and unicellular animalcules.
- Protoplasmic grade body organisations.
- They exhibits all kinds of symmetry
- Contains one or more nuclei, which can be monomorphic or dimorphic.
- Single or colonial
- Body either naked or covered by pellicle or test, made of silica or calcium carbonate.
- Locomotory organelles may be flagella, cilia, pseudopodia or absent.

General Characters

- Nutrition may be holozoic (animal-like: *Amoeba*), holophytic (plant-like: *Euglena*), saprophytic, mixotrophic, and parasitic.
- Digestion occurs intracellularly, in food vacuoles.
- Respiration and excretion through either body surface or with contractile vacuoles. Contractile vacuoles mainly maintain water balance through osmoregulation.
- Reproduction may be sexual or asexual:
  - Asexual: binary or multiple fission, plasmotomy, or budding.
  - Sexual: Conjugation and syngamy.
- Life history is often complicated by the alternation of sexual and asexual generations.

General Characters

- They never develop the blastula stage during development.
- Free-living organisms are mostly aquatic, inhabiting fresh and sea waters and dump places. Parasitic and commensal protozoa live over or inside the bodies of animals and plants. Sufficient moisture is essential in their environment.

Classification

Kingdom: Protista

Subkingdom: Protozoa

Phylum 1: Sarcomastigophora

Phylum 2: Labyrinthomorpha

Phylum 3: Apicomplexa

Phylum 4: Microspora

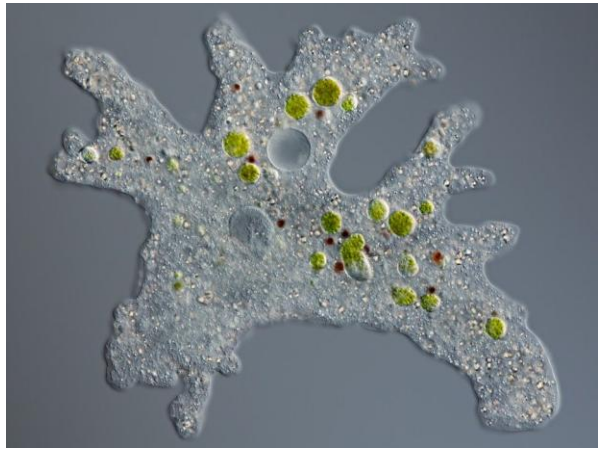
Phylum 5: Ascetospora

Phylum 6: Myxozoa

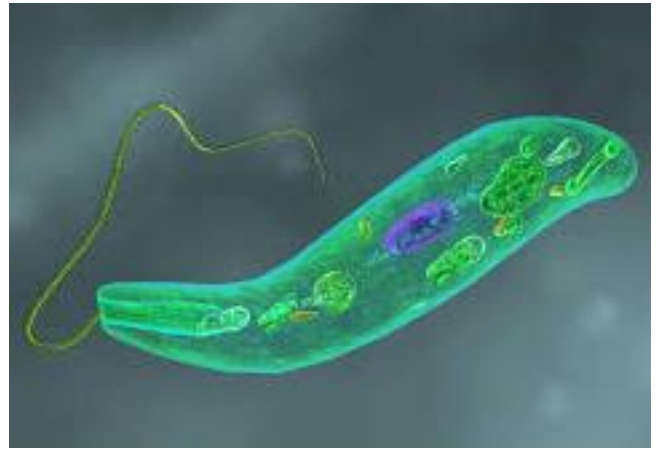
Phylum 7: Ciliophora

Phylum Sarcomastigophora

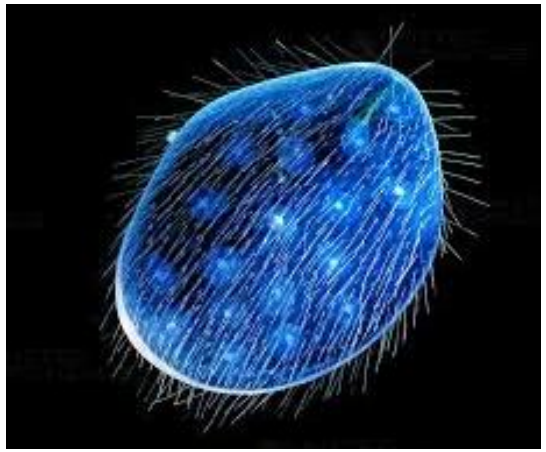
- Locomotion: Pseudopodia or flagella or both
- Nucleus: Monomorphic (single type), except in hererokaryotic Foraminiferida.
- Reproduction: Fission (asexual) or syngamy (sexual)
- Spore formation: Absent



Amoeba



Euglena

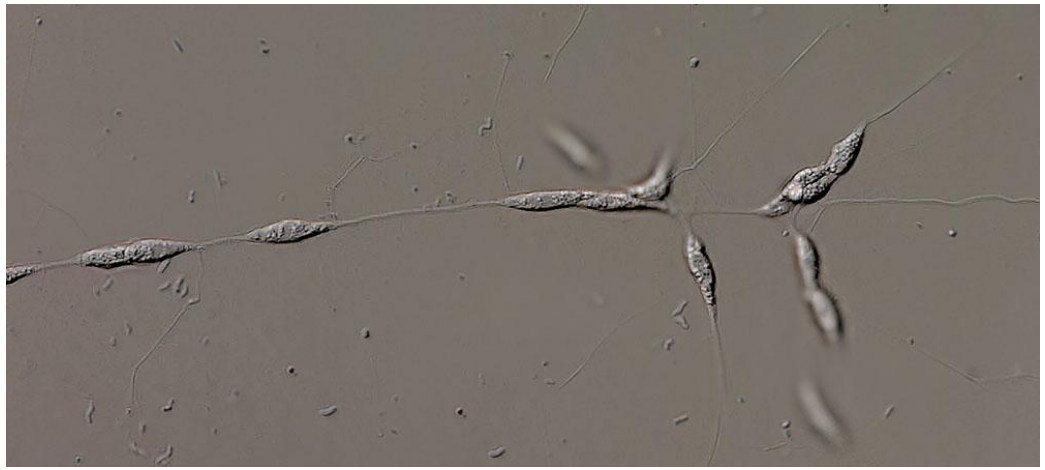


Opalina

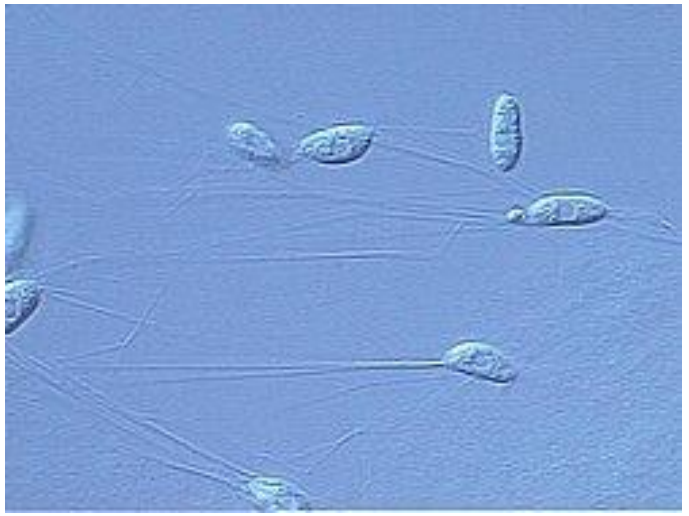
Giardia

Phylum Labyrinthomorpha

- Free-living, found in marine and estuarine water.
- Individuals are spindle-shaped and form a net along filamentous tracts.
- Ectoplasm reticulate type in the trophic stage. Unique cell surface organelles are associated with the ectoplasmic networks.
- Lacks any locomotory organs.
- Most species forms zoospores.



Labyrinthula

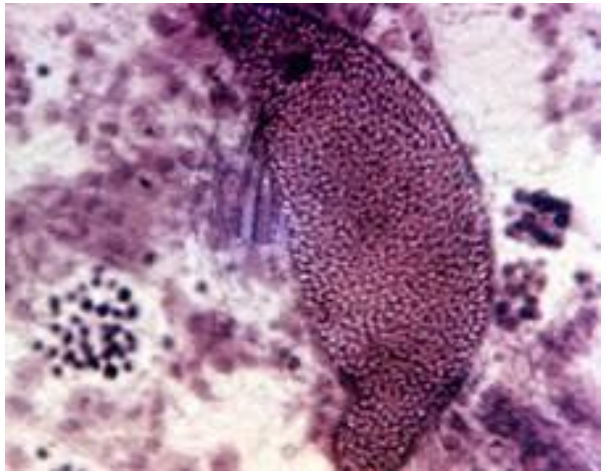


Aplanochytrium

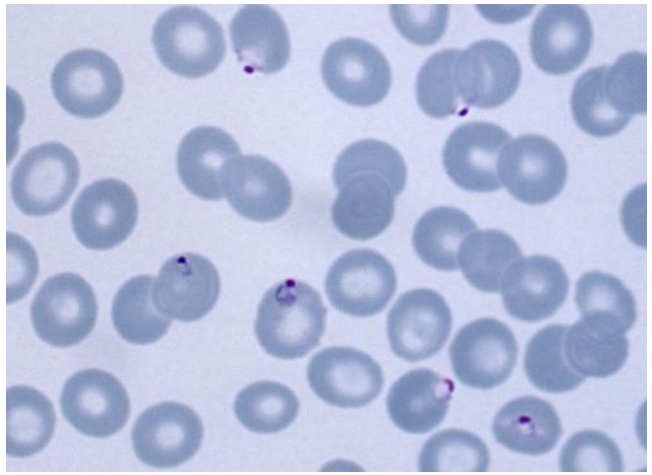
Phylum Apicomplexa

- Parasitic
- Anterior part of the body forms apical complex, made up of polar rings, rhoptires, micronemes, conoid, and subpellicular microtubules.
- Microspores are generally present at some stages.
- Absence of cilia but flagellated or amoeboid gametes in some species.
- Reproduction asexual or sexual:
  - Asexual: binary fission
  - Sexual: gametic (either isogameteous or anisogametous).

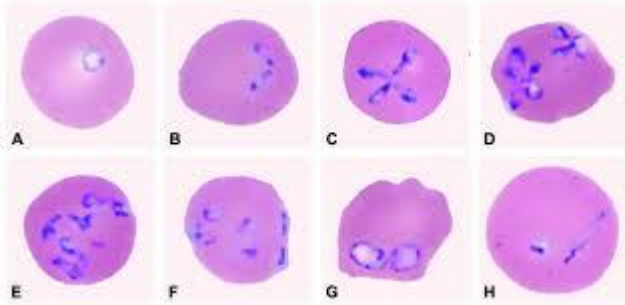
Perkinsus



Monocystis



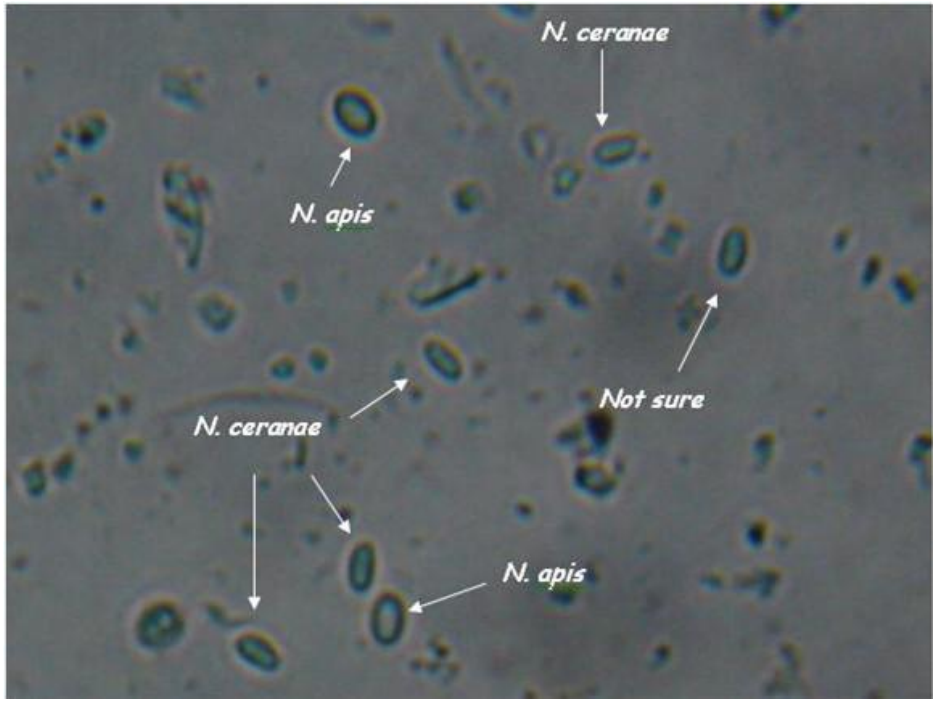
Plasmodium



Bebesia

Phylum Microspora

- Obligatory intracellular parasites found in nearly all major animal groups.
- Spores unicellular, each with an imperforate wall, containing one uninucleate or dinucleate sporoplasm.
- Spore is with a simple or complex extrusion apparatus associated with the polar tube and polar cap.
- Mitochondria absent.
- Usually dimorphic in sporulation sequence.

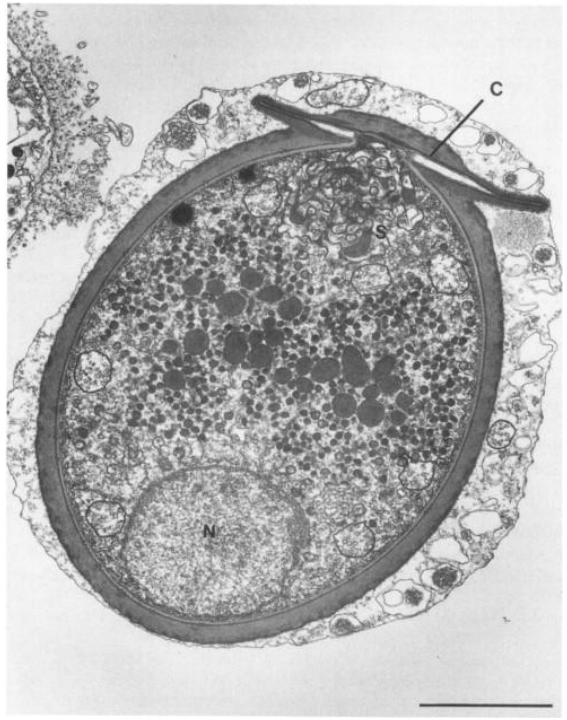


Nosema

Glugea

Phylum Ascetospora

- Parasitic
- Spores are usually multicellular.
- Sporoplasm may be one or more
- Spores without polar capsules or polar filaments.



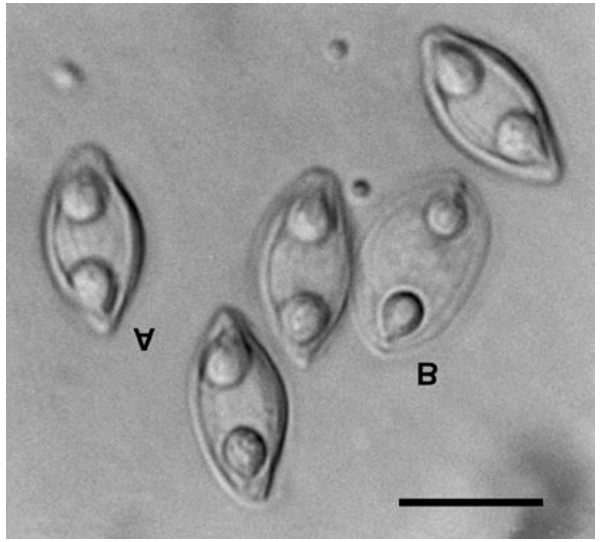
Haplosporidium

Enterosporidium

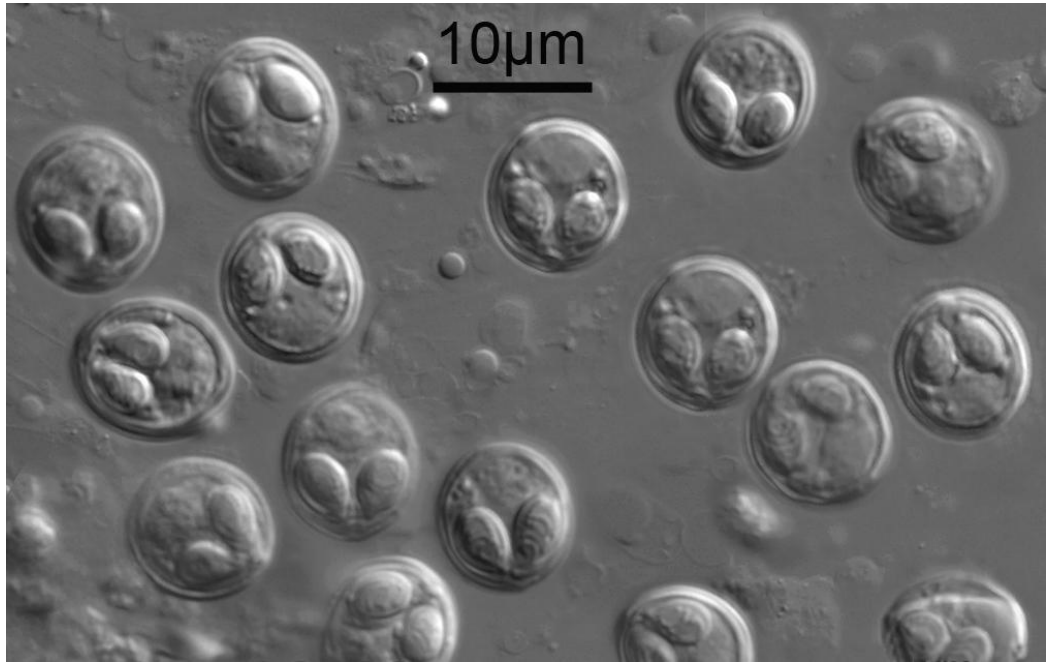
Phylum Myxozoa

- Extracellular parasites of annelids and cold-blooded vertebrates (especially fishes).
- Polar capsule and sporoplasm one to many.
- Spore wall consist of one, two, three or many valves.
- Spores are of multicellular in origin.

Remarks: Recent molecular analysis suggests these are not protozoans, rather highly degenerated multicellular animals.



Myxidium



Myxobolus

Phylum Ciliophora

- Locomotory organelles are simple cilia or compound ciliary organelles, typically at least in one stage of the life cycle.
- Subpellicular infraciliature is always present, even during the absence of cilia.
- Nucluei bimorphic.
- Presence of cytostome and cytopyge.
- Nutrition heterotrophic.
- Presence of typical contractile vacuoles
- Both sexual and asexual reproduction are present:
  - Asexual: transverse binary fission
  - Sexual: conjugation, autogamy or cytogamy

Paramoecium

Vorticella