

Protozoa (Characters, Classification and Types)

The protozoa (Gr., *protos* = first or primitive; *zoon* = animal) are microscopic, eukaryotic, unicellular, solitary or colonial, commonly motile and phagocytic heterotrophic animalcules. The term protozoa was coined by Goldfuss (1818) and unicellular nature of protozoa was established by von Siebold (1845). There are about 50,000 species of protozoa (*i.e.*, 30,000 living and 20,000 extinct) which are found in all moist places such as sea, freshwater and soil. Each protozoan functions as an independent unit and is able to perform effectively all the activities necessary for life.

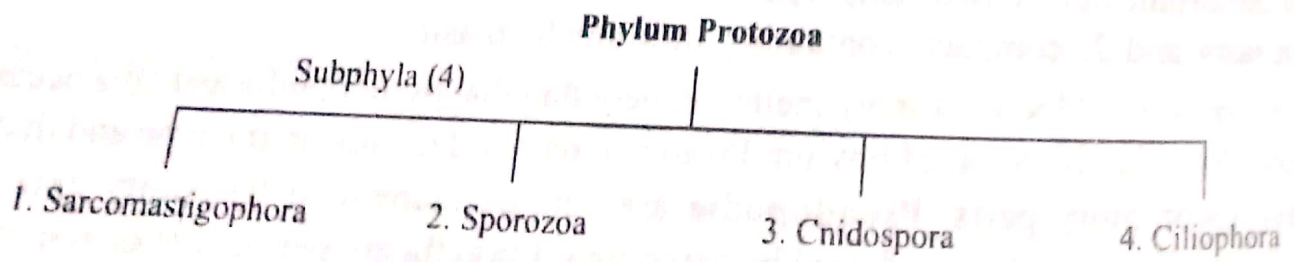
2.1 GENERAL CHARACTERS

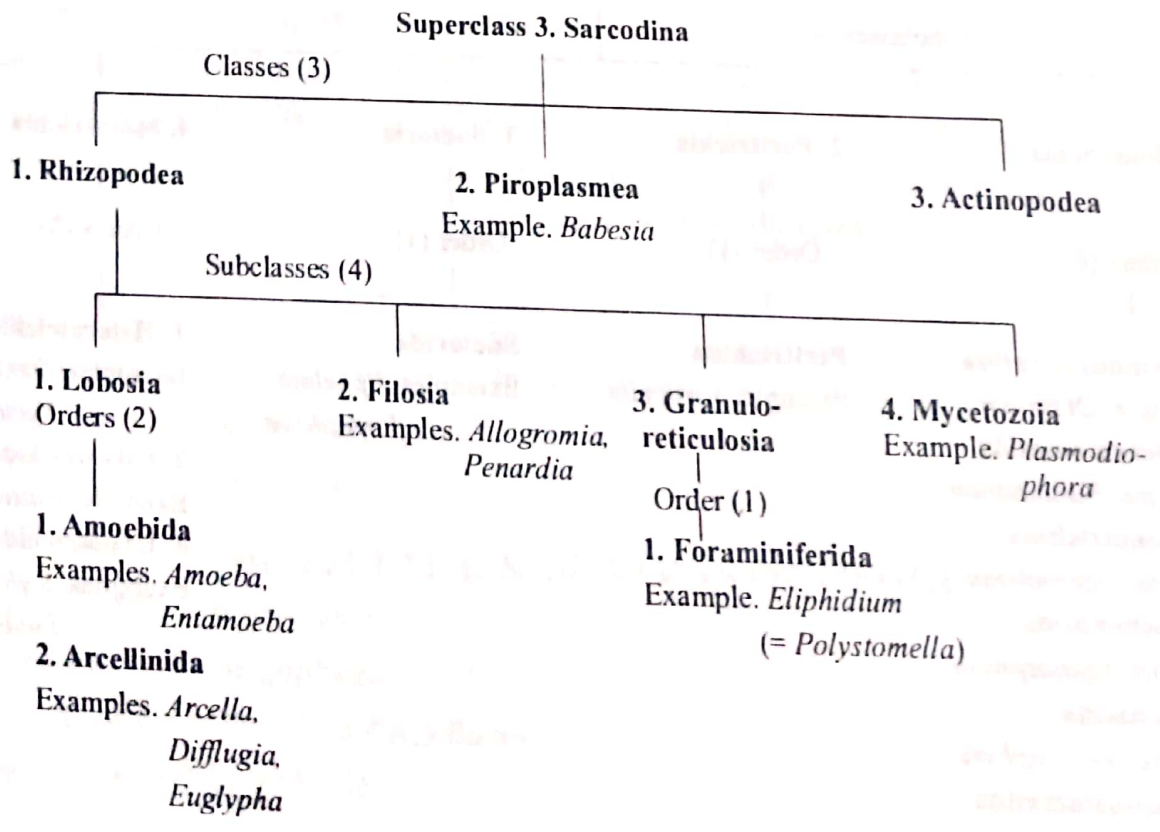
1. Protozoa are small, generally microscopic animalcules. Individual independent protozoa range in size from a micrometer (*e.g.*, *Micromonas*) to a few millimeters in some dinoflagellates, amoebas and ciliates.
2. They are simplest and most primitive animals having **cellular level of organisation**.
3. **Unicellular or single-celled** animals having no tissues or organs. Specialised parts of living material (*i.e.*, protoplasm) form membrane-bound organelles or organoids.
4. The single cell performs all necessary functions. There is no **physiological division of labour**.
5. The body is bounded by the plasma membrane. The rigidity or flexibility of the body and its shape are largely dependent on the nature of the **cytoskeleton** (*e.g.*, pellicle;) and **exoskeleton** (*e.g.*, test).
6. Animalcules may be **free-living, commensal, mutualistic or parasitic** (both ectoparasitic and endoparasitic). The free-living protozoans are aquatic, inhabiting fresh and salt waters. These may be **solitary or colonial**; in colonial forms the individuals are alike and independent.
7. Body shape variable; it may be spherical, oval, elongated or flattened.
8. Cytoplasm is differentiated into an outer **ectoplasm** (or cell cortex) and inner **endoplasm**.
9. Protozoans may have one or more **nuclei** which may be **monomorphic or dimorphic**. In case of dimorphic nuclei, two basic types are recognized: 1. vesicular, containing considerable nucleoplasm and 2. compact, containing little nucleoplasm.
10. Three major types of locomotor organelles namely flagella, pseudopodia and cilia occur among protozoa. The classification of phylum Protozoa mainly depends on the type and distribution of these locomotory parts. **Pseudopodia** are semipermanent to transitory extensions of protoplasm of body surface and used by sarcodina. **Flagella** are permanent or semipermanent

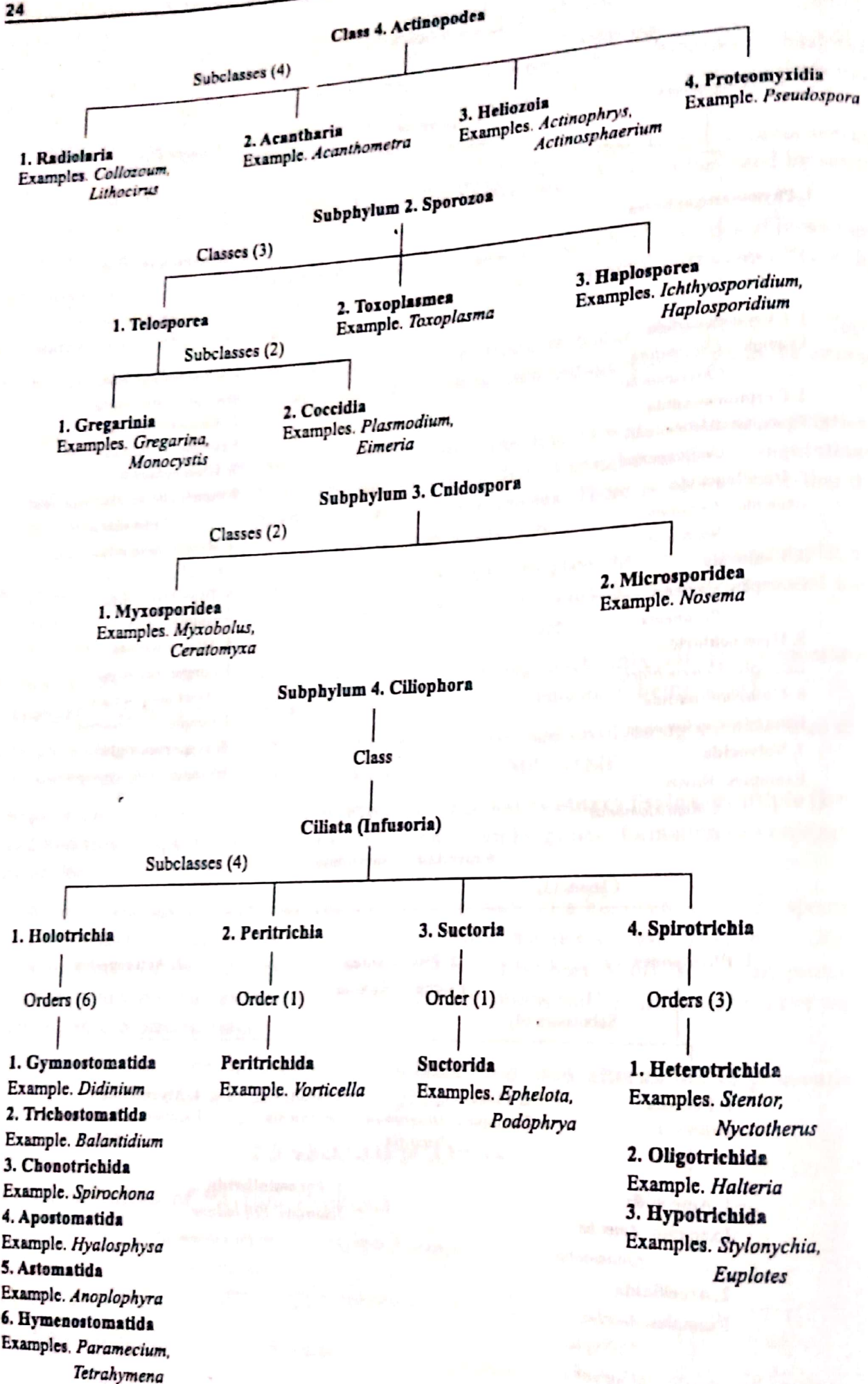
... includes asexual and sexual phases.

2.2 CLASSIFICATION

Outline Classification of Phylum Protozoa







According to Honigberg *et al.*, (1964) phylum Protozoa has been classified into four subphyla: Sarcomastigophora, Sporozoa, Cnidospora and Ciliophora.

Subphylum 1. Sarcomastigophora

1. The locomotory organs are either flagella or pseudopodia or both.
2. Single type of nucleus (monomorphic).
3. Asexual reproduction by binary fission and multiple fission.
4. Sexual reproduction by syngamy.

Subphylum 2. Sporozoa

1. All are endoparasites.
2. Body covered with thick pellicle.
3. Locomotory organs are absent in adult. Flagella present only in microgametes of some group.
4. Nucleus is of the single type.
5. Saprozoic nutrition.
6. Asexual reproduction by multiple fission.
7. Sexual reproduction by syngamy followed by spore formation.
8. Spores contain one to many sporozoites which represent the infective phase.

Subphylum 3. Cnidospora

1. All are parasitic.
2. Spore formation occurs throughout life.
3. Spores have one to many cells, each with one or more **polar filaments** (which are coiled threads and can be shot out for attaching to the host) and one or more **sporoplasms** (analogous structures to sporozoites).
4. Without sporogony, zygote gives rise to one or more trophozoites, each with many nuclei.

Subphylum 4. Ciliophora

1. Most species are free-living, some are commensal or parasitic.
2. Body organization complex.
3. Presence of simple **cilia** or compound ciliary structures as locomotory or feeding organelles at some stage in the life cycle. Subpellicular cilia present even when cilia absent.
4. Nuclear dimorphism occurs, *i.e.*, they have two nuclei, a large vegetative or trophic **macronucleus** and a small generative or reproductive **micronucleus**.
5. Nutrition heterotrophic.
6. Contractile vacuole typically present.
7. Asexual reproduction by transverse binary fission; or by budding or multiple fission.
8. Sexual reproduction by conjugation.
9. Gametes are always absent.

SUBPHYLUM 1. SARCOMASTIGOPHORA

It includes **three** superclasses:

Superclass 1. Mastigophora

1. They are commonly called **flagellates**.
2. Body is covered by pellicle.

- 3. Locomotary organs of adults are flagella.
- 4. Asexual reproduction by longitudinal binary fission.
- 5. Free living or parasitic.

Superclass 2. Opalinata

- 1. Entire body surface is covered by longitudinal, oblique rows of cilia. Infraciliature characteristic of the true ciliates is lacking.
- 2. Cytostome absent; saprozoic nutrition.
- 3. Two or many monomorphic nuclei.
- 4. Asexual reproduction by longitudinal binary fission.
- 5. Sexual reproduction involves syngamy with flagellated gametes.
- 6. Gut (i.e., rectum) parasites/commensals of anurans (frogs, toads, tadpoles) and also of fishes, salamanders and reptiles.

Examples. *Opalina*, *Cepedea*, *Zelleriella*.

(Note. Superclass Opalinata includes single class **Opalinatea** and single order **Opalinida** both having characters of superclass).

Superclass 3. Sarcodina (or Rhizopoda)

- 1. The amoeboid form is predominant.
- 2. Locomotion and feeding by pseudopodia, or by locomotive protoplasmic flow without distinct pseudopodia. Flagella when present, usually restricted to developmental stages of life cycle.
- 3. Pseudopodia may be lobopodia, filopodia or reticulopodia.
- 4. Body naked or with external or internal test or skeleton.
- 5. Nutrition holozoic and saprozoic.
- 6. Asexual reproduction by fission.
- 7. Sexual reproduction by flagellate (rarely amoeboid) gametes.
- 8. Most species are solitary and free-living.

SUPERCLASS 1. MASTIGOPHORA

It is divided into two classes:

Class I. Phytomastigophorea

- 1. Chlorophyll containing chromatophores (or chloroplasts) are present.
- 2. There are one or two flagella.
- 3. Nutrition mostly holophytic (by photosynthesis).
- 4. Reserve food is starch or paramylon.

Class II. Zoomastigophorea

- 1. Chloroplasts (chromatophores) are absent.
- 2. There are one to many flagella; often undulating membrane is present.
- 3. Nutrition holozoic or saprozoic.
- 4. Reserve food is glycogen.
- 5. Parasitic, commensal or symbiotic.