CHAP: ANIMAL-LIKE PROTISTS

- ✓ **Life Within a Single Plasma Membrane**
- ✓ **Phylum Sarcomastigophora**
- ✓ **Phylum Labyrinthomorpha**
- ✓ **Phylum Apicomplexa**
- ✓ **Phylum Microspora**
- ✓ **Phylum Acetospora**
- ✓ **Phylum Myxozoa**
- ✓ **Phylum Ciliophora**

LIFE WITHIN A SINGLE PLASMA MEMBRANE

- ✓ Protozoa have unicellular (cytoplasmic) organization. But they are not simple organisms.
- ✓ Often, they are more complex than any particular cell in higher organisms.
- ✓ Some individual protozoans come together to form colonies.
- ✓ The individuals in a colony are not dependent on one another for most functions.
- ✓ However, some protozoan colonies are complex.
- ✓ Their individual cells become specialized.
- ✓ Therefore, it becomes difficult to differentiate between a colony and a multicellular organism.

Maintaining Homeostasis in Protozoans

Protozoans maintain homeostasis by following methods:

1. Support

The bodies of protozoans are supported by **pellicle** and **cytoplasm.**

(a) A regular arrangement of microtubules is called the pellicle. Pellicle underlies the plasma membrane of many protozoa. The pellicle is a rigid structure. It maintains the shape of the protozoan. But it is also flexible.

(b) Cytoplasm: The cytoplasm of a protozoan is differentiated into two regions: The portion of the cytoplasm just beneath the pellicle is called **ectoplasm**. It is relatively clear and firm. The inner cytoplasm is called **endoplasm**. It is granular and more fluid like.

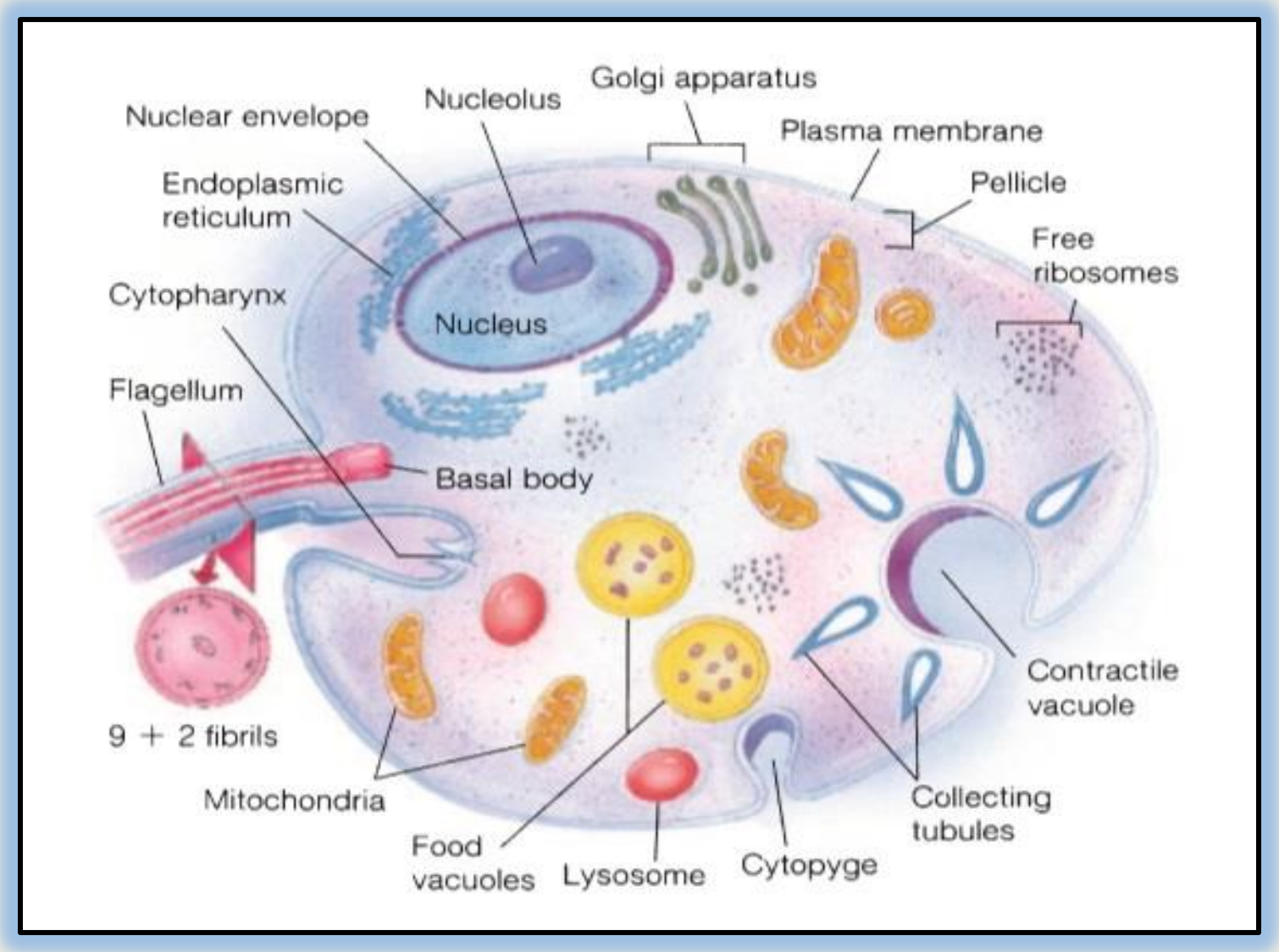

Fig: A Protozoan Protist. This drawing of a stylized protozoan with a flagellum illustrates the basic protozoan morphology.

2. Osmoregulation

The maintenance of water and salt balance in the body is called osmoregulation.

- ✓ Most **marine protozoa** have solute concentrations similar to that of their environments.
- ✓ **Freshwater protozoa**, however, must regulate the water and solute concentrations of their cytoplasm.
- ✓ Water enters freshwater protozoa by **osmosis.**
- ✓ **Contractile vacuoles** remove this excess water.
- ✓ In some protozoa, contractile vacuoles form by the coalescence of smaller vacuoles.
- ✓ In others, the vacuoles are permanent organelles that collecting tubules radiating into the cytoplasm fill.
- ✓ Contracting **microfilaments** have been implicated in the emptying of contractile vacuoles.

3. Ingestion of Food

There are different methods of ingestion of food.

(i) Most protozoans absorb dissolved nutrients by active transport.

(ii) Some protozoan ingests whole or particle of food by endocytosis.

It forms food vacuole.

(iii) Some protozoa ingest food through **cytopharynx.**

4. Process of Digestion

Digestion and transport of food occurs in food vacuoles. These food vacuoles are formed during endocytosis.

(i) Food vacuoles fuse with **Lysosomes.**

(ii) These lysosomes contain enzymes. The change of enzyme and acidity will help in digestion.

(iii) These food vacuoles circulate through the cytoplasm and distribute the products of digestion.

(iv) The vacuoles are called **egestion vacuoles** after completion of digestion. They release their contents by exocytosis. Sometimes a temporary pole is formed at a specialized region of the plasma membrane or pellicle. This pore is called the **cytopyge**.

5. Respiration and Excretion

- ✓ The protozoans have small size.
- ✓ They have a large surface area in proportion to their volume. It helps in gas exchange or excretion.
- ✓ Both gas exchange and excretion occur by **diffusion** across the plasma membrane.

i. **Gas exchange involves absorption of oxygen and elimination of the carbondioxide.**

ii. **Excretion is the elimination of the nitrogenous waste.**

iii. **By product in protozoa is mostly ammonia.**

6. Reproduction

Both asexual and sexual reproduction occurs among the protozoa.

1) ASEXUAL REPRODUCTION

- **Binary fission**
- **Budding**
- **Multiple Fission or Schizogony**

2) SEXUAL REPRODUCTION

1. Binary fission

- ✓ In binary fission, mitosis produces two nuclei that are distributed into two similar-sized individuals when the cytoplasm divides.
- ✓ During cytokinesis, some organelles duplicate to ensure that each new protozoan has the needed organelles to continue life.
- ✓ Depending on the group of protozoa, cytokinesis may be longitudinal or transverse

2. Budding

- ✓ It is another limp of asexual reproduction.
- ✓ Mitosis occurs during budding. It is followed by the incorporation of one nucleus into a cytoplasmic mass.
- ✓ This cytoplasmic mass is much smaller than the parent cell.

3. Multiple Fission or Schizogony

- ✓ In this case, a large number of daughter cells are formed bv the division of a single cell.
- ✓ Multiple mitotic divisions occur in a mature cell in schizogony.
- ✓ Large number of nuclei are formed. Then cytoplasmic divisions occur.
- ✓ Cytoplasmic divisions result in the separation of each nucleus into a new cell.

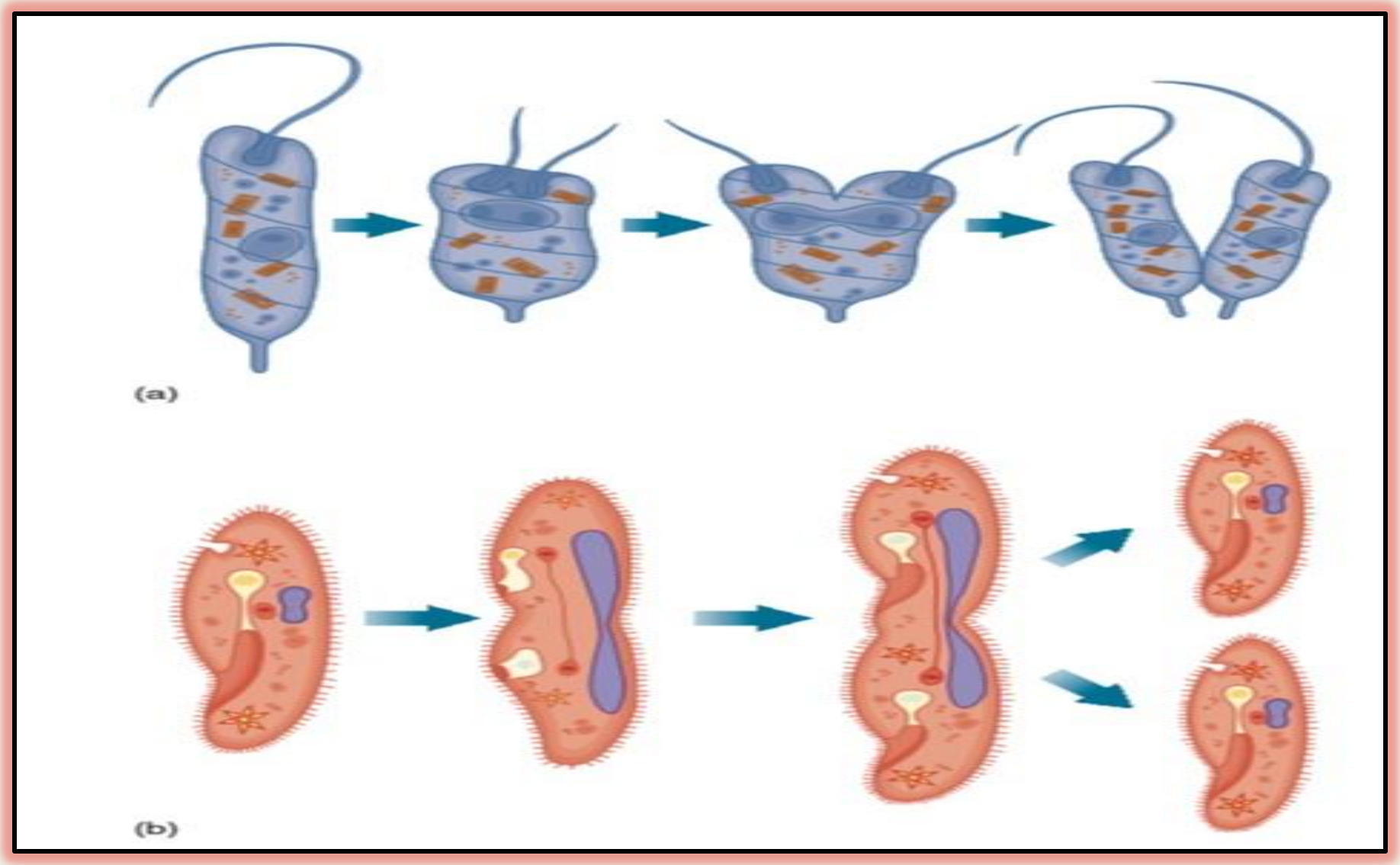

Fig: Asexual Reproduction in Protozoa. Binary fission begins with mitosis. Cytoplasmic division (cytokinesis) divides the organelles between the two cells and results in two similarly sized protozoa. Binary fission is (a) longitudinal in some protozoa (e.g., mastigophorans) and (b) transverse in other protozoa (e.g., ciliates).

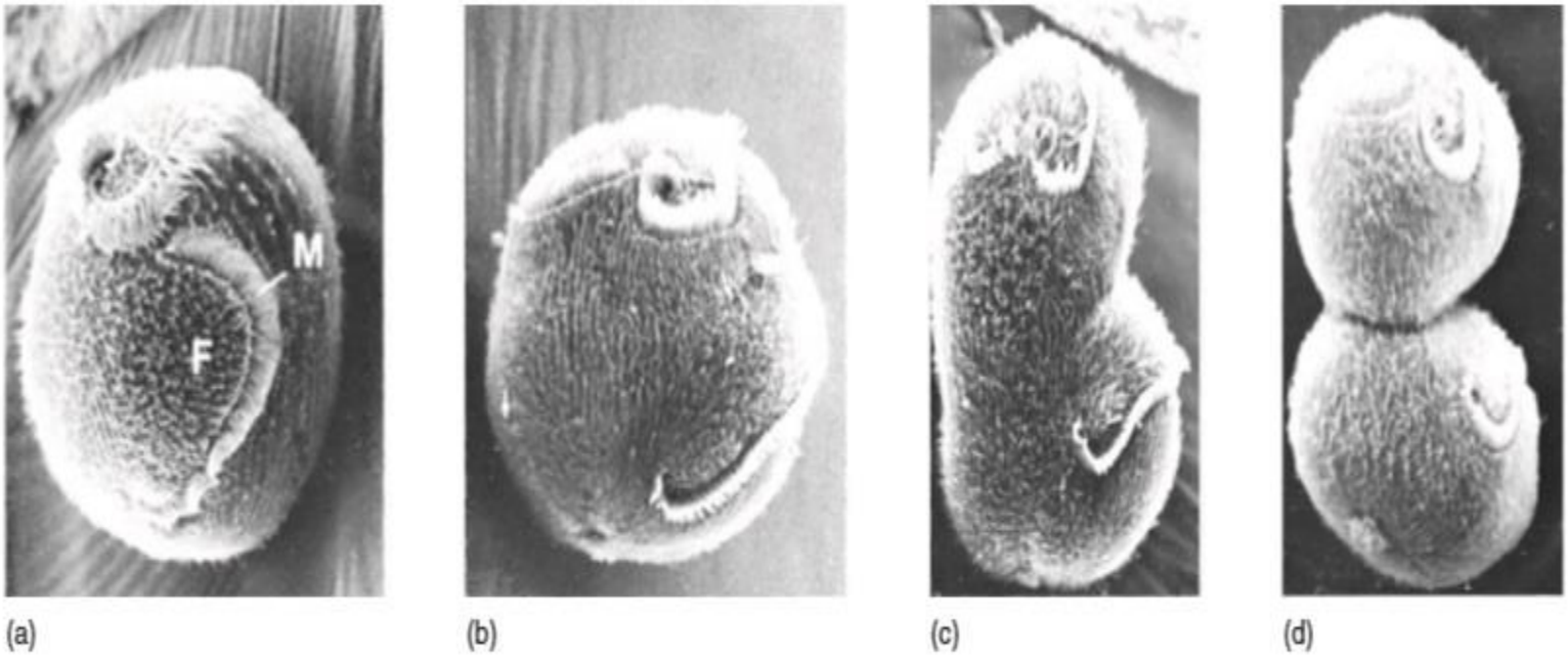

Fig: Binary Fission of the Ciliate, *Stentor coeruleus*. (a,b) Fission includes the division of some surface features—in this case, cilia modified into a bandlike structure called a membranelle (M). F designates the frontal field. The arrow in (b) shows the beginning of a fission furrow. (c,d) Fission is completed by division of the cytoplasm.

Sexual Reproduction

- ✓ Sexual reproduction requires gamete formation and the subsequent fusion of gametes to form a zygote.
- ✓ In most protozoa, the sexually mature individual is haploid.
- ✓ Gametes are produced by mitosis, and meiosis follows union of the gametes. .

SUMMARY OF PROTOZOAN CLASSIFICATION*

Kingdom Protista (pro-tees′ta) Single-celled eukaryotes.

Subkingdom Protozoa (pro″to-zo′ah) Animal-like protistans.

Phylum Sarcomastigophora (sar″o-mas-ti-gof′o-rah)
Protozoa that possess flagella, pseudopodia, or both for locomotion and feeding; single type of nucleus. About 18,000 species.

Subphylum Mastigophora (mas″ti-gof′o-rah)
One or more flagella for locomotion; autotrophic, heterotrophic, or saprozoic.

Class Phytomastigophorea (fi″to-mas-ti-go-for-ee′ah)
Chloroplasts usually present; mainly autotrophic, some heterotrophic. *Euglena*, *Volvox*, *Chlamydomonas*.

Class Zoomastigophorea (zo″o-mas-ti-go-for-ee′ah)
Lack chloroplasts; heterotrophic or saprozoic. *Trypanosoma*, *Trichonympha*, *Trichomonas*, *Giardia*, *Leishmania*.

Subphylum Sarcodina (sar″ko-din′ah)
Pseudopodia for movement and food gathering; naked or with shell or test; mostly free living.

Superclass Rhizopoda (ri-zop′o-dah)
Lobopodia, filopodia, reticulopodia, or no distinct pseudopodia. *Amoeba*, *Entamoeba*, *Naegleria*, *Arcella*, *Difflugia*; foraminiferans (*Gumbelina*). About 4,000 species.

Superclass Actinopoda (ak″ti-nop′o-dah)
Spherical, planktonic; axopodia supported by microtubules; includes marine radiolarians with siliceous tests and freshwater heliozoans (*Actinophrys*). About 3,000 species.

Subphylum Opalinata (op″ah-li-not′ah)
Cylindrical; covered with cilia. *Opalina*, *Zelleriella*.

Phylum Labyrinthomorpha (la″brinth-o-mor′fa)
Trophic stage as ectoplasmic network with spindle-shaped or spherical, nonamoeboid cells; saprozoic and parasitic on algae and seagrass; mostly marine and estuarine. *Labyrinthula*.

Phylum Apicomplexa (a″pi-kom-plex′ah)
Parasitic with an apical complex used for penetrating host cells; cilia and flagella lacking, except in certain reproductive stages. The gregarines (*Monocystis*), coccidians (*Eimeria*, *Isospora*, *Sarcocystis*, *Toxoplasma*), *Plasmodium*. About 5,500 species.

Phylum Microspora (mi″cro-spor′ah)
Unicellular spores; intracellular parasites in nearly all major animal groups. The microsporeans (*Nosema*). About 850 species.

Phylum Acetospora (ah-sēt-o-spor′ah)
Multicellular spore; all parasitic in invertebrates. The acetosporans (*Paramyxa*, *Haplosporidium*).

Phylum Myxozoa (mix″o-zoo′ah)
Spores of multicellular origin; all parasitic. The myxozoans (*Myxosoma*). About 1,250 species.

Phylum Ciliophora (sil″i-of′or-ah)
Protozoa with simple or compound cilia at some stage in the life history; heterotrophs with a well-developed cytostome and feeding organelles; at least one macronucleus and one micronucleus present. *Paramecium*, *Stentor*, *Euplotes*, *Vorticella*, *Balantidium*. About 9,000 species.

*For many years the four main groups of protozoa were amoebae, ciliates, flagellates, and spore formers. The following taxonomy continues to follow the principles of evolutionary taxonomy rather than cladistic taxonomy. It should be noted that the true evolutionary relationships of many protozoan groups have yet to be elucidated, and some of the following taxa may be either para- or polyphyletic. The reason for this approach is that it is a compromise between reasonably current evolutionary thinking and the practical need for a system of nomenclatures that allows faculty and students to communicate with one another and retrieve information from the older literature.

PHYLUM SARCOMASTIGOPHORA

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- **Subphylum Mastigophora**
  - Class Phytomastigophorea
  - Class Zoomastigophorea
- **Subphylum Sarcodina**
  - **Superclass rhizopoda**
    - Class lobosea
- **Subphylum Actinopoda**
- **Subphylum Opalinata**

PHYLUM SARCOMASTIGOPHORA

CHARACTERISTICS:

1. Unicellular or colonial

2. Locomotion by flagella, pseudopodia, or both

3. Autotrophic, saprozoic, or heterotrophic

4. Single type of nucleus

5. Sexual reproduction (usually)

SUBPHYLUM MASTIGOPHORA:

FLAGELLAR LOCOMOTION

- ✓ Members of the subphylum Mastigophora use flagella in locomotion.
- ✓ Flagella may produce two-dimensional, whiplike movements or helical movements that push or pull the protozoan through its aquatic medium.