

General Characteristics of Protozoa

Protozoa are single celled organisms. They come in many different shapes and sizes ranging from an *Amoeba* which can change its shape to *Paramecium* with its fixed shape and complex structure. They live in a wide variety of moist habitats including fresh water, marine environments and the soil.



Amoeba proteus protozoa

Some are parasitic, which means they live in other plants and animals including humans, where they cause disease. *Plasmodium*, for example, causes malaria. They are motile and can move by:

- **Cilia** - tiny hair like structures that cover the outside of the microbe. They beat in a regular continuous pattern like flexible oars.
- **Flagella** - long thread-like structures that extend from the cell surface. The flagella move in a whip-like motion that produces waves that propel the microbe around.
- **Amoeboid movement** - the organism moves by sending out pseudopodia, temporary protrusions that fill with cytoplasm that flows from the body of the cell.

Protozoa are eukaryotic microorganisms. Although they are often studied in zoology courses, they are considered part of the microbial world because they are unicellular and microscopic.

Protozoa are notable for their ability to move independently, a characteristic found in the majority of species. They usually lack the capability for photosynthesis, although the genus *Euglena* is renowned for motility as well as photosynthesis (and is therefore considered both an alga and a protozoan). Although most protozoa reproduce by asexual methods, sexual reproduction has been observed in several species. Most protozoal species are aerobic, but some anaerobic species have been found in the human intestine and animal rumen.

Protozoa are located in most moist habitats. Free-living species inhabit freshwater and marine environments, and terrestrial species inhabit decaying organic matter. Some species are parasites of plants and animals.

Protozoa play an important role as **zooplankton**, the free-floating aquatic organisms of the oceans. Here, they are found at the bases of many food chains, and they participate in many food webs.

Size and shape. Protozoa vary substantially in size and shape. Smaller species may be the size of fungal cells; larger species may be visible to the unaided eye. Protozoal cells have no cell walls and therefore can assume an infinite variety of shapes. Some genera have cells surrounded by hard shells, while the cells of other genera are enclosed only in a cell membrane.

Many protozoa alternate between a free-living vegetative form known as **atrophozoite** and a resting form called a **cyst**. The protozoal cyst is somewhat analogous to the bacterial spore, since it resists harsh conditions in the environment. Many protozoal parasites are taken into the body in the cyst form.

Most protozoa have a single nucleus, but some have both a macronucleus and one or more micronuclei. Contractile vacuoles may be present in protozoa to remove excess water, and food vacuoles are often observed.

Nutrition and locomotion. Protozoa are **heterotrophic** microorganisms, and most species obtain large food particles by **phagocytosis**. The food particle is ingested into a food vacuole. Lysosomal enzymes then digest the nutrients in the particle, and the products of digestion are distributed throughout the cell. Some species have specialized structures called **cytostomes**, through which particles pass in phagocytosis.

Many protozoal species move independently by one of three types of locomotor organelles: flagella, cilia, and pseudopodia. **Flagella** and **cilia** are structurally similar, having a "9-plus-

2" system of microtubules, the same type of structure found in the tail of animal sperm cells and certain cells of unicellular algae. How a protozoan moves is an important consideration in assigning it to a group.

Classification of Protozoa

All protozoal species are assigned to the kingdom **Protista** in the Whittaker classification. The protozoa are then placed into various groups primarily on the basis of how they move. The groups are called phyla (singular, phylum) by some microbiologists, and classes by others. Members of the four major groups are illustrated in Figure 1 .

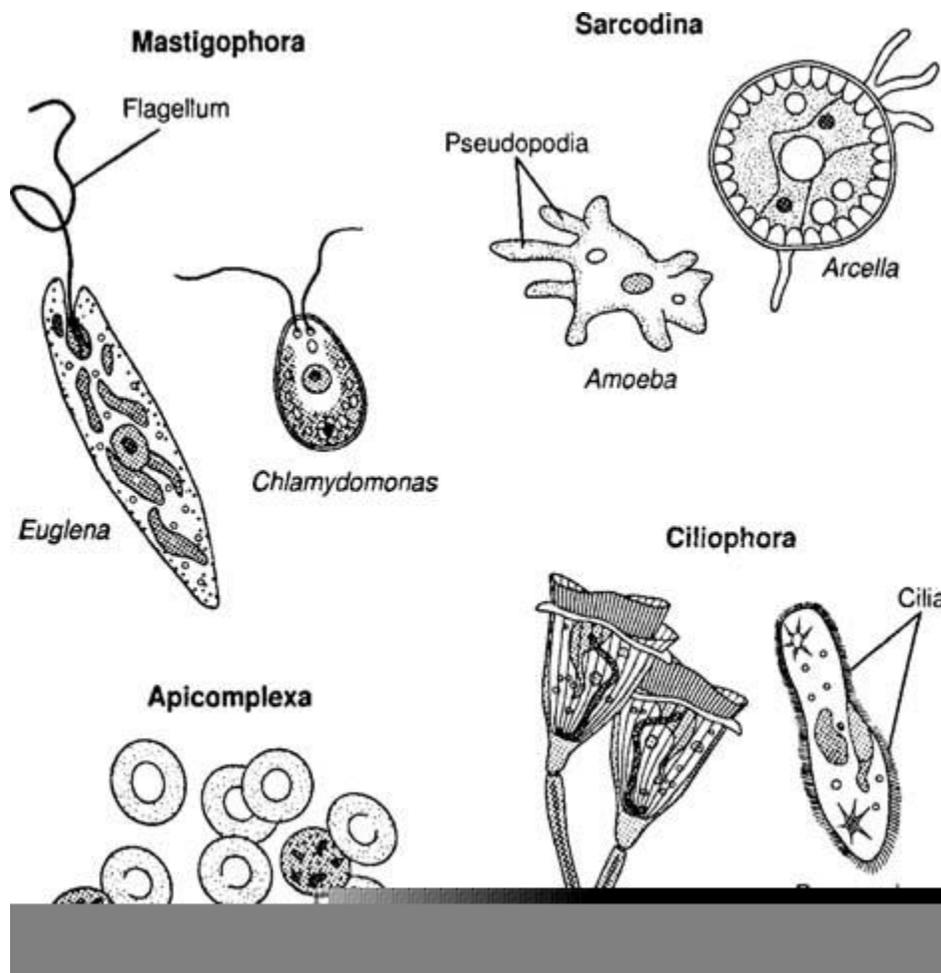


Figure 1
An array of protozoa showing representatives of the four major groups.