

# PROTOZOA

## Introduction

Protozoa are unicellular, eukaryotic organisms that are natural inhabitants of water and soil. They play an essential role in ecosystems and human health, with some acting as parasites. Most protozoa are aerobic heterotrophs, while intestinal protozoa can grow anaerobically. They obtain food through various means, such as phagocytosis and specialized feeding structures.

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## Classification of Protozoa

Protozoa are classified based on their mode of locomotion and other structural features:

1. **Phylum Sarcomastigophora**
  - **Class Lobosea (Amoeboids)**
    - Move using pseudopodia.
    - Example: *Entamoeba histolytica* (causes amoebic dysentery).
  - **Class Zoomastigophorea (Flagellates)**
    - Move using one or more flagella.
    - Examples: *Giardia lamblia* (causes giardiasis), *Leishmania* (causes leishmaniasis).
2. **Phylum Apicomplexa (Sporozoa)**
  - Parasitic protozoa that lack locomotory organelles.
  - Exhibit a complex life cycle involving spore formation.
  - Example: *Plasmodium* spp. (causes malaria).
3. **Phylum Ciliophora (Ciliates)**
  - Move using hair-like structures called cilia.
  - Exhibit nuclear dimorphism (macro- and micronucleus).
  - Example: *Paramecium* (free-living ciliate protozoan).
4. **Phylum Microspora**
  - Spore-forming intracellular parasites.
  - Largely affect immunocompromised individuals.
  - Example: *Enterocytozoon bienersi* (causes microsporidiosis).

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## Reproduction in Protozoa

1. **Asexual Reproduction**
  - **Binary Fission:** Occurs in ciliates (*Paramecium*) and flagellates (*Giardia*, *Leishmania*).
  - **Budding:** Produces unequal-sized daughter cells (*Arcella*, *Noctiluca*).
  - **Multiple Fission (Schizogony):** Produces multiple daughter cells (*Amoeba*, *Plasmodium*).
2. **Sexual Reproduction**
  - **Gametogenesis:** Formation of haploid gametes.

- **Zygote Formation:** Fusion of gametes to form a diploid zygote.
  - **Sporogony:** Multiple fission of the zygote producing sporozoites (Plasmodium).
  - **Conjugation:** Genetic exchange in ciliates (Paramecium).
3. **Encystment**
- Some protozoa form protective cysts to survive unfavorable conditions.
  - Example: Oocyst formation in Apicomplexa (Plasmodium).
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## Representative Protozoa

### 1. Entamoeba histolytica

#### Classification:

- **Phylum:** Sarcomastigophora
- **Subphylum:** Sarcodina
- **Movement:** Pseudopodia

#### Life Cycle:

1. Cyst stage: Infectious form, ingested through contaminated food or water.
  2. Excystation: Cyst transforms into trophozoites in the intestine.
  3. Trophozoite stage: Actively feeds, multiplies, and invades the intestinal wall, sometimes reaching the liver.
  4. Encystation: Forms new cysts, which are excreted in feces.
- **Disease:** Causes amoebic dysentery (Amoebiasis).
  - **Structure:** Exists in three stages:
    - **Trophozoite:** Active feeding stage, capable of invading tissues and found in feces of infected individuals.
    - **Precyst:** Non-motile, non-pathogenic intermediate stage.
    - **Cyst:** Infective stage found in contaminated food and water.
  - **Symptoms:** Abdominal pain, diarrhea with blood and mucus, weight loss.
  - **Transmission:** Ingestion of cysts from contaminated food and water.
  - **Prevention:** Proper sanitation, safe drinking water, and hygiene.
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### 2. Plasmodium spp. (Malaria Parasite)

#### Classification:

- **Phylum:** Apicomplexa (Sporozoa)
- **Movement:** Non-motile

#### Life Cycle:

1. **Sporozoite stage:** Injected into humans by female *Anopheles* mosquitoes.

2. **Liver stage:** Sporozoites enter liver cells and multiply into merozoites.
  3. **Erythrocytic stage:** Merozoites infect red blood cells, multiply, and cause symptoms of malaria.
  4. **Gametocyte stage:** Some merozoites form gametocytes, taken up by mosquitoes, continuing the cycle.
- **Disease:** Causes malaria.
  - **Species:** *P. vivax*, *P. falciparum*, *P. malariae*, *P. ovale*.
  - **Life Cycle:**
    - **Sporozoite Stage:** Infects human liver cells after mosquito bite.
    - **Merozoite Stage:** Infects red blood cells, leading to symptoms.
    - **Gametocyte Stage:** Sexual forms ingested by mosquitoes, continuing the cycle.
  - **Symptoms:** Fever, chills, sweating, anemia, organ failure (severe cases).
  - **Transmission:** Female *Anopheles* mosquito.
  - **Prevention:** Mosquito control, prophylactic medications, vaccines.
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### 3. *Giardia lamblia*

#### Classification:

- **Phylum:** Sarcomastigophora
- **Subphylum:** Mastigophora
- **Movement:** Flagella

#### Life Cycle:

1. Cyst stage: Infectious form, ingested via contaminated water.
  2. Excystation: Cysts release trophozoites in the small intestine.
  3. Trophozoite stage: Attaches to the intestinal wall, causing diarrhea.
  4. Encystation: Forms cysts that are excreted and spread via fecal contamination
- **Disease:** Causes giardiasis, a diarrheal illness.
  - **Structure:**
    - **Trophozoite:** Pear-shaped, flagellated, attaches to intestinal wall.
    - **Cyst:** Oval, infective stage, survives in contaminated water.
  - **Symptoms:** Diarrhea, bloating, fatigue, weight loss.
  - **Transmission:** Contaminated food, water, or person-to-person contact.
  - **Prevention:** Proper sanitation, water filtration, hygiene.
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### 4. *Leishmania* spp.

#### Classification:

- **Phylum:** Sarcomastigophora
- **Subphylum:** Mastigophora

- **Movement:** Flagella

#### **Life Cycle:**

1. **Promastigote stage:** Infectious form, transmitted via the bite of a sandfly.
2. **Amastigote stage:** Inside macrophages, multiplies within the host's cells.
3. The infected cells burst, releasing amastigotes, which are taken up by sandflies and continue the cycle.
  - **Disease:** Causes Leishmaniasis (cutaneous, mucocutaneous, visceral forms).
  - **Structure:**
    - **Amastigote:** Intracellular, found in human macrophages.
    - **Promastigote:** Flagellated, found in sandfly vector.
  - **Symptoms:** Skin sores (cutaneous), severe organ damage (visceral).
  - **Transmission:** Bite of infected sandflies.
  - **Prevention:** Vector control, protective clothing, insect repellents.

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#### **5. Paramecium spp.**

##### **Classification:**

- **Phylum:** Ciliophora
- **Movement:** Cilia

##### **Life Cycle:**

1. Asexual reproduction via **binary fission** (splitting into two).
2. Sexual reproduction via **conjugation**, where two cells exchange genetic material.
3. Grows and multiplies in aquatic environments.
  - **Habitat:** Free-living ciliate protozoan in freshwater.
  - **Structure:**
    - Covered with cilia for movement and feeding.
    - Has two types of nuclei (macronucleus and micronucleus).
    - Contains contractile vacuoles for osmoregulation.
  - **Feeding Mechanism:** Uses oral groove to ingest food through phagocytosis.
  - **Reproduction:**
    - Asexual by binary fission.
    - Sexual by conjugation, where genetic material is exchanged between individuals.
  - **Significance:** Important in food chains and as model organisms in research.