I. Protists
   - Commonly called protozoans
   - All single celled eukaryotes

Three most important phyla:
   1. Sarcomastigophora: includes the amebas and the flagellates
   2. Apicomplexa: all parasitic
   3. Ciliophora: ciliates

Maintaining Homeostasis for a Single Cell
   1. Locomotion:
      a. Pseudopodia (false feet) are the chief mechanism of amoeboid movement, also used for food gathering and defense
      b. Cilia (hair like) and flagella (whip like) are other locomotory structures that beat the water, also used for feeding, reproduction, respiration, excretion, and Osmoregulation
   2. Nutrition/Digestion:
      a. Autotrophic (*holophytic*) = make their own food
      b. Heterotrophic = obtain food from other sources
         i. Phagotrophs (*holozoic*) = ingest solid visible particles of food
         ii. Osmotrophs (*saprozoic*) = ingest food in a soluble form, digested externally
   3. Excretion/Osmoregulation:
      a. Excess water and some nitrogenous wastes are expelled by **contractile vacuoles**
4. Respiration:
   a. Respiration and most waste elimination are through the cellular membrane
5. Reproduction: *(All protozoa can reproduce asexually)*
   a. **Asexual Reproduction** (fission)
      i. Binary fission = one cell divides into two equal and identical cells
      ii. Multiple fission (schizogony) = a number of individuals are produced simultaneously
      iii. Budding = fission of smaller daughter cells from adult, unequal division
   b. **Sexual Reproduction**
      i. Syngamy = fertilization of a gamete by another, different gamete
      ii. Autogamy = fusion of nuclei from the same gametes to form a zygote within the same organism
      iii. Conjugation = the full or partial exchange of genetic material between two organisms, no offspring

**Life Cycles**
- Consist of active or vegetative phases and cyst phases (encystment)
- Cyst = a resistant, quiescent (sleeping) stage in a cyst wall

II. **Phyla of Protozoa**
   A. **Phylum Sarcomastigophora**
      - Includes protozoa that move by flagella (Mastigophorans) and those that move by pseudopodia (Sarcodinans)
Subphylum Mastigophora (flagellates)
- Have one or more flagella
- Found in fresh and marine water
- Reproduce asexually by *longitudinal* binary fission

1. Class Phytomastigophorea (phytoflagellates)
   - important producers in marine communities
   - contain chlorophyll in one or more chloroplasts
   - most are photosynthetic
   - some have a *stigma*, or eyespot, a light sensitive receptor

*Ex. Euglena*

2. Class Zoomastigophorea (zooflagellates)
   - colorless
   - heterotrophic, holozoic or saprozoic
   - many are medically important parasites

*Ex. Trypanosoma* (African Sleeping Sickness)

Subphylum Sarcodina (amebas)
- Move and feed by means of pseudopodia
- Some have protective shells called *tests*
- Found in fresh and marine water, moist soils
- Some are planktonic
- A few are parasitic
- Heterotrophic, holozoioc omnivores
- Feed by *phagocytosis*
- Reproduce by binary fission and budding
- Produce spores by *sporulation*

*Ex. Entamoeba histolytica* (amebic dysentery)
Special Groups of Sarcodinans

Foraminiferans:
- Mostly marine
- Many chambered tests of calcium carbonate and sand grains

Radiolarians:
- Marine forms, planktonic
- Tests made of siliceous (glass) material

B. Phylum Apicomplexa
- All are endoparasites of animals
- Contain **apical complex** organelles
- Move by pseudopodia, flagella, and body contractions
- Both asexual and sexual reproduction
- Multiple hosts
- Some point develop spore (oocyst) which is infective for the next host
  
  *Ex. Plasmodium vivax* (malaria), *Toxoplasma* (defects)

C. Phylum Ciliophora
- Move by cilia
- Found in fresh and marine water
- Most are free living, though some are commensalistic or parasitic
- Usually solitary and motile
- Are always multinucleated, possessing at least one *macronucleus* and one *micronucleus*:
  a) Macronuclei: metabolic and cellular functions
  b) Micronuclei: used for sexual reproduction
- **Pellicle**: thickened cell membrane or tough outer sheath
- Cilia short and arranged in longitudinal or diagonal rows
- Cilia may cover whole surface or be restricted to certain areas
- Possess cytostome (cell mouth) and cytopharynx (gullet)
- Contractile vacuole typically present
- Most are holozoic heterotrophs
- Reproduce by binary fission and sexual conjugation
  
  *Ex. Paramecium*

**Ecological Relationships:**

~ 10,000 species are symbiotic

Mutualism = both partners benefit

Commensalism = one partner benefits without affecting the other

Parasitism = one partner benefits at the expense of the other