Eukaryotes: The Other Guys
Part III: Protozoa

The Protists

- Algae and protozoa have been traditionally combined into the Kingdom Protista
  - Subkingdom Algae
  - Subkingdom Protozoa
- Protist: any eukaryotic unicellular or colonial organism that lacks true tissues

The Algae: Photosynthetic Protists

Group of photosynthetic organisms

- Seaweed and kelp are the most recognizable

The algae exhibit all of the eukaryotic organelles

- Chloroplasts contain green chlorophyll
- Other pigments create yellow, red, and brown coloration

The Algae

- Widespread inhabitants of fresh and marine water
- **Plankton:**
  - Floating community of microscopic organisms
  - Essential role in the aquatic food web
  - Produce most of the earth's oxygen
- Primary medical threat from algae is through ingestion of toxins during a *red tide*

Biology of the Protozoa

- The protozoa include about 65,000 species
- Most members are harmless inhabitants of the water and soil
- A few species are parasites responsible for hundreds of millions of infections in humans per year

Nutritional Habitat and Range

- Heterotrophic and require their food in complex organic form
- Free-living species:
  - Scavenge dead plant or animal debris
  - Graze on live cells of bacteria and algae
- Parasitic species:
  - Live on fluids of the host such as plasma and digestive juices
  - May actively feed on tissues

Styles of Locomotion

- **Pseudopods ("false feet")**
  - Amoeboid motion
  - Serve as feeding structures
- **Flagella**
  - Vary in number from one to several
- **Cilia**
  - Distributed over the entire surface of the cell in characteristic patterns

Feeding and Dormant Stages

- **Trophozoite**
  - Motile feeding stage
  - Requires ample food and moisture to remain active
- **Cyst**
  - Dormant, resting stage
  - Formed when conditions become unfavorable for growth and feeding
  - Important factor in spread of disease

Life Cycles and Reproduction

- Life cycles vary from simple to complex
  - Some protozoan groups exist only in trophozoite state
  - Many types alternate between trophozoite and cyst stage depending on the conditions of the habitat
  - Life cycle dictates the mode of transmission

- Protozoan reproduction:
  - Simple, asexual methods, usually mitosis
  - Several parasitic species reproduce by multiple fission
  - Sexual reproduction also occurs

Protozoan Identification and Cultivation

- Most protozoa can be identified to the level of genus because of their unique appearance
- Considerations in identification:
  - Shape and size of cell
  - Type, number, and distribution of locomotor structures
  - Presence of special organelles or cysts
  - Number of nuclei
- Blood, sputum, cerebrospinal fluid, fecal, or vaginal specimens smeared on a slide w/ or w/o staining

Important Protozoan Pathogens

- **Parasitology:** study of protozoa and helminths
- **Parasite:** term most often used to denote protozoan and helminth pathogens

Pathogenic Flagellates: Trypanosomes

- *Trypanosoma brucei*: African Sleeping Sickness
- *Trypanosoma cruzi*: Chagas disease
- Long, crescent-shaped cells with a single flagellum
- Both found in the blood during infection
- Both transmitted by blood-sucking vectors

The Parasitic Helminths

- Tapeworms
- Flukes
- Roundworms

- Usually large enough to be seen with the naked eye:
  - 1 mm to 25 m in length

General Worm Morphology

- Multicellular animals equipped with organs and organ systems
  - Reproductive tract is the most developed
  - Primitive digestive, excretory, nervous, and muscular systems
  - Thick cuticles for protection
  - Mouth glands for breaking down the host's tissue

Life Cycles and Reproduction

- Complete life cycle:
  - Fertilized egg
  - Larval stage
  - Adult stage

- Majority of helminths derive nutrients and reproduce sexually in the host's body

- Nematodes: sexes have different morphologies

- Trematodes: sexes are separate or **hermaphroditic**
  - Male and female sex organs in the same worm

- Cestodes: generally hermaphroditic

- General life cycle:
  - Transmission of an egg or larva to the body of another host, either a different or the same species
  - Intermediate (secondary) host: the host in which larval development occurs
  - Definitive (final) host: host in which adulthood and mating occur

- Sources for human infection:
  - Food, soil, water, infected animals

- Routes of infection:
  - Oral intake or penetration of unbroken skin

- Humans are the definitive hosts for many species and the sole biological reservoir for about half of the diseases
  - Animals or insect vectors also serve as reservoirs

A Helminth Cycle: The Pinworm

- *Enterobius vermicularis*
  - Causes a very common infestation of the large intestine
  - Worms range from 2 to 12 mm long
  - Tapered, curved cylinder shape

- Simple, uncomplicated infection that does not spread beyond the intestine

Helminth Classification and Identification

Classification criteria:

- Shape
- Size
- Degree of development of organs
- Presence of hooks, suckers, other special structures
- Mode of reproduction
- Kinds of hosts
- Appearance of eggs and larvae

Identification:

- Microscopic detection of adult worm, larvae, or eggs
  - Often have distinctive shapes or external and internal structures
- Occasionally cultured to verify all life stages

Distribution and Importance of Parasitic Worms

- About 50 species of helminths parasitize humans
  - Distributed in all areas of the world that support human life
  - May be geographically restricted; higher incidence in tropical areas
- Yearly estimate of worldwide case numbers in the billions
  - Conservative estimate of 50 million infections in North America
- Humans evolved in the constant presence of helminths
  - Only recently have humans evolved into a “helminth-free” existence
  - Absence of helminth infections may contribute to autoimmunity and allergy