Chapter 12B: EUKARYOTES
The Protists & Helminths

1. Protists
   • Algae
   • Protozoa

2. Helminths
1. Protists

A. Algae

B. Protozoa
A. Algae
Overview of the Algae

Characteristics of algae:

- unicellular or multicellular eukaryotes
- almost all are photoautotrophs (photosynthetic)
- all are essentially aquatic (live in fresh or saltwater)
- all are capable of asexual reproduction
  - some are capable of sexual reproduction as well

**produce an estimated 80% of O₂ in the atmosphere!**
Diatoms

- unicellular or filamentous (form multicellular filaments)

- have a unique cell wall structure composed of a carbohydrate called pectin & silica
  - responsible for geometric, glass-like appearance

- widely distributed throughout photic zone

- important part of aquatic food webs
Dinoflagellates

• what are commonly referred to as “plankton”

• unicellular algae with 2 perpendicular flagella

• some produce potent neurotoxins
  • source of toxic algal blooms (e.g., “red tide”)

• important part of the oceanic food web
B. Protozoa
Overview of the Protozoa

Characteristics of protozoa:

• all are unicellular eukaryotes
• all are heterotrophs (a few can be photosynthetic)
• capable of asexual reproduction (some sexual reproduction)
• parasitic species have complex life cycles
• some form protective cysts as part of their life cycles

Protozoan phyla we will consider:

Archaeozoa          Ciliophora
Microspora          Euglenozoa
Apicomplexa         Amoebozoa
Archaezoa

- do NOT have mitochondria
  - have an analogous organelle called a mitosome
- most have multiple flagella
- several parasitic genera can cause human disease
  - *Trichomonas*, *Giardia*
Apicomplexa

• non-motile obligate intracellular parasites

• have a unique “apical complex” of fibers and vacuoles that release digestive enzymes
  • aid in penetration of host animal tissue

• includes species of *Plasmodium* responsible for the disease malaria
  
  *P. vivax* (inside RBCs)
**Plasmodium vivax**

**Life Cycle (malaria)**
Caused by protozoa in the genus *Plasmodium*:

- 4 main *Plasmodium* species cause malaria:
  - *P. vivax*
    - most *common* malaria pathogen
  - *P. falciparum*
    - most *deadly* malaria pathogen
  - *P. ovale* & *P. malariae*
    - cause milder form of malaria much like *P. vivax*
Transmission:

- vector transmission through the saliva of biting (female) mosquitoes (*Anopholes*)

Signs/Symptoms:

- *Plasmodium* life cycle involves infection and destruction of RBCs
- periodic fever, chills
- anemia can be severe
- tissue damage due to capillary blockage
Diagnosis:

- in most cases diagnosis is made through the microscopic examination of a blood smear

Treatment:

- **quinine** is the traditional medicine for malaria
  - causes death of merozoites in RBCs
- quinine derivatives **chloroquine** & **mefloquine** are more commonly used today

Prevention:

- elimination, avoidance of mosquito vectors
- an truly effective vaccine has yet to be produced
Ciliophora ("ciliates")

- all have many small projections called **cilia**
  - used for locomotion & to direct food into the **cytostome** ("mouth")
- some have **multiple** nuclei
  - have contractile vacuole to expel excess water taken in by osmosis (expelled by exocytosis)
Sexual Reproduction in Ciliates

Most ciliates are capable of sexual reproduction by a process called **conjugation**:

- conjugating *Paramecia* ea produce 4 haploid micronuclei by meiosis, 3 of which disintegrate

- remaining micronucleus divides by mitosis (2)

- exchange of 1 micronucleus between cells

- “old” & “new” micronuclei fuse, divide by mitosis, one of which replaces original micronucleus
Euglenozoa

- some are photosynthetic (*Euglena*)
  - have a light-sensitive eyespot & a single flagellum

- includes the hemoflagellates (*Trypanosoma*)
  - responsible for “sleeping sickness” & Chagas disease
Sleeping Sickness

“tse tse fly”

Trypanosoma brucei

Chagas Disease

“kissing bug”

Trypanosoma cruzi
Amoebozoa

- aka “amoebas”
- have distinct form of locomotion called “amoeboid movement”
  
  - extend cytoplasmic projections called pseudopods
  - also used to engulf and ingest food by phagocytosis
3. Helminths
Overview of the Helminths

Helminths are parasitic worms found in 2 animal phyla, the **Platyhelminthes** (flatworms) and the **Nematodes** (roundworms).

- multicellular eukaryotic heterotrophs
- have complex life cycles frequently involving multiple hosts
- contain distinct organ systems
  - some may be reduced or absent due to dependence on host (e.g., no digestive system, no locomotion)
Platyhelminthes (flatworms):

- typically hermaphroditic (monoecious)
- have a proctostome (single opening, no anus)
- we will look at 2 classes:

  Trematodes (flukes) & Cestodes (tapeworms)

Nematodes (roundworms):

- typically dioecious (2 sexes)
- have complete digestive system (mouth & anus)
- we will look at 2 types: pinworms & hookworms
Trematodes (flukes)

Members of this class of flatworms are all parasites associated with particular host tissues (liver, blood, lung)

- can have multiple larval stages and intermediate hosts
- hermaphroditic (monoecious)
- attach to host tissue via oral and ventral suckers
- absorb nutrients through outer cuticle

(a) Fluke anatomy

(b) *Clonorchis sinensis*  

(liver fluke)
Fluke Life Cycle (blood fluke)

A. Eggs of the parasite are deposited in water via human feces.

B. Miracidia escape from the eggs and swim to snails.

C. In snails (intermediate host), the miracidia develop into cercariae.

D. The cercariae penetrate the skin of a person (definitive host) who walks in the water.

E. The cercariae pass into the bloodstream, where infection takes place.
Tapeworms (cestodes)

- intestinal parasites
- **scolex** (head) has hooks & suckers for attachment
- no digestive system, absorb nutrients
- repeating **proglottids** have male & female reproductive organs (monoecious)
- mature proglottids detach & pass w/feces allowing transmission to other hosts
Typical Tapeworm Life Cycle

1. Encysted larva
2. Secondary host
3. Feces-contaminated food
4. Larva in feces
5. Mature proglottid (sac of eggs)
6. Mixed with the host's feces
7. Tapeworm attached to human intestine
8. Proglottid
9. Hook
10. Sucker

Primary host

- Woman eating food

- Cow eating grass
Pinworms

- entire life cycle in human hosts
- live in large intestine
- females lay eggs on anus

Enterobius vermicularis

- a **dioecious** parasitic roundworm (nematode)
- transmitted to new hosts via eggs
Hookworms

• dioecious nematodes

• live, mate, lay eggs in small intestine

• eggs pass with feces, hatch in soil

• larvae enter new host through skin, pass to lungs via blood, lymph

• coughed up, swallowed to reach small intestine repeat life cycle

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Hookworm Life Cycle

A. Eggs enter the soil via human feces.

B. Larvae emerge as rod-like rhabditiform larvae.

C. They revert to thread-like filariform larvae.

D. The filariform larvae contact the skin when a person walks barefoot in the soil, and then they pass into the tissues.

E. The larvae move through the bloodstream to the lungs, from where they are coughed up and swallowed.

F. Adults mature in the small intestines.
Key Terms for Chapter 12

• mitosome
• cytostome
• pseudopods
• monoecious, dioecious
• scolex, proglottids

Relevant Chapter Questions
rvw: 11-14  MC: 6, 8-10