2.3 Protists

P. 60 - 67

Must watch!

What are Protists?

- ➔ Eukaryotic organisms
- ➔ Most diverse group (catch all group)
  - from single celled amoebas to large stationary kelp!
- ➔ Mostly aquatic, but some are terrestrial

Helpful Protists

Protists play key roles in aquatic ecosystems, some also inhabit moist terrestrial ecosystems

Producers

- Some are photosynthetic and are major producers in the world's oceans.

Consumers

- Non-photosynthetic protists are important consumers, especially at the microscopic level, where they dominate the lowest levels of most aquatic food pyramids.

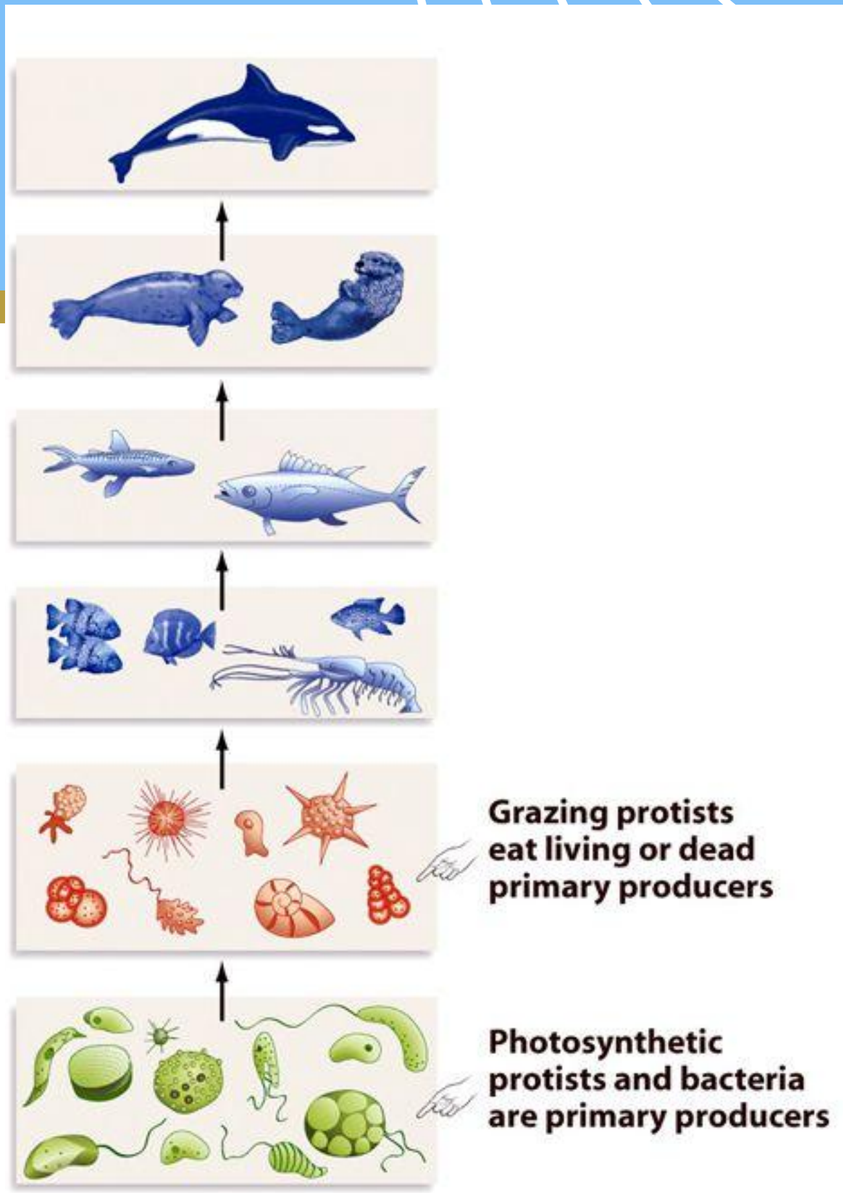


Figure 28-4 Biological Science, 2/e

Helpful Protists

Many protists

Food Additives

- Agar and carrageenan (food thickeners), are made from seaweed, a protist!
- ex. ice cream, coconut milk

Nori

- Seaweed used to wrap sushi rolls

Other Products

- Used in toothpaste, cosmetics and paints

Harmful Protists

Some protists cause serious disease.

Malaria

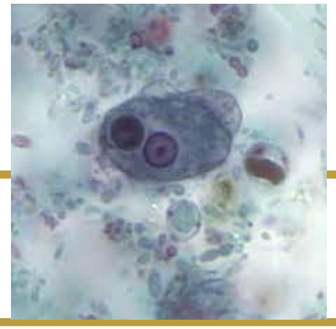
Plasmodium falciparum

Sleeping Sickness

African trypanosomiasis

Amoebic Dysentery

Entamoeba histolytica



Harmful Protists: Beaver Fever

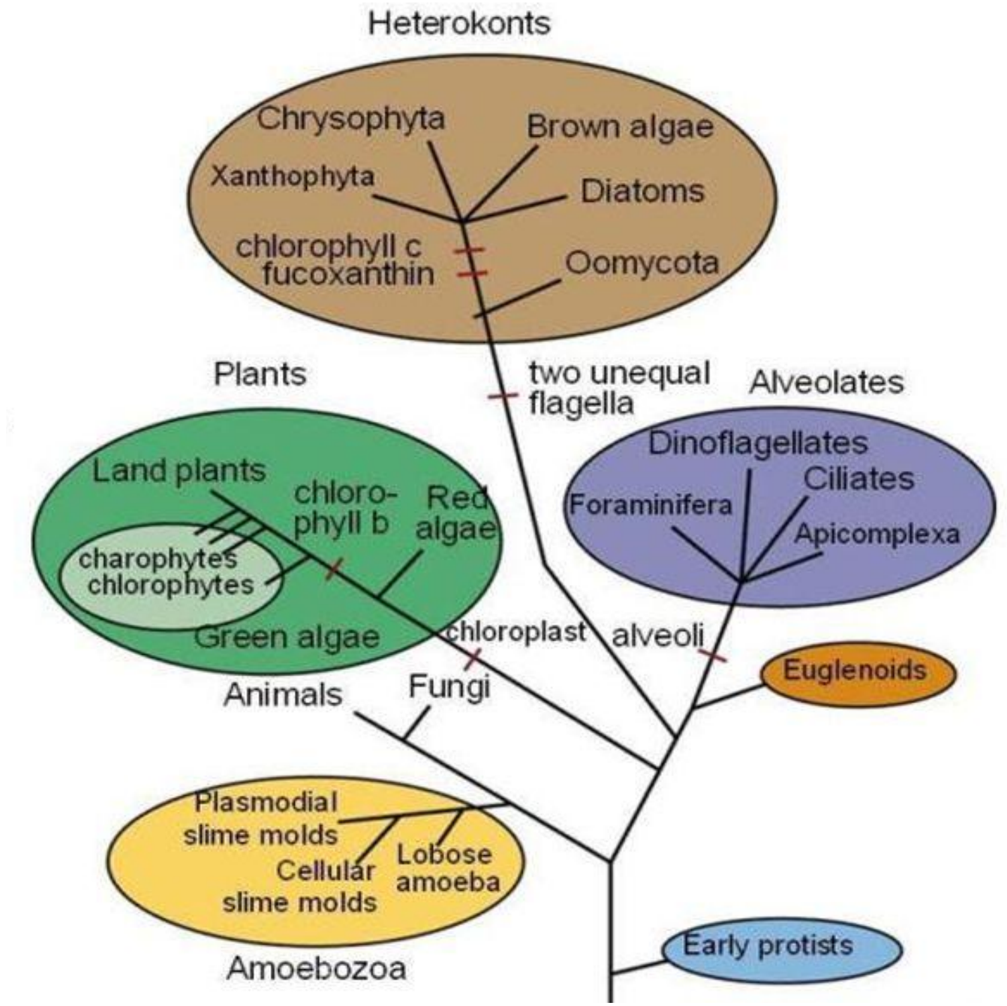
Giardia lambia

- Less serious but of concern in Ontario is giardiasis, or ‘beaver fever’.
- Cause: Giardia lamblia, the most common intestinal parasite in humans in NA.
- Symptoms: intense diarrhea, dehydration, nausea, stomach cramps and gas
- Common in bodies of water - host infected by drinking contaminated water.

Origins of Eukaryotes

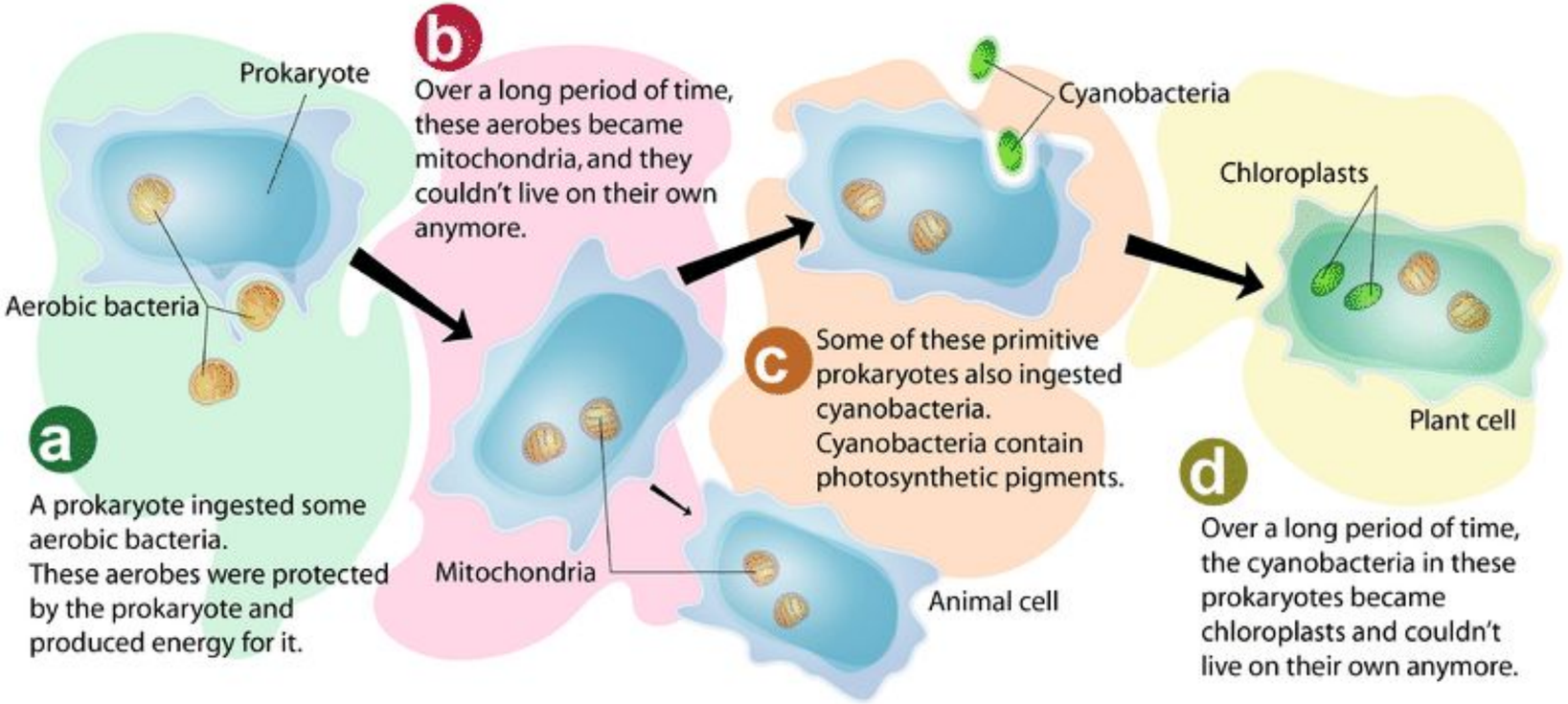
Protists were the first eukaryotes.

- ➔ mitochondria and chloroplasts are thought to have originated by endosymbiosis



Origins of Eukaryotes

Endosymbiosis is a relationship in which a single-celled organism lives within another organism.



- Proteobacteria ingested → mitochondria
- Cyanobacteria ingested → chloroplasts

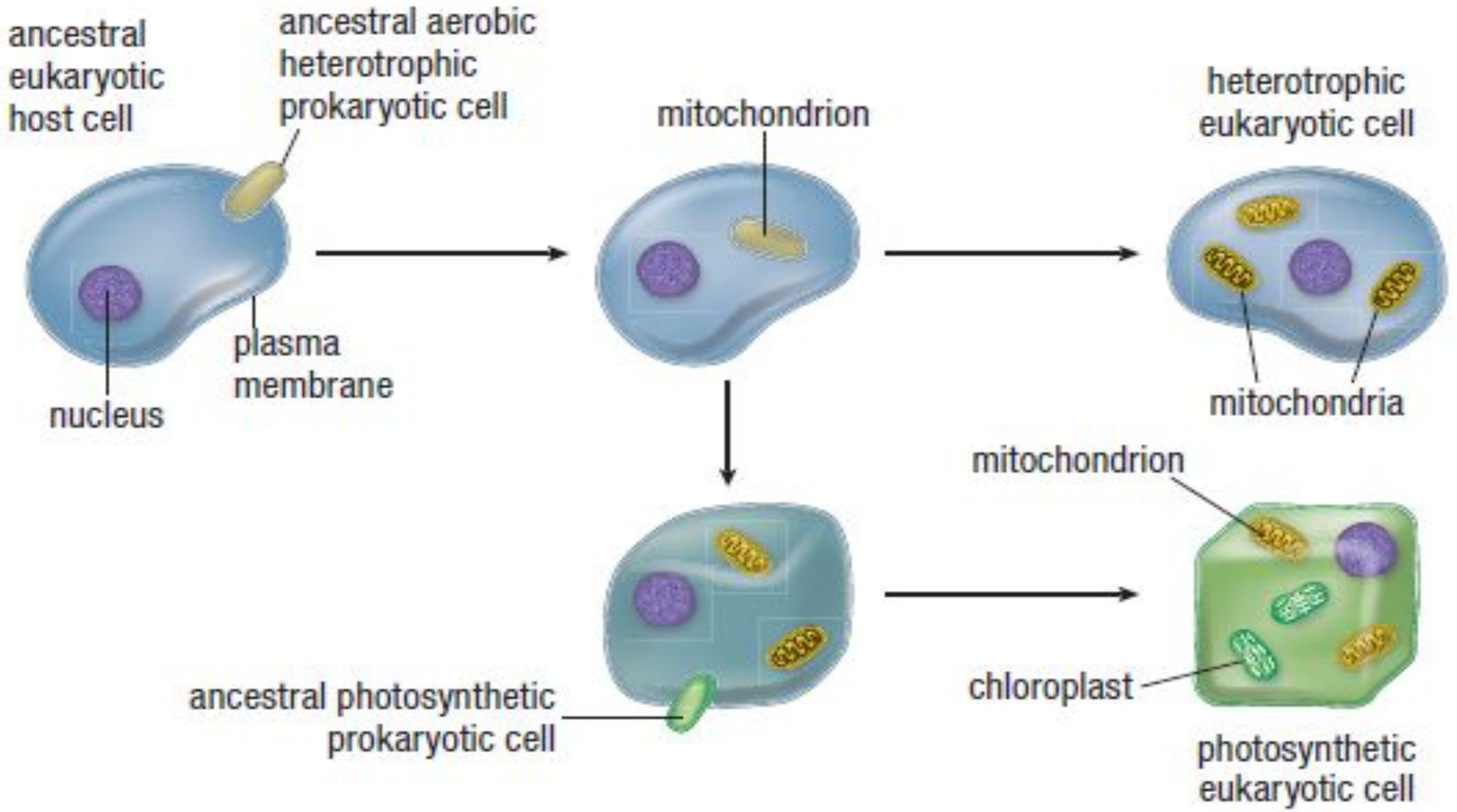


Figure 5 There is strong evidence that mitochondria and chloroplasts originated when aerobic and photosynthetic prokaryotes began living as symbiotic organisms within ancestral eukaryotic cells.

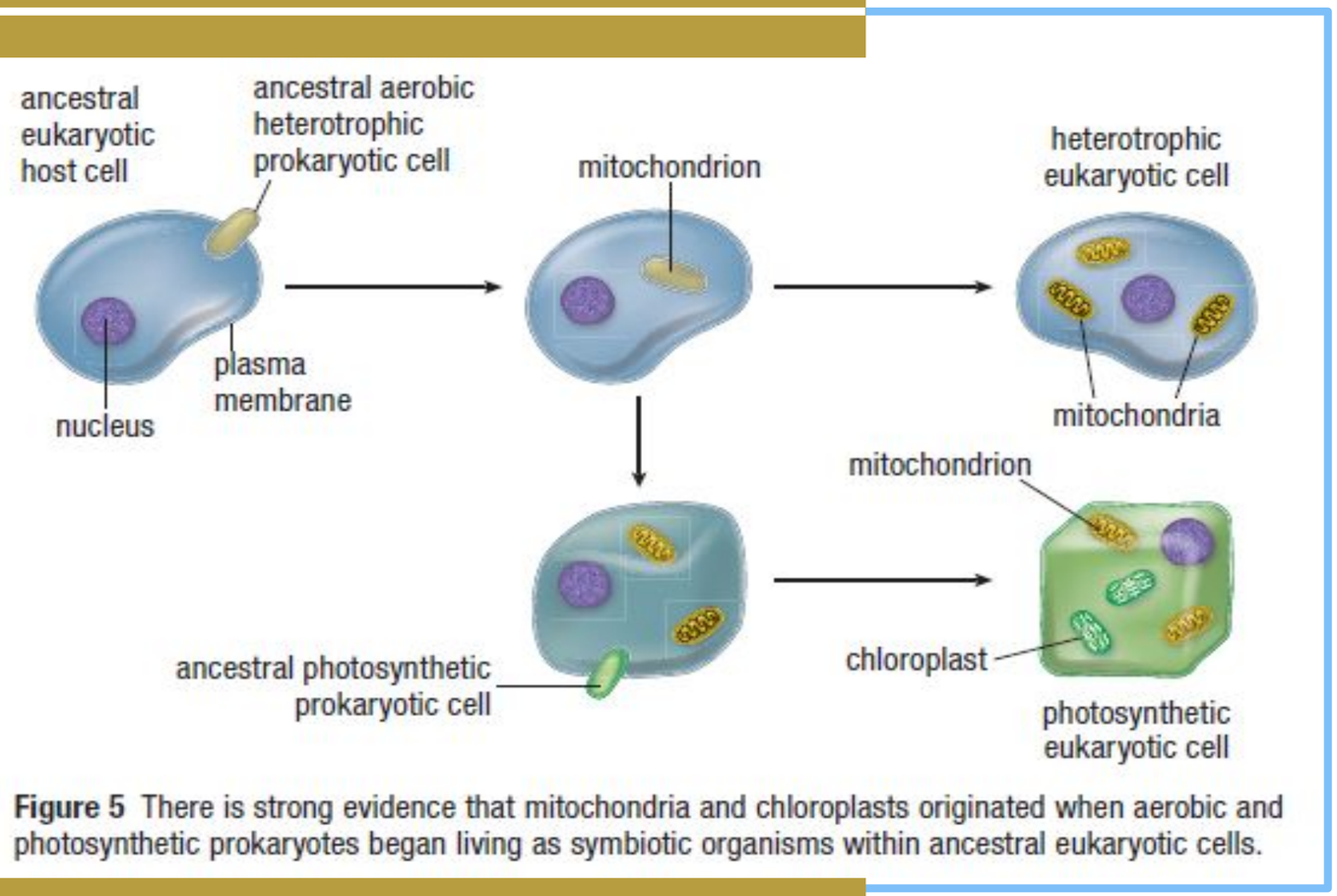


Figure 5 There is strong evidence that mitochondria and chloroplasts originated when aerobic and photosynthetic prokaryotes began living as symbiotic organisms within ancestral eukaryotic cells.

Evidence of Endosymbiosis

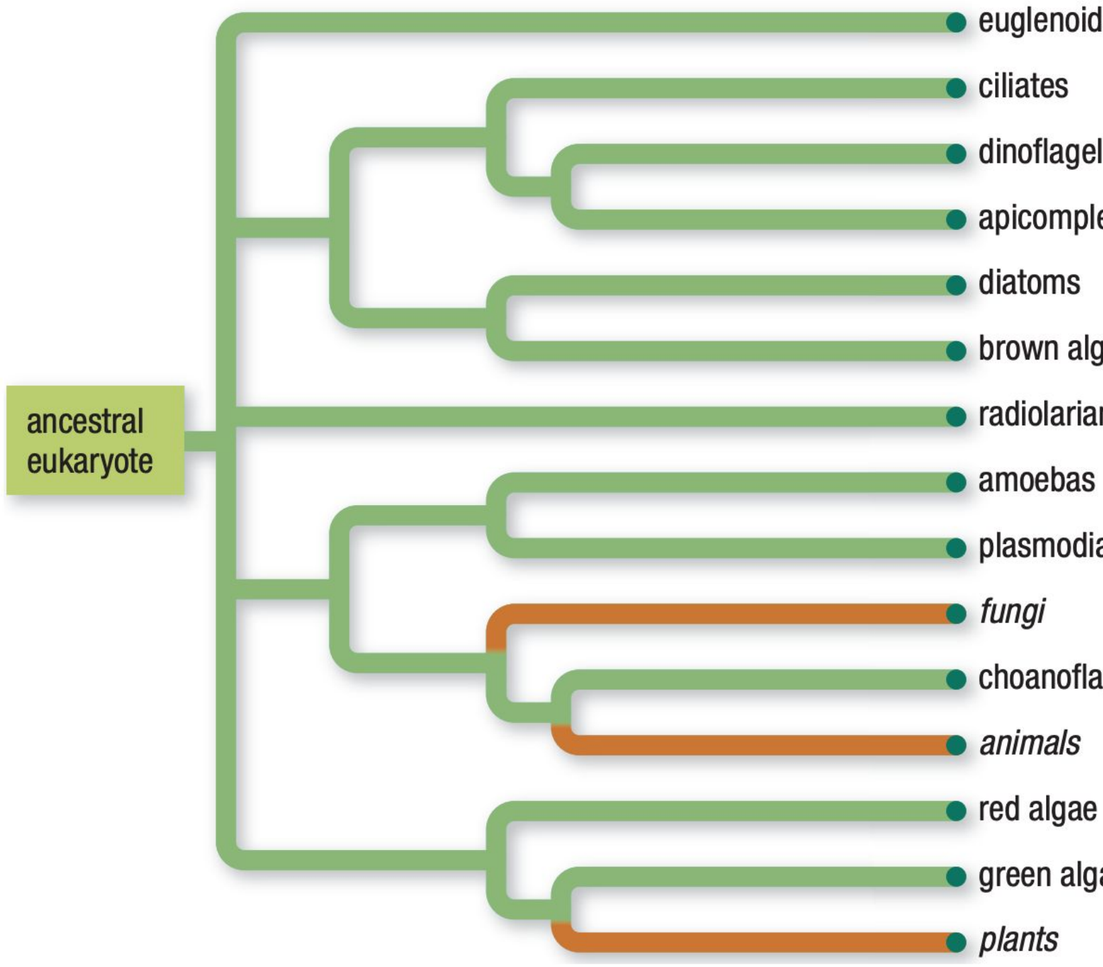
Present-day mitochondria and chloroplasts:

- have two membranes
  Their inner membranes are similar to those of their ancestral prokaryote, while their outer membranes match the cell membranes of the eukaryote.
- have their own internal chromosomes, which are very similar to prokaryotic chromosomes
- Reproduce independently within eukaryotic cells by binary fission (like prokaryotes)

Classification and Phylogeny

Protists are the most diverse kingdom

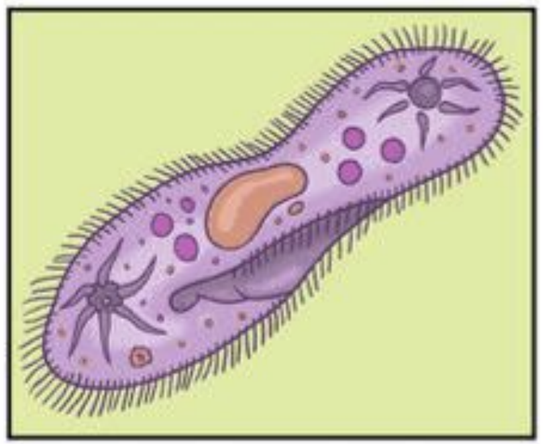
- The Kingdom Protista is not based on evolutionary kinship, but more on convenience as a “catch-all” for species that do not fit into the four other kingdoms
- More meaningful classifications will likely soon replace this single kingdom



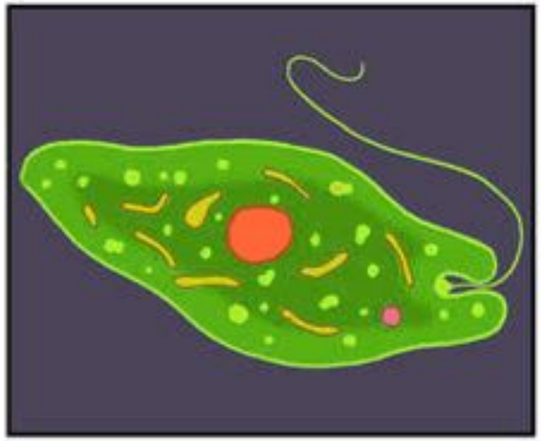
Types of Protists

Three informal groups of protists:

- Animal-like protists (protozoan) *(e.g. paramecium)*
- Plant-like protists *(e.g. euglena)*
- Fungus-like protists *(e.g. slime molds)*



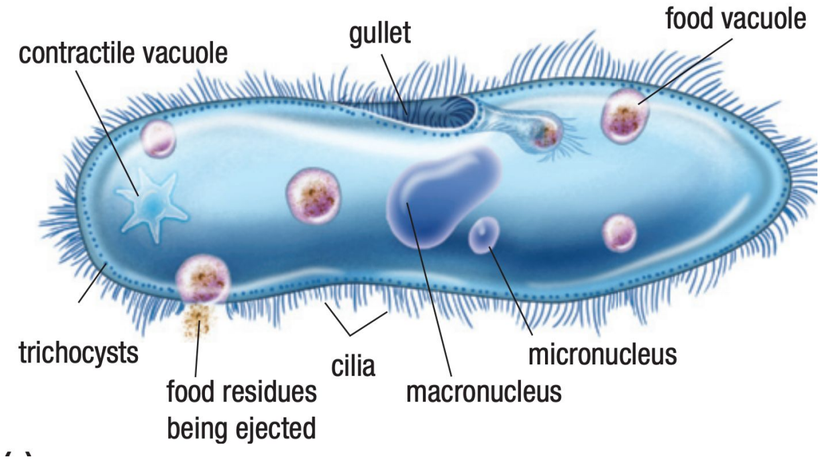
"Animal Like" *Paramecium aurelia*

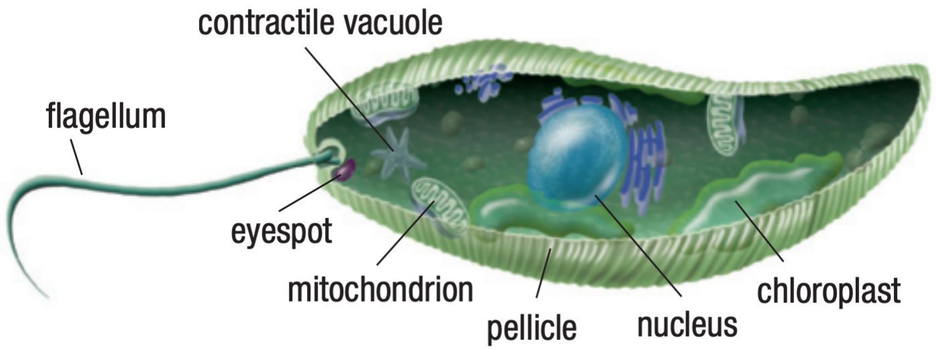


"Plant Like" *Euglena viridis*

"Fungus Like" *Fuligo septic*

Many protists have complex cells





Paramecium

- heterotrophic
- macro and micronuclei
- specialized vacuoles that contract to eliminate excess water
- a gullet (moth) for taking in food
- cilia for movement
- trichocysts that release long fibers for defence

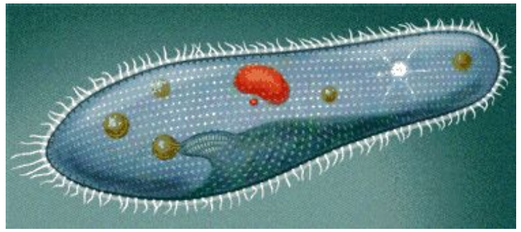
Euglena

- autotrophic
  - contain chloroplast for photosynthesis
- eyespot for detecting light
- stiff flexible supporting layer called a pellicle
- large flagella for movement

Characteristics of Representative Protists

Euglenoids

- *Autotrophs and photosynthetic*
- Unicellular
- Usually 2 flagella for moving
- Stiff proteins on outer surface covering
- Plant-like



Ciliates

- *Heterotroph*
- Unicellular
- Very complex internal structure
- Many cilia and no cell walls
- Animal-like

Apicomplexa

- *Heterotrophs*
- Unicellular
- No cell wall
- All are parasites of animals
- Animal-like

Diatoms plant-like

- *Autotrophs and photosynthetic*
- Unicellular
- Move by gliding
- Covered by glass-like silica shells
- Plant-like

Amoebas

- *Heterotrophs*
- Some have hard outer skeletons
- They move by extensions of the cytoplasm called pseudopods
- Animal-like

Slime Moulds

- *Heterotrophs*
- Life cycles have unicellular and multicellular stages
- Move with flagella or pseudopods
- Fungal-like

Red Algae

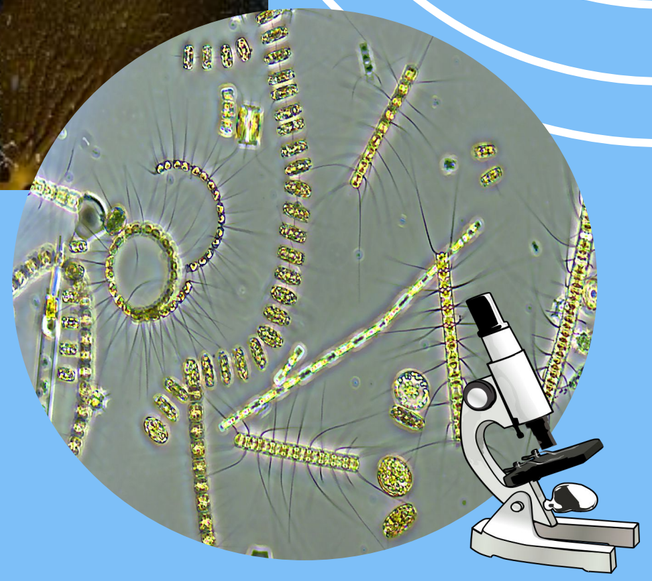
- *Autotrophs and photosynthetic*
- Almost all are multicellular
- Have no cilia or flagella
- Cell walls made of cellulose
- Plant-like

Interactions in Ecosystems

- Protists play key roles as major producers in the world's oceans.

- These photosynthetic protists, such as green, red and brown algae have large gas-filled bladders that help them float towards the light.
  - → This allows for photosynthesis.

- Phytoplankton are microscopic algae that live in marine environments.
  - → They produce about half Earth's oxygen.

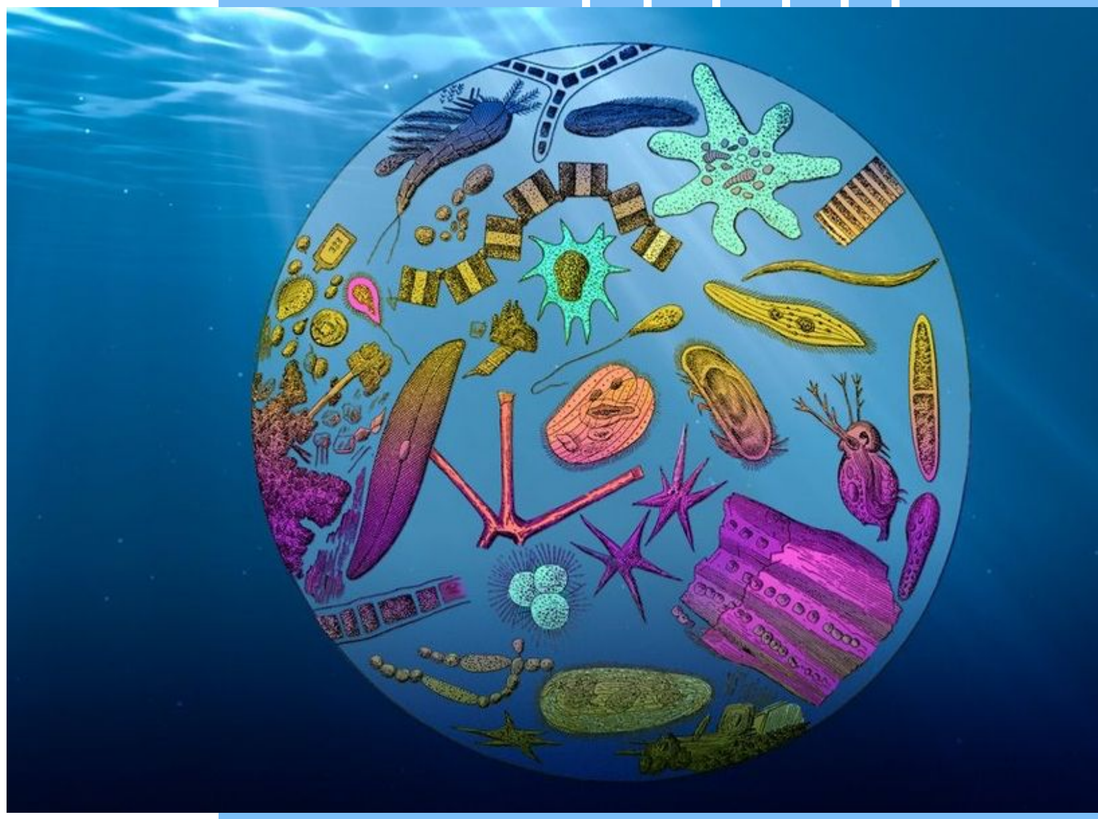


Interactions in Ecosystems

- The world's population of protists is thought to be declining by 1% each year, most likely due to
  - → warming ocean temperatures
  - → increasing acidity
    (affecting ability to build protective coating)

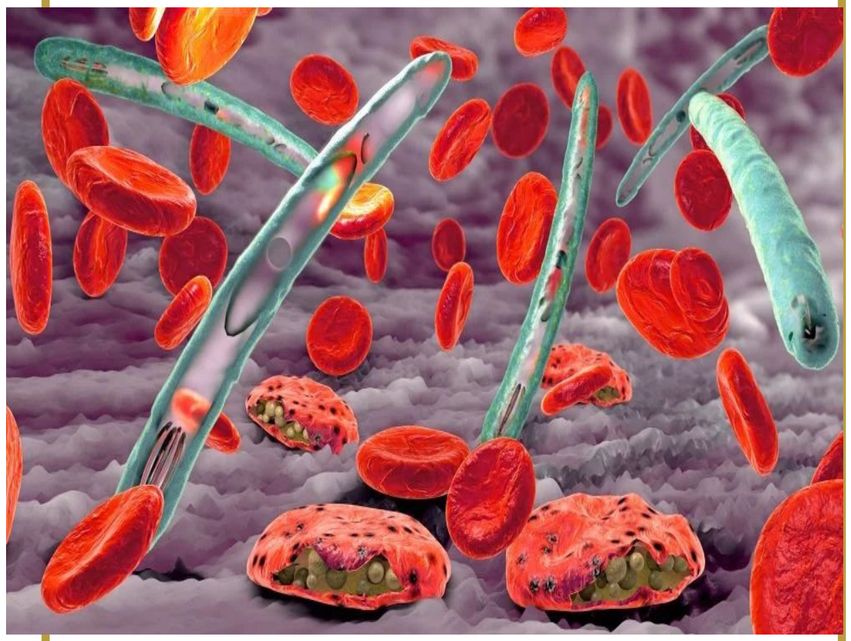
- Warmer water temperatures may also cause the population sizes of some species to increase

- Fluctuations in population size due to climate change can interfere with natural food webs.



(Chu, 2017)

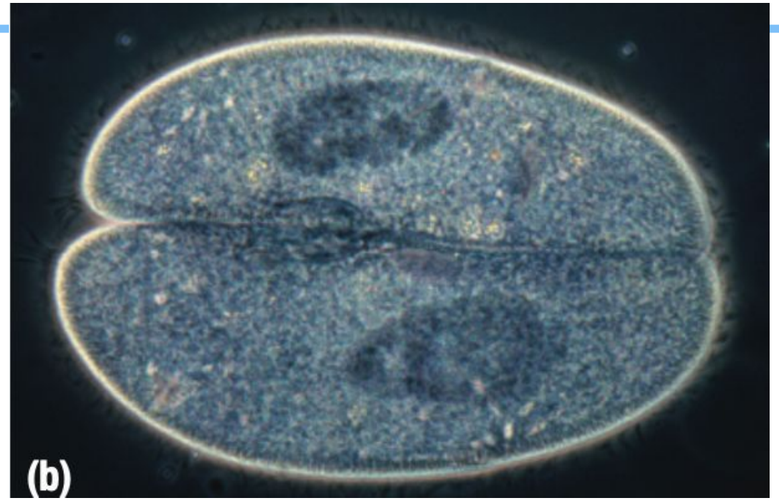
Climate Change and Malaria



- Malaria, caused by a plasmodium (protist) is spread through mosquito bites
- In the past, malaria was only found localized to tropical places
- Due to global warming, we are seeing malaria show up in previously unaffected areas

Life Cycles

Single celled protists reproduce **sexually and asexually**



Asexual Reproduction (Binary Fission)

- cell divides into two genetically **identical** daughter cells
- In **paramecium (a)**
  - macronucleus elongates and divides
  - micronuclei and cytoplasm split approximately equally

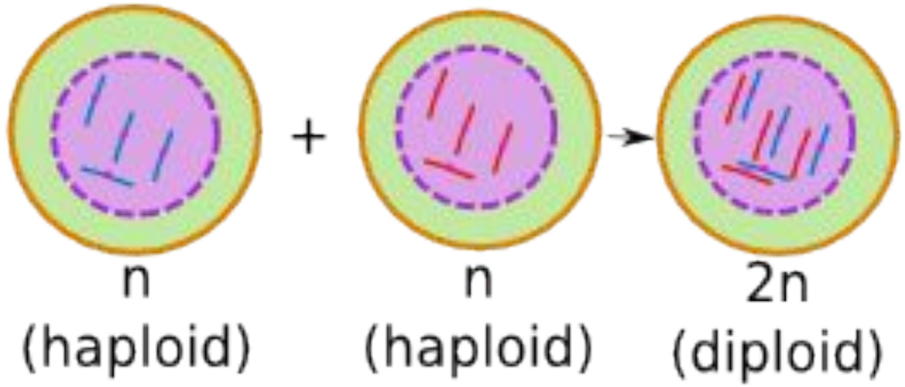
Sexual Reproduction (Conjugation)

- cells align and exchange genetic material
- In **paramecium (b),** conjugation involves the exchange of special micronuclei

Life cycles of multicellular protists is more complex

- some make sex cells (sperm and eggs) that are **haploid** (have half the genetic information, or “n”)
  - When these egg and sperm fuse, the resulting cell is called a **zygote**, most of which are **diploid** (contain two copies of every chromosome, or “2n”)

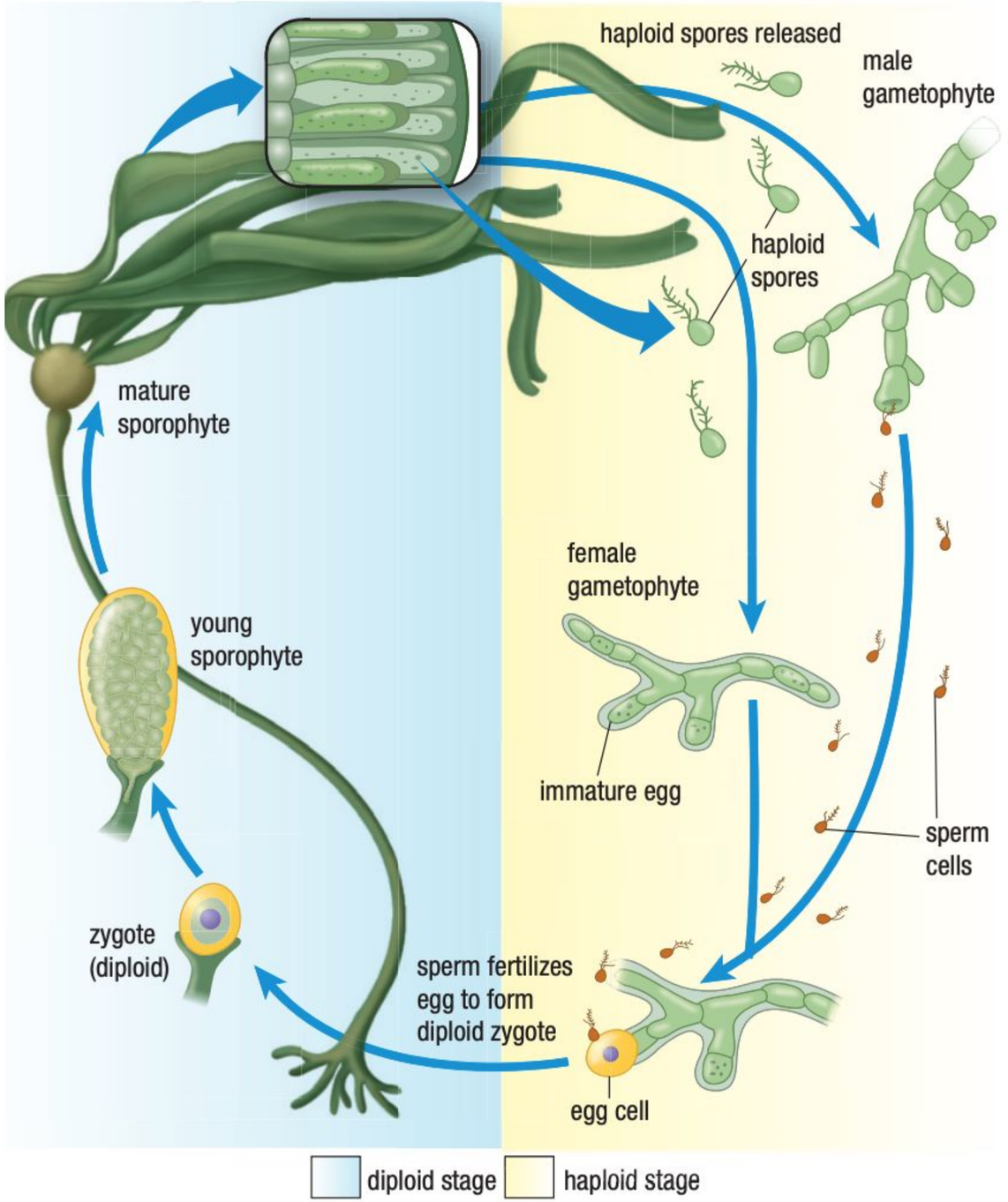
This is a form of sexual reproduction



Brown Algae Life Cycle

Alternation of Generations

- The large brown alga is a **diploid (2n) sporophyte** that produces and releases single-celled **haploid (n) spores**.
- These spores then find and attach to a surface and begin dividing and growing into **multicellular haploid gametophytes** (male and female).
- These gametophytes eventually produce **haploid sperm and eggs**. When an egg is **fertilized** by a sperm, it becomes a **diploid (2n) zygote** that **grows** into a multicellular **sporophyte**.

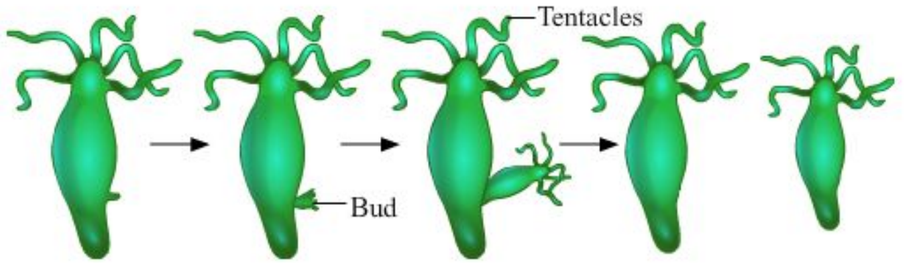


Hydra
Sexual and Asexual Reproduction

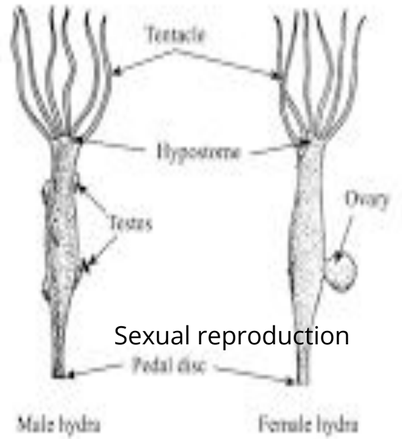
- Some species reproduce both asexually and sexually to produce an adult that resembles the original adult (completing a life cycle)

- Hydra can reproduce **asexually** by forming **buds**. These buds grow into adult hydras.

- Hydra can also reproduce **sexually**, with one hydra releasing sperm into the water that reaches eggs on another hydra



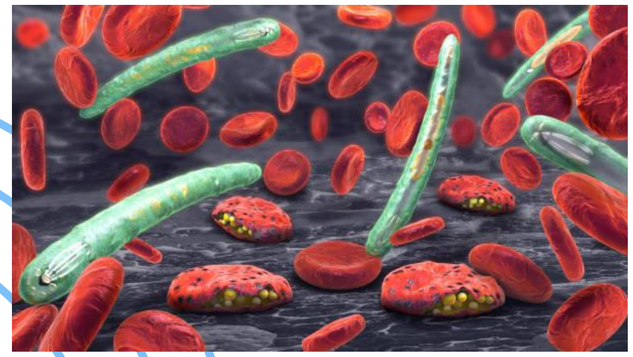
Asexual reproduction by budding

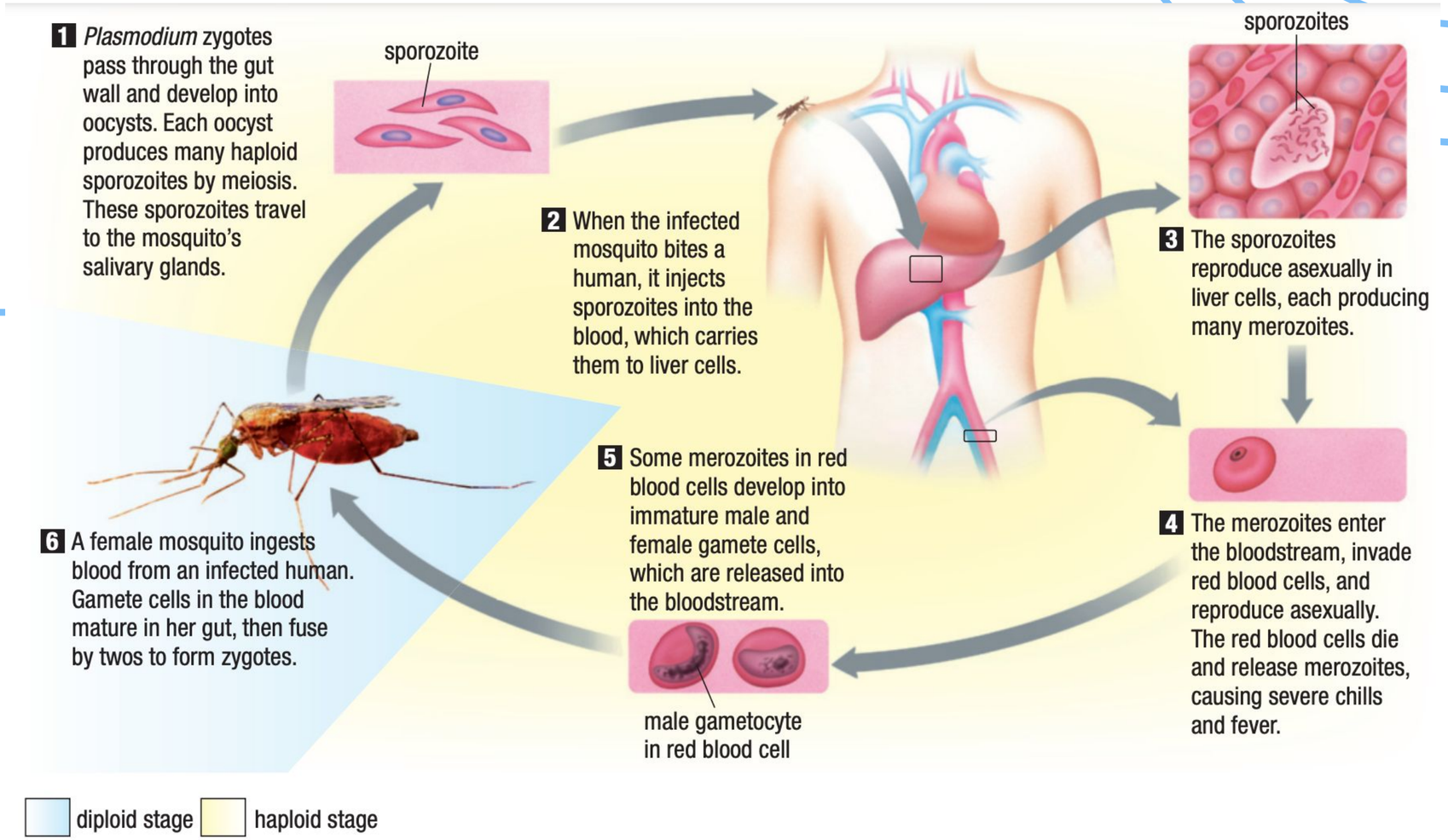


Sexual reproduction

Life Cycle of *Plasmodium*

- Parasitic organism
- Causes malaria





Must watch!