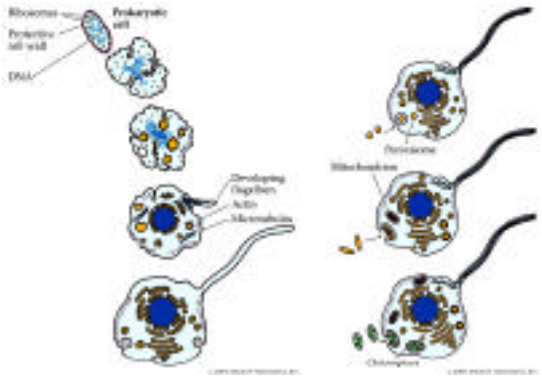
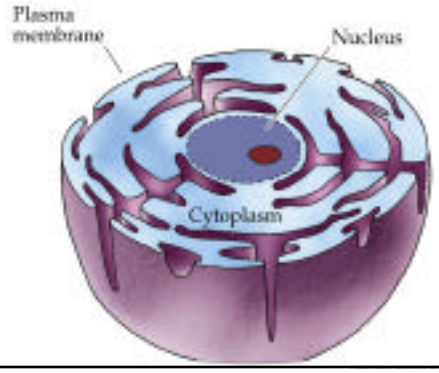
Protists and the Dawn of the Eukarya

Chapter 27



Membrane folding



Endosymbiotic Hypothesis

- ✓ 1. Nuclear envelope and E.R. presumed to have evolved from invagination of cell or plasma membrane
  - ✒ (Circular naked DNA to linear DNA packed on histones)
- ✓ 2. Purples non-sulfur or Rhizobial or Rickettsial bacteria gave rise to mitochondria
- ✓ Cyanobacteria (prochlorobacteria) gave rise to chloroplasts
- ✓ 3. Ly gelis suggested spirocheates gave rise to euka gella
- ✓ Pero maybe endosymbionic

Testing the Hypothesis -

Chlorella inside a *Paramecium*

Cyanophera - 50,000 -1 million years -

still have peptidoglycan

15% DNA compare to 5%

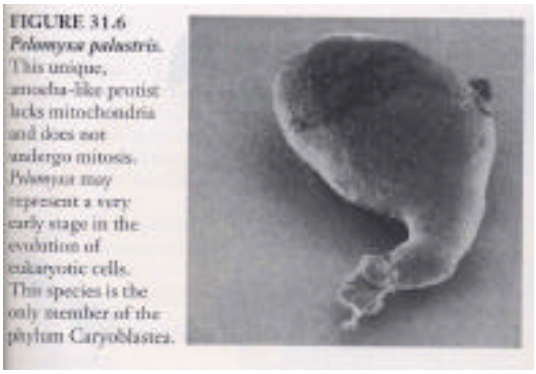


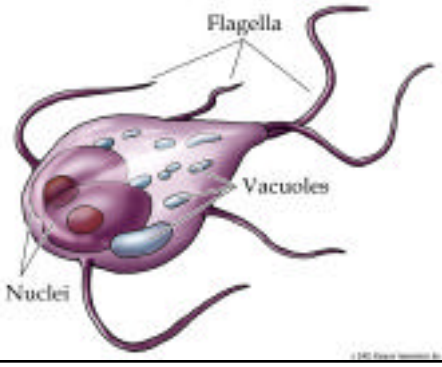
FIGURE 31.6 *Pelomyxa palustris.* This unique, amoeba-like protist lacks mitochondria and does not undergo mitosis. *Pelomyxa* may represent a very early stage in the evolution of eukaryotic cells. This species is the only member of the phylum Caryoblastea.

Testing the Hypothesis -

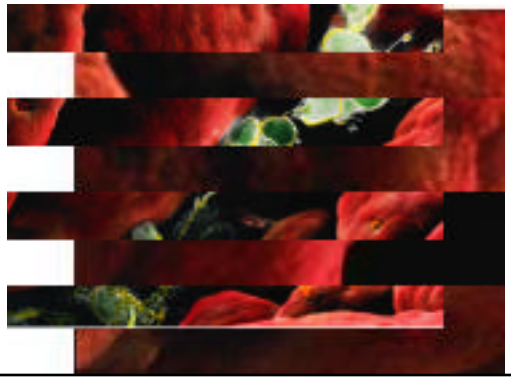
✓Coral bleaching
- ✒Symbionic relationship with dinoflagellates

✓Treatment with chloramphenical
- ✒Kills chloroplasts

Giardia (Archaezoa)



Giardia lamblia



27.1 Major Monophyletic Protist Groups

GROUP	COMMON NAME	ATTRIBUTES	EXAMPLES
Euglenozoa		Unicellular, with flagella	
Euglenoids		Mostly photoautotrophic	*Euglena*
Kinetoplastids		Have a single, large mitochondrion	Trypanosome
Alveolata		Unicellular cavities (alveoli) below cell surface	
Pyrrophytes	Dinoflagellates	Flagellates give golden-brown color	Gymnodin
Apicomplexa		Apical complex for penetration of host	Plasmodium
Ciliophora	Ciliates	Cilia; two types of nuclei	Paramecium
Stramenopila		Two unequal flagella, one with hairs	
Bacillariophyta	Diatoms	Unicellular, photoautotrophic, have pectin walls	
Phaeophyta	Brown algae	Multicellular, marine, photoautotrophic	Fucus, Macrocystis
Oomycota	Water molds, powdery mildews	Mostly coenocytic, heterotrophic	Saprolegnia
Rhodophyta	Red algae	No flagella; photoautotrophic; phycoerythrin	Chondrus
Chlorophyta	Green algae*	Photoautotrophic	Chlamydomonas, *Ulva*
Choanoflagellida		Resemble sponge cells; heterotrophic	

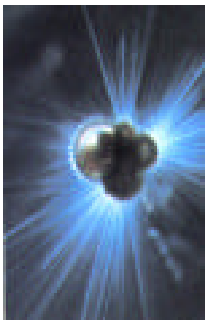
* The green algae do not constitute a monophyletic group. The Chlorophyta do not include all green algae that constitute a monophyletic group; members belong to two different kingdoms.

Protists are very diverse

Protists that live in a pond

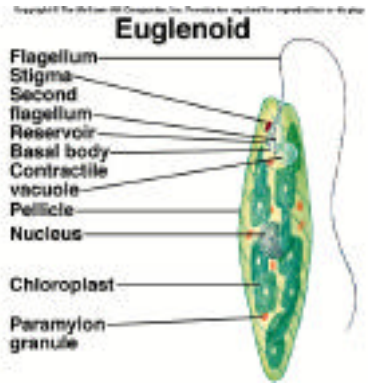
Protista

- ✓ Eukaryotic
- ✓ Mostly unicellular or grouped
- ✓ Nutrition by ingestion, absorption or photosynthesis
- ✓ Asexual and sexual reproduction

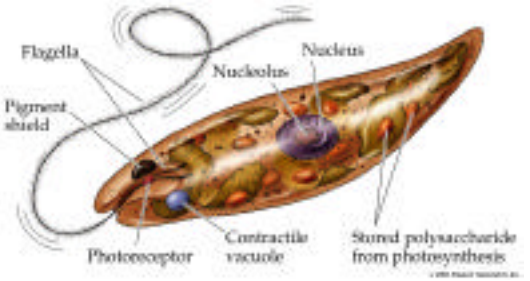


Euglenozoa (anterior flagella)

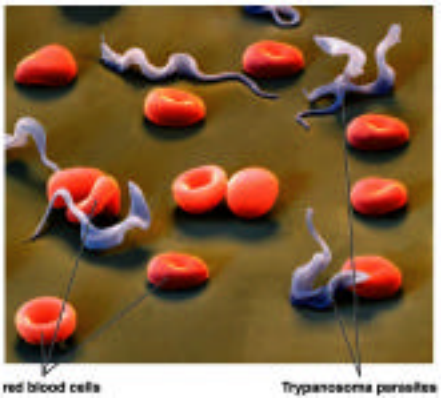
- ✓ Euglenoids (*Euglenophyta*)
  - ➨ Two flagella (large & small); pigmented eyespot; Photosynthesis & heterotrophic, lacks a cell wall, but has protein pellicle; divide by binary fission.
- ✓ Kinetoplasts
  - ➨ Unicellular, parasitic, flagellum, large mitochondrion,
  - ➨ Trypanosomas (African sleeping sickness, Chagas)



Euglenoid structure



Kinetoplast



Alveolata (alveoli below plasma membrane)

✓Dinoflagellates

- ✒*Pyrrophyta*
  - ☞Two flagella; may or may not have cellulose cell wall(not very common in protists); some bioluminesce.
  - ☞Red tides, plankton, fire algae

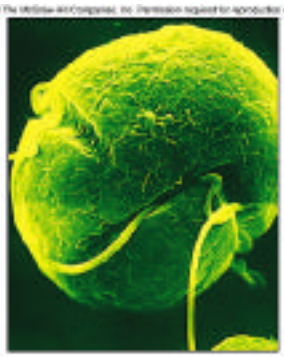
✓Apicomplexans (sporozoans)

- ✒Immobile, parasitic, complex life cycles- *Plasmodium*

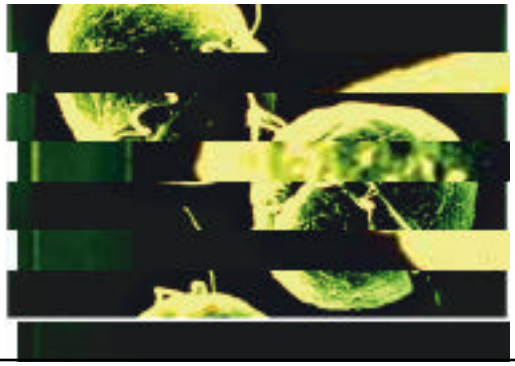
✓Ciliates (Ciliophora)

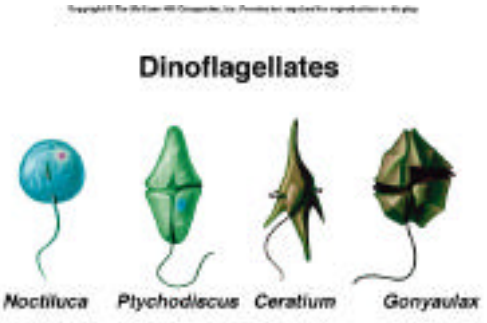
- ✒Ciliated, 2 or more nuclei, heterotrophs, vacuole, pellicle- *Paramecium*

Dinoflagellate (*Gymnodinium*)

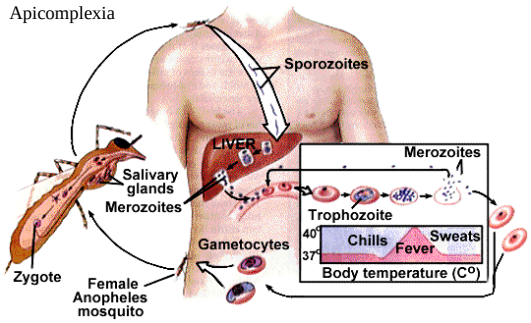


Dinoflagelate (*Gymnodinium*)

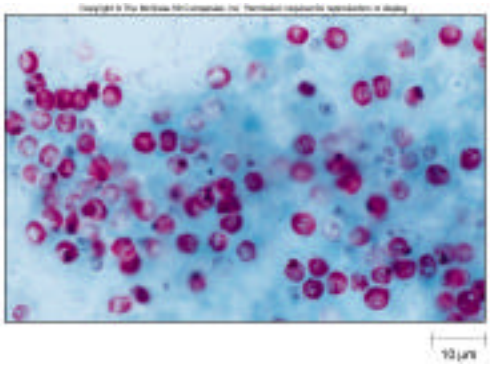




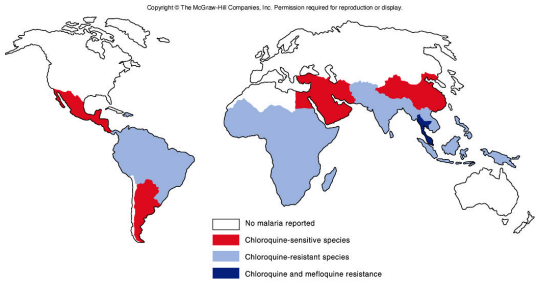
Life cycle of *Plasmodium* (malaria)



Cryptosporidium parvum



Malaria distribution in 1996



Malaria

- ✓1955 - WHO began eradication
  - ✒Insecticides such as DDT
  - ✒Treating infected patients
  - ✒10/52 nations eradicated malaria
  - ✒Bureaucracy and complacency and resistance The program failed in 1976
- ✓Today - 3 million people die/year
- ✓300-500 million are infected/year

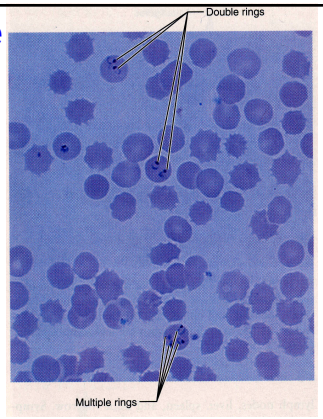
Malaria

- ✓Organism
  - ✒*Plasmodium vivax*
  - ✒*Plasmodium falciparum*
  - ✒*Plasmodium malariae*
  - ✒*Plasmodium ovale*
- ✓Non-motile

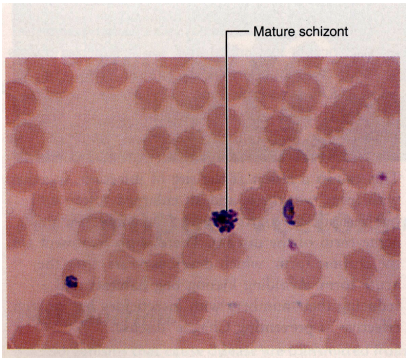
Malaria

- ✓Transmission
  - ✒Infected female *Anophles* mosquito
  - ✒Sharing needles
  - ✒blood transfusions
- ✓Resistance
  - ✒Some lack the receptors on their RBC
  - ✒Sickle cell anemia

Trophozoite



Schozont



Malaria

✓Sign/symptoms

- ✒Incubation is about 1-2 weeks
  - ☞Flu-like - fever, headache, pain in joints, and muscles - last for about 3 weeks
  - ☞Cold phase - Cold chills for an hour
  - ☞Hot phase - high fever (104°F)
  - ☞Wet phase - temp fall and sweating occurs
  - ☞Repeats every 48-72 hrs
    - ✒RBC become rigid, capillaries get plugged, tissue oxygen deprivation, anemia, enlarged spleen

Malaria

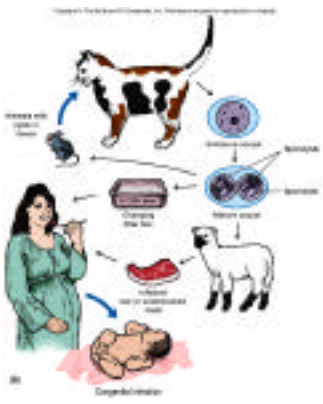
✓Treatment

- ✒Chloroquine - while living in endemic areas
- ✒Primaquine - after leaving endemic areas
- ✒Mefloquine + doxycycline
- ✒Quinine

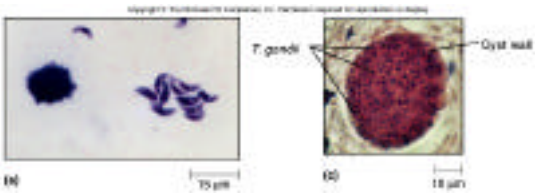
✓Prevention

- ✒DEET
- ✒Insecticide covered netting

Toxoplasma gondii



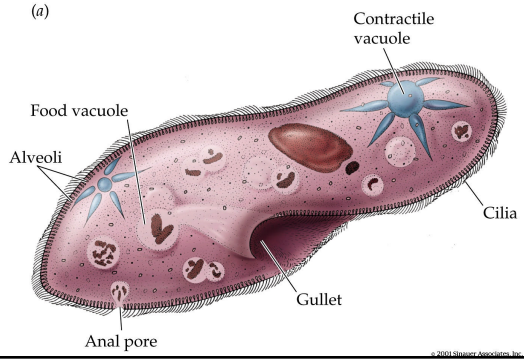
Toxoplasma gondii

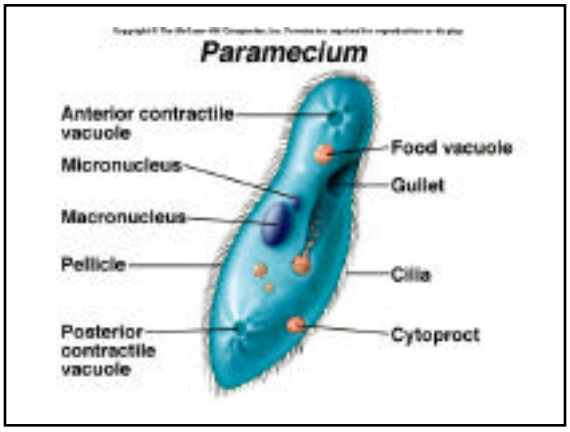


Invasive forms

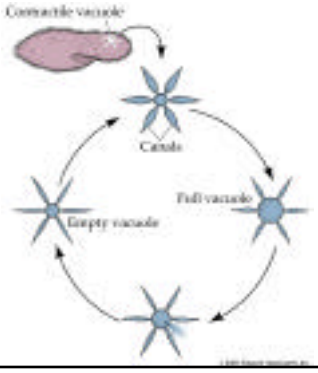
Cyst in meat

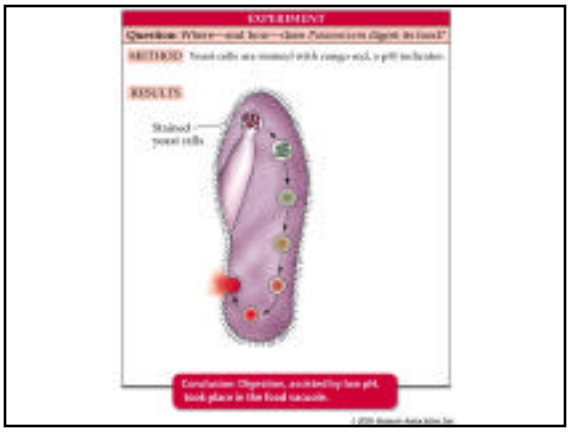
Ciliophora *(Paramecium)* structure



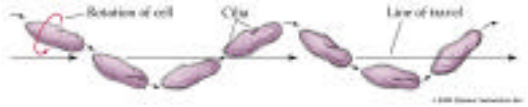


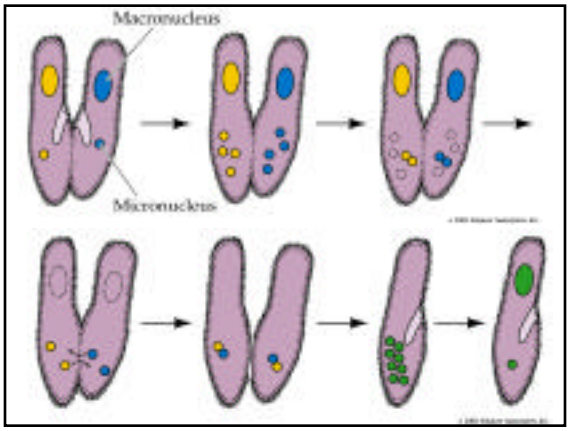
Regulating turgor pressure (no cell wall)



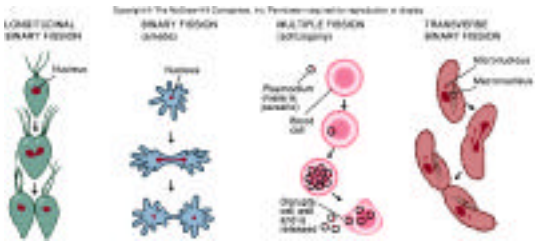


Paramecium movement

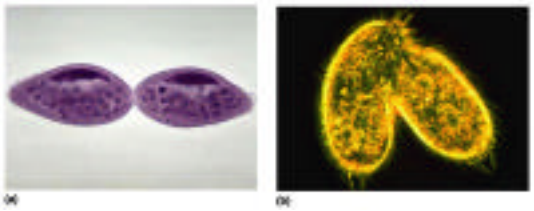




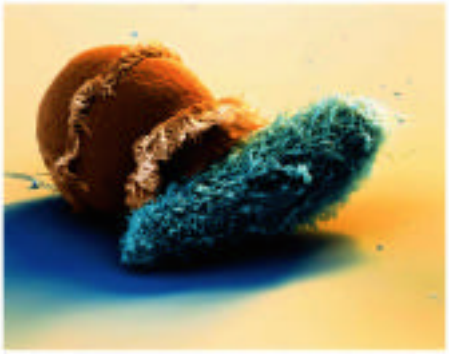
Protist asexual reproduction



Asexual and sexual reproduction



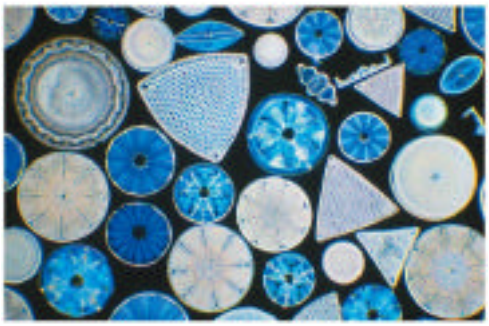
Didinium eating a *Paramecium*



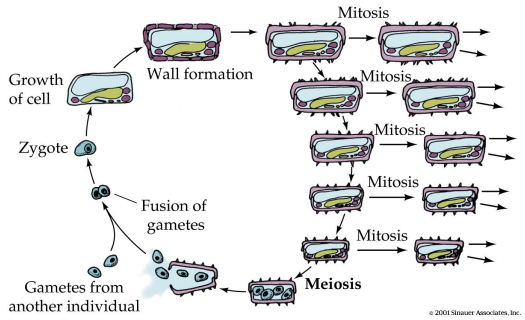
Stramenopila

- ✓ Diatoms, *Bacillariophyta* (*Chrysophyta*)
  - ✒ Two unequal flagella; yellow and brown pigments; phototrophic, contain silica or $CaCO_3$ in two part cell walls
  - ✒ Road signs, tooth paste, diatomacious earth, insecticides
- ✓ ,Brown algae, Phaeophyta
  - ✒ multicellular, giant kelps, photosynthesis
  - ✒ Fucoxanthin, chlorophylls a & c
- ✓ Water molds, *Oomycota*
  - ✒ Cellulose cell wall; form egg-like spores; have motile zoospores.
  - ✒ Diseases on plants, mildews, and fish diseases

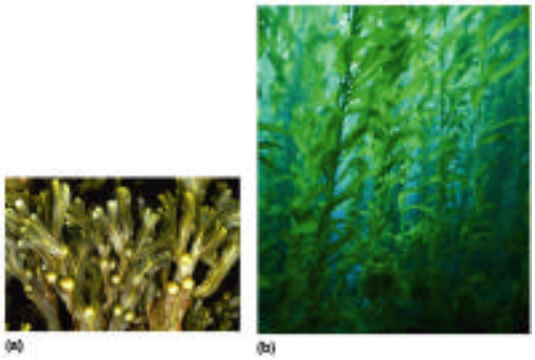
Diatoms



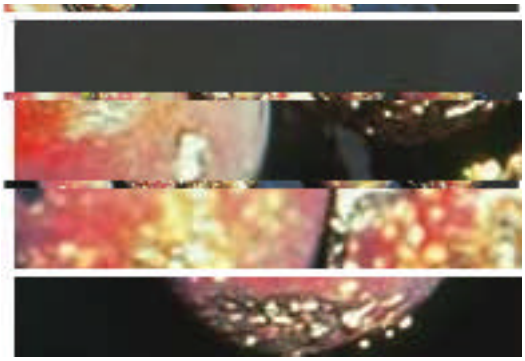
Diatom reproduction



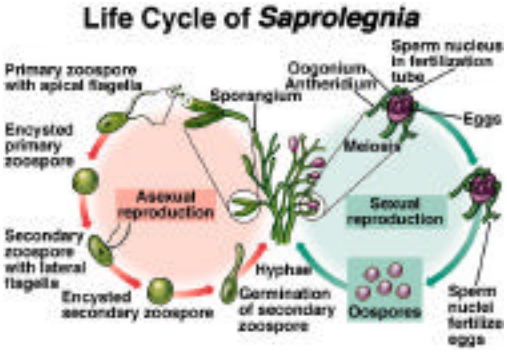
Phaeophyta (Brown algae)



Oomycetes (Downy mildew)



Oomycota



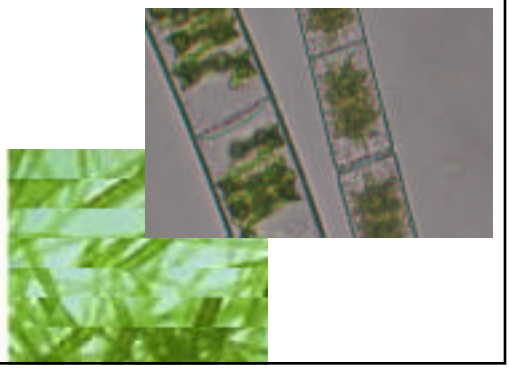
Plantlike protists

✓ Rhodophytes (red algae)
- ✒Sea weeds, $CaCO_3$ in cell walls - usually cellulose, agar come from red algae, carrageenan
- ✒Phycoerythrin, phycocyanin, carotenoids and chlorophyll

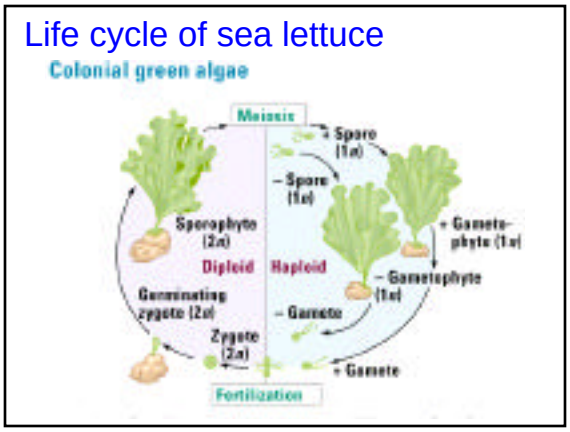
✓ Chlorophytes (green algae)
- ✒Ancestor of plants, very plant-like, photosynthesis, multicellular
- ✒Chlorophylls a & b

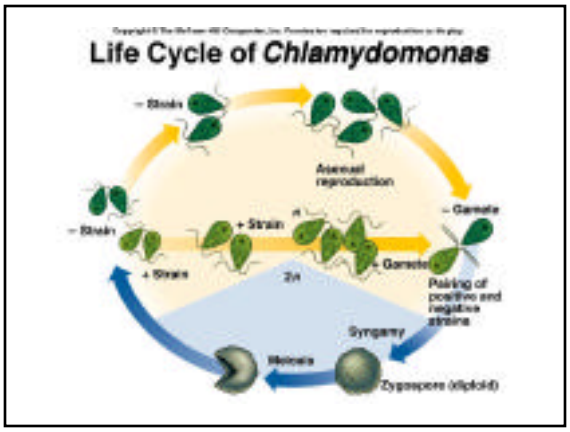
Rhodophyta (red algae)

Chorophyta (Green algae)

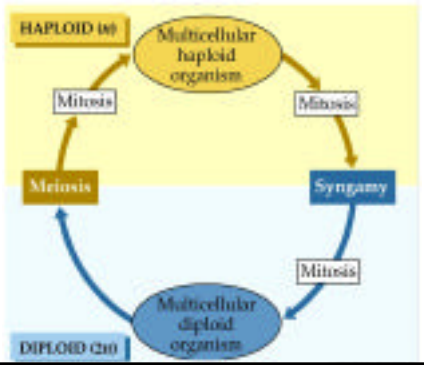


Life cycle of sea lettuce





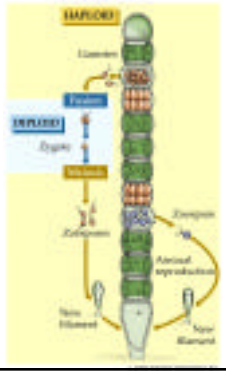
Alternation of generations



Isomorphic life cycle (*Ulva lactuca*)

Haplotonic life cycle (*Ulothrix*)

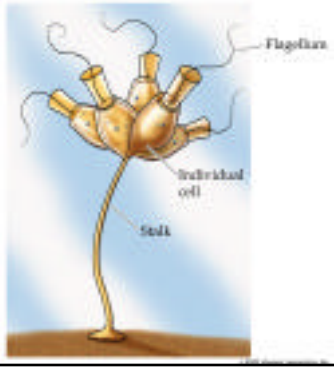
Haploid and diploid differ in structure



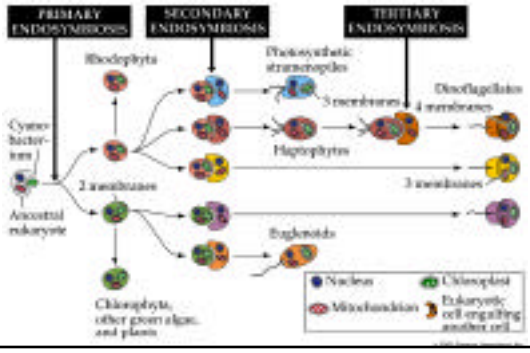
Choanoflagellida

✓ Resemble animal sponge cells; heterotrophic
✓ Link to the animal kingdom

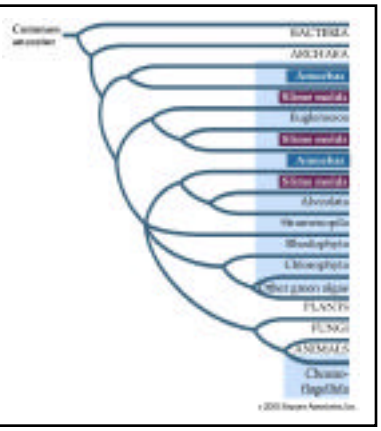
Choanoflagellate



Second endosymbiosis



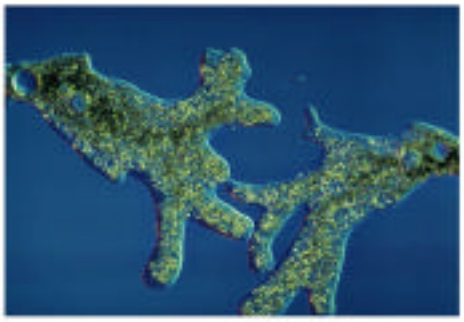
Several development events with recurrent body forms



Amoebas and slime molds

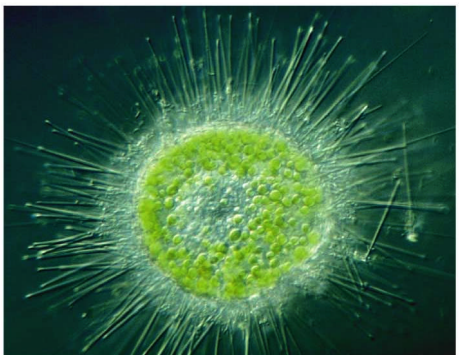
✓ Sarcodines (*Sarcodina*)
- Amoebas
  - pseudopodium
- Actinopods - Thin stiff pseudopods
  - Radiolarians
    - Exclusively marine, secrete glassy endoskeletons
  - Heliozoans
    - No endoskeleton, fresh water
- Forminifera
  - have shells of calcium carbonate, white cliffs of Dover, make up sand or Plankton

Amoeba

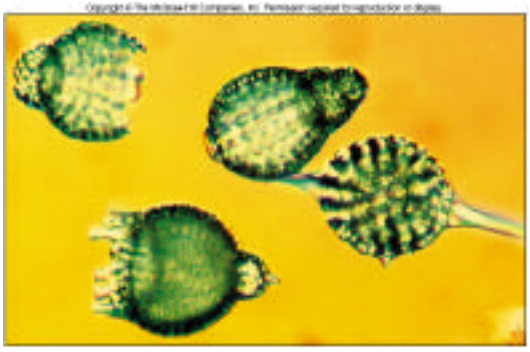


Radiolarian

Heliozoan



Radiolarans (hard silica shells)



Foraminiferans

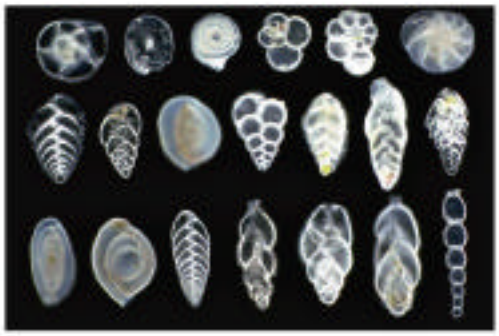


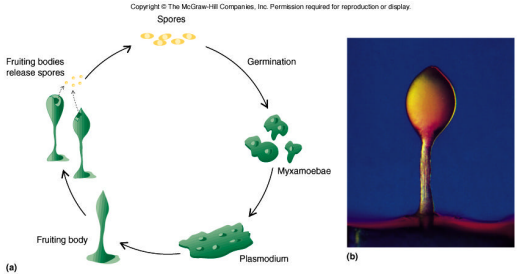
FIGURE 31.8
White cliffs of Dover. The limestone that forms these cliffs is composed almost entirely of fossil shells of protists, including coccolithophores (a type of algae) and foraminifera.

Funguslike protists

✓Slime molds

- Plasmodial (multinucleate, amoeboid mass) lack cell wall; pair of flagella, fruiting bodies
- cellular psuedoplasmodia (slightly motile aggregation of cells), fruiting body, cellulose cell wall; amoeboid

Slime molds

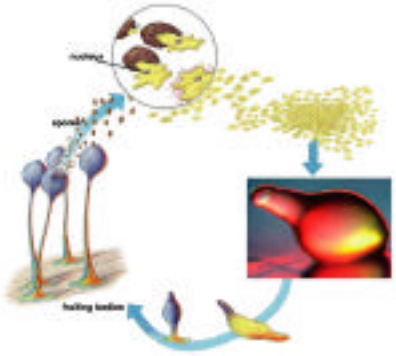


Acellular slime mold

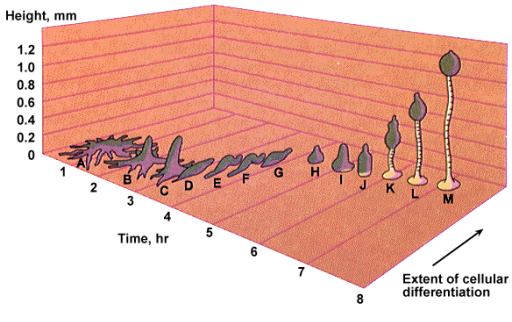
Cellular slime mold

Acellular slime mold

Cellular slime mold



Development of a slime mold



Plasticity (polymorphism)

Naegleria has many forms

Human tissue - ameba

Water - flagella

Adverse conditions - cyst