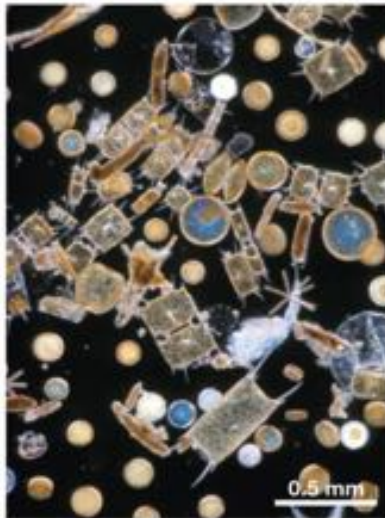


PROTISTS

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Protists

- Includes all eukaryotes
 - ▣ Except land plants, fungi, and animals
- No single trait found in Protista but not in other groups
- Low species diversity
 - 10% of Eukarya
- Extremely abundant



Open ocean: Surface waters teem with microscopic protists, such as these diatoms.
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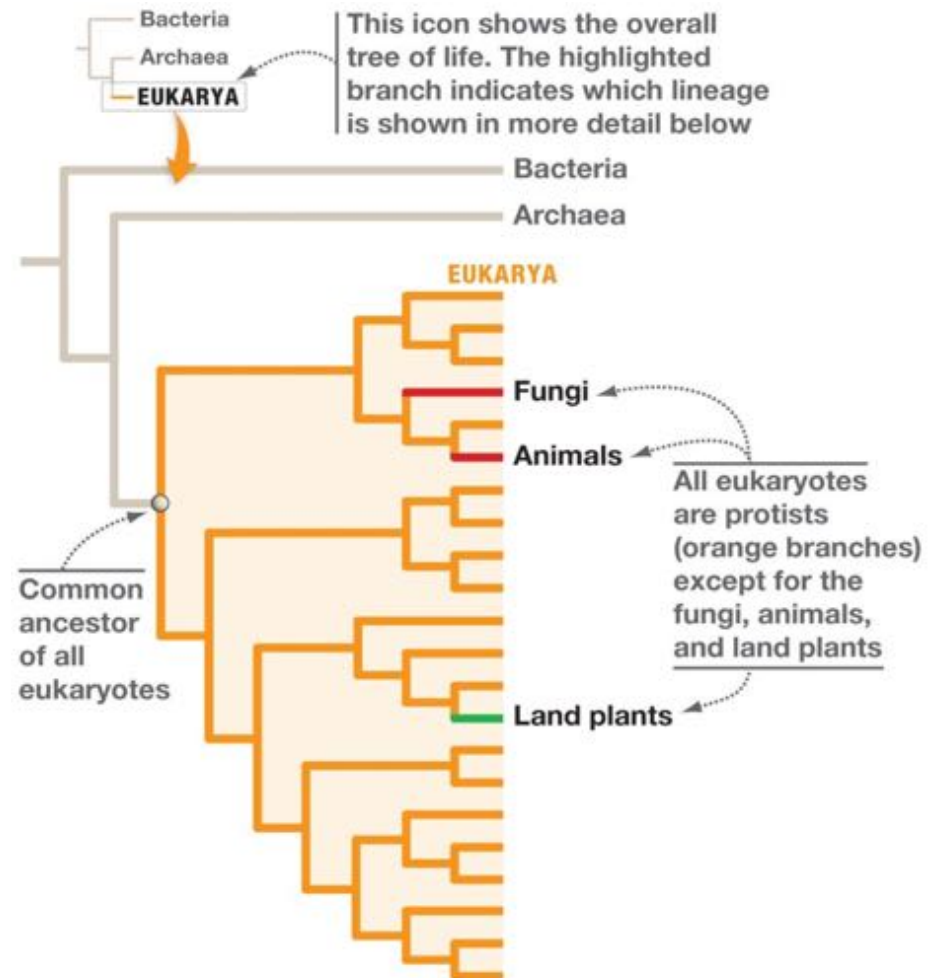
Shallow coastal waters: Gigantic protists, such as these kelp, form underwater forests.



Intertidal habitats: Protists such as these red algae are particularly abundant in tidal habitats.

Protists

- Not monophyletic
 - ▣ *Paraphyletic*
 - Some (not all) descendants of common ancestor



Protists and humans

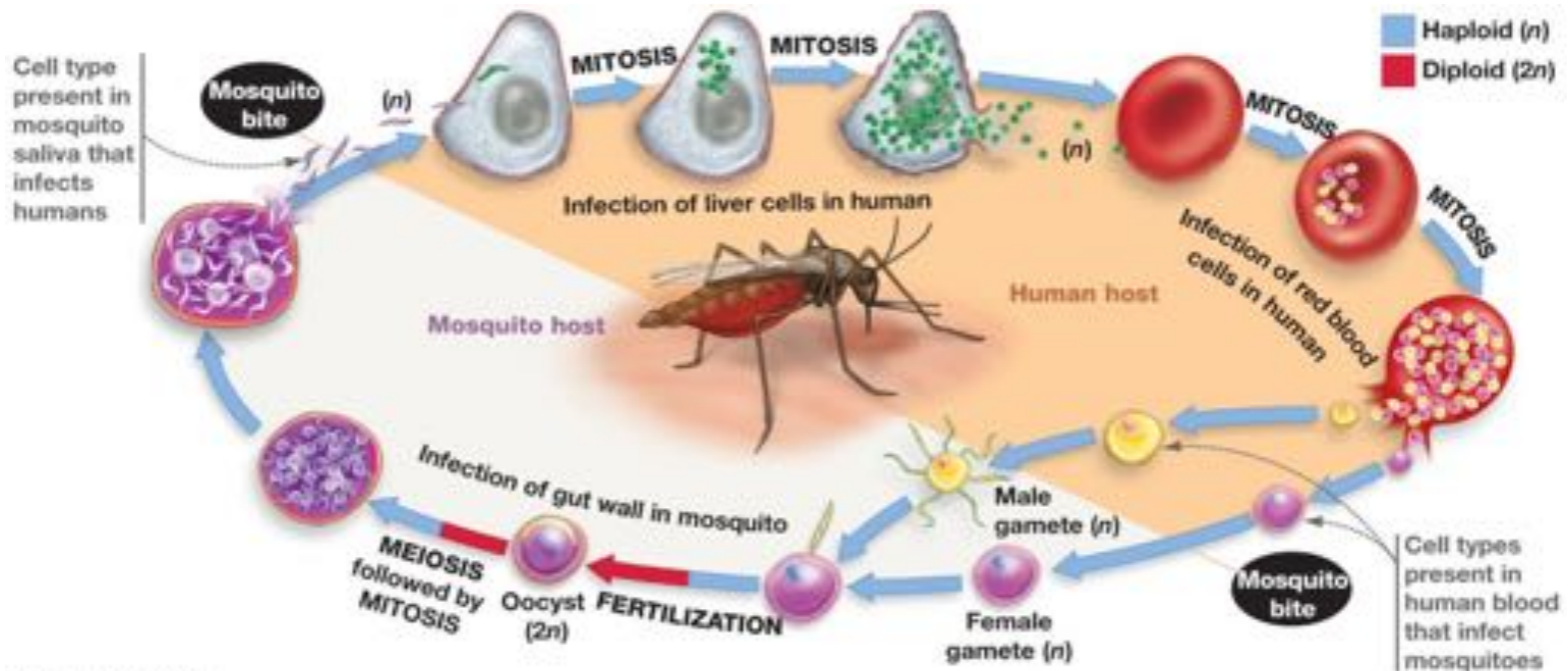
□ Irish potato famine of 1845

▣ *Phytophthora infestans*

- Malaria

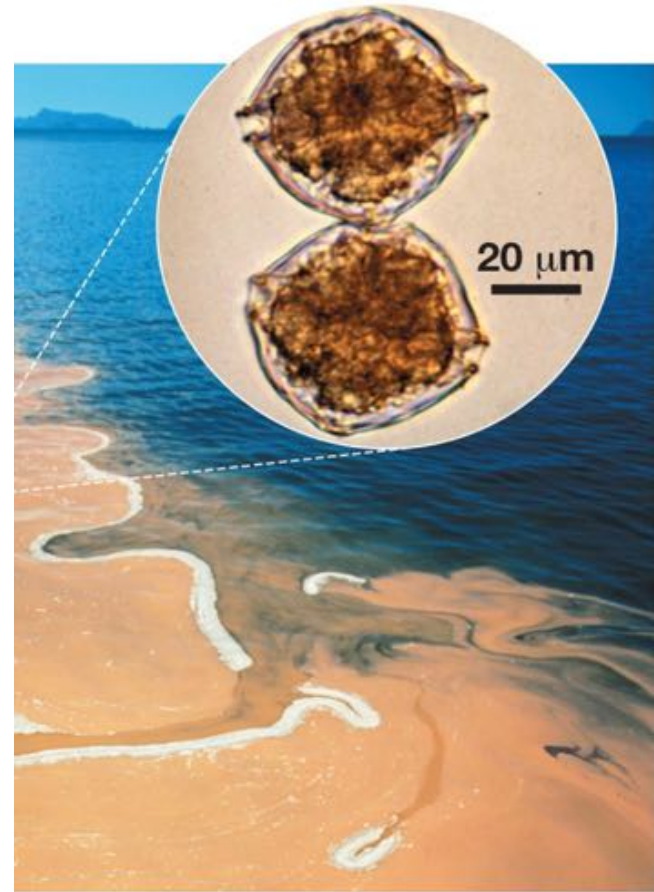
- Mosquitos are vectors

- *Plasmodium* (parasitic)

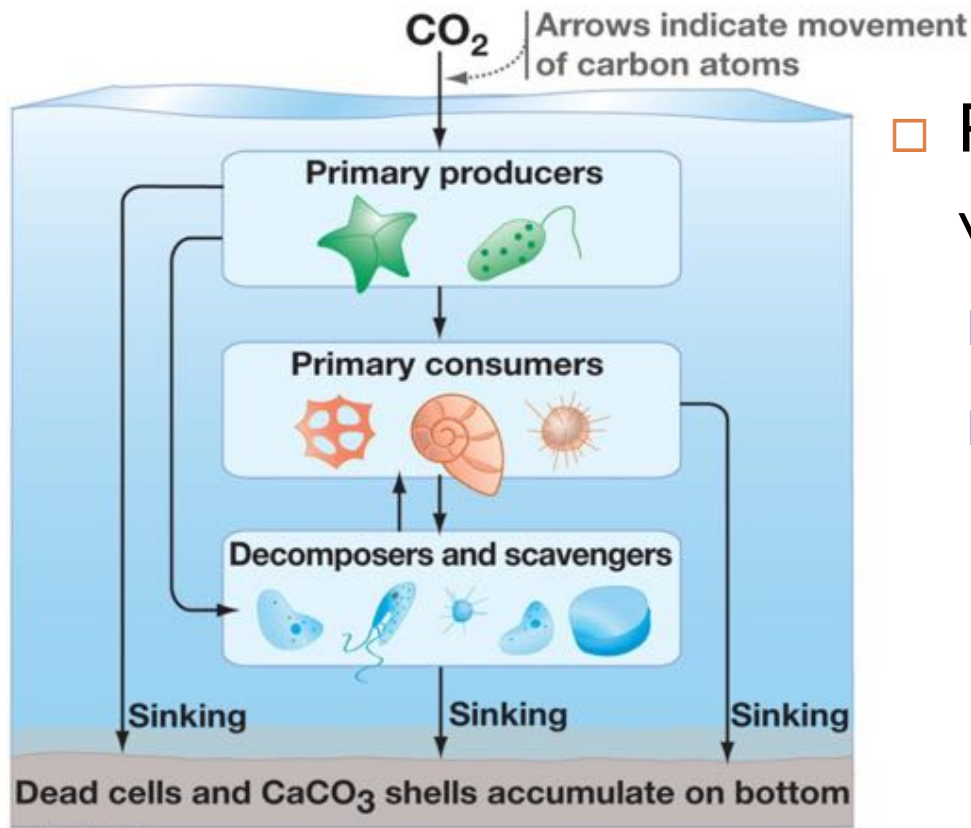


Algal Blooms

- Red tides
- Dinoflagellates
 - ▣ Toxin-producing protists
- Poisoning in humans
 - ▣ Eating shellfish



Aquatic food chains

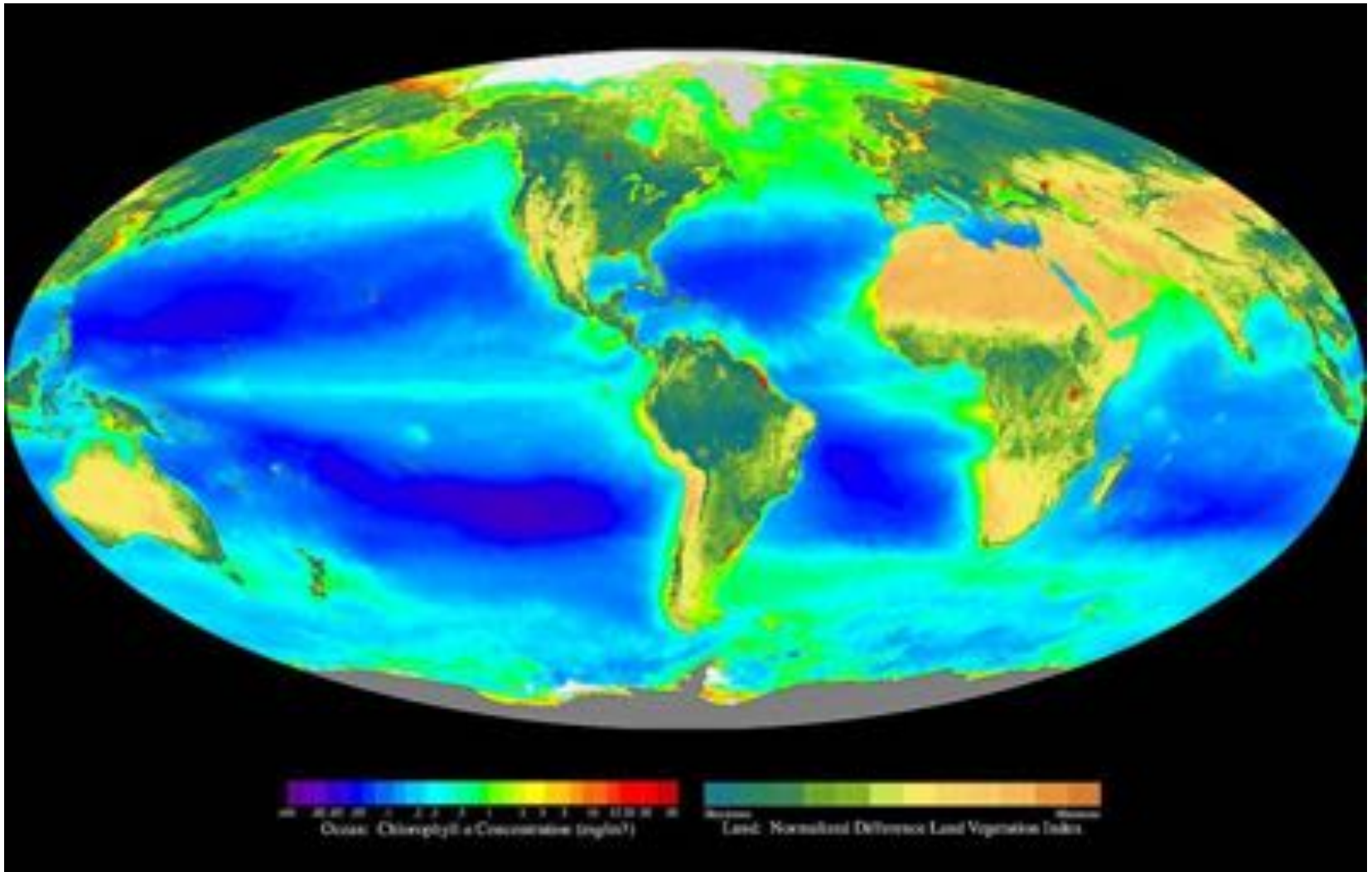


- Protists fix half of world's carbon
 - ▣ Phytoplankton
 - ▣ Serve as base of food chains in aquatic environments

Protists and climate change

- Global carbon cycle
 - ▣ Movement of C atoms
- Phytoplankton act as key *carbon sink*
 - ▣ Repository for C
 - ▣ Could help mediate global warming

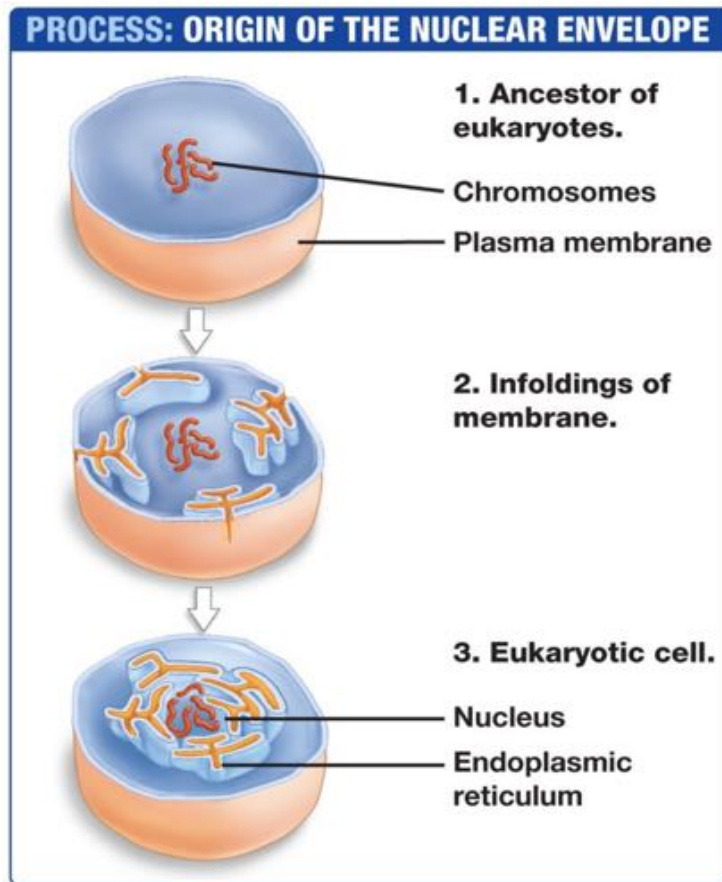
Protists and climate change



Diversification of Protista

- Paraphyletic
 - ▣ Don't share derived characteristics separating them from other groups
- Earliest eukaryotes must have had:
 - ▣ Unicellular
 - ▣ Nucleus
 - ▣ Mitochondria
 - ▣ No cell wall
- How did those come to be?

Origin of the nuclear envelope



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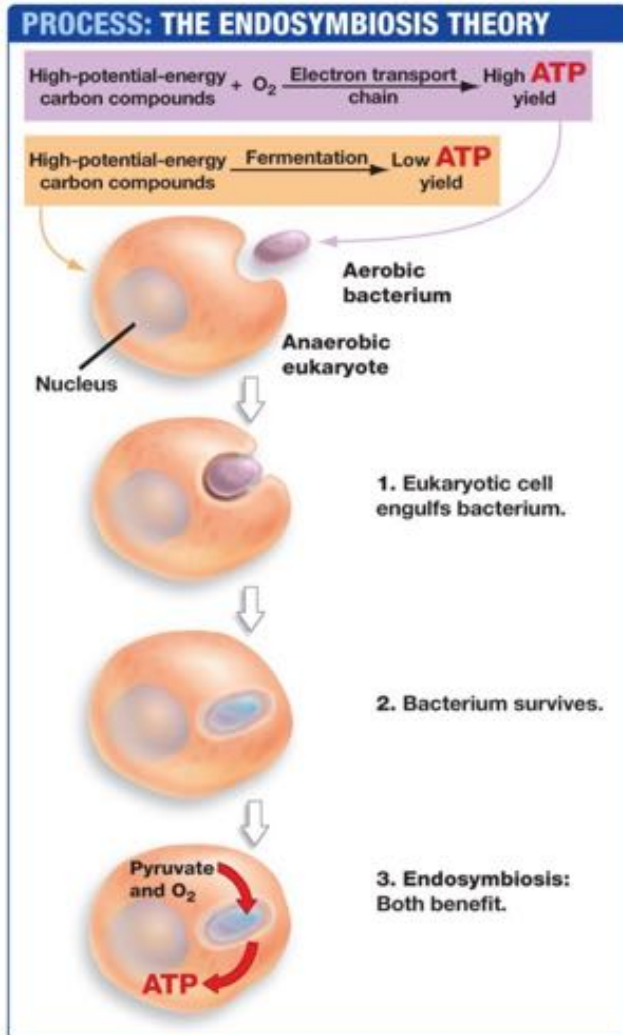
- Leading hypothesis
 - ▣ Cell membrane folded in on itself
 - ▣ Also creating ER
- Evidence
 - ▣ Infoldings are present in some bacteria
 - ▣ Nuclear envelopes is continuous with ER
- Advantage
 - ▣ Separation of transcription and translation

Origin of the mitochondrion

- Endosymbiosis theory
 - ▣ Mitochondrion took up residence in eukaryotic cell
 - ▣ 2 billion years ago
- Symbiosis
 - ▣ Mutually beneficial for 2 species when in contact
- Endosymbiosis
 - ▣ Symbiosis when 1 lives inside another



Origin of the mitochondrion



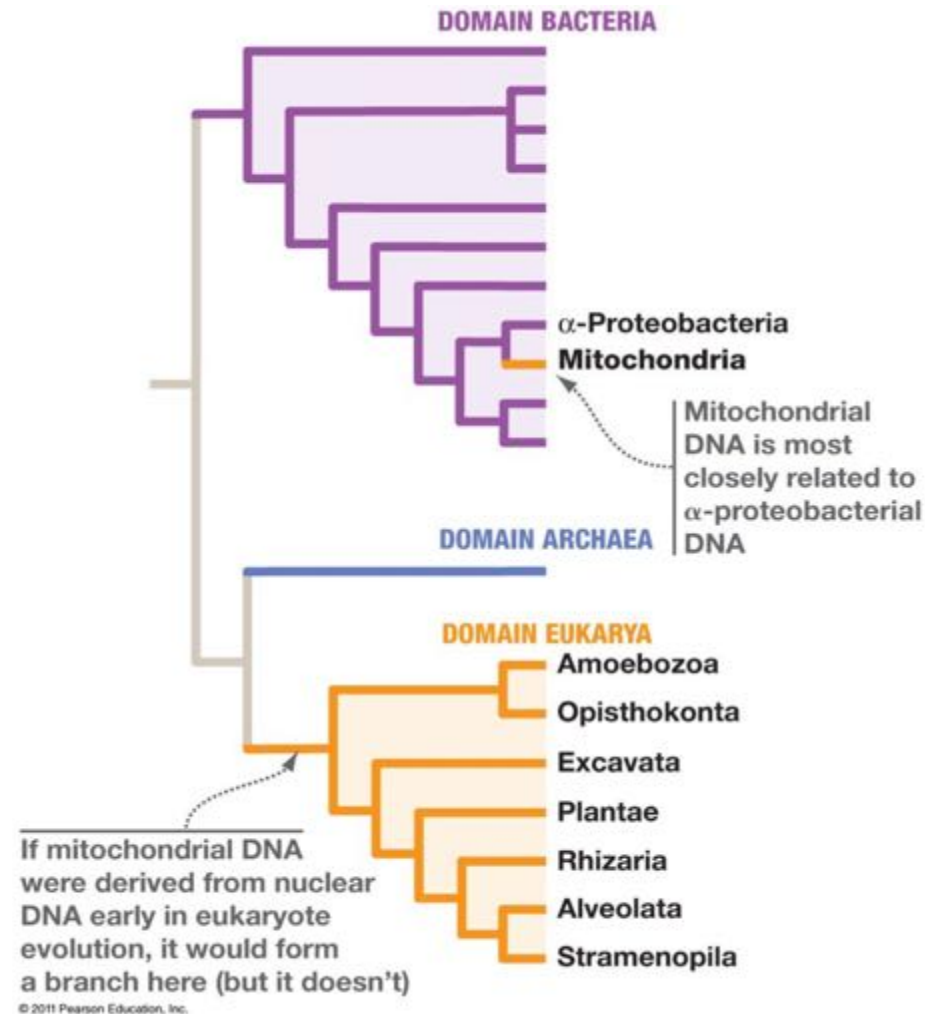
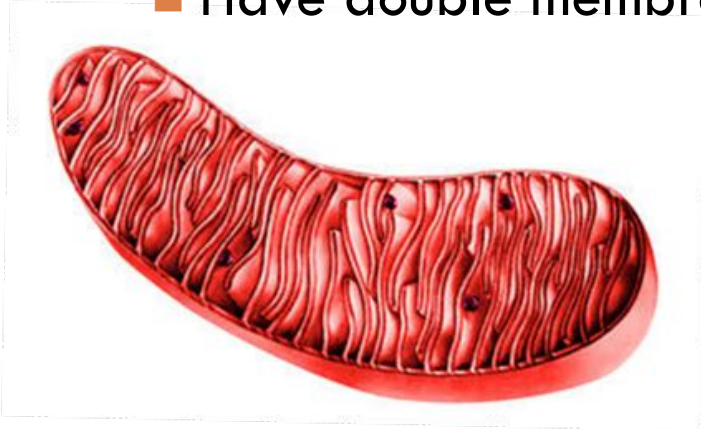
- Endosymbiosis theory
 - ▣ Eukaryote engulfs bacteria
 - But didn't consume
 - ▣ Eukaryote provided protection
 - ▣ Bacterium supplied ATP

Origin of the mitochondrion

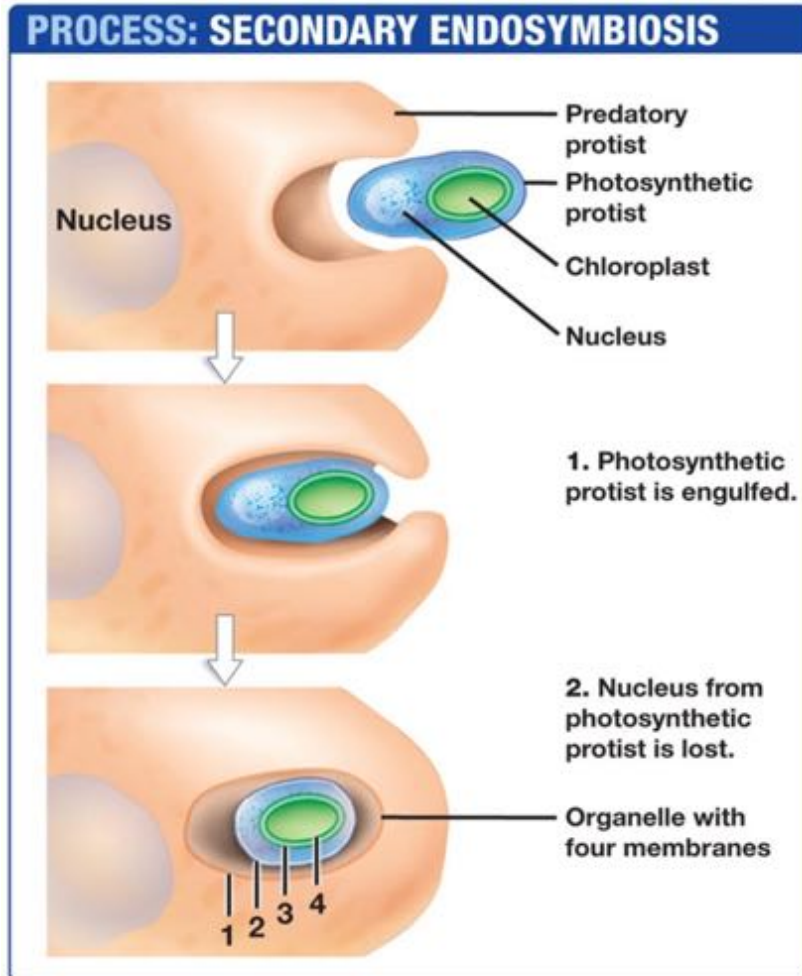
□ Evidence

▣ Mitochondria

- Same size as bacterium
- Have own genomes
 - Self-replicate
- Manufacture own proteins
- Have double membranes



Origin of the chloroplast

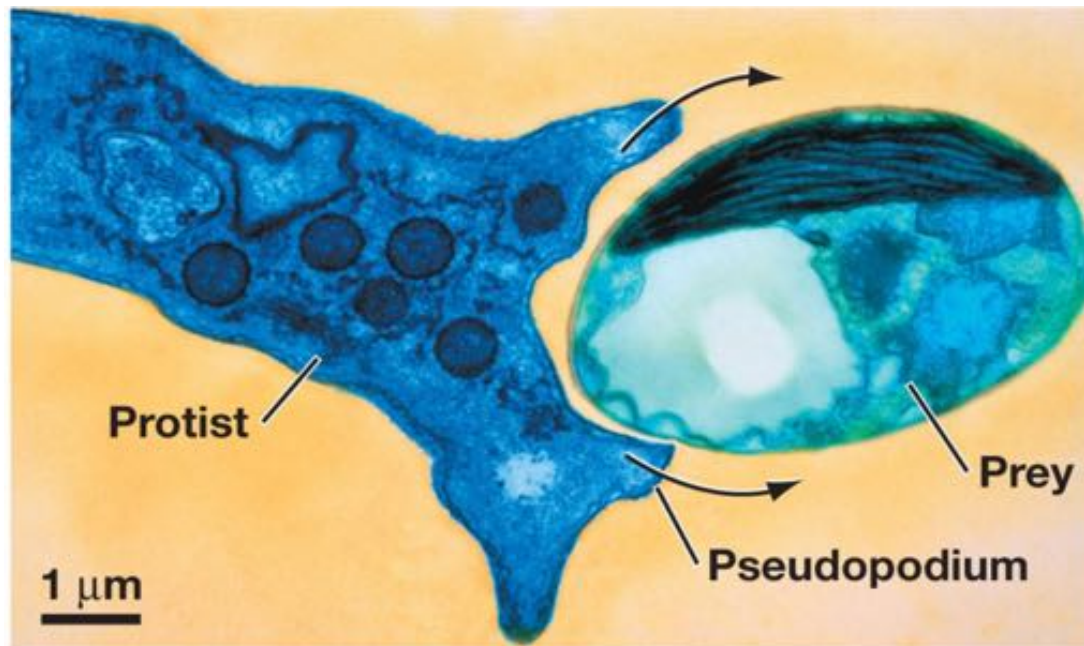


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- Photosynthesis originated in bacteria
- Protist engulfed cyanobacteria
- Another protist engulfed that protist
 - ▣ Secondary endosymbiosis
- Chloroplasts
 - ▣ Have 4 membranes

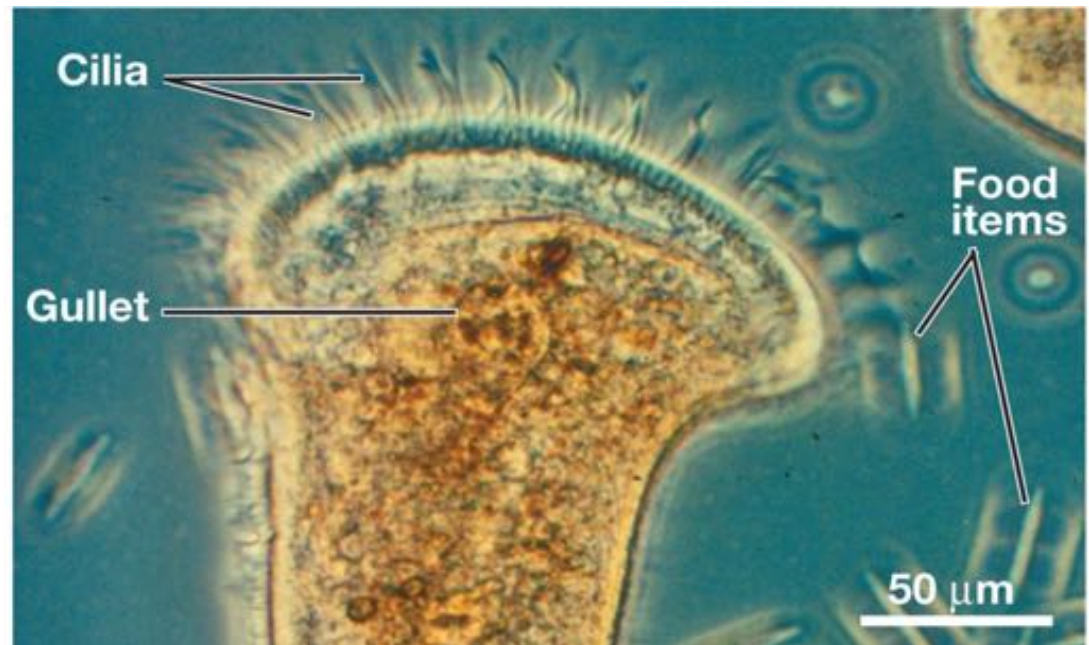
How do protists eat?

- Phagocytosis
 - ▣ Ingest packets of food
 - ▣ Eat bacteria, archaea, and other protists



How do protists eat?

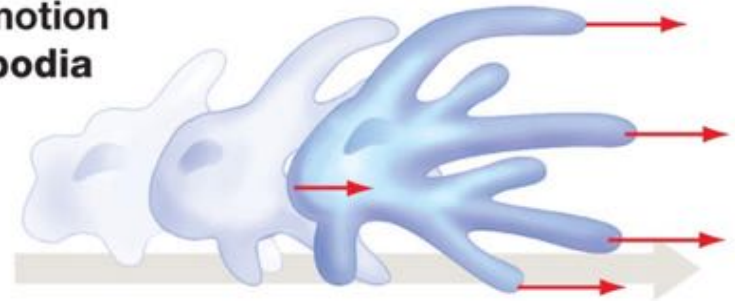
- Absorptive feeding
 - ▣ Nutrient taken directly from environment
 - ▣ Common
 - ▣ Decomposers
 - ▣ Parasites



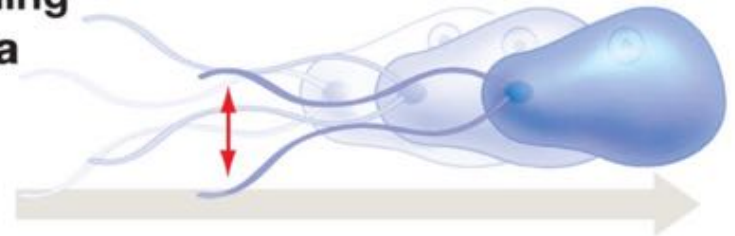
Protist motion



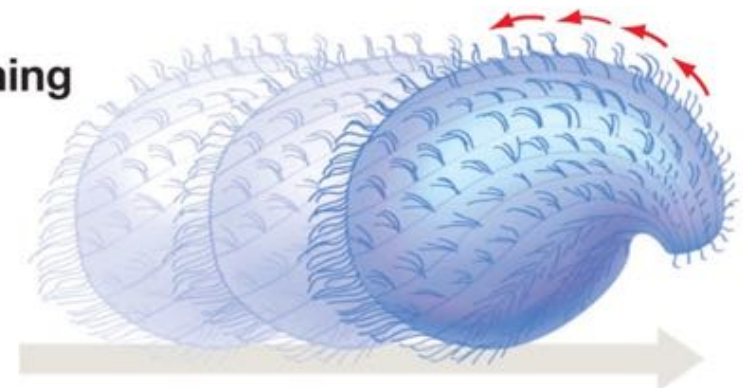
**Amoeboid motion
via pseudopodia**



**(a) Swimming
via flagella**



**(b) Swimming
via cilia**

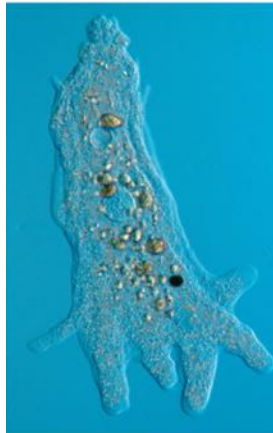


Key lineages of Protists

- Eukarya have 7 major lineages
 - ▣ 1 is Opisthokonta: fungi & animals
 - ▣ 6 have Protists
 - Each as at least one distinctive morphological char.

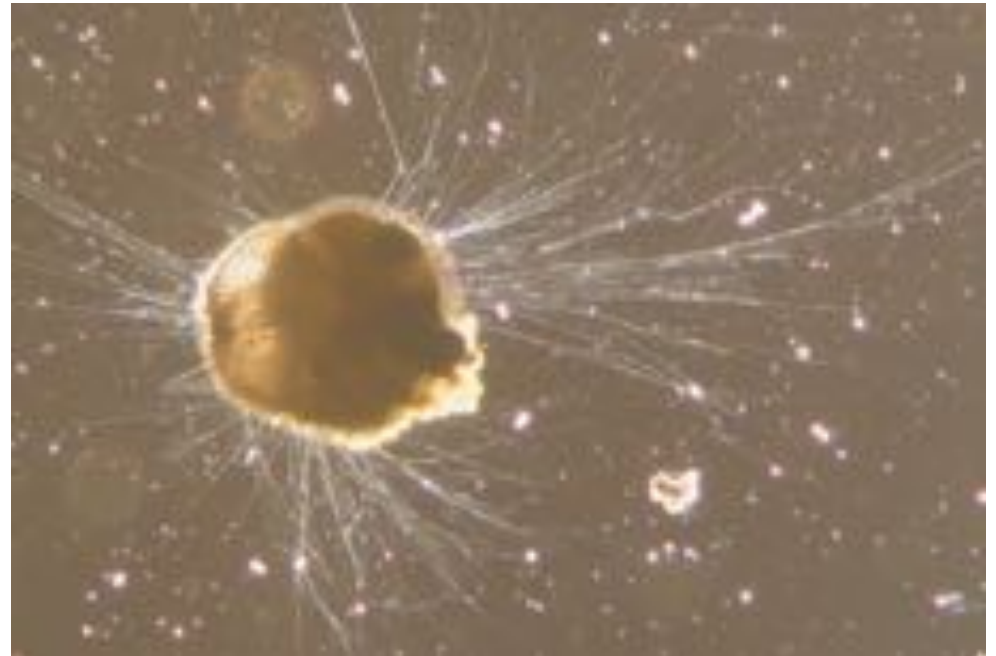
Amoebozoa

- Phagocytosis
- Amoeboid motion
 - ▣ Lobose pseudopods
 - blunt
- Includes:
 - ▣ Amoebae
 - ▣ Slime molds



Rhizaria

- Amoeba-like
- Lack cell walls
- Amoeboid motion
 - ▣ Long, slender pseudopodia



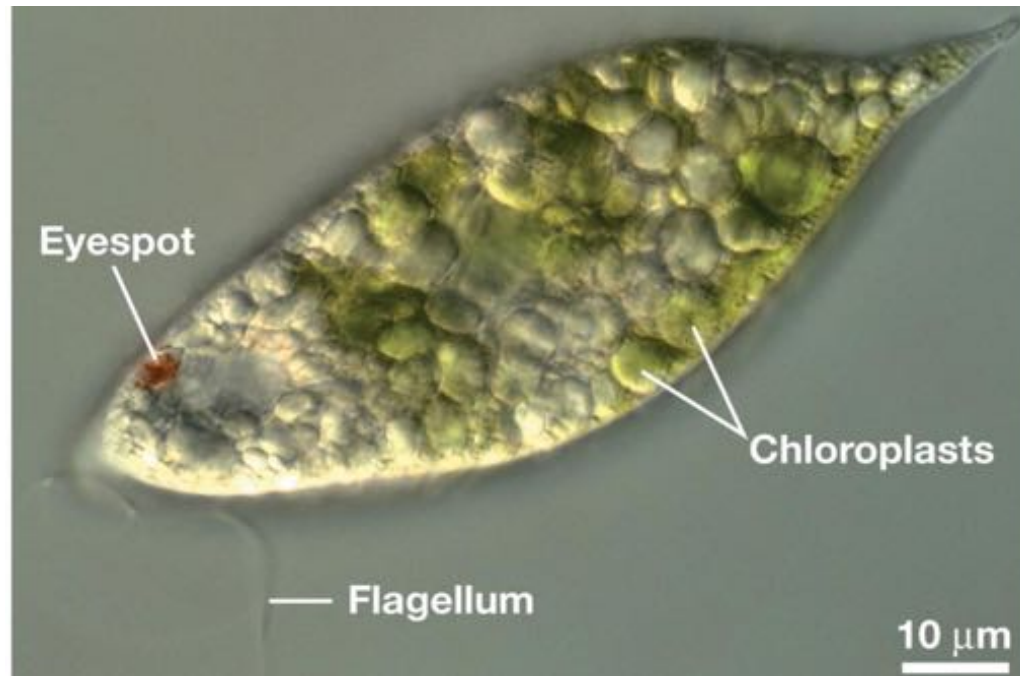
Excavata

- “excavated” feeding groove
- Lacks mitochondria
- e.g. *Giardia*
- Have flagella



Excavata: Euglenida

- 1/3 are photosynthetic
- Some have light sensitive eyespots
 - ▣ Swim towards light



Plantae

- ❑ Red algae, green algae, & land plants
- ❑ Mostly multicellular
- ❑ Cell walls: cellulose
- ❑ Mostly photosynthetic
- ❑ No flagella



Alveolata



- Small sacs
 - Alveoli
- Unicellular
- Diverse in morphology

Stramenopila

- Some stage:
 - ▣ distinctive hollow hairs
- Types:
 - ▣ Oomycota
 - Cell wall: cellulose
 - ▣ Diatoms
 - Cell wall: glass
 - Dominant ocean primary producers
 - ▣ Brown algae:
 - Photosynthetic, multicellular

