

Biology



Concepts and Applications | 9e
Starr | Evers | Starr

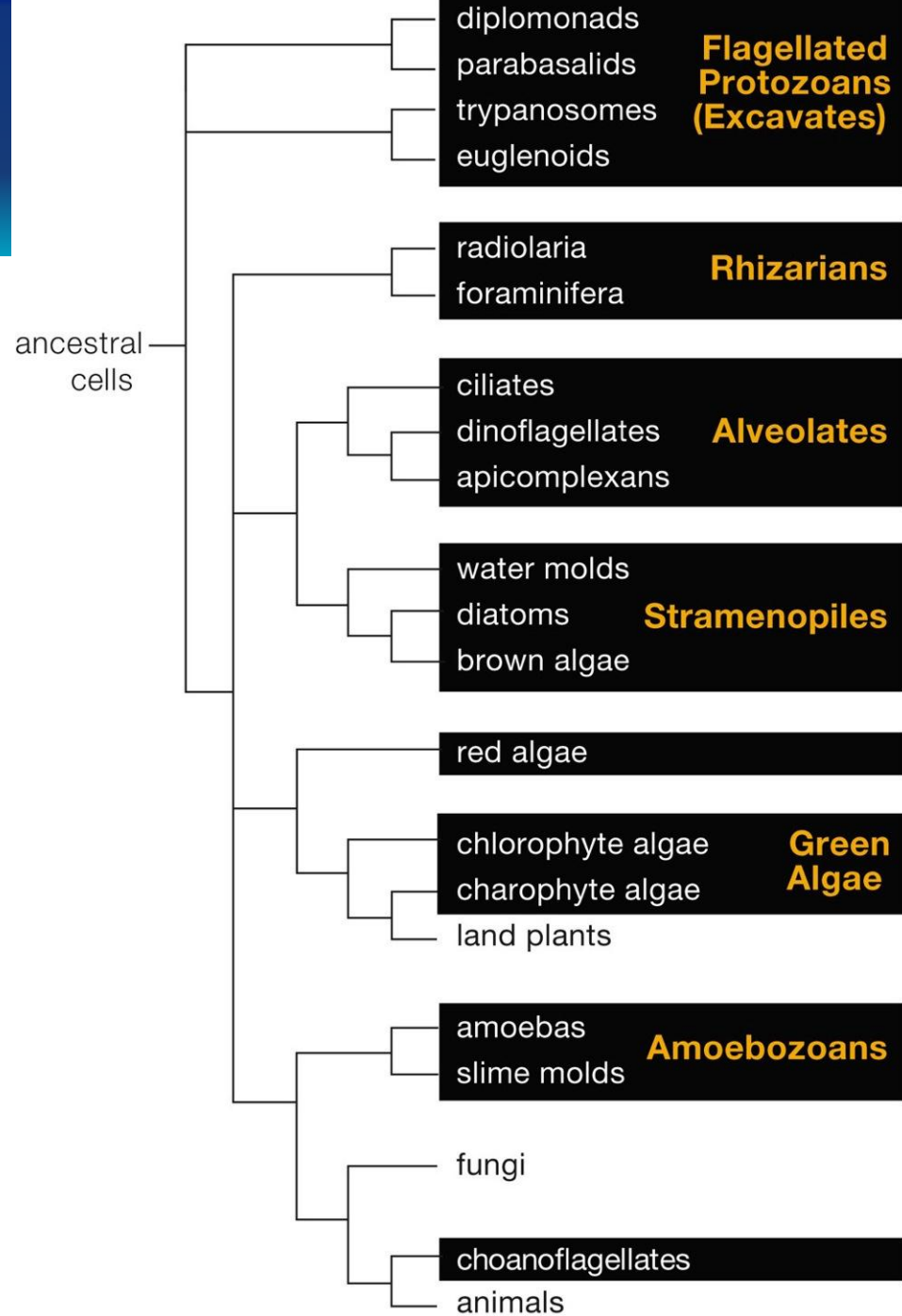
Chapter 20

The Protists

20.1 What Are Protists?

- Protists
 - Protists are a collection of mostly single-celled eukaryotes
 - Protists are not a natural group, but a collection of lineages, some only distantly related to one another
 - Many have chloroplasts

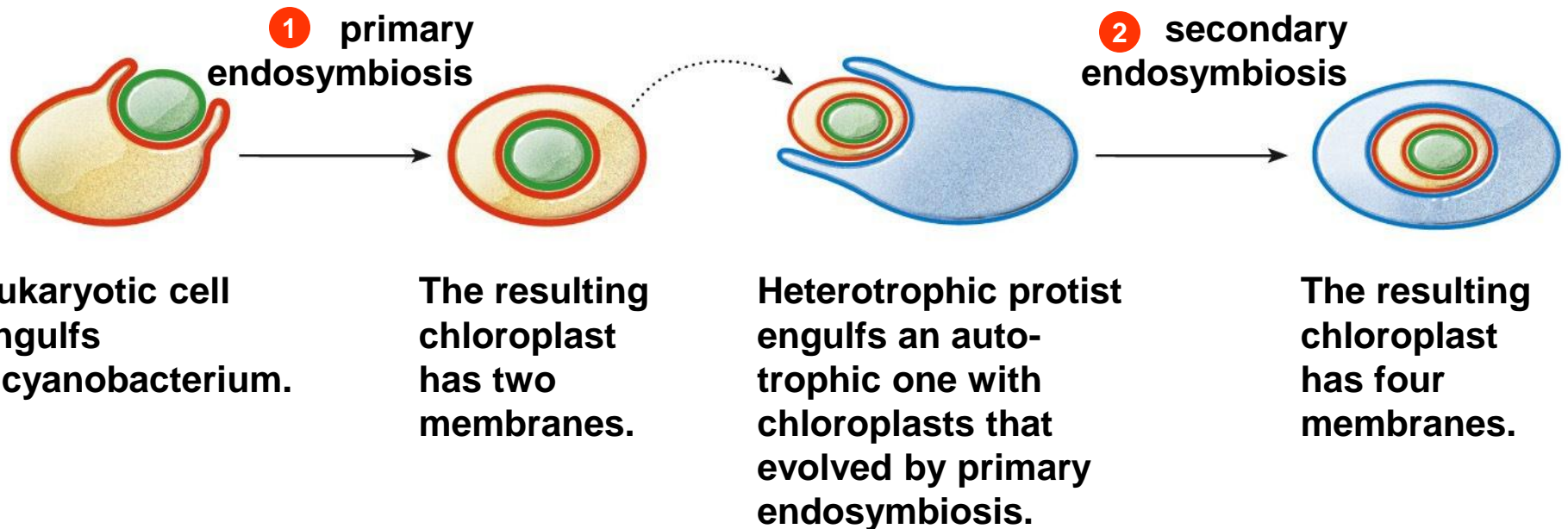
What Are Protists? (cont'd.)



What Are Protists? (cont'd.)

- Chloroplasts evolved by endosymbiosis
 - Primary endosymbiosis – bacterium enters cell and descendants evolve into organelles
 - Secondary endosymbiosis – photosynthetic protist engulfed by a heterotrophic protist

What Are Protists? (cont'd.)



Eukaryotic cell engulfs a cyanobacterium.

The resulting chloroplast has two membranes.

Heterotrophic protist engulfs an autotrophic one with chloroplasts that evolved by primary endosymbiosis.

The resulting chloroplast has four membranes.

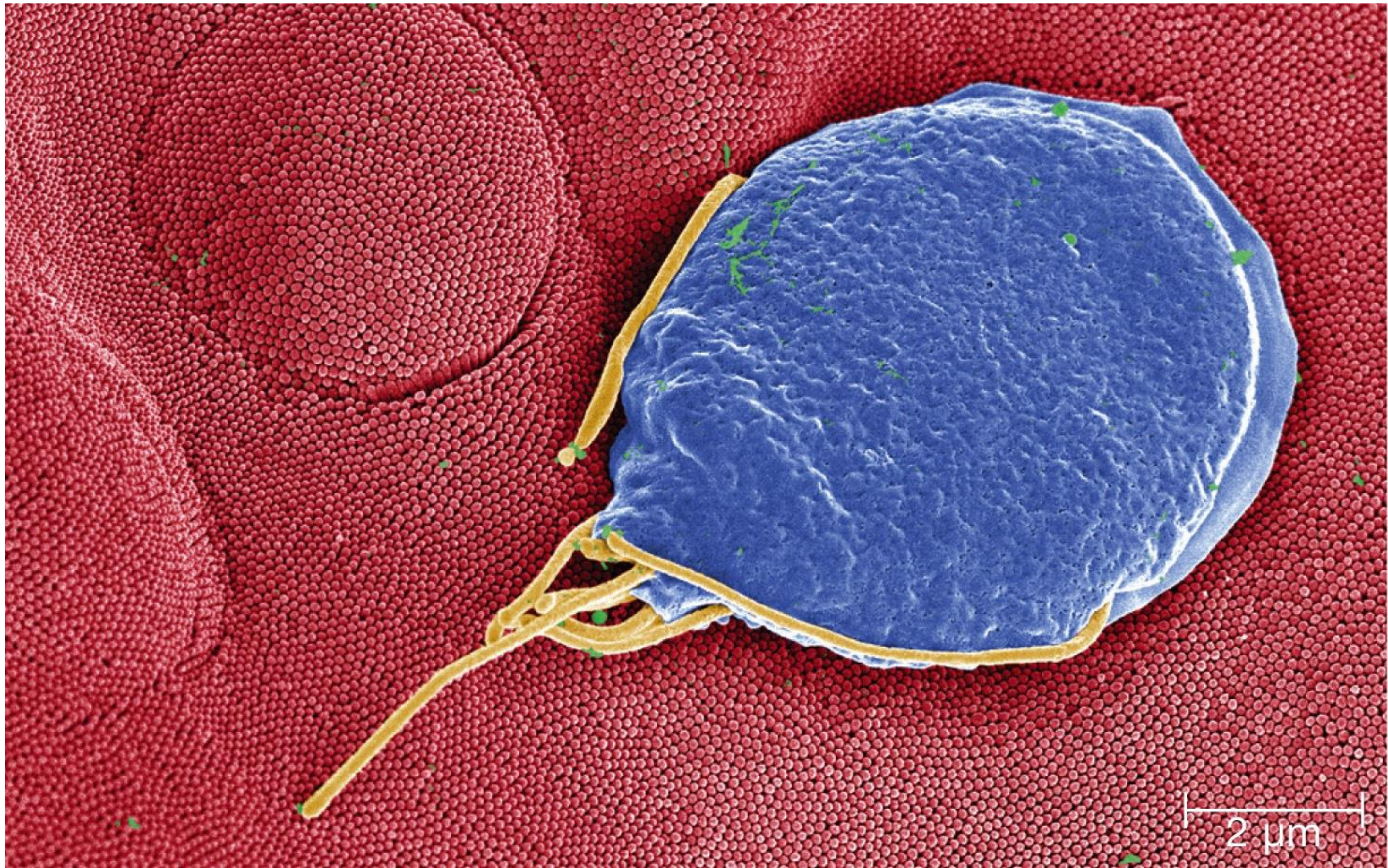
20.2 What Are Flagellated Protozoans?

- Flagellated protozoans are single cells with no cell wall – a protein covering (pellicle) helps maintain the cell's shape

What Are Flagellated Protozoans? (cont'd.)

- Diplomonads and parabasalids
 - Have multiple flagella
 - Are adapted to oxygen-poor habitats
 - Instead of mitochondria, they have organelles that produce ATP by an anaerobic pathway
 - Both groups include species that infect humans

What Are Flagellated Protozoans? (cont'd.)

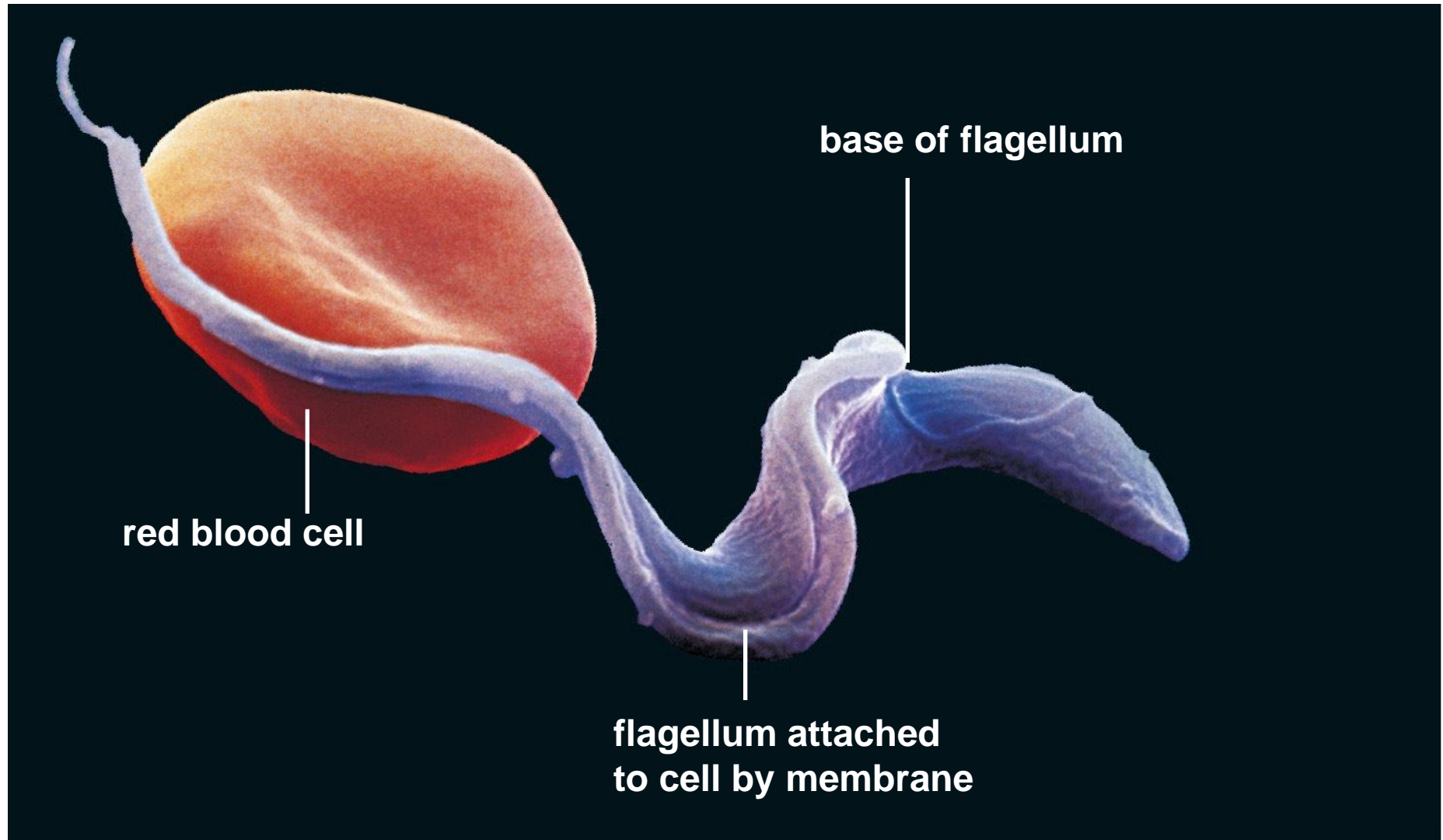


© CDC / Dr. Stan Erlandsen

What Are Flagellated Protozoans? (cont'd.)

- Trypanosome
 - Parasitic flagellate
 - Has a single mitochondrion
 - Has a membrane-encased flagellum
 - Insects transmit trypanosomes, such as *Trypanosoma brucei*, which causes African sleeping sickness

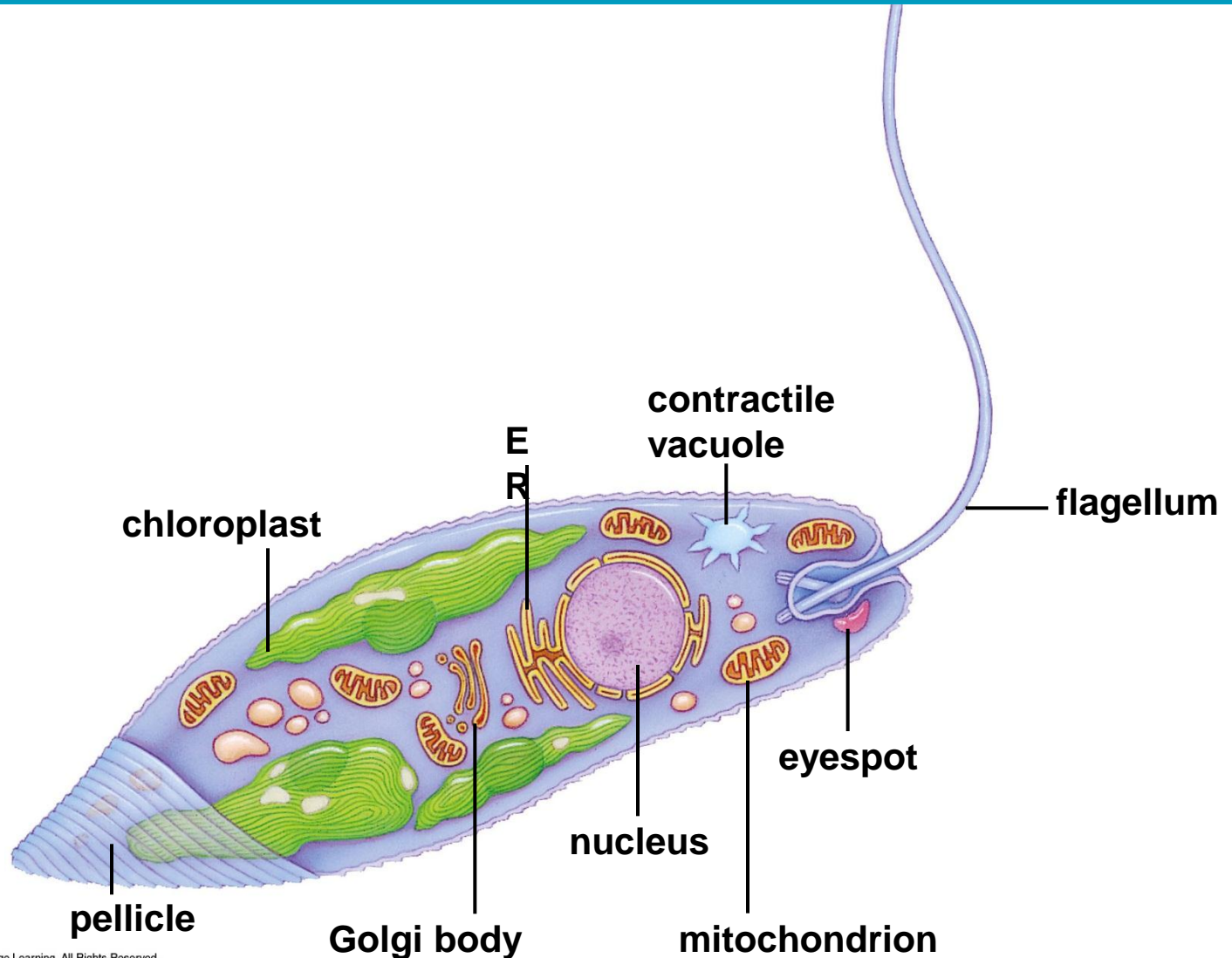
What Are Flagellated Protozoans? (cont'd.)



What Are Flagellated Protozoans? (cont'd.)

- Euglenoid
 - Flagellated protozoan with multiple mitochondria
 - Some have chloroplasts that evolved by secondary endosymbiosis from a green alga
 - Typically live in fresh water
 - Have a *contractile vacuole*, an organelle that collects and expels excess water

What Are Flagellated Protozoans? (cont'd.)



© Cengage Learning. All Rights Reserved.

20.3 What Are Rhizarians?

- Rhizarians include two groups: foraminiferans and radiolarians
 - Are single-celled marine protists with sieve-like shells
 - Capture food with microtubule-reinforced cytoplasmic extensions that protrude through the shell's openings
 - Both are marine heterotrophs and may be part of plankton

What Are Rhizarians? (cont'd.)

- Foraminiferan
 - Heterotrophic single-celled protist
 - Calcium carbonate shell
 - Long cytoplasmic extensions
 - Deposits of their remains are mined for chalk and limestone

What Are Rhizarians? (cont'd.)

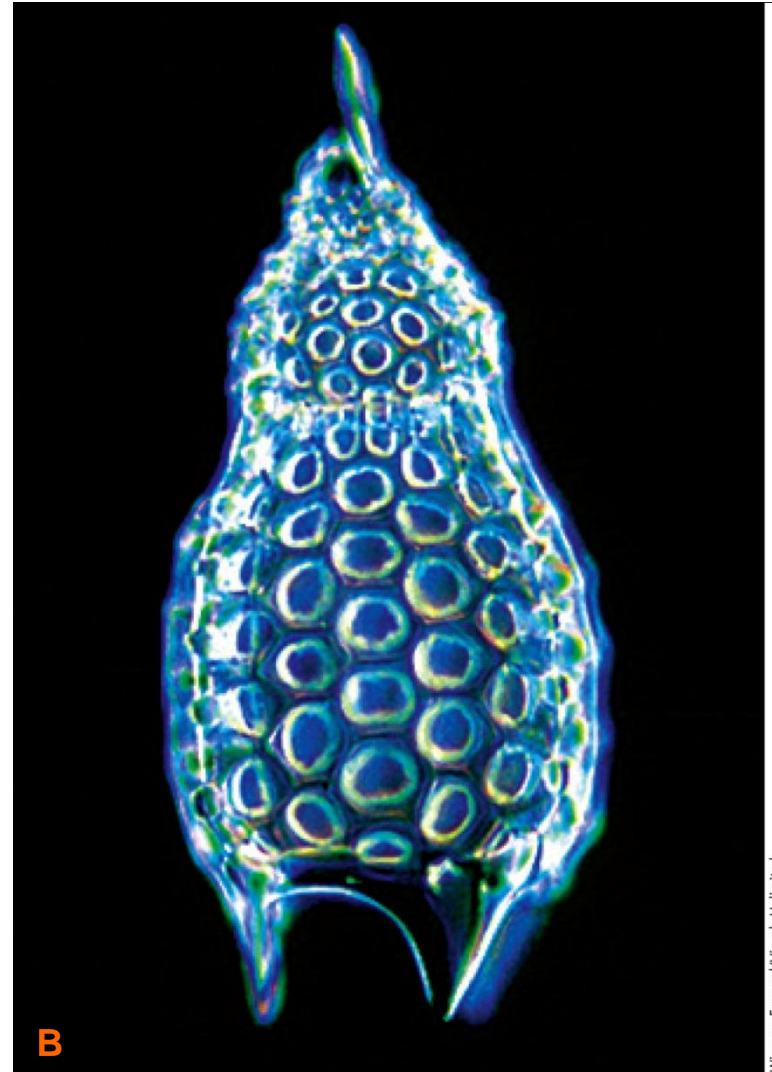
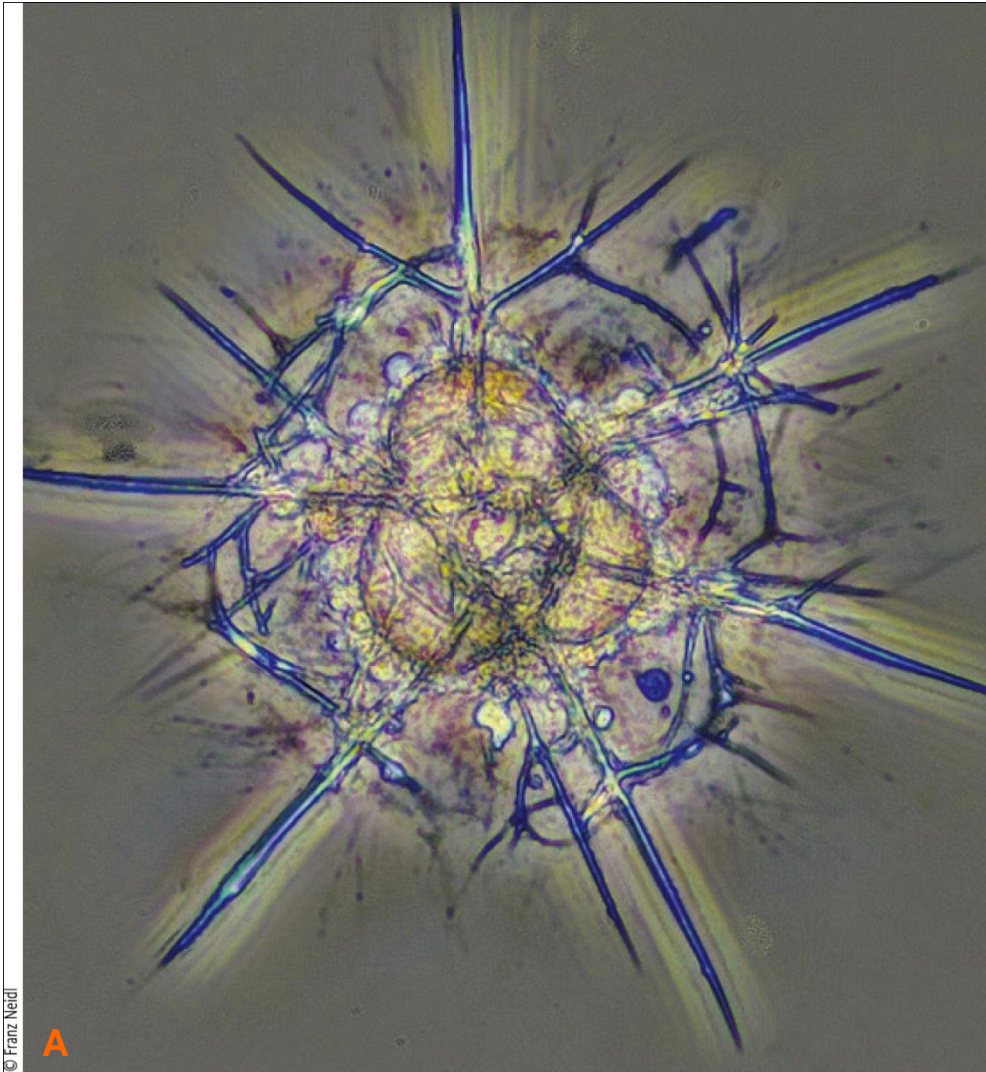
- Radiolarian
 - Heterotrophic single-celled protist
 - Glassy silica shell
 - Long cytoplasmic extensions that stick out through the porous shell and capture prey

What Are Rhizarians? (cont'd.)



Courtesy of Allen W. H. Be & David A. Caron

What Are Rhizarians? (cont'd.)



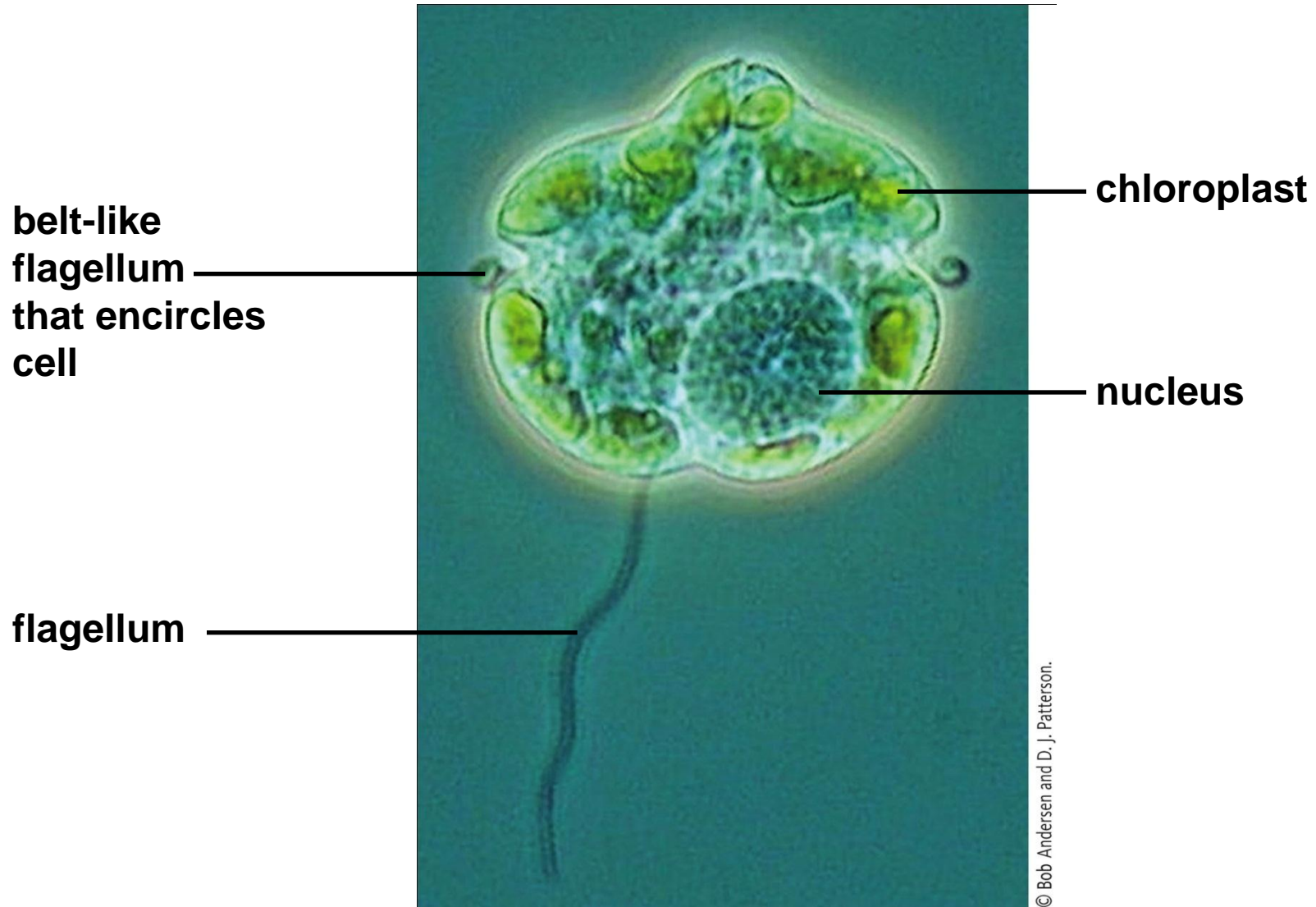
20.4 What Are Alveolates?

- Alveolates
 - Member of a protist lineage having small sacs beneath the plasma membrane
 - Dinoflagellate, ciliate, or apicomplexan
 - Most dinoflagellates and ciliates are aquatic and free-living, but all apicomplexans are parasites

What Are Alveolates? (cont'd.)

- **Dinoflagellates**
 - Whirling aquatic heterotrophs and autotrophs
 - Have cellulose plates
 - Photosynthetic
 - Supply reef-building corals with sugars and oxygen
 - Some dinoflagellates are bioluminescent

What Are Alveolates? (cont'd.)



© Bob Andersen and D. J. Patterson.

20.5 How Does Malaria Affect Human Health?

- Malaria is a leading cause of human death, killing more than 1.3 million people every year
- *Plasmodium*, a single-celled apicomplexan, causes malaria
 - Mosquitoes carry *Plasmodium* from one human host to another

How Does Malaria Affect Human Health? (cont'd.)

- Life cycle of *Plasmodium*
 - Infected mosquito bites a human
 - Sporozoites enter blood, which carries them to the liver
 - Sporozoites reproduce asexually in liver cells, mature into merozoites
 - Merozoites leave the liver and infect red blood cells.
 - Some merozoites reproduce asexually in red blood cells

ANIMATION: Apicomplexan life cycle

Please wait, loading

To play movie you must be in Slide Show Mode

PC Users: Please wait for content to load, then click to play

Mac Users: [CLICK HERE](#)

20.6 What Are Stramenopiles?

- Stramenopiles
 - Include heterotrophic water molds
 - Single-celled diatoms
 - Multicelled brown algae
- Stramenopiles are defined mainly by genetic similarities, rather than visible traits

What Are Stramenopiles? (cont'd.)

- Brown algae
 - Multicelled marine protist
 - Range in size from microscopic strands to giant kelps
 - Contain the brown pigment fucoxanthin
 - Source of algin, used as thickeners and emulsifiers

What Are Stramenopiles? (cont'd.)

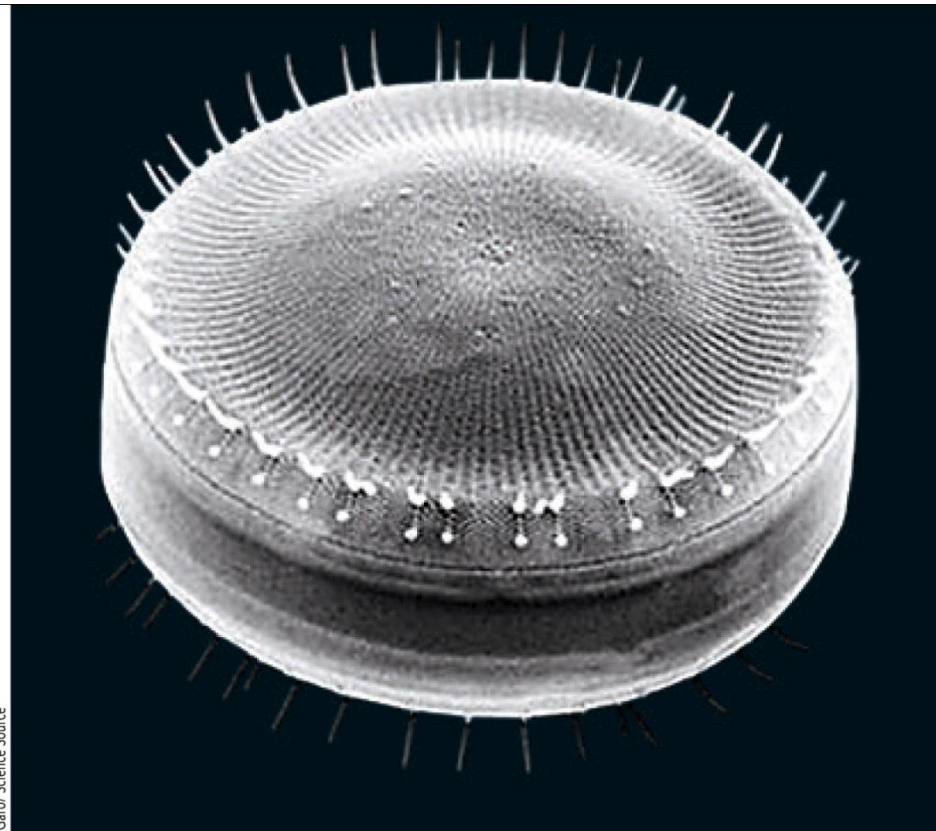


© Wim van Egmond / Visuals Unlimited

What Are Stramenopiles? (cont'd.)

- Diatoms
 - Silica-shelled photosynthetic cells
 - Some cells live individually
 - Others form chains
 - Abundant in cool waters

What Are Stramenopiles? (cont'd.)



B



C

Science Museum of Minnesota

What Are Stramenopiles? (cont'd.)

- Water molds
 - Decomposers and parasites
 - Grow as a mesh of absorptive filaments
 - Some parasitic species are important plant pathogens: *Phytophthora* destroy crops and forests

What Are Stramenopiles? (cont'd.)



Pavel Svihra



Heather Angel.

A

B

20.7 Which Protists are Closest To Plants?

- Red algae
 - Photosynthetic protist
 - Most red algae are multicelled and marine
 - Deposit cellulose in cell walls
 - Store sugars as starch
 - Has chloroplasts containing chlorophyll *a* and red pigments called phycobilins
 - Pigments allow them to capture light even in deep waters

Which Protists are Closest To Plants? (cont'd.)

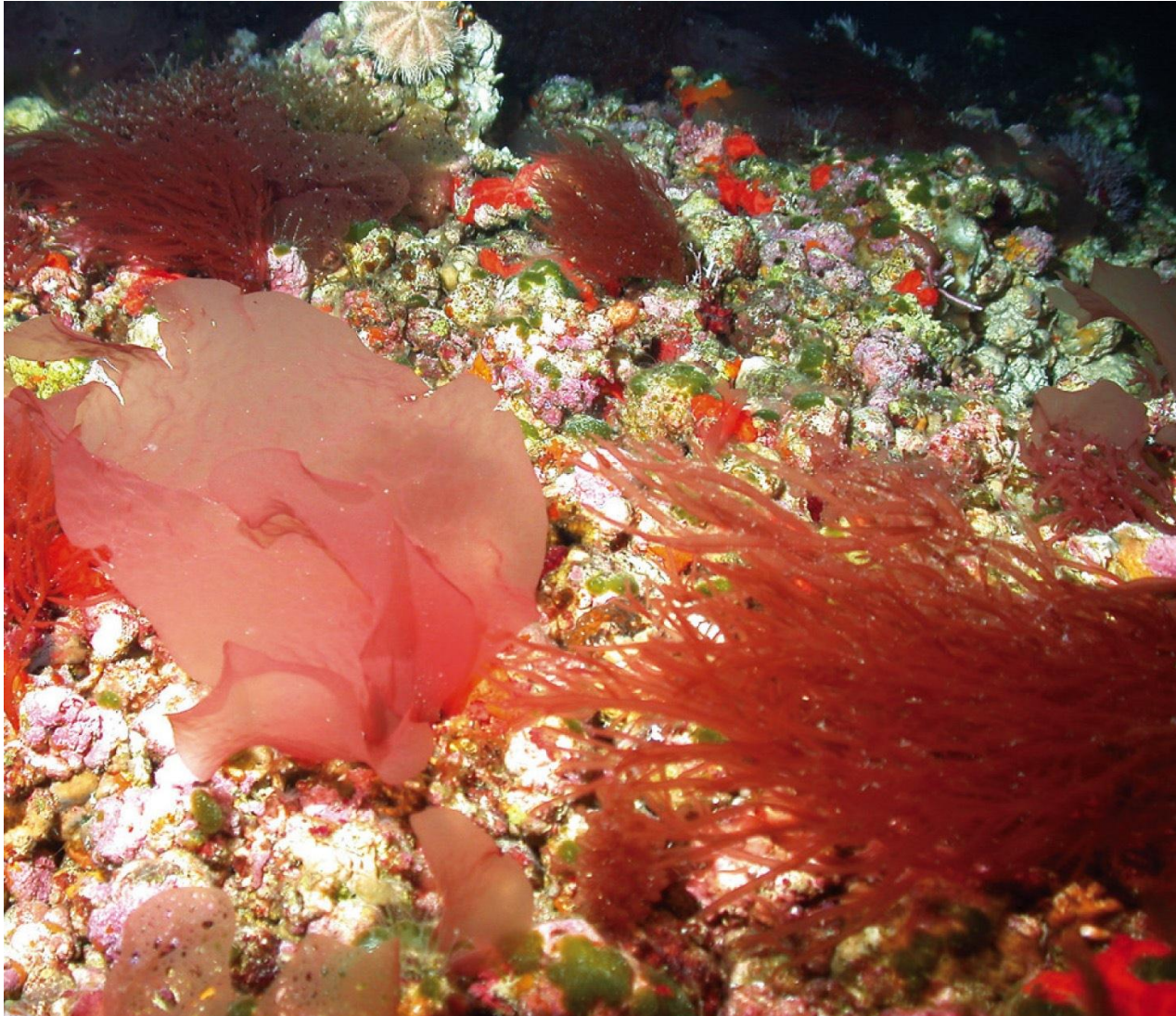


Image courtesy of FGB-NIMS/UNCW-NURC

Which Protists are Closest To Plants? (cont'd.)

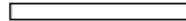
- Alternations of generations
 - Like many multicelled algae, the Porphyra life cycle is an alternation of generations
 - Alternates between haploid bodies (gametophytes) and diploid multicelled bodies (sporophytes)

Which Protists are Closest To Plants? (cont'd.)

- Alternation of generations: the process
 - The diploid gametophyte is sheetlike
 - Gametes form at its edges
 - Fertilization produces a diploid zygote
 - The zygote develops into a diploid sporophyte
 - Haploid spores form by meiosis on the sporophyte body, and are released
 - Spores germinate and develop into a new gametophyte

ANIMATION: Red alga life cycle

Please wait, loading



0%

To play movie you must be in Slide Show Mode

PC Users: Please wait for content to load, then click to play

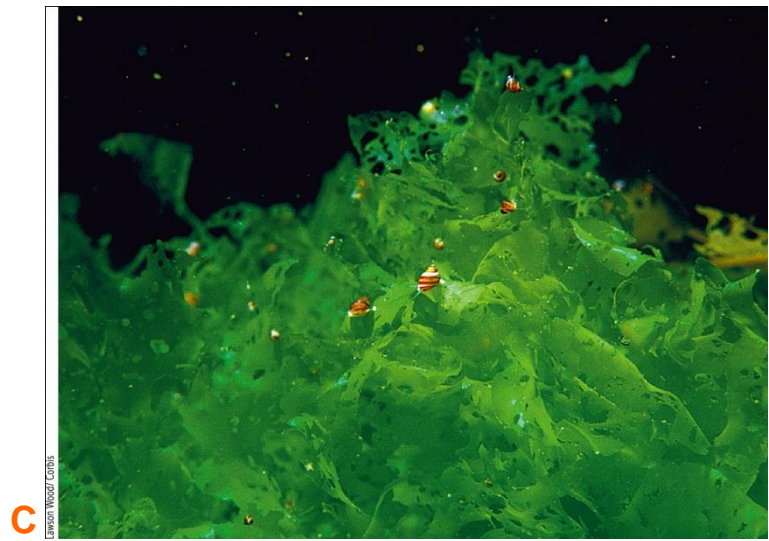
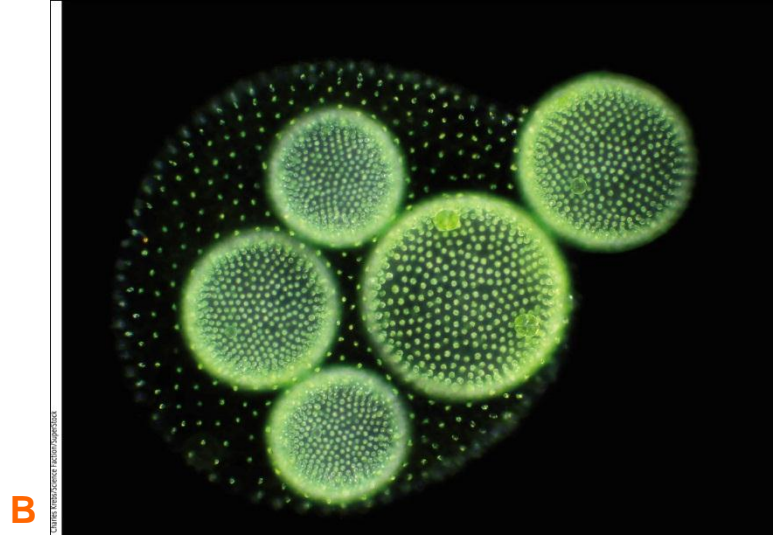
Mac Users: [CLICK HERE](#)

Which Protists are Closest To Plants? (cont'd.)

- Green algae
 - Closest relatives of land plants
 - *Charophyte algae* (Chara): closest relatives; unlike most other green algae, divide by cell plate formation, and have plasmodesmata cytoplasmic connections
 - May be single cells, colonial, or multicelled
 - Some multicelled algae have an alternation of generations

Which Protists are Closest To Plants?

(cont'd.)



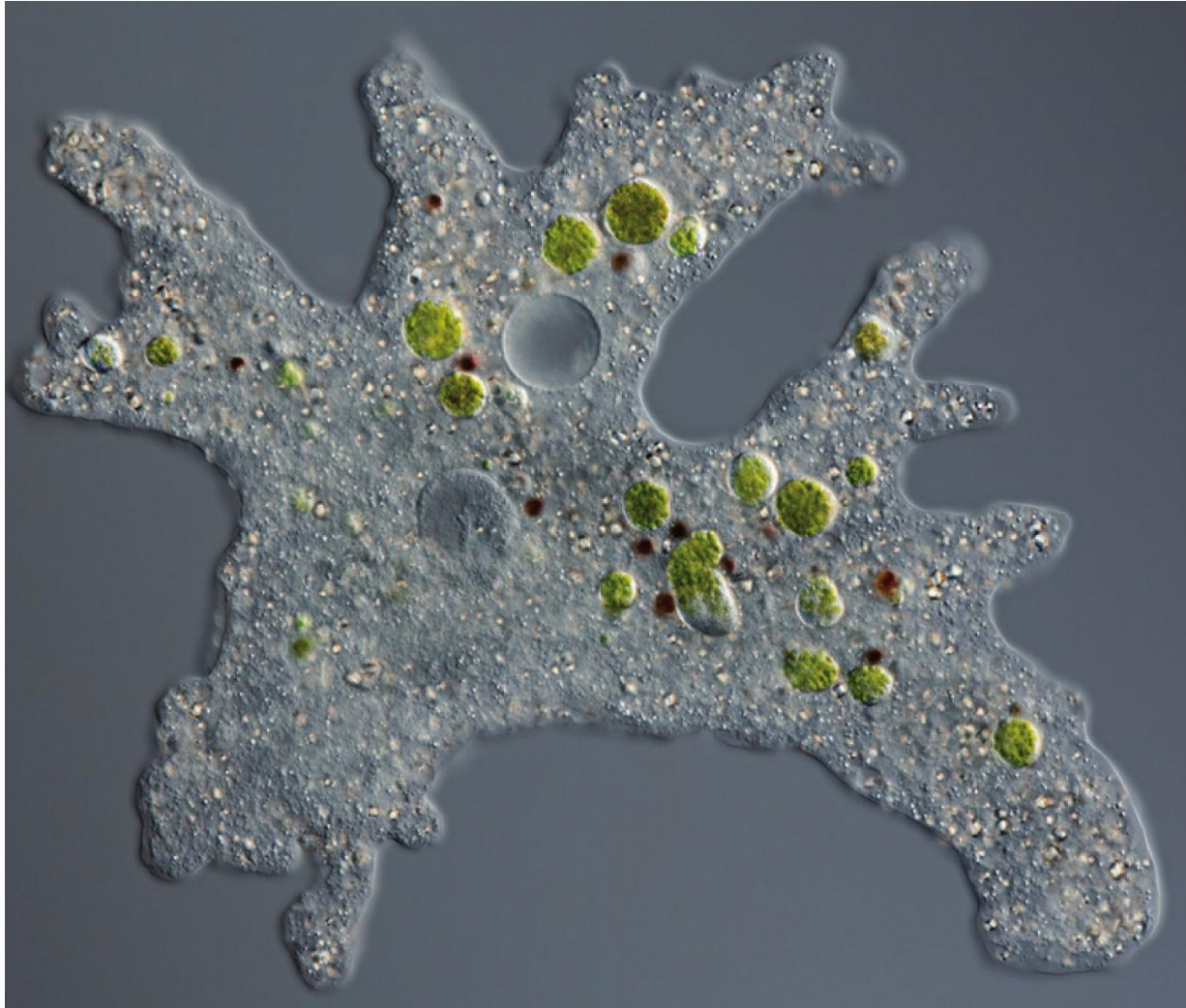
20.8 What Are Amoebozoans?

- Amoebozoans
 - Include heterotrophic free-living amoebas and slime molds
 - Many are solitary
 - Some display communal behavior
 - Have cell differentiation that hints at complexities to come in animals

What Are Amoebozoans?

- Amoebas
 - Live as single cells
 - Extend pseudopods to move and to capture prey
 - Most are predators in freshwater habitats
 - Some live in the gut of humans and other animals

What Are Amoebozoans? (cont'd.)



@micro_photo/iStockphoto.com

What Are Amoebozoans? (cont'd.)

- Slime molds
 - Slime molds are “social amoebas”
 - Animal signaling mechanisms may have started in amoebozoan ancestors
 - Two types, common on the floor of temperate forests:
 - Plasmodial slime molds
 - Cellular slime molds

What Are Amoebozoans? (cont'd.)

- Cellular slime mold
 - Amoeba-like protist
 - Feeds as a single predatory cell
 - Joins with others to form a multicellular spore-bearing structure when conditions are unfavorable
 - When food is scarce, cells aggregate into a mobile, multicelled “slug” that seeks a suitable spot, differentiates into a fruiting body, and disperses spores

ANIMATION: Cellular slime mold life cycle

Please wait, loading

To play movie you must be in Slide Show Mode

PC Users: Please wait for content to load, then click to play

Mac Users: [CLICK HERE](#)

What Are Amoebozoans? (cont'd.)

- Plasmodial slime mold
 - Protist that feeds as a multinucleated mass
 - Forms a spore-bearing structure when environmental conditions become unfavorable
 - Oozes along the forest floor and over logs, devouring bacteria
 - When food runs low, the mass forms spore-bearing structures

What Are Amoebozoans? (cont'd.)



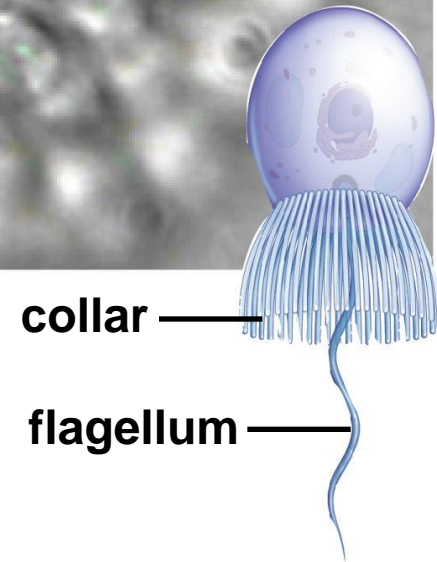
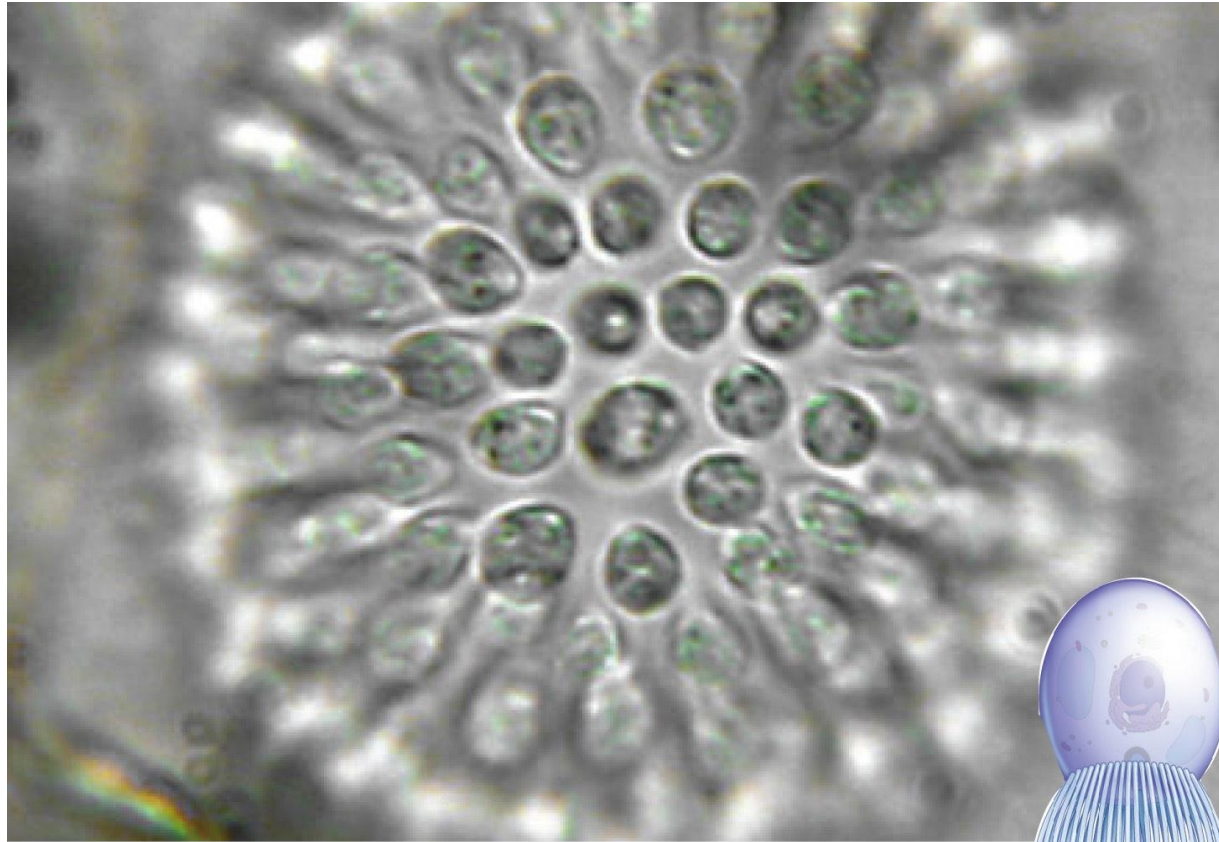
© Edward S. Ross.

20.9 Which Protists Are Closest To Animals?

- Choanoflagellates
 - Closest known protistan relatives of animals
 - Has flagellum surrounded by a “collar” of threadlike projections
 - Similar to sponge cells
 - Most live as single cells
 - Some are colonial

Which Protists Are Closest To Animals?

(cont'd.)



photo, Courtesy of Damian Zanette; art, From Starr/Evers/Starr, Biology Today and Tomorrow with Physiology, 4E. © Cengage Learning

20.10 Algal Blooms

- Harmful algal bloom (HAB)
 - A population explosion of an aquatic protist, or of another aquatic microorganism
 - Toxins released during some algal blooms can harm wildlife and endanger human health
 - Keeping harmful algal toxins out of the human food supply requires constant vigilance
 - Nutrients in water (fertilizers, farm waste, sewage) can cause runaway algal growth
 - Sometimes called “red tides”

Algal Blooms (cont'd.)



© Peter M. Johnson / www.flickr.com/photos/pmjohnso.