

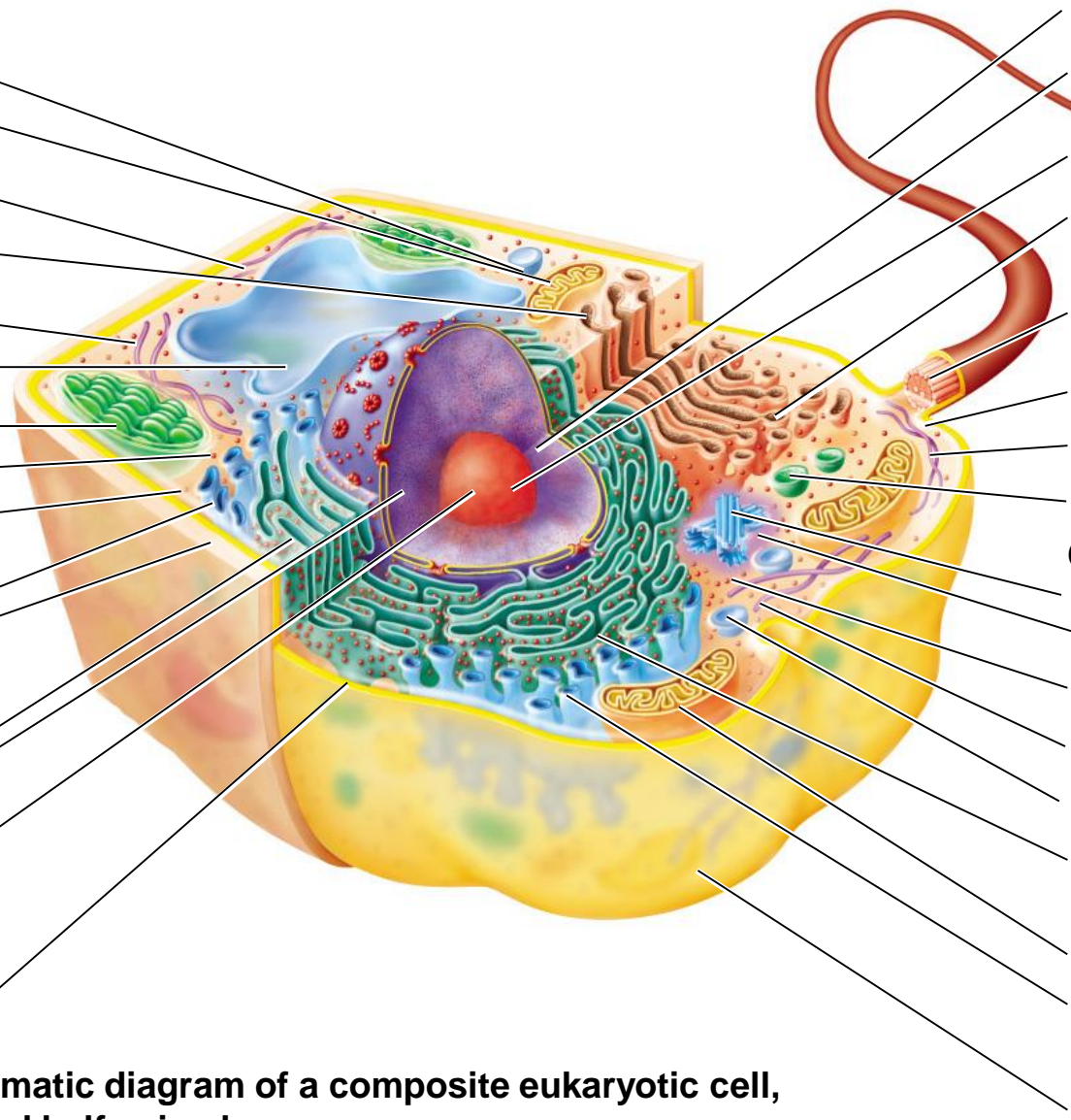
**Figure 4.22a Eukaryotic cells showing typical structures.**

**PLANT CELL**

- Peroxisome
- Mitochondrion
- Microfilament
- Golgi complex
- Microtubule
- Vacuole
- Chloroplast
- Ribosome
- Cytoplasm
- Smooth endoplasmic reticulum
- Cell wall
- Nucleus
- Nucleolus
- Plasma membrane

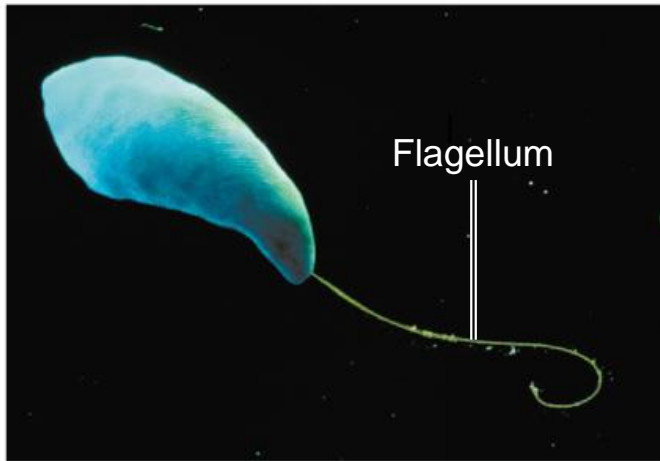
**ANIMAL CELL**

- Flagellum
- Nucleus
- Nucleolus
- Golgi complex
- Basal body
- Cytoplasm
- Microfilament
- Lysosome
- Centrosome: Centriole
- Pericentriolar material
- Ribosome
- Microtubule
- Peroxisome
- Rough endoplasmic reticulum
- Mitochondrion
- Smooth endoplasmic reticulum
- Plasma membrane



**(a) Highly schematic diagram of a composite eukaryotic cell, half plant and half animal**

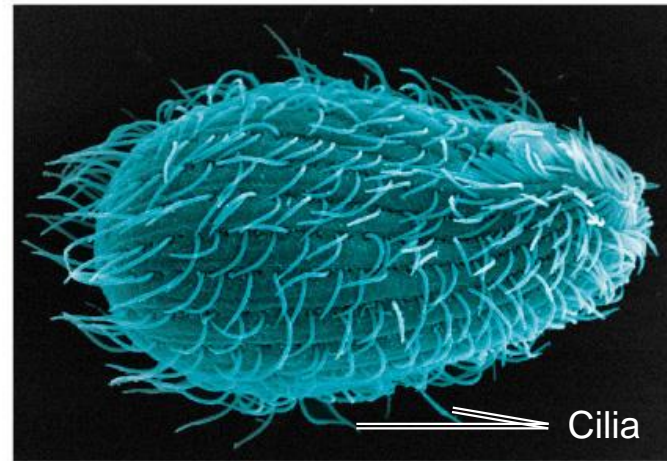
# Eukaryotic flagella and cilia.



**(a)** A micrograph of *Euglena*, a chlorophyll-containing alga, with its flagellum.

SEM

10  $\mu$ m



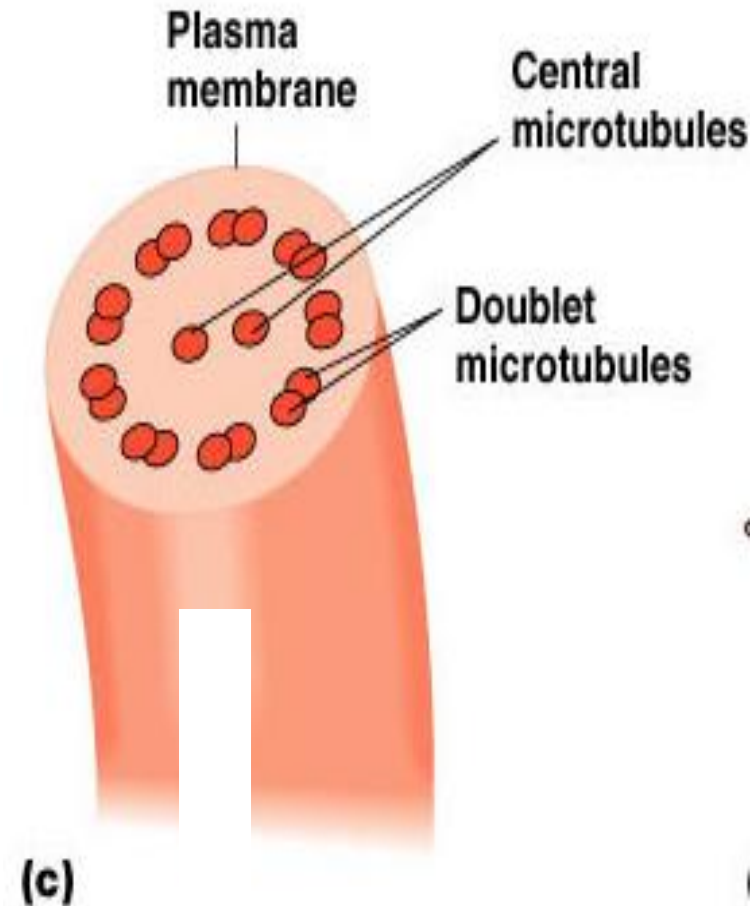
**(b)** A micrograph of *Tetrahymena*, a common freshwater protozoan, with cilia.

SEM

10  $\mu$ m

# Flagella and Cilia

- projection used for locomotion or movement
- Contain cytoplasm with microtubes inside and enclosed by plasma membrane**
- Flagella: few and long,
- Cilia: numerous and short
- Microtubules: long, hollow, made of a protein (tubulin) in 9 pairs + 2 arrangements
- Move in a wave-like manner---



# Cell Wall

## Cell wall

Plants, algae, fungi

Carbohydrates

Cellulose (plant & algae), chitin (fungi), glucan, mannan (yeast)

## Glycocalyx

Carbohydrates extending from animal plasma membrane

Bonded to proteins and lipids in membrane

Strengthen cell surface, help attach cell together and cell-cell recognition,

# Plasma Membrane

Phospholipid bilayer

Peripheral proteins

Integral proteins

Transmembrane proteins

**Sterols**

**Glycocalyx carbohydrates** as receptor, provide attachments sites for bacteria

# Plasma Membrane

Selective permeability allows passage of some molecules

Simple diffusion

Facilitative diffusion

Osmosis

Active transport

## Endocytosis

**Phagocytosis:** Pseudopods extend and engulf particles, eg. White blood cell

**Pinocytosis:** Membrane folds inward bringing in fluid and dissolved substances

# Organelles

- **Mitochondrion:** cellular respiration
- **Chloroplast:** photosynthesis
- **Peroxisome:** oxidation of fatty acids; destroys  $\text{H}_2\text{O}_2$
- **Centrosome:** consists of protein fibers and centrioles

# Organelles

## Membrane-bound:

Nucleus

Contains chromosomes

ER

Transport network

Golgi complex

Membrane formation and secretion

Lysosome

Digestive enzymes

Vacuole

Brings food into cells and provides support

Mitochondrion

Cellular respiration

Chloroplast

Photosynthesis

Peroxisome

Oxidation of fatty acids;  
destroys  $H_2O_2$



# Eukaryotic Cell

Not membrane-bound:

Ribosome

Protein synthesis

Centrosome

Consists of protein fibers and centrioles

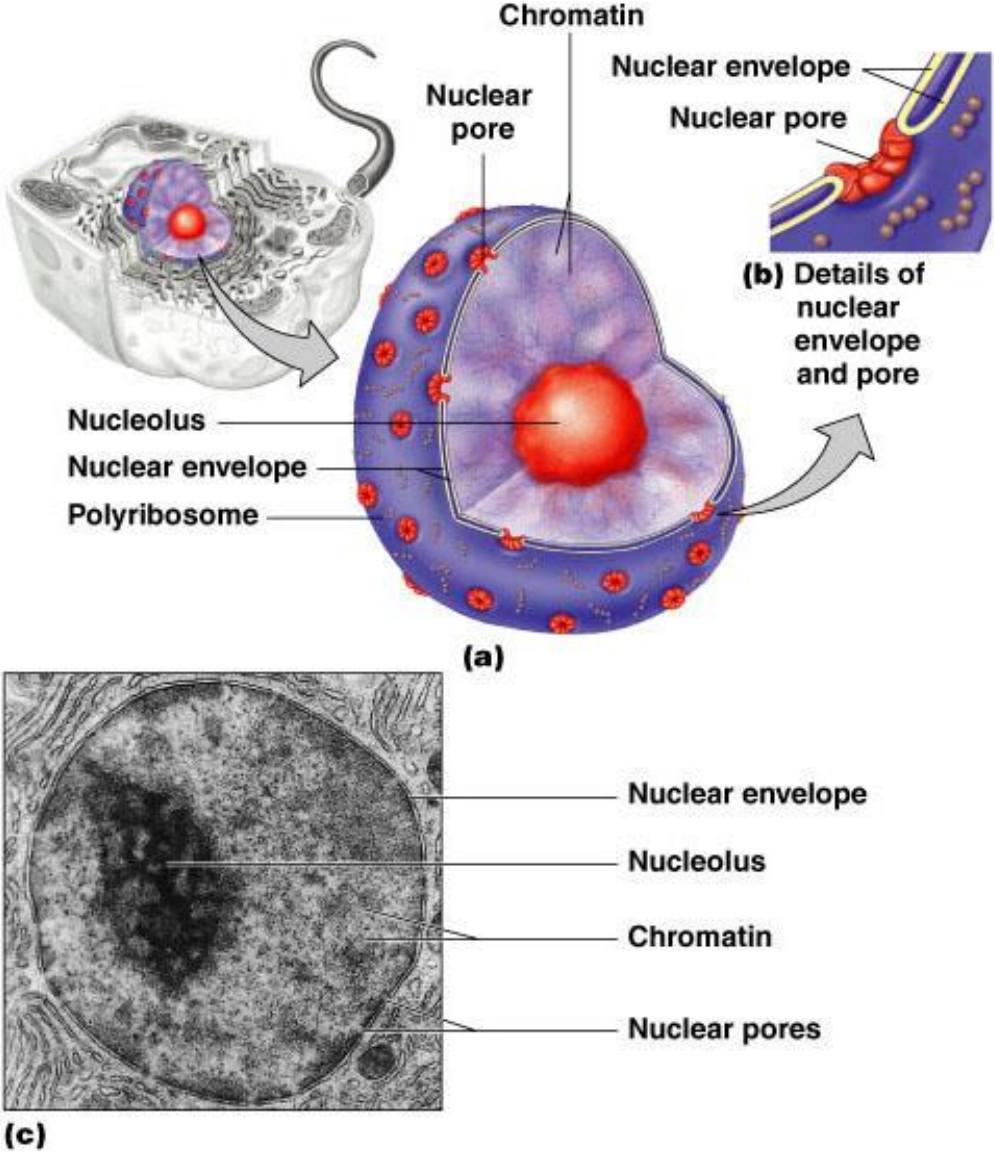
Centriole

Mitotic spindle formation

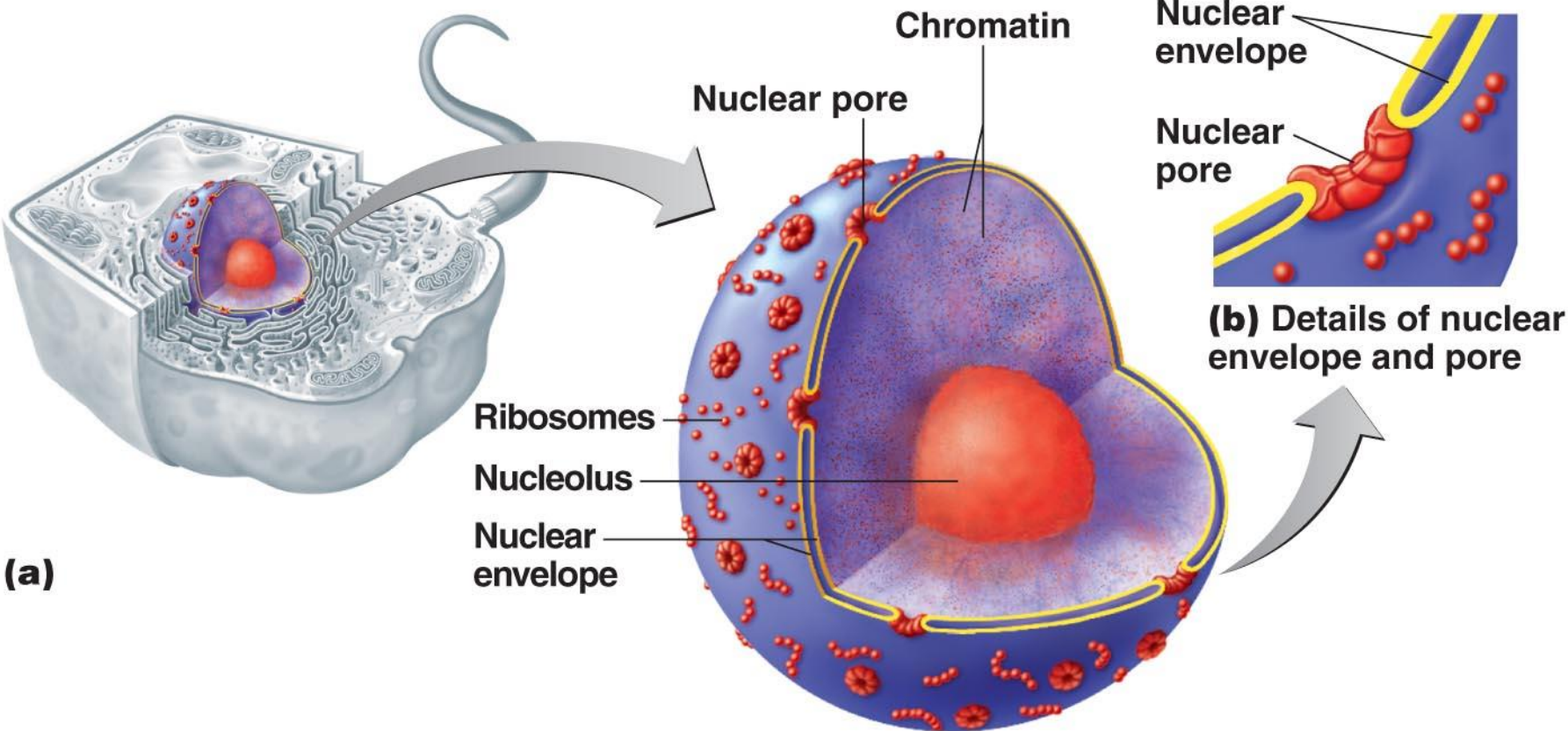
# Ribosomes

- Protein synthesis
- 80S
  - Membrane-bound: attached to ER
  - Free: in cytoplasm
- 70S
  - In chloroplasts and mitochondria

# Nucleus



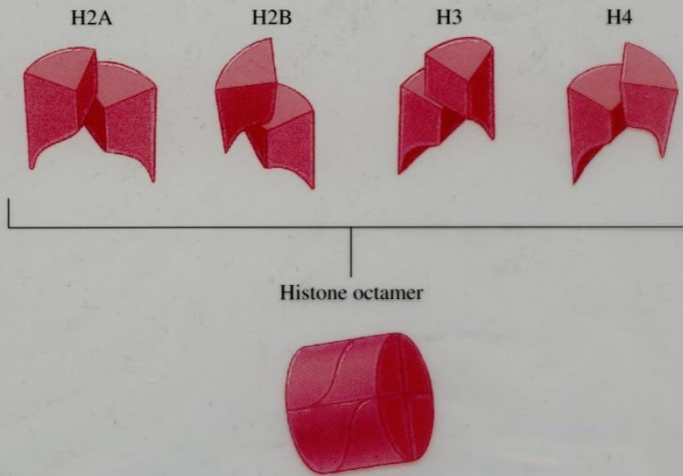
# The Eukaryotic Nucleus



# Nucleus

- Nuclear envelope: like plasma membrane
- Nuclear pore: in envelope, control movement between nucleus and cytoplasm
- Nucleolus: within envelope, condensed regions of chromosomes for synthesizing ribosomal RNA
- Nucleosome: 165 base pairs of DNA + 9 histones
- Chromatin: DNA and associated proteins appear as threadlike mass
- Chromosome: chromatin coil into shorter and thicker rodlike body

(a)



(b)

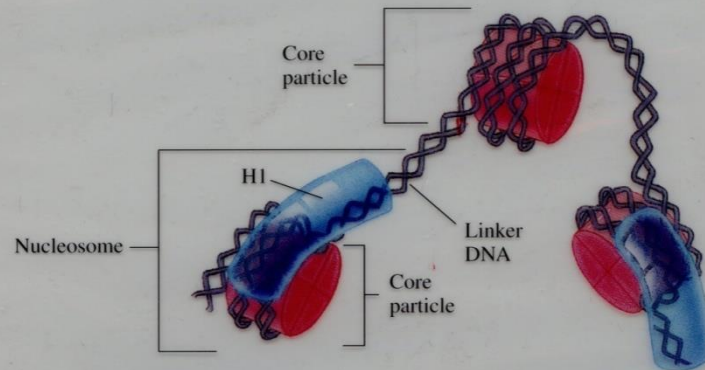


Figure 24-46  
Nucleosome structure

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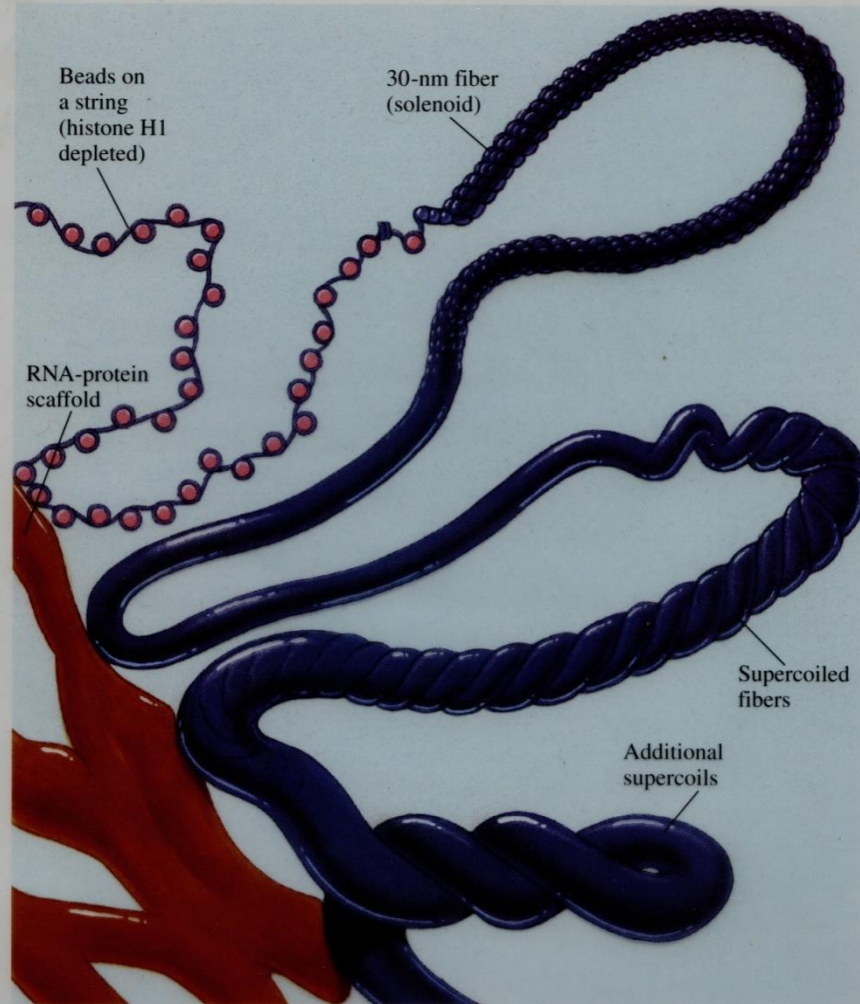
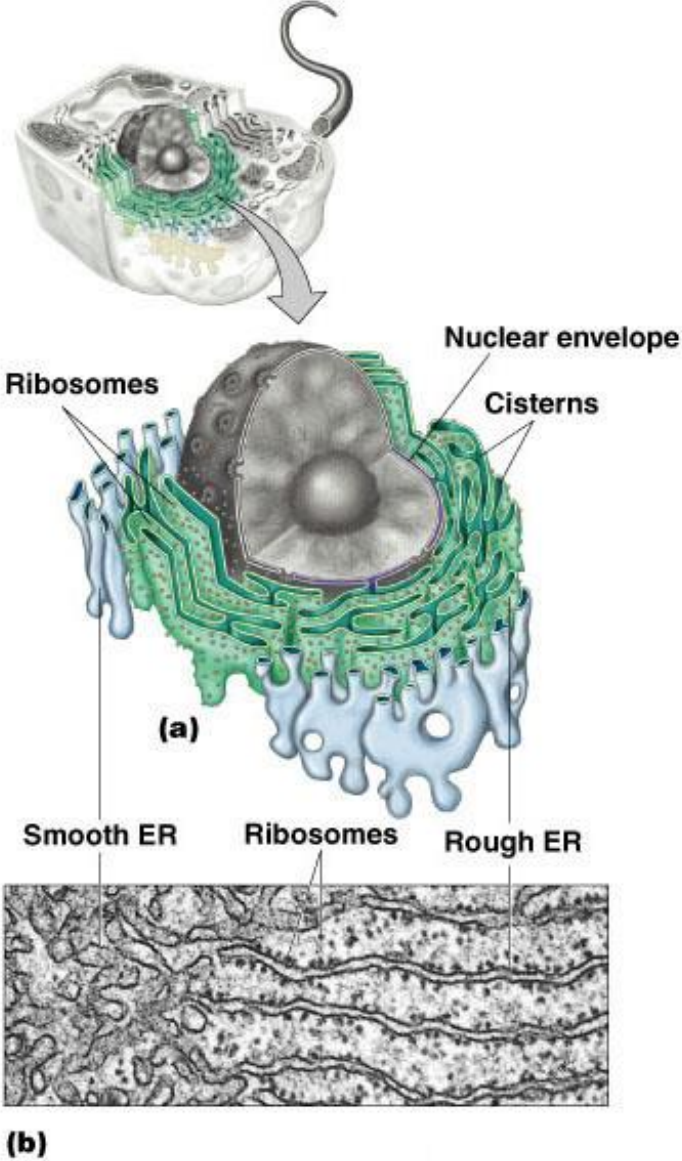


Figure 24-49  
Chromatin structure

# Endoplasmic Reticulum





# Detailed Drawing of Endoplasmic Reticulum

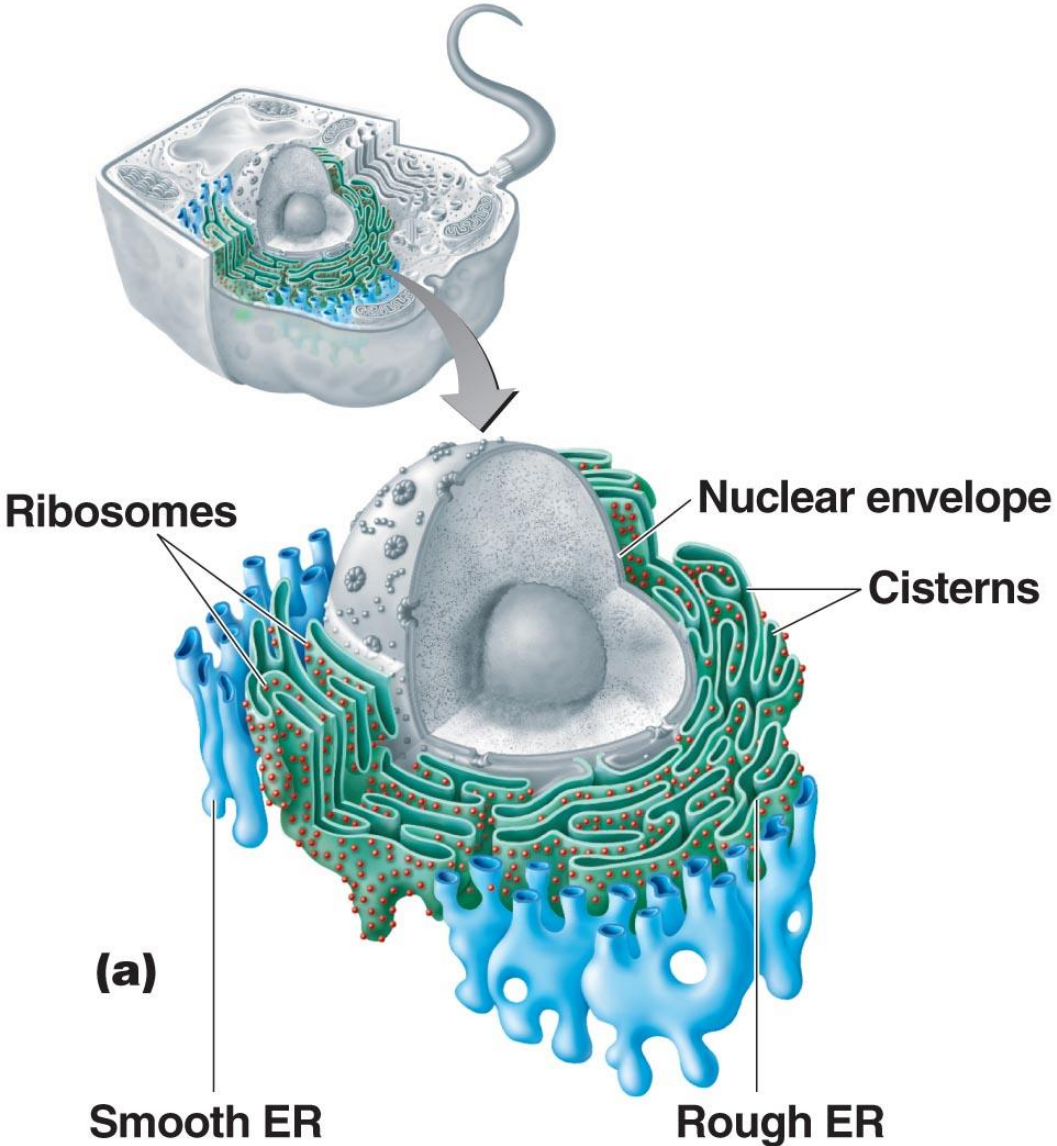


Figure 4.25a

# Endoplasmic reticulum (ER)

- Network of flattened membranous sacs or tubes (cisterns)
- **Rough ER:**
  - continuous with nuclear membrane and unfolds into flattened sacs,
  - outer surface studded with ribosome.
  - Protein synthesized in ribosomes attached to rough ER enter cisterns within ER for processing & sorting
  - attach protein to carbohydrate (glycoprotein) or phospholipid
  - a factory for synthesizing secretory proteins & membrane molecules

# Endoplasmic reticulum (ER)

- Smooth ER

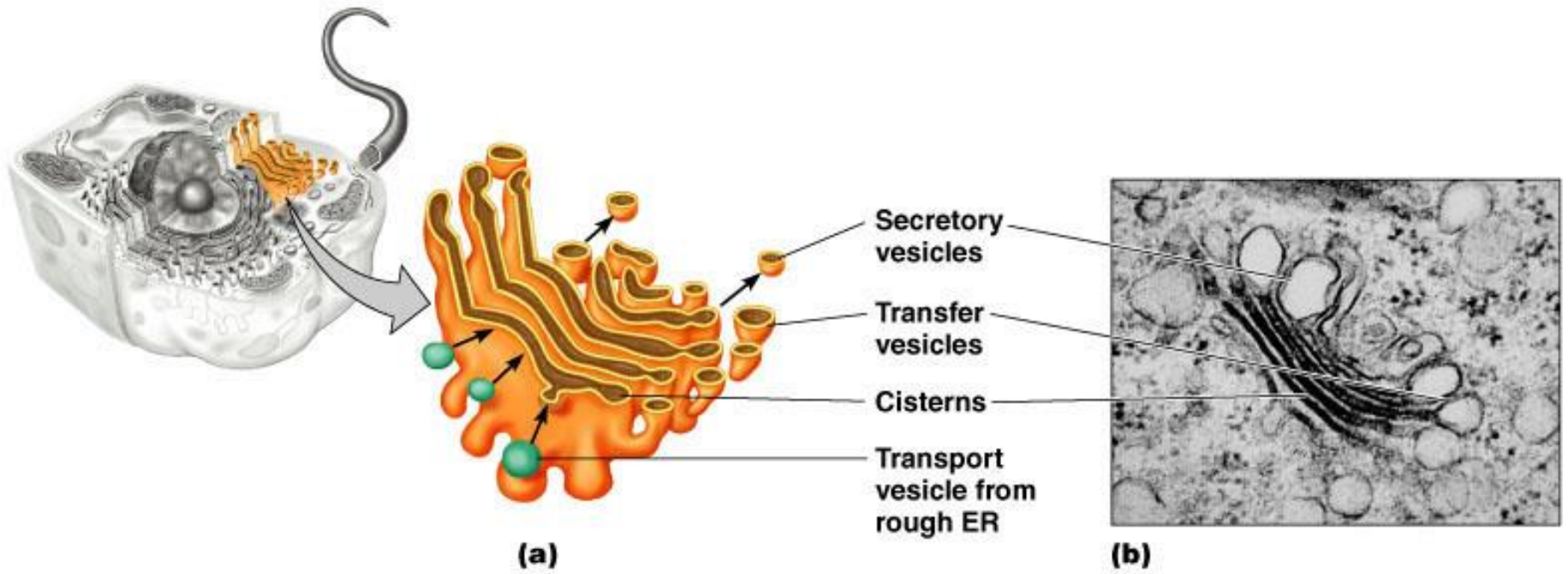
- extend from rough ER, contain unique enzymes
- synthesize phospholipid, fats, steroids
- help release glucose into bloodstream & detoxify harmful substances (in liver cell)

# Ribosomes

- 80S (60S subunit + 40 S subunit)
  - Membrane-bound: attached to ER, synthesize proteins for membrane and export from cell
  - Free: in cytoplasm, synthesize proteins used inside cell
- 70S
  - In chloroplasts and mitochondria

Polyribosome: 10-20 ribosome join together

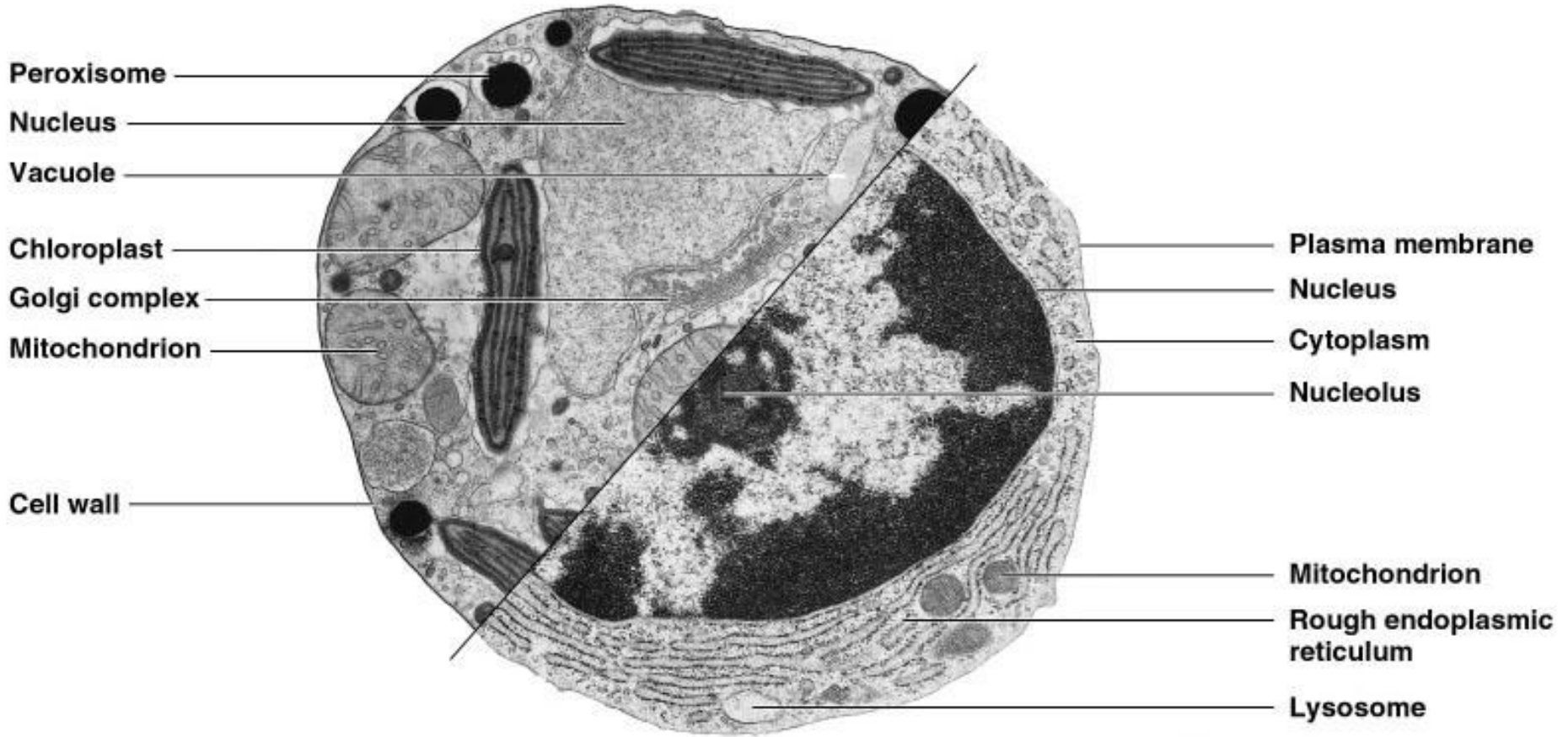
# Golgi Complex



# Golgi complex

- Consist of 3-20 cisterns which are often curved
- Protein synthesizes by ribosome on rough ER buds from membrane to form transport vesicle, which fused with cistern of Golgi complex and release protein into cistern. Then this protein is modified and transferred to another cistern.

# Lysosomes



**(b)** Plant cell (*Tribonema vulgare*),  
an algal cell

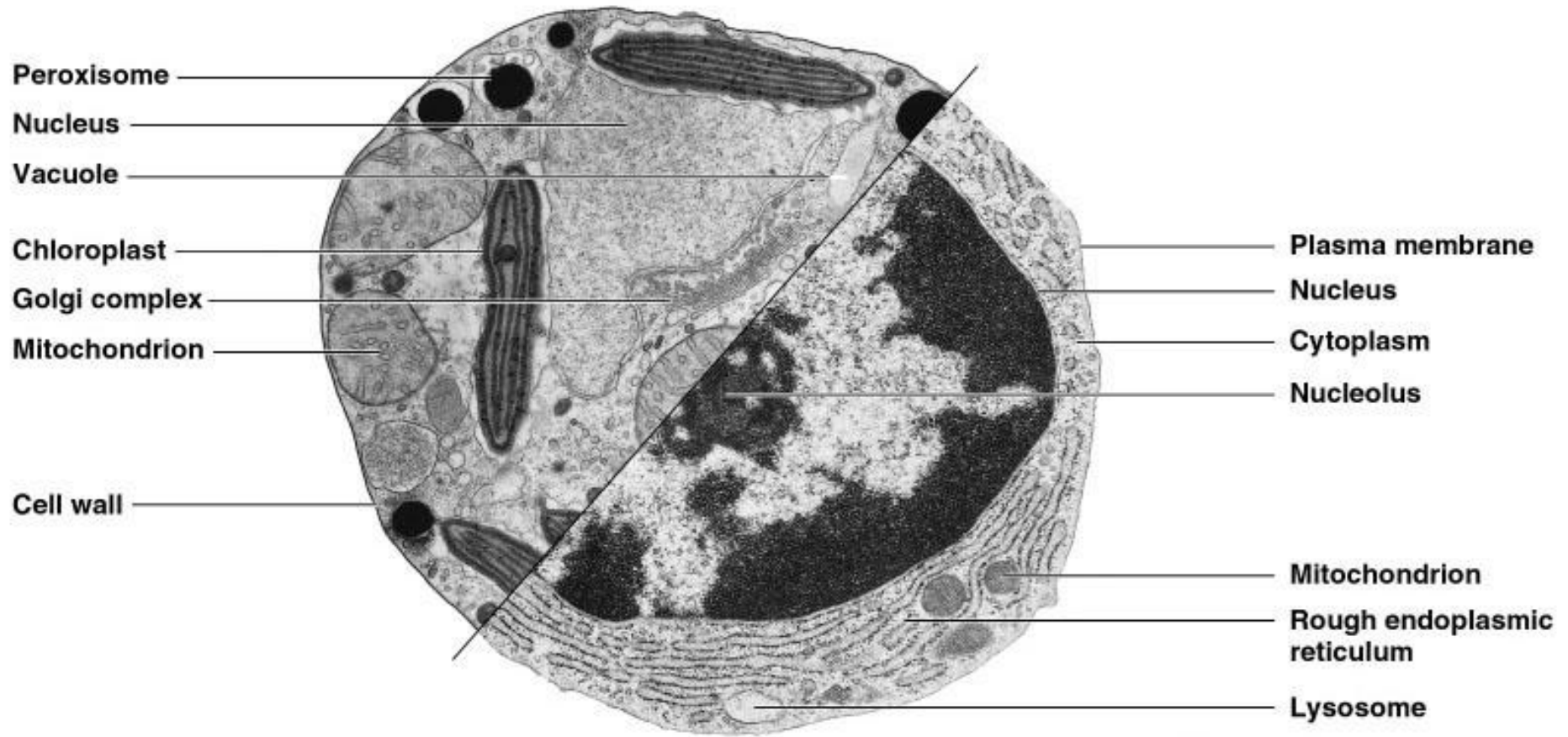
Animal cell, an antibody-secreting  
plasma cell

# Lysosomes

- Formed from Golgi complex
- Single membrane enclosed spheres
- Contains many digestive enzymes to break down molecules, bacteria
- Phagocytes contain many lysosomes



# Vacuoles



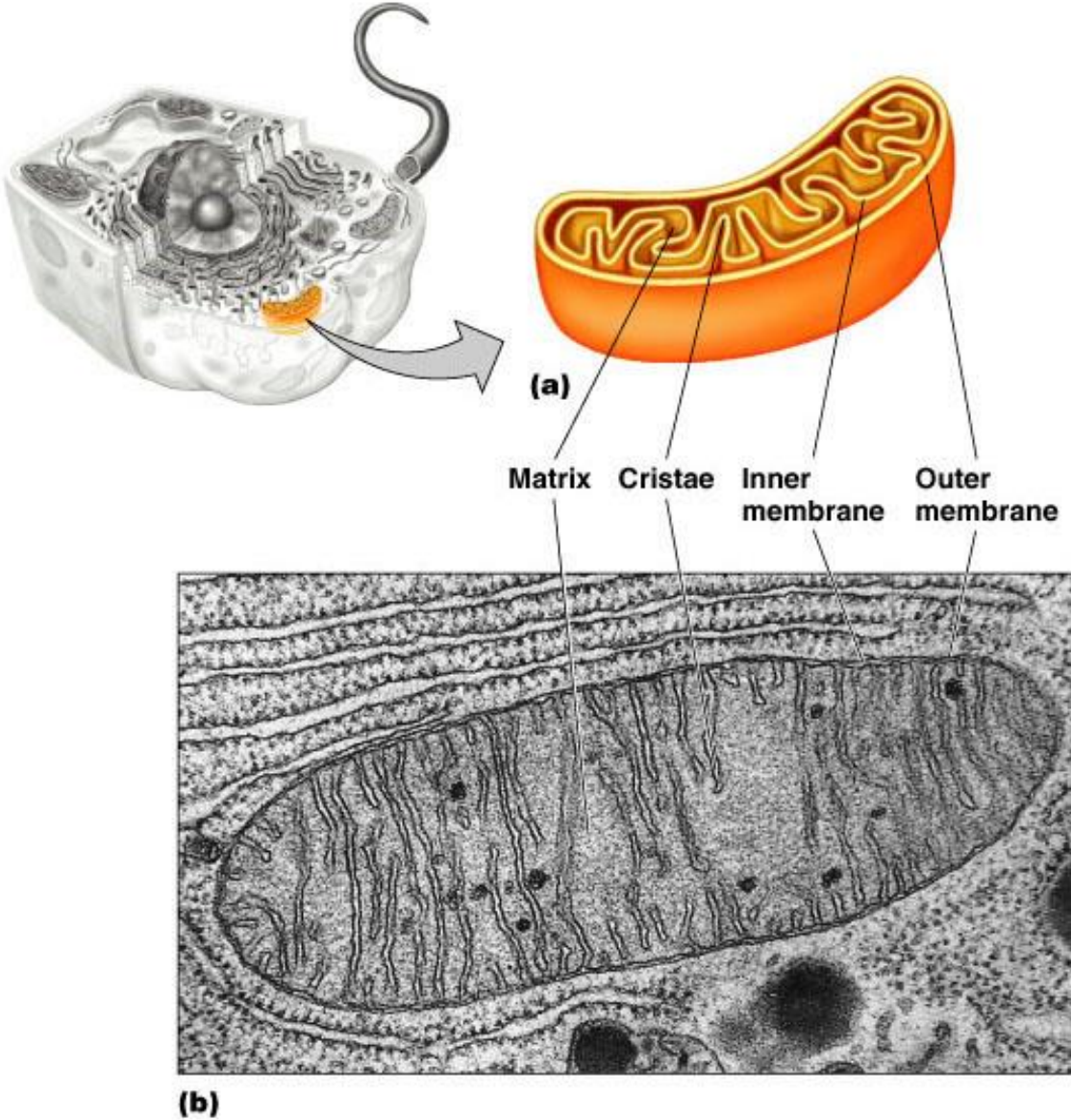
**(b)** Plant cell (*Tribonema vulgare*), an algal cell

Animal cell, an antibody-secreting plasma cell

# vacuoles

- Derived from Golgi complex
- A space enclosed by a membrane
- Have diverse function
  - temporary storage function
  - help bring food into cell during endocytosis
  - store waste & poison in plant cell
  - take up water to increase size & provide rigidity to leaves and stems

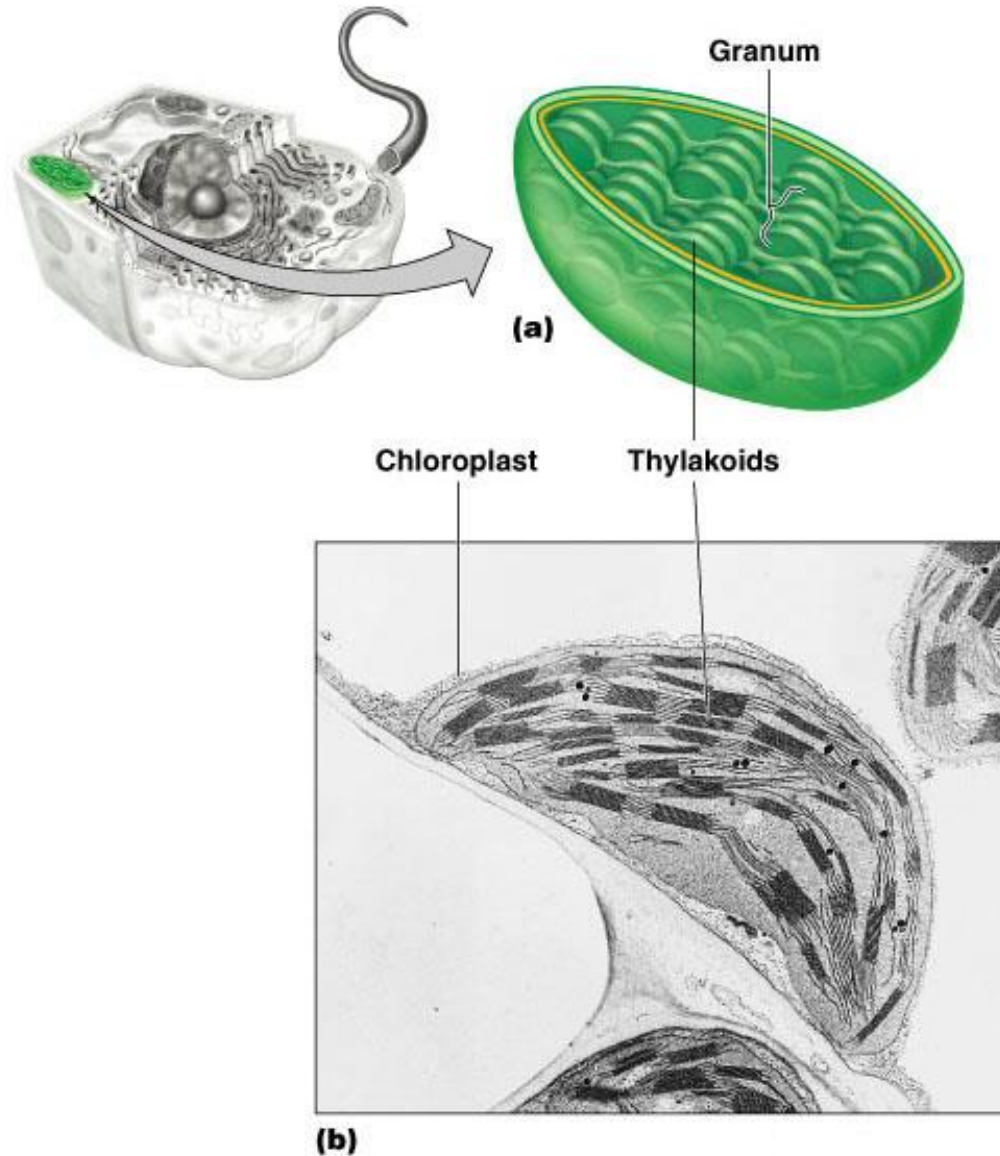
# Mitochondrion



# Mitochondria

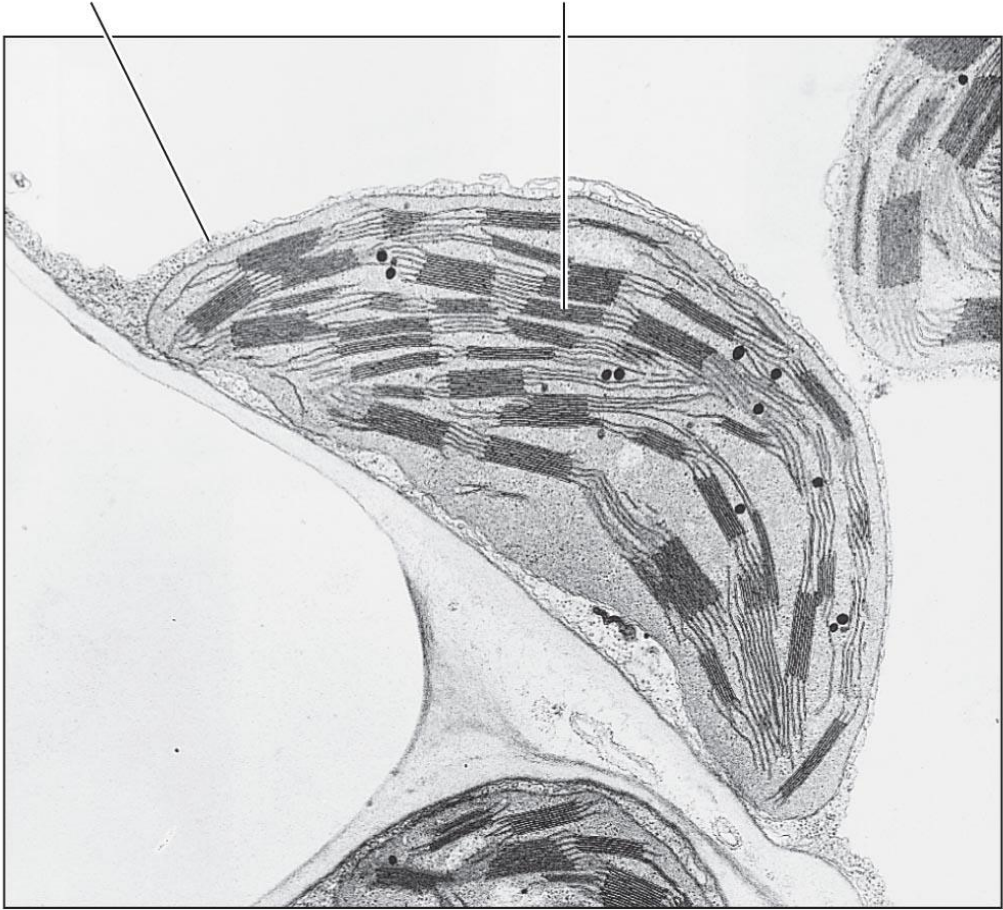
- Double membrane structure
- Outer membrane is smooth and inner membrane is in a series folds (cristae) to provide large area for reaction
- Center of mitochondria is semifluid (matrix)
- “powerhouse of cell” due to production of ATP
- Contains 70S ribosome and its own DNA
- Reproduce on their own

# Chloroplast



# Chloroplasts

**Chloroplast**      **Thylakoids**



**(b)**

TEM

1.5  $\mu\text{m}$

Figure 4.28b

# Chloroplast

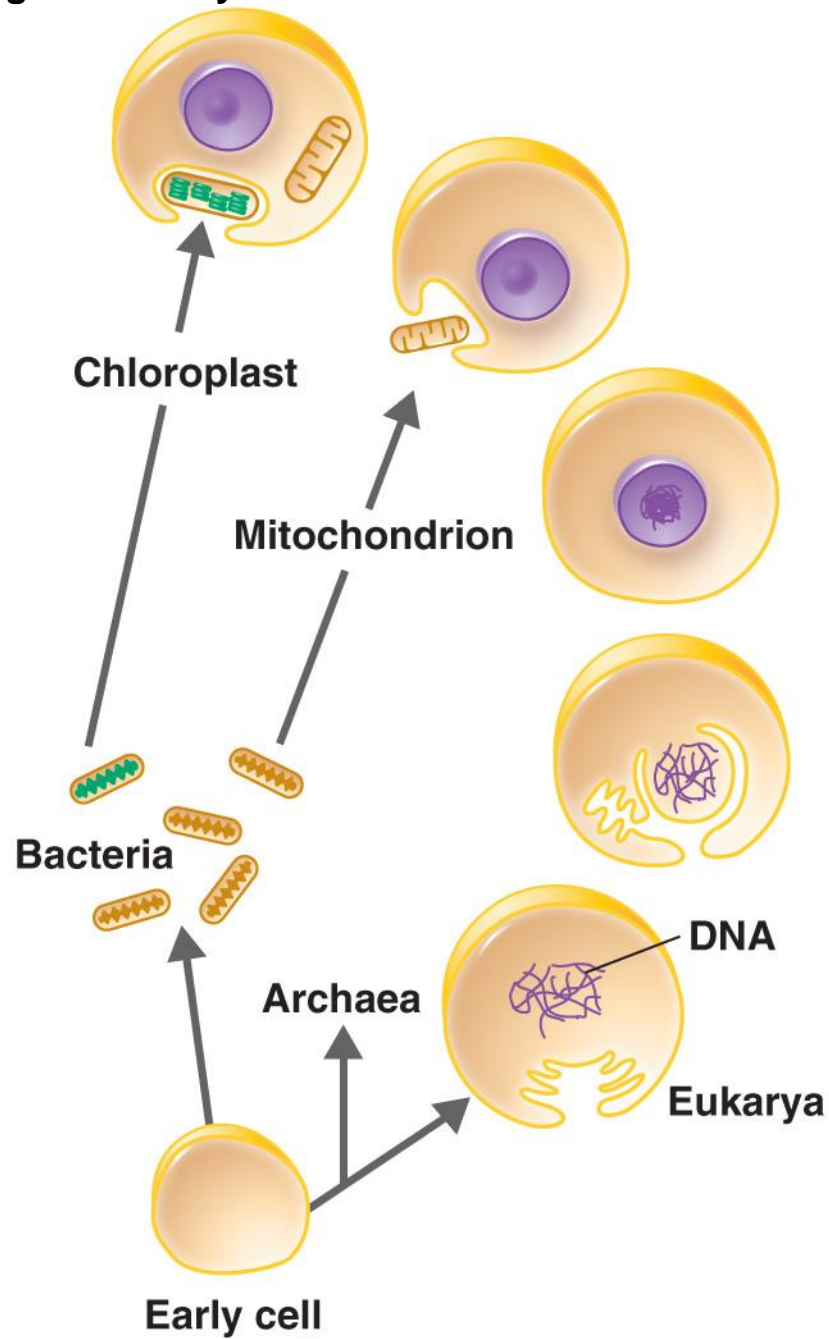
- Double membrane structure
- Contain chlorophyll & enzymes for photosynthesis
- Contain flattened membrane sacs (thylakoids), stacks of thylakoids called grana
- Contain 70S ribosome, DNA & enzymes
- Reproduce on their own

# peroxisome

- Organelles similar in structure to lysosomes, but smaller
- Contain enzymes to oxidize substances (AA, Fatty acid), toxic materials (alcohol)
- By-product:  $H_2O_2$ , that can be degraded by catalase
- Protect other parts of cell from the toxic effects of  $H_2O_2$



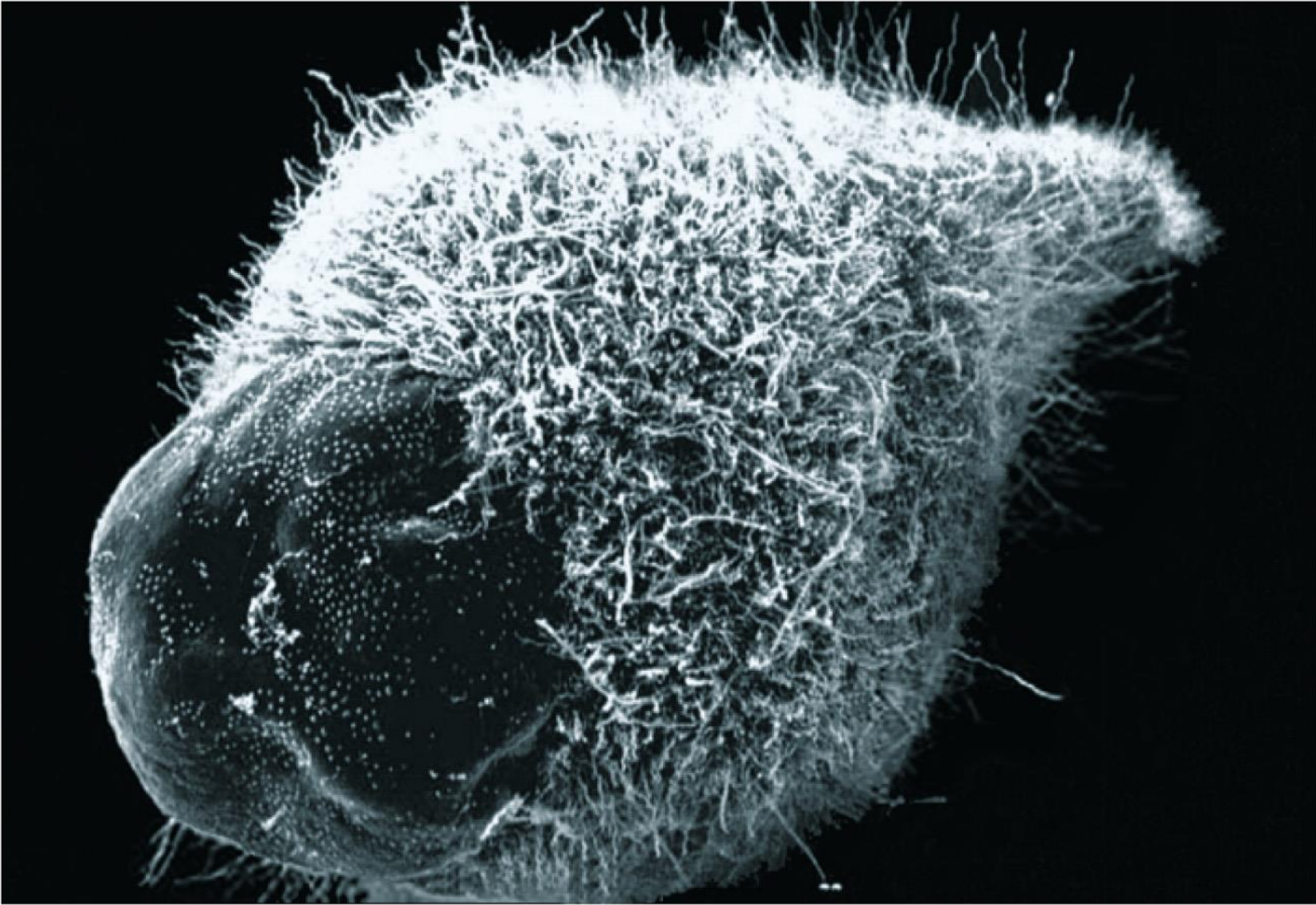
Figure 10.2 A model of the origin of eukaryotes.



# Endosymbiotic theory

- Explain the origin of eukaryote from prokaryotes
- Larger bacterial cell lost cell wall and engulfed smaller bacterial cells.
- Relationship in which one organism lives within another is called endosymbiosis

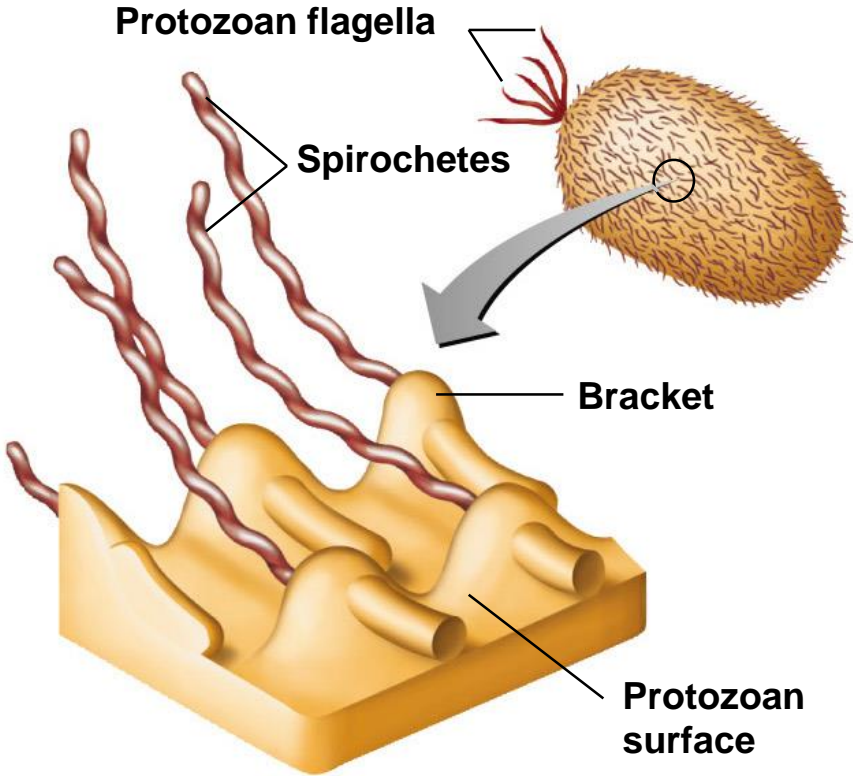
Applications of Microbiology 4.1 *Mixotricha*, a protozoan that lives in the termite gut.



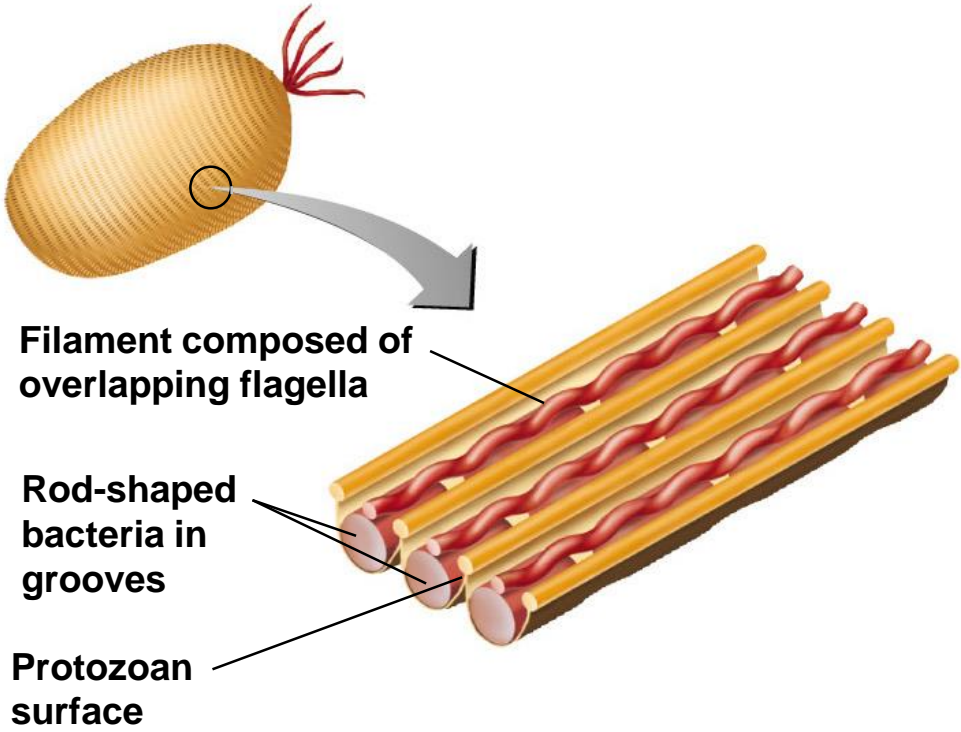
SEM

100  $\mu\text{m}$

**Applications of Microbiology 4.2 Arrangements of bacteria on the surfaces of two protozoans.**



**(a)**



**(b)**