Lecture 7
BT 206
23 Jan 2023
By Prof Manish Kumar

Atypical Cell Walls

- Acid-fast cell walls
  - Like gram-positive
  - Waxy lipid (**mycolic acid**) bound to peptidoglycan
  - *Mycobacterium*
  - *Nocardia*
  - Red Carbolfuchsin stain

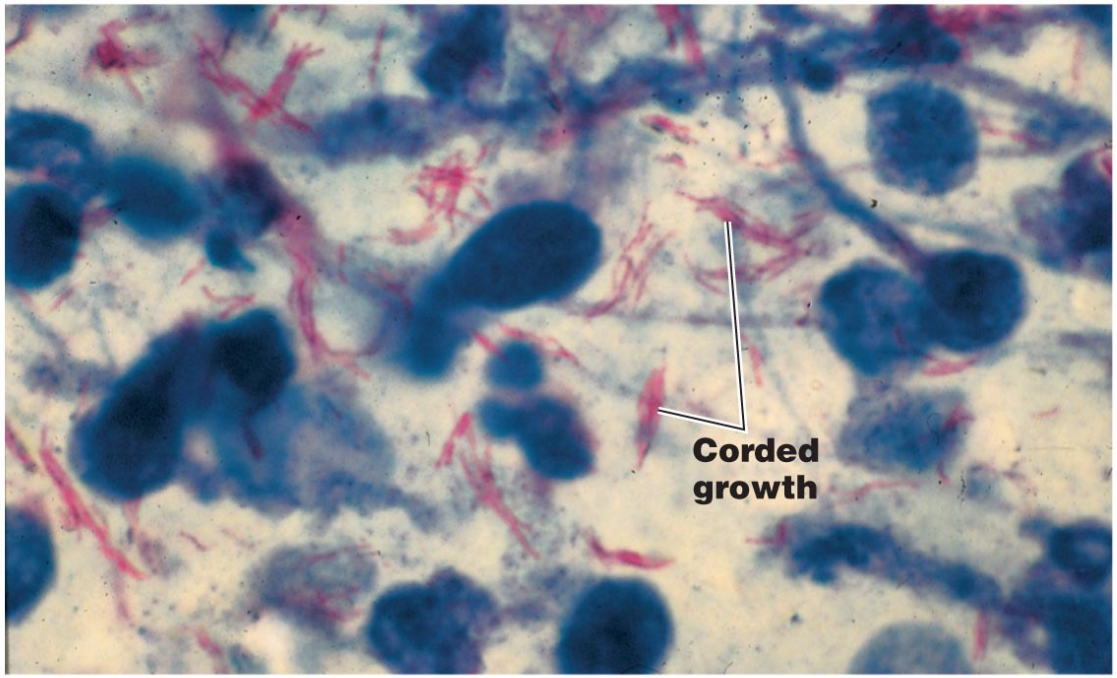


Figure 24.8

Atypical Cell Walls

- Mycoplasmas
  - Lack cell walls
  - Sterols in plasma membrane
- Archaea
  - Wall-less or
  - Walls of pseudomurein (lack NAM and D-amino acids)

Damage to the Cell Wall

- Lysozyme digests disaccharide in peptidoglycan
- Penicillin inhibits peptide bridges in peptidoglycan
- **Protoplast** is a wall-less gram-positive cell
- **L forms** are wall-less cells that swell into irregular shapes (*Proteus* spp.)
- **Spheroplast** is a wall-less gram-negative cell
  - Protoplasts and spheroplasts are susceptible to osmotic lysis

The Plasma Membrane

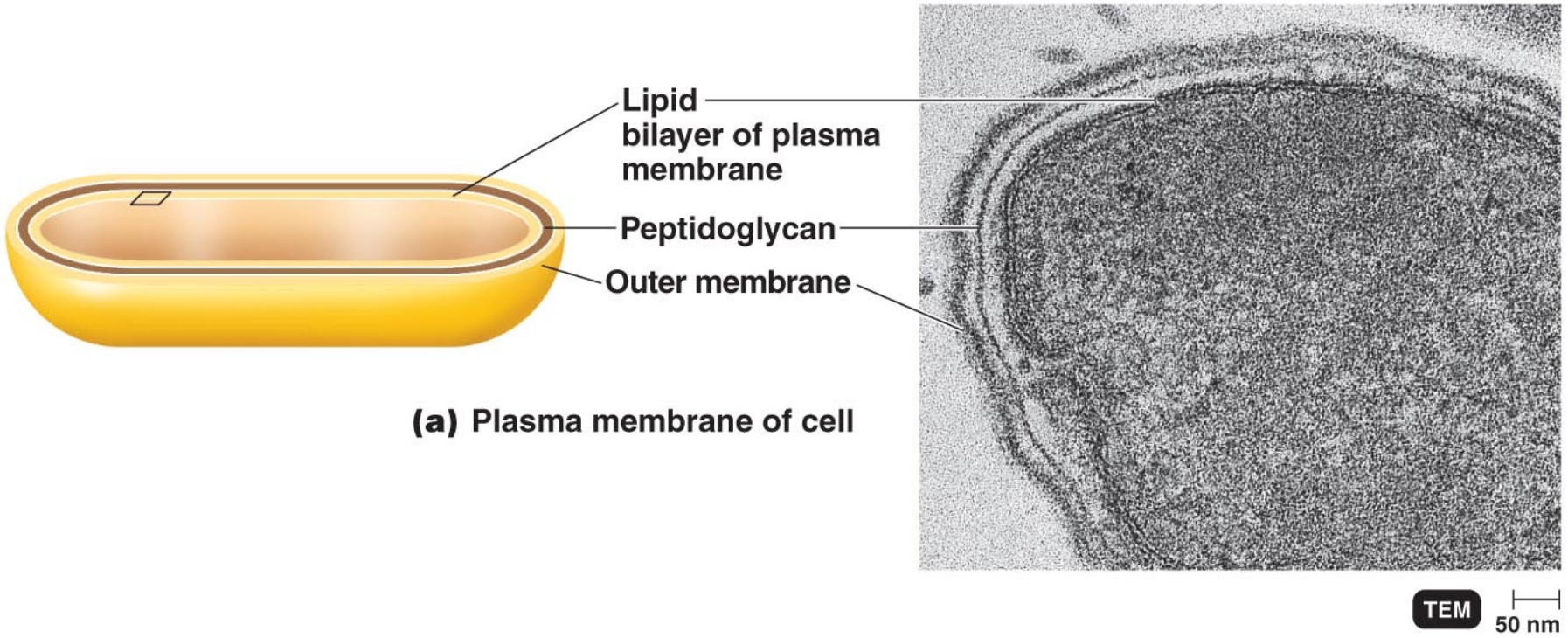
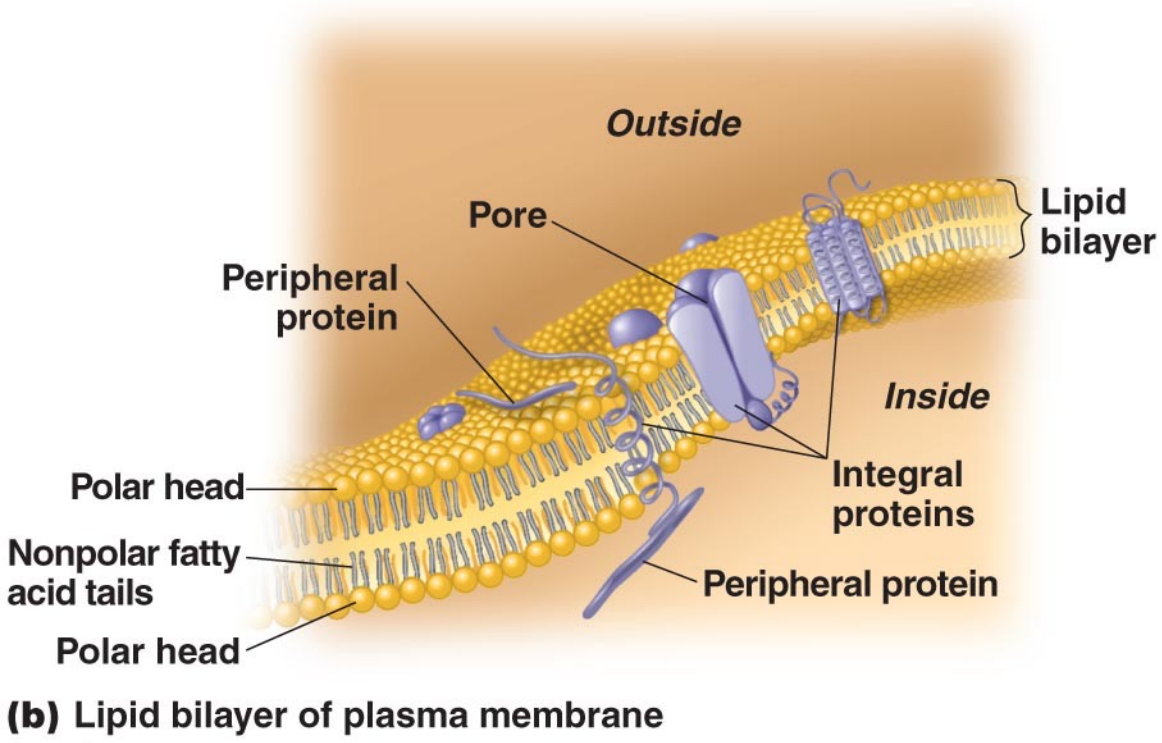


Figure 4.14a

The Plasma Membrane

- Phospholipid bilayer
- Peripheral proteins
- Integral proteins

Transmembrane Proteins



(b) Lipid bilayer of plasma membrane

Figure 4.14b

Fluid Mosaic Model

- Membrane is as viscous as olive oil
- Proteins move to function
- Phospholipids rotate and move laterally

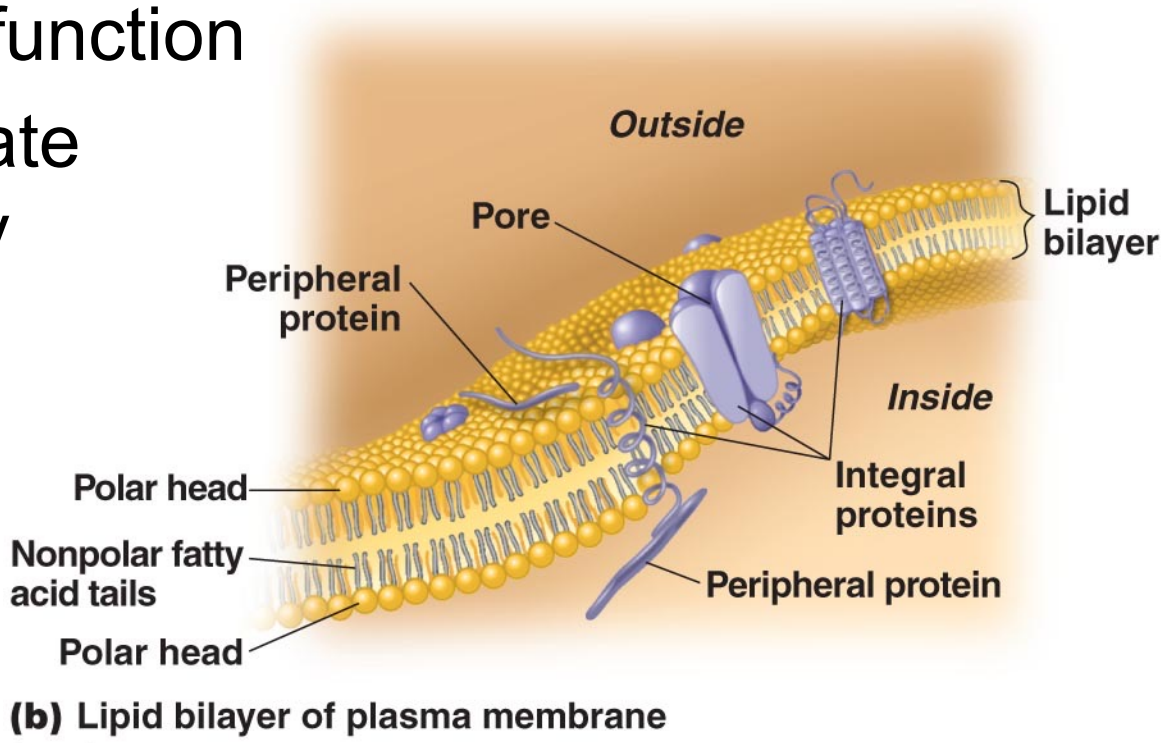


Figure 4.14b

The Plasma Membrane

- **Selective permeability** allows passage of some molecules
- Enzymes for ATP production
- Photosynthetic pigments on foldings called **chromatophores** or **thylakoids**

Chromatophores

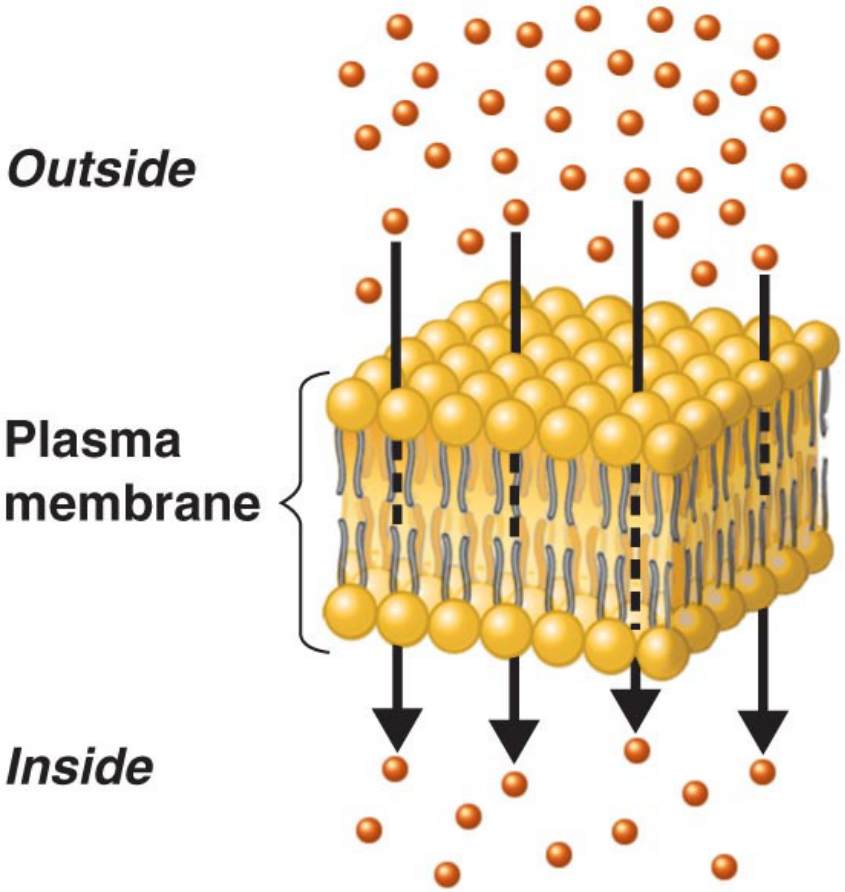
Figure 4.15

The Plasma Membrane

- Damage to the membrane by alcohols, quaternary ammonium (detergents), and polymyxin antibiotics causes leakage of cell contents

Movement of Materials across Membranes

- **Simple diffusion**: Movement of a solute from an area of high concentration to an area of low concentration

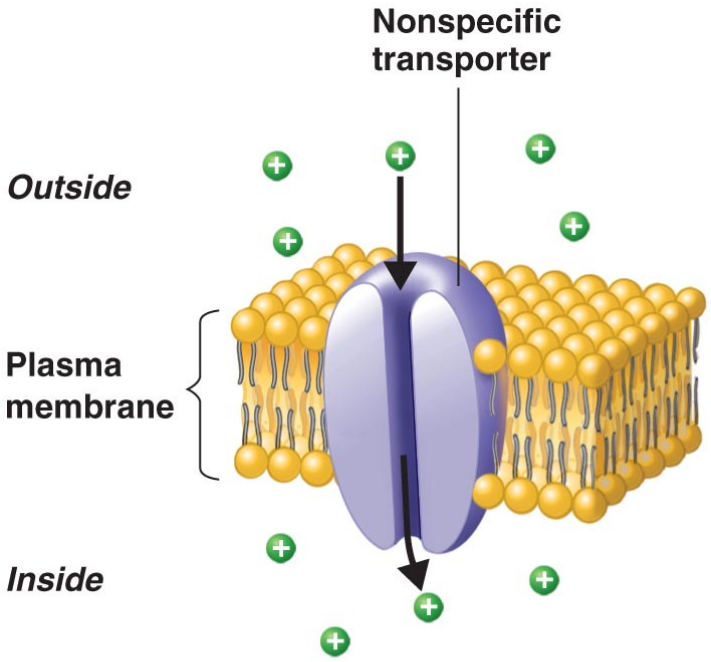


(a) Simple diffusion through the lipid bilayer

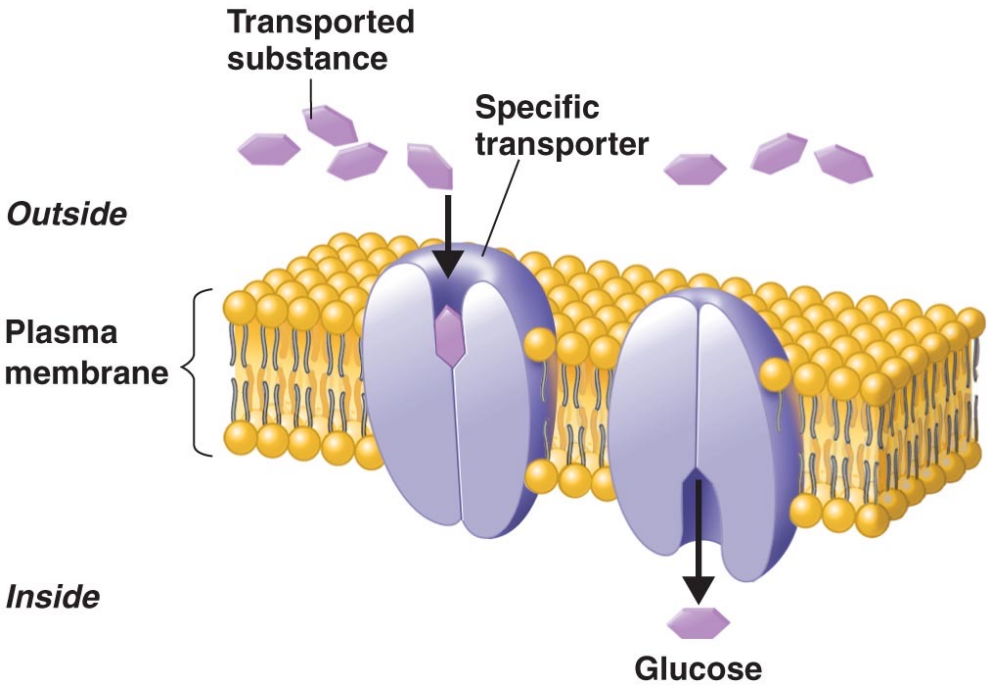
Figure 4.17a

Movement of Materials across Membranes

- **Facilitated diffusion**: Solute combines with a transporter protein in the membrane



(b) Facilitated diffusion through a nonspecific transporter

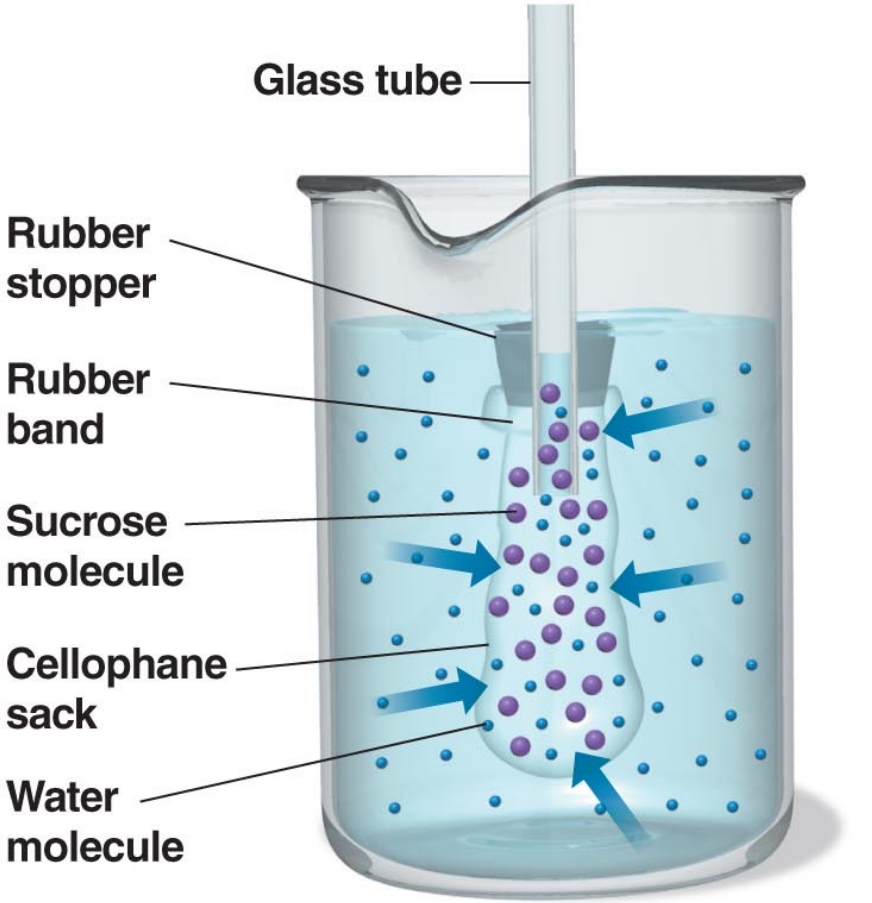


(c) Facilitated diffusion through a specific transporter

Figure 4.17b-c

Movement of Materials across Membranes

- **Osmosis**: The movement of water across a selectively permeable membrane from an area of high water to an area of lower water concentration
- **Osmotic pressure**: The pressure needed to stop the movement of water across the membrane

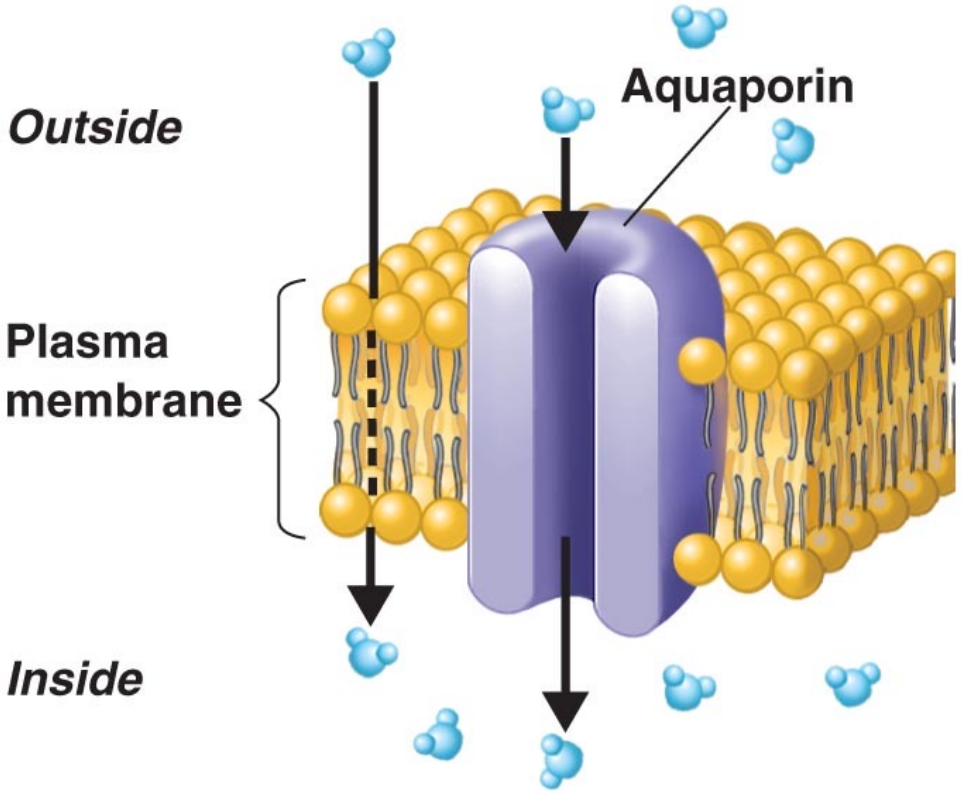


(a) At beginning of osmotic pressure experiment

Figure 4.18a

Movement of Materials across Membranes

- Through lipid layer
- Aquaporins (water channels)



(d) Osmosis through the lipid bilayer (left) and an aquaporin (right)

Figure 4.17d

The Principle of Osmosis

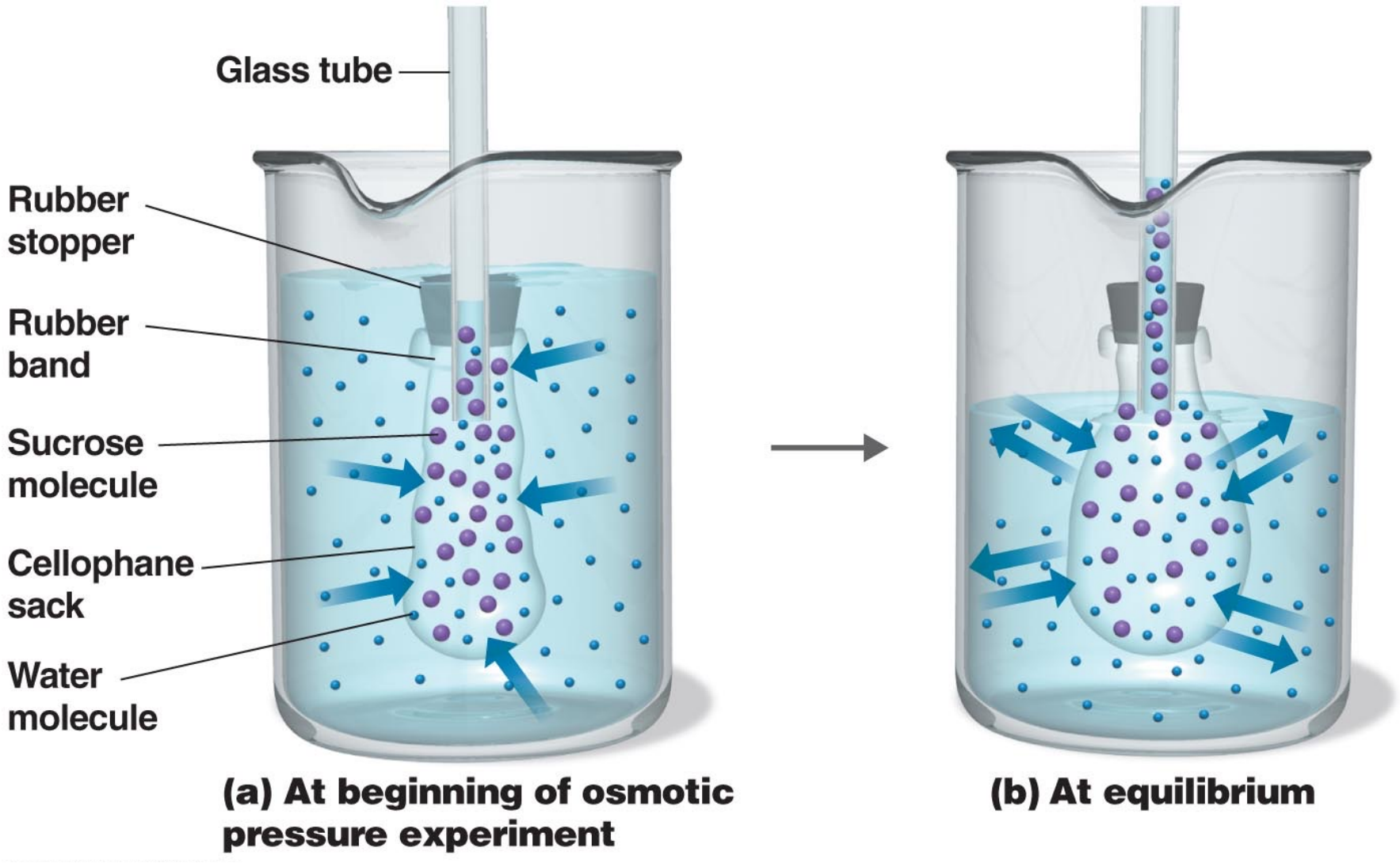
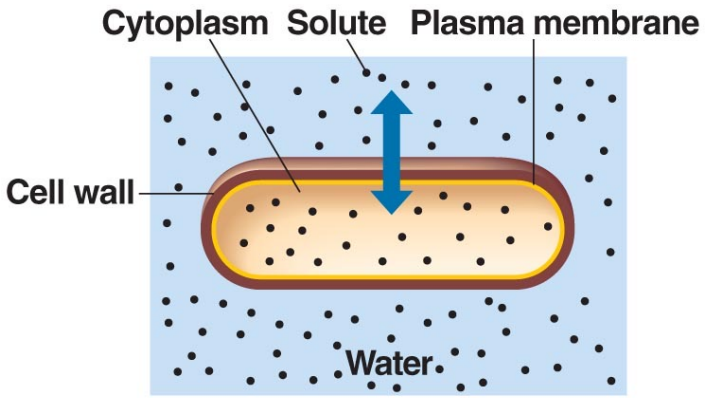
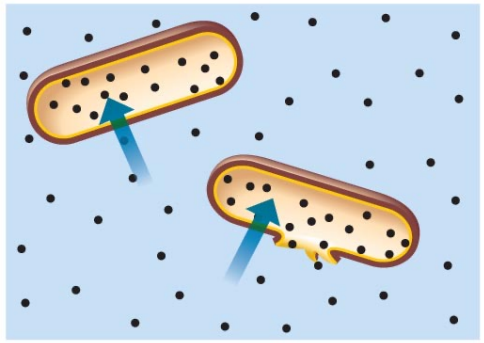


Figure 4.18a–b

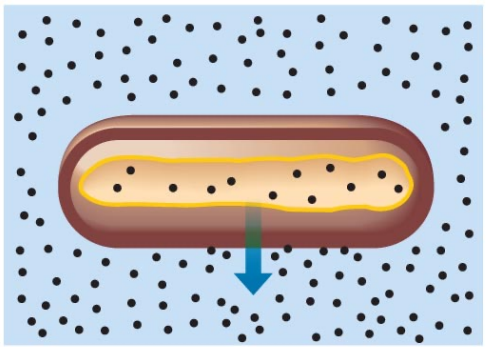
The Principle of Osmosis



(c) Isotonic solution. No net movement of water



(d) Hypotonic solution. Water moves into the cell. If the cell wall is strong, it contains the swelling. If the cell wall is weak or damaged, the cell bursts (osmotic lysis).



(e) Hypertonic solution. Water moves out of the cell, causing its cytoplasm to shrink (plasmolysis).

Figure 4.18c–e

Movement of Materials across Membranes

- **Active transport**: Requires a transporter protein and ATP
- **Group translocation**: Requires a transporter protein and PEP (phosphoenolpyruvic acid)
- PEP is high energy phosphate compound

Cytoplasm

- The substance inside the plasma membrane

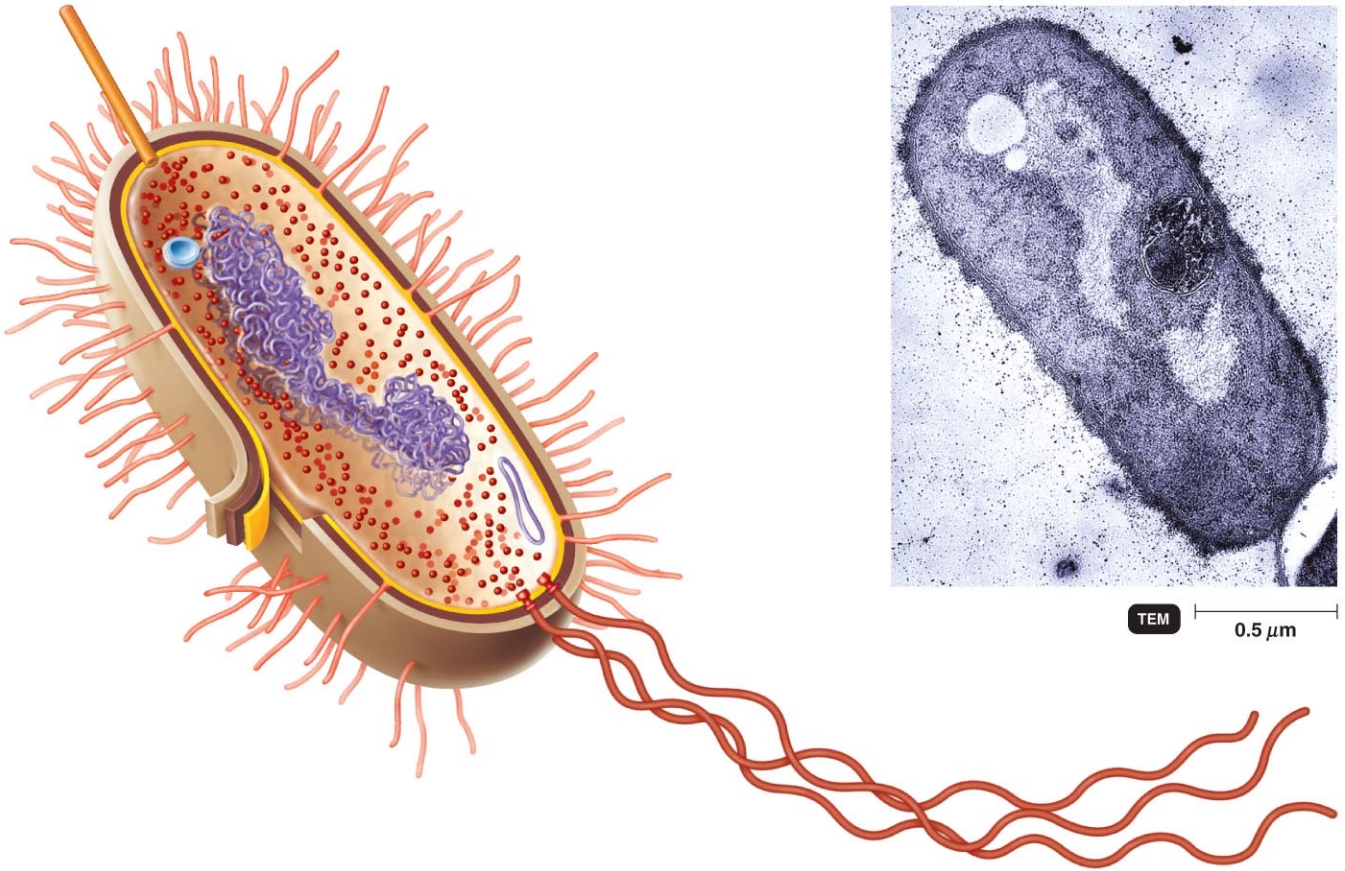


Figure 4.6

The Nucleoid

- **Bacterial chromosome**

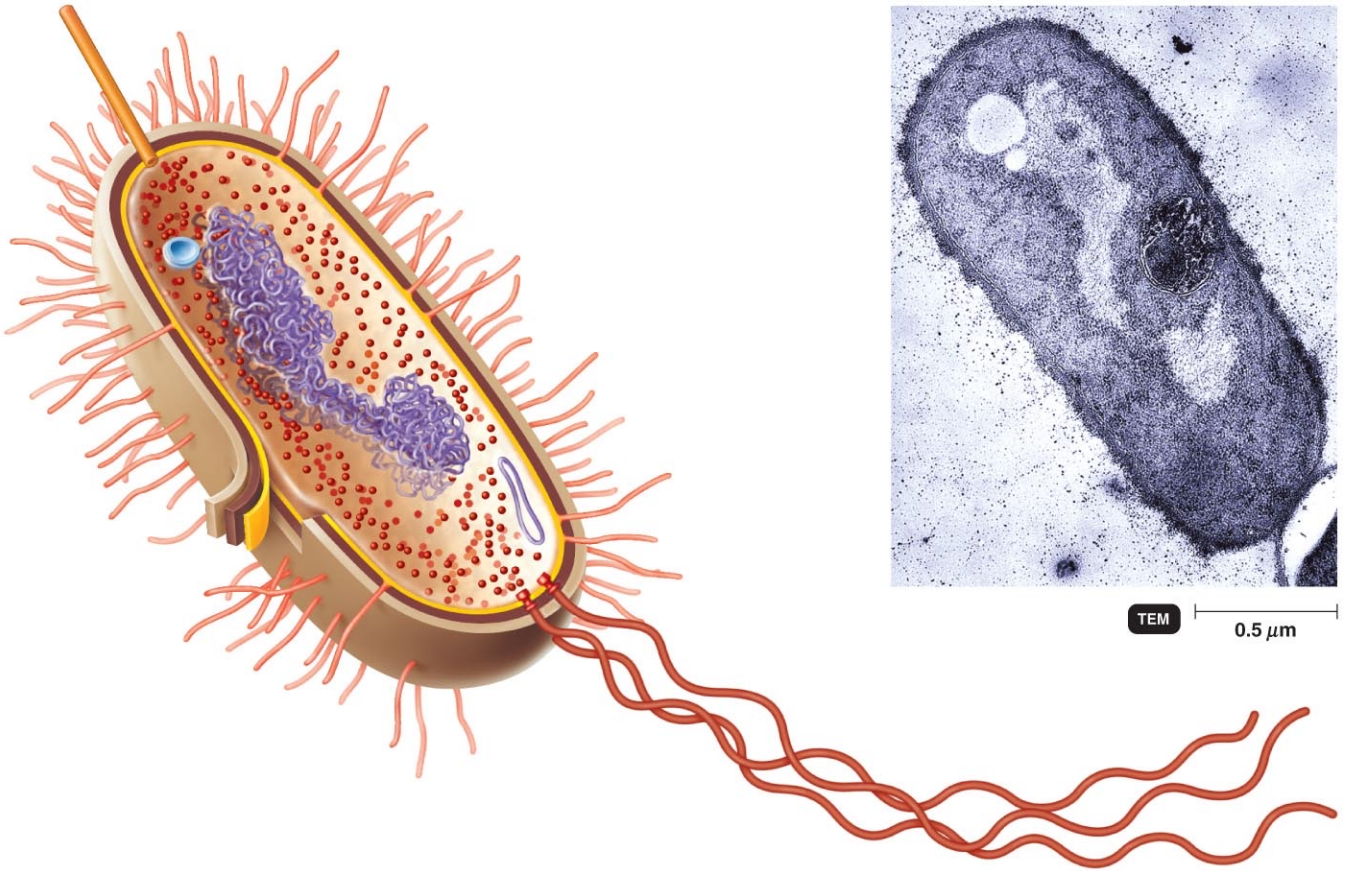


Figure 4.6

Ribosomes

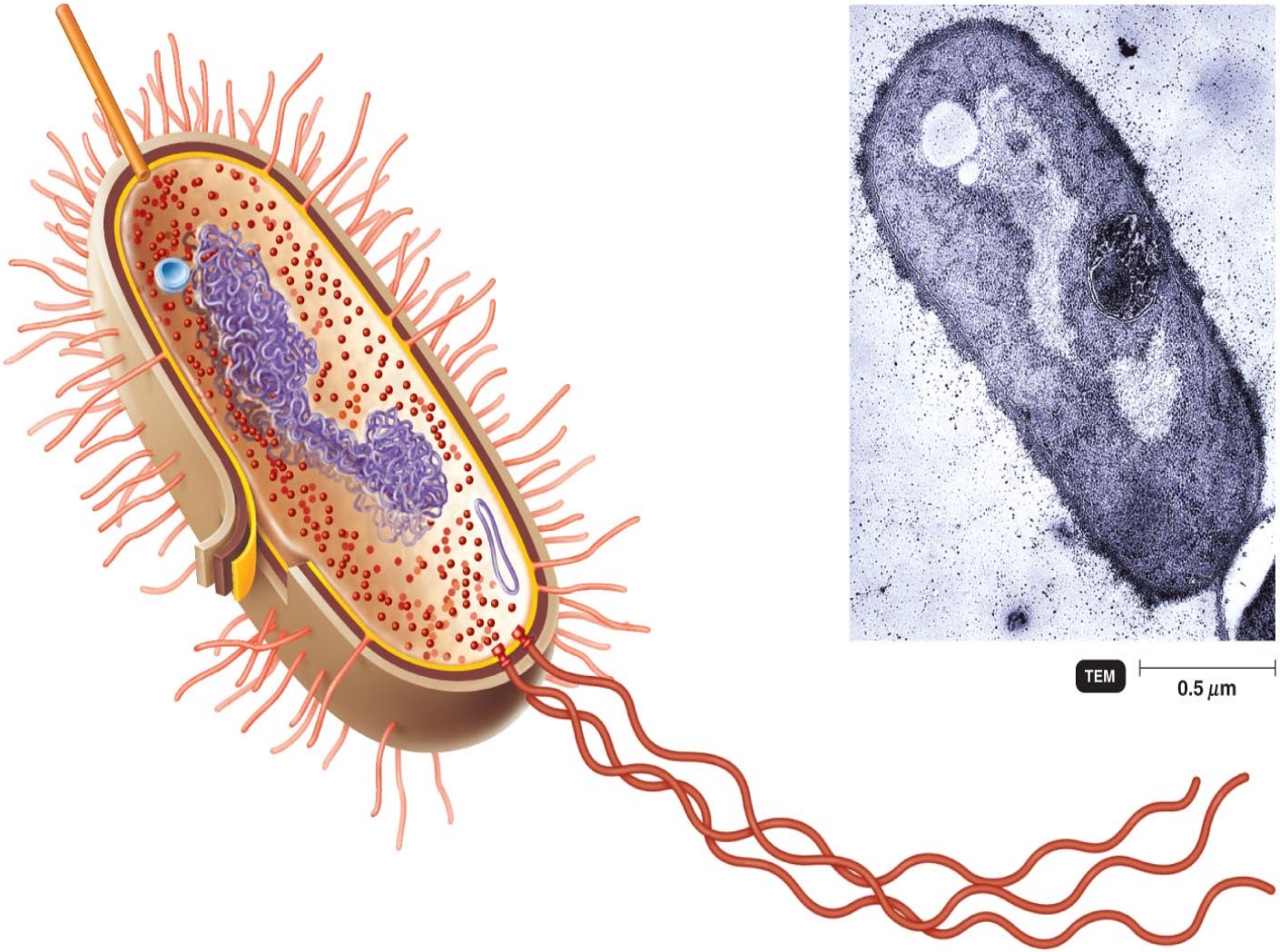


Figure 4.6

The Prokaryotic Ribosome

- Protein synthesis
- 70S
  - 50S + 30S subunits
  - Letter S stands for Svedberg units, relative rate of sedimentation during ultra-high-speed centrifugation
  - Antibiotics Erythromycin and Chloramphenicol bind 50S subunit

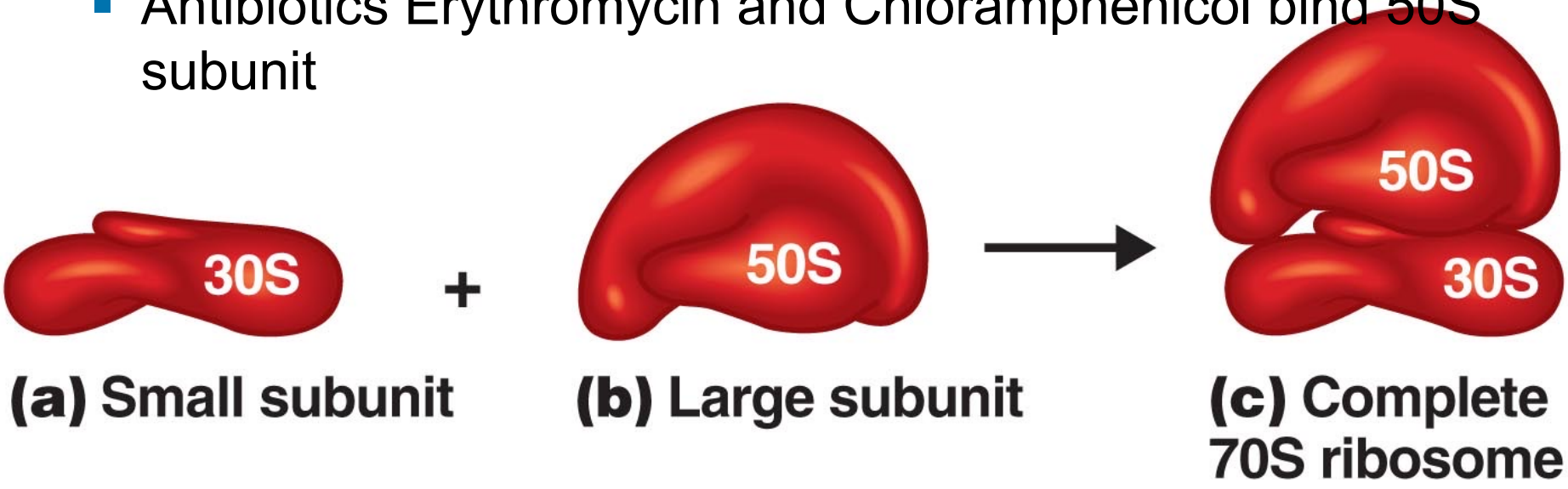


Figure 4.19

Inclusions (several reserve deposits in cytoplasm)

- **Metachromatic granules (volutin)** — Phosphate reserves
- **Polysaccharide granules** — Energy reserves
- **Lipid inclusions** — Energy reserves
- **Sulfur granules** — Energy reserves
- **Carboxysomes** — Ribulose 1,5-diphosphate carboxylase for CO_2 fixation
- **Gas vacuoles** — Protein-covered cylinders
- **Magnetosomes** — Iron oxide (destroys H_2O_2)

Magnetosomes

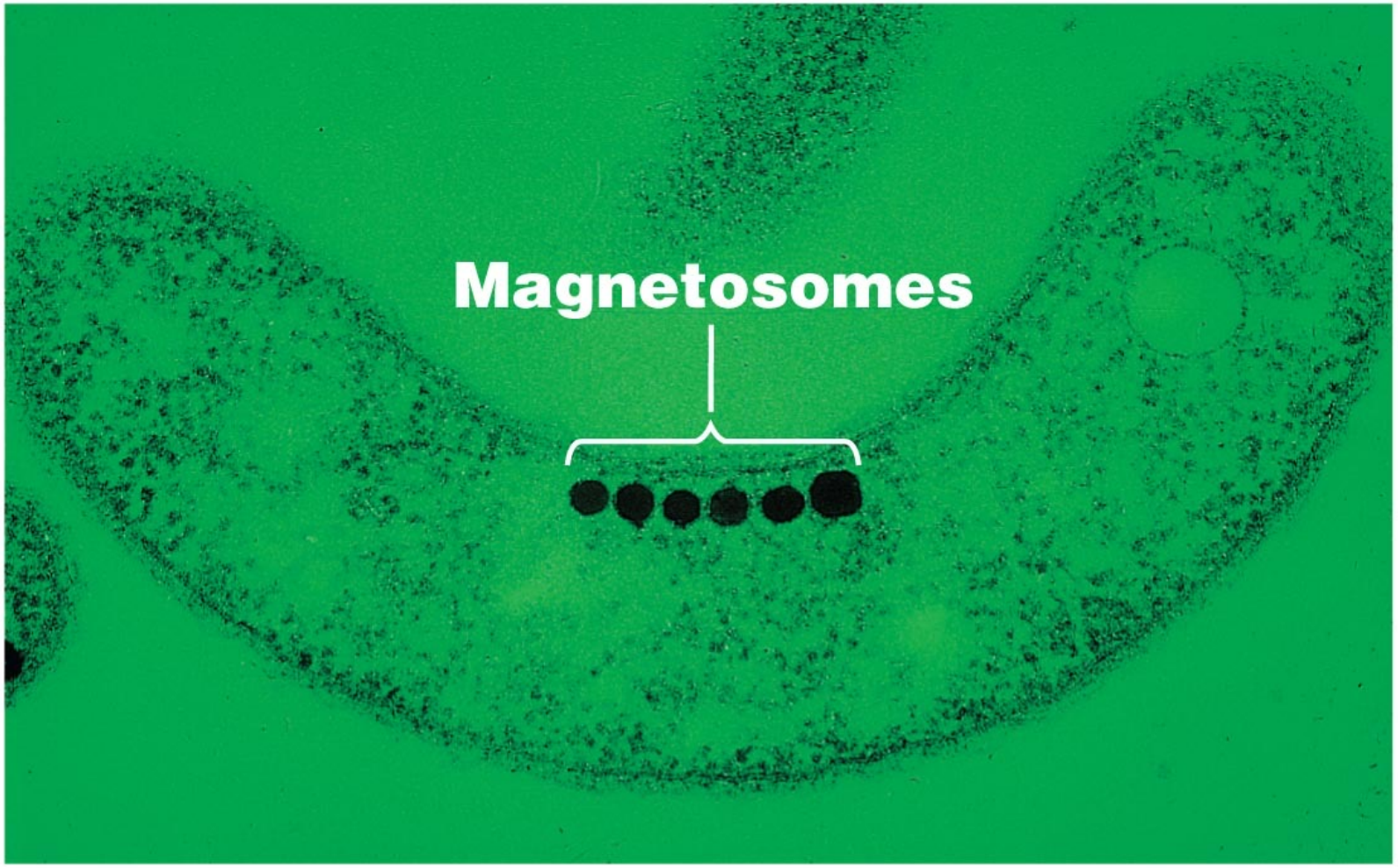
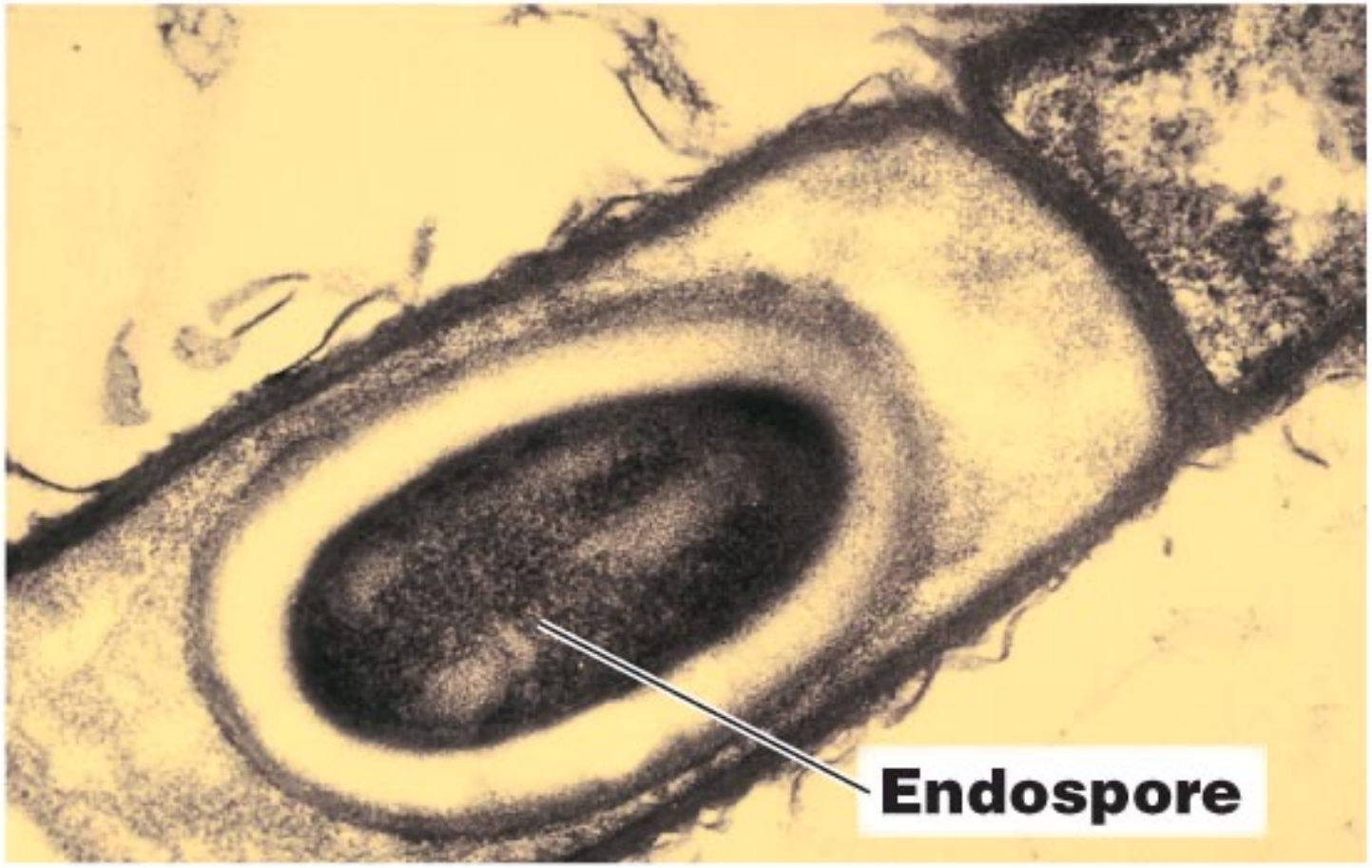


Figure 4.20

Endospores

- Resting cells
- Resistant to desiccation, heat, chemicals
- *Bacillus, Clostridium*
- **Sporulation**: Endospore formation
- **Germination**: Return to vegetative state
- Mostly true endospores are formed in G+ve bacteria, with exception of one G-ve bacteria, *Coxiella burnetti* that cause Q fever.

Endospores



(b) An endospore in *Bacillus anthracis*

TEM

1 μm

Figure 4.21b

Formation of Endospores by Sporulation

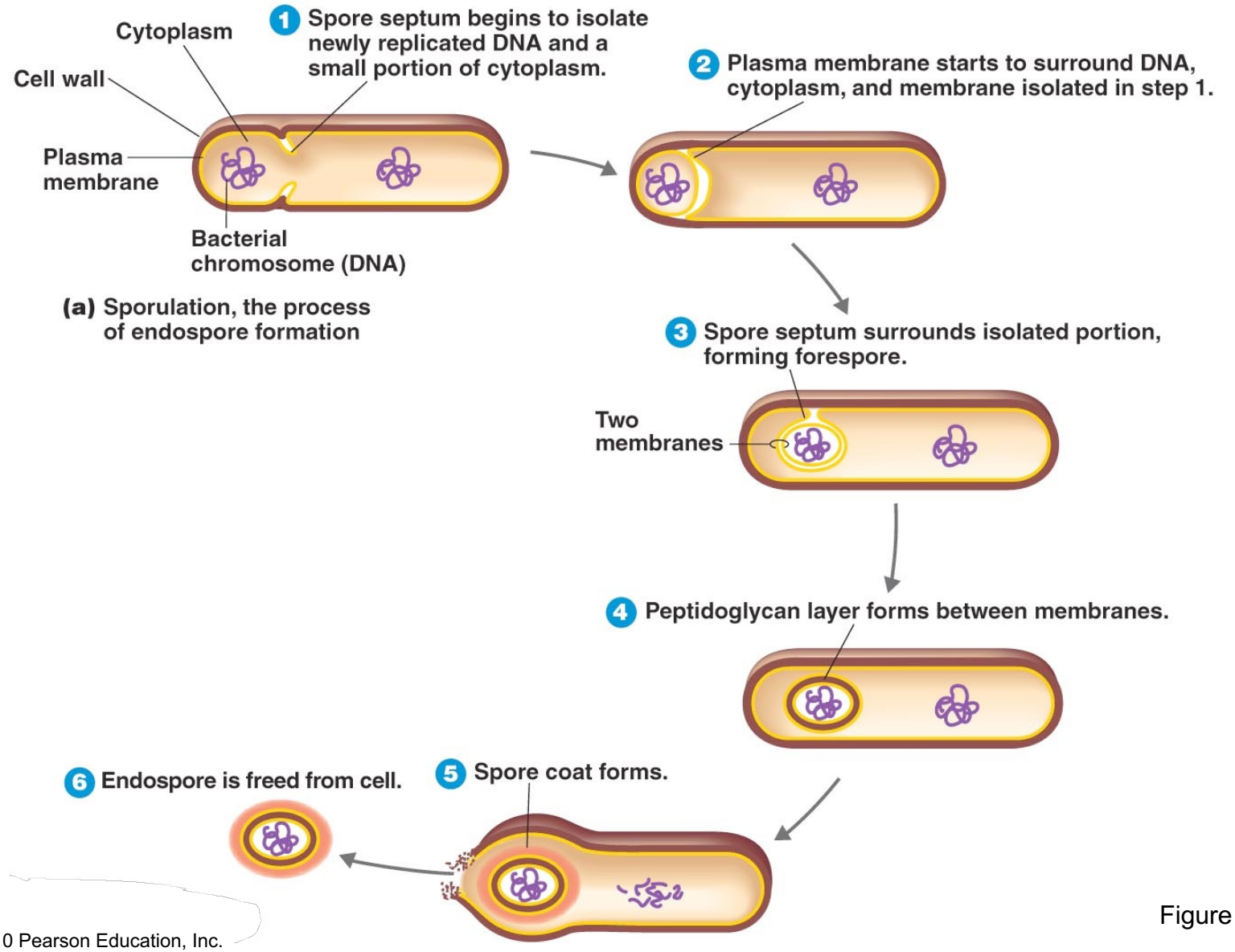


Figure 4.21a

Lecture 8
BT 206
24 Jan 2023
By Prof Manish Kumar

The Eukaryotic Cell

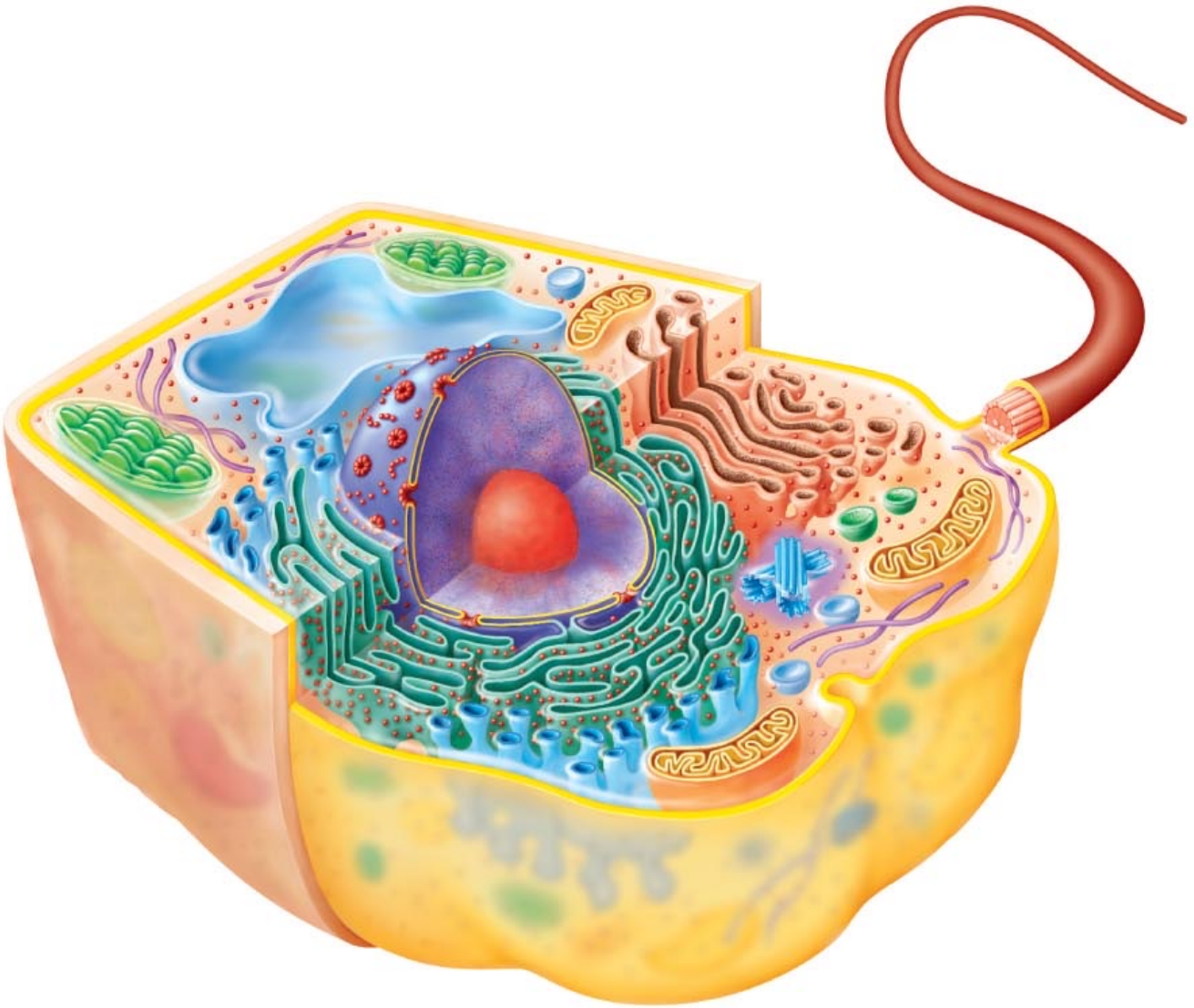


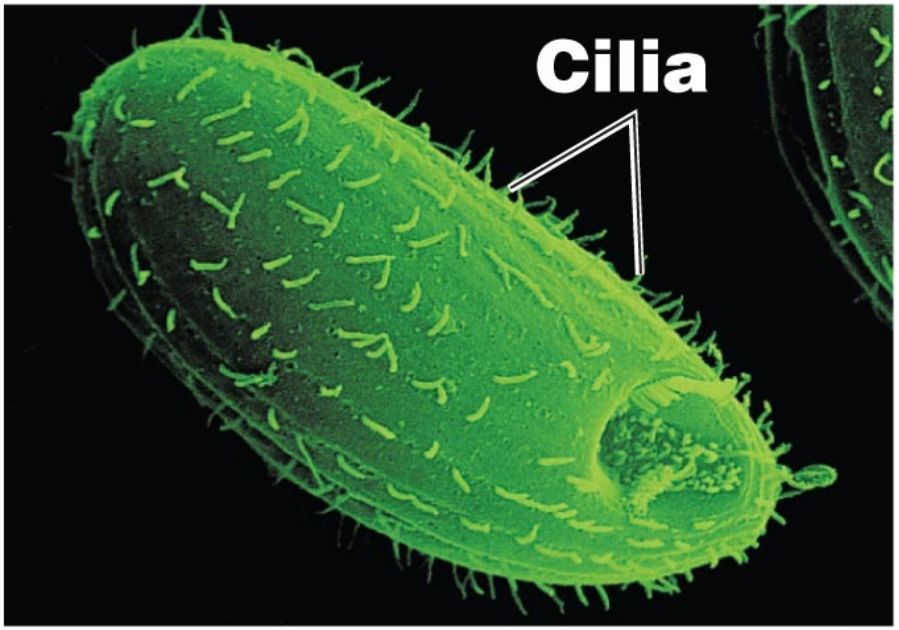
Figure 4.22a

Flagella and Cilia

(a) *Euglena*, an alga

TEM

12 μm



(b) *Tetrahymena*, a protozoan

SEM

20 μm

Figure 4.23a-b

Flagella and Cilia

- **Microtubules**
- Tubulin
- 9 pairs + 2 array

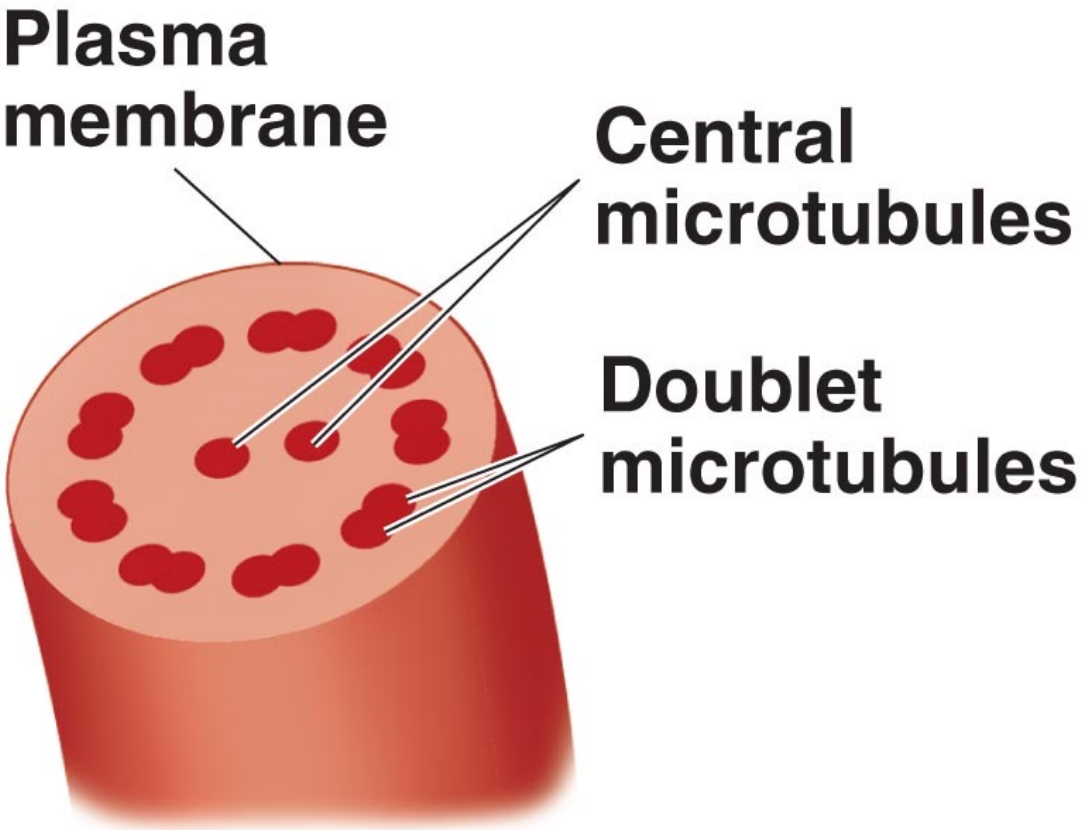


Figure 4.23c

The Cell Wall and Glycocalyx

- Cell wall
  - Plants, algae, fungi
  - Carbohydrates
- Cellulose, chitin, glucan, mannan
- **Glycocalyx**
  - Carbohydrates extending from animal plasma membrane
  - Bonded to proteins and lipids in membrane

The Plasma Membrane

- Phospholipid bilayer
- Peripheral proteins
- Integral proteins
- Transmembrane proteins
- Sterols
- Glycocalyx carbohydrates

The Plasma Membrane

- Selective permeability allows passage of some molecules
- Simple diffusion
- Facilitative diffusion
- Osmosis
- Active transport
- **Endocytosis**
  - Phagocytosis: Pseudopods extend and engulf particles
  - Pinocytosis: Membrane folds inward, bringing in fluid and dissolved substances

Cytoplasm

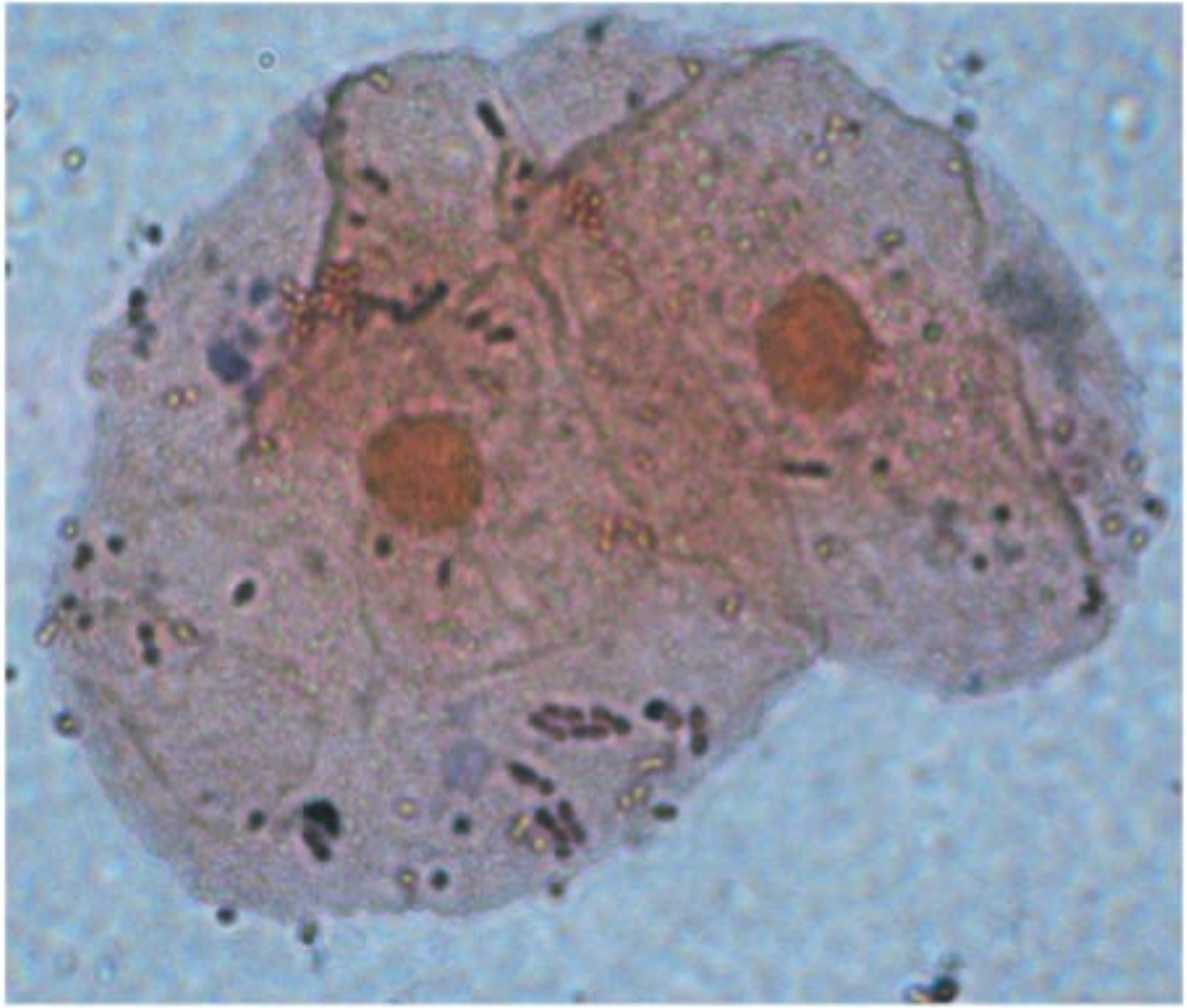


Table 4.2

Cytoplasm

- **Cytoplasm**: Substance inside plasma membrane and outside nucleus
- **Cytosol**: Fluid portion of cytoplasm
- **Cytoskeleton**: Microfilaments, intermediate filaments, microtubules
- **Cytoplasmic streaming**: Movement of cytoplasm throughout cells

Ribosomes

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

Organelles

- **Nucleus**: Contains chromosomes
- **ER**: Transport network
- **Golgi complex**: Membrane formation and secretion
- **Lysosome**: Digestive enzymes
- **Vacuole**: Brings food into cells and provides support

Organelles

- **Mitochondrion**: Cellular respiration
- **Chloroplast**: Photosynthesis
- **Peroxisome**: Oxidation of fatty acids; destroys H_2O_2
- **Centrosome**: Consists of protein fibers and centrioles

The Eukaryotic Nucleus

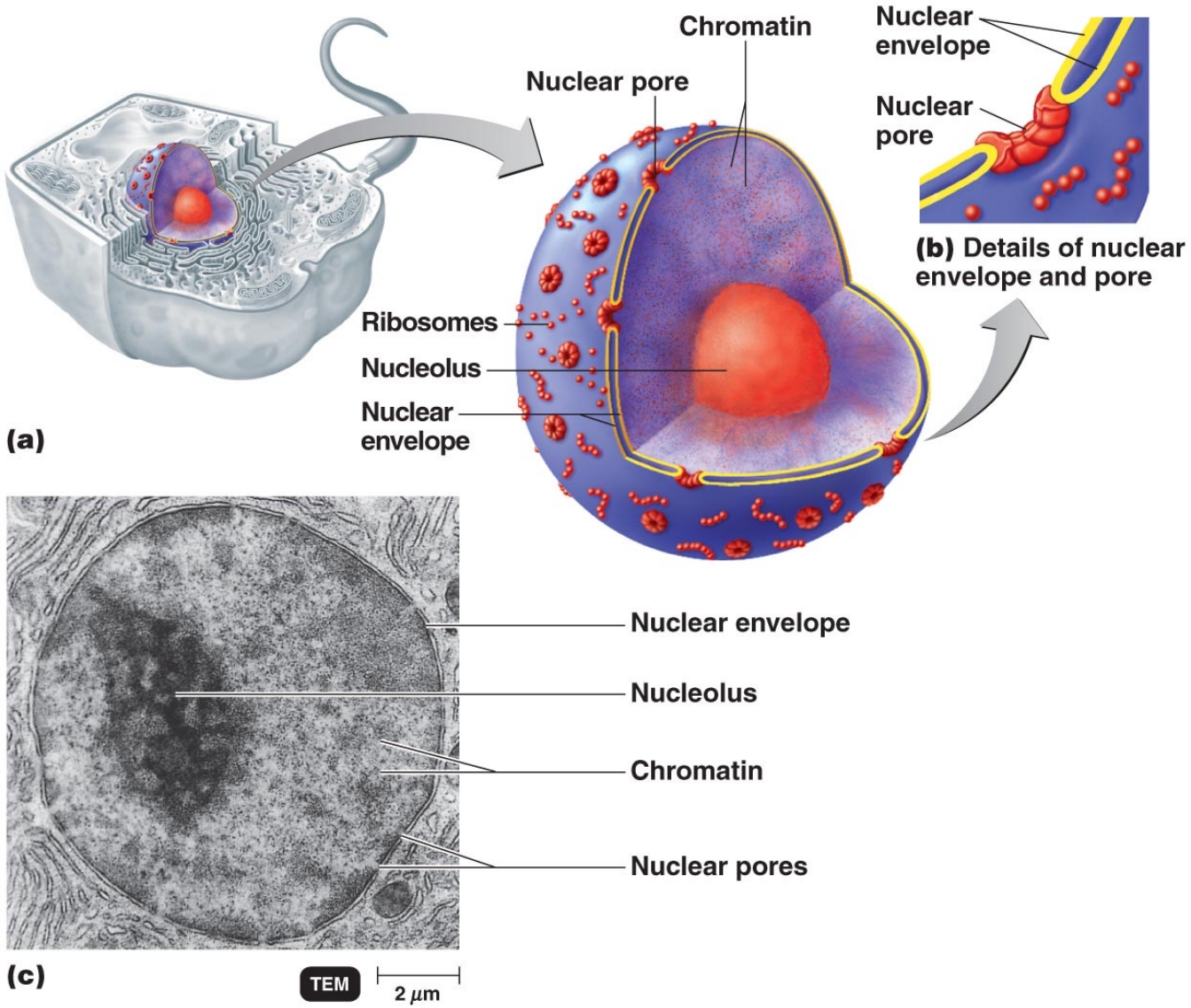


Figure 4.24

The Eukaryotic Nucleus

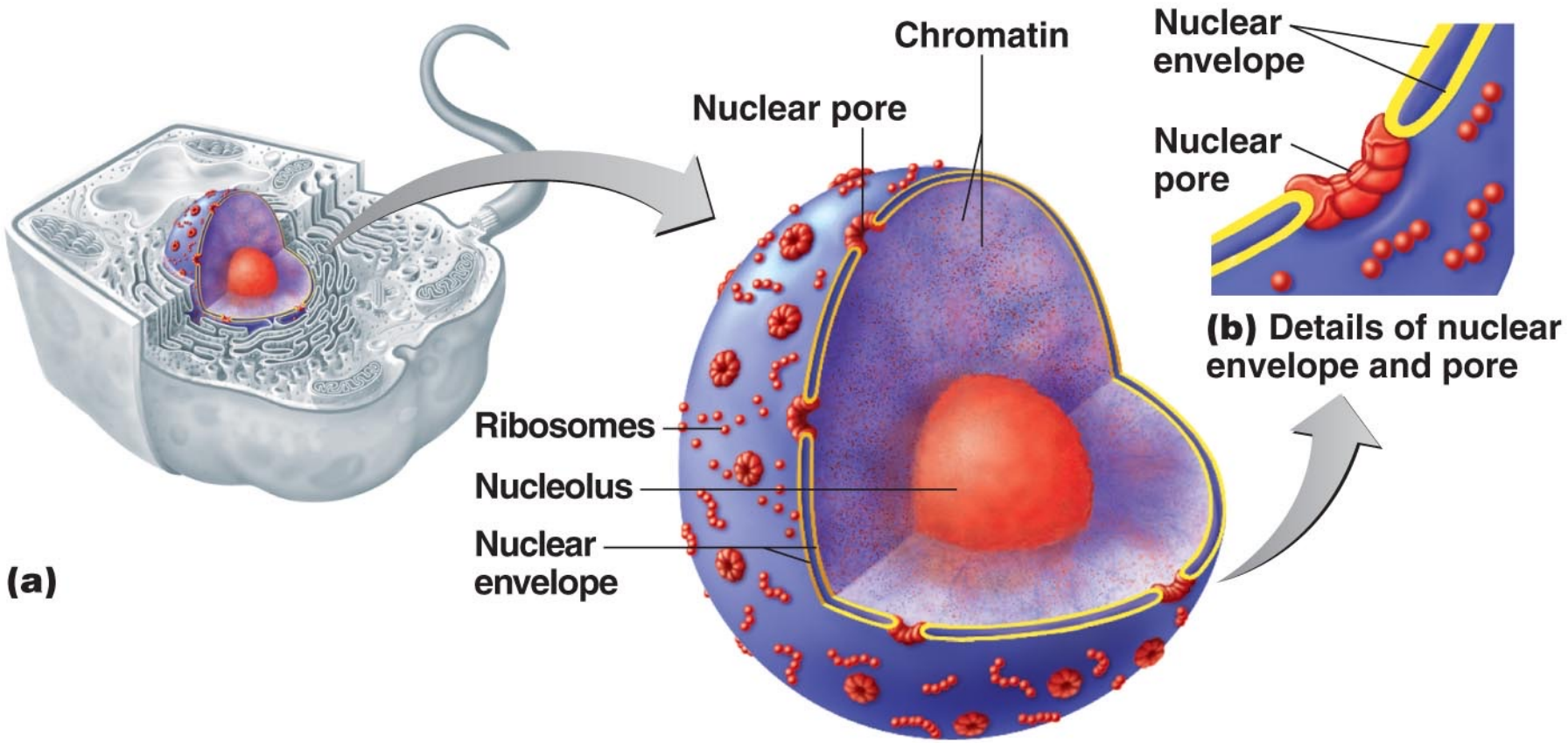


Figure 4.24a–b

Rough Endoplasmic Reticulum

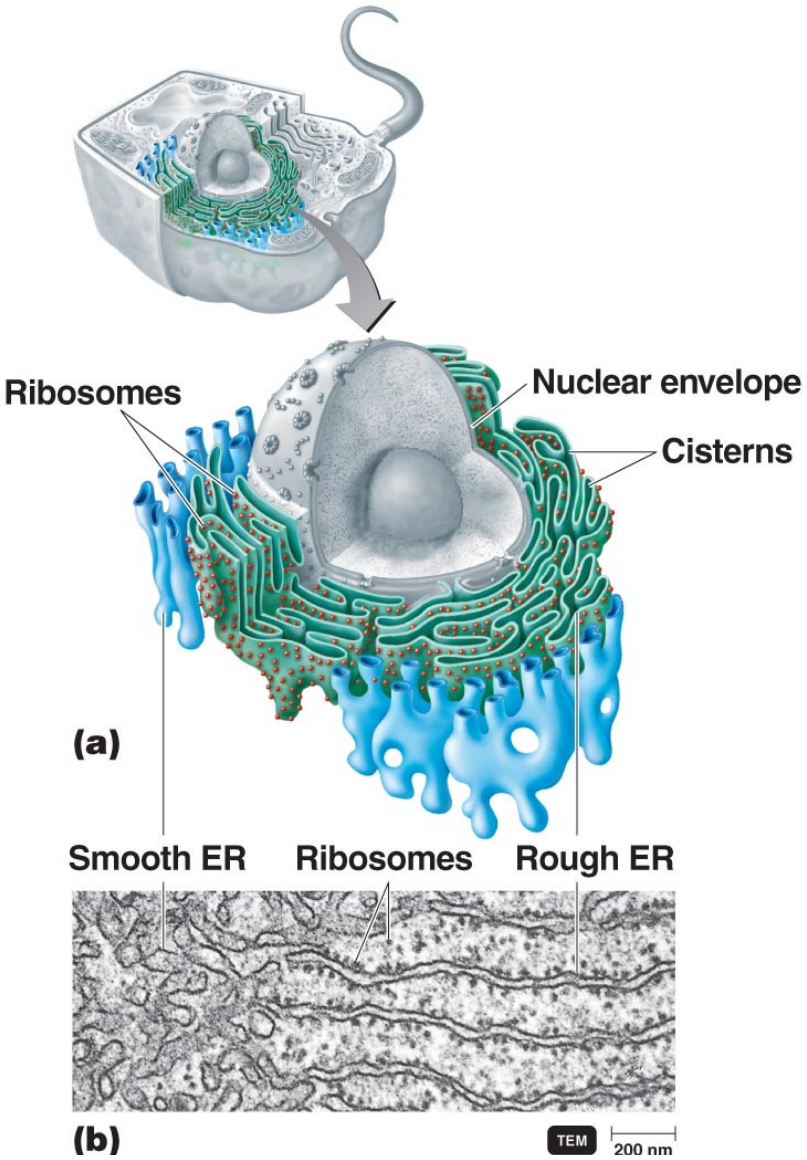


Figure 4.25

Detailed Drawing of Endoplasmic Reticulum

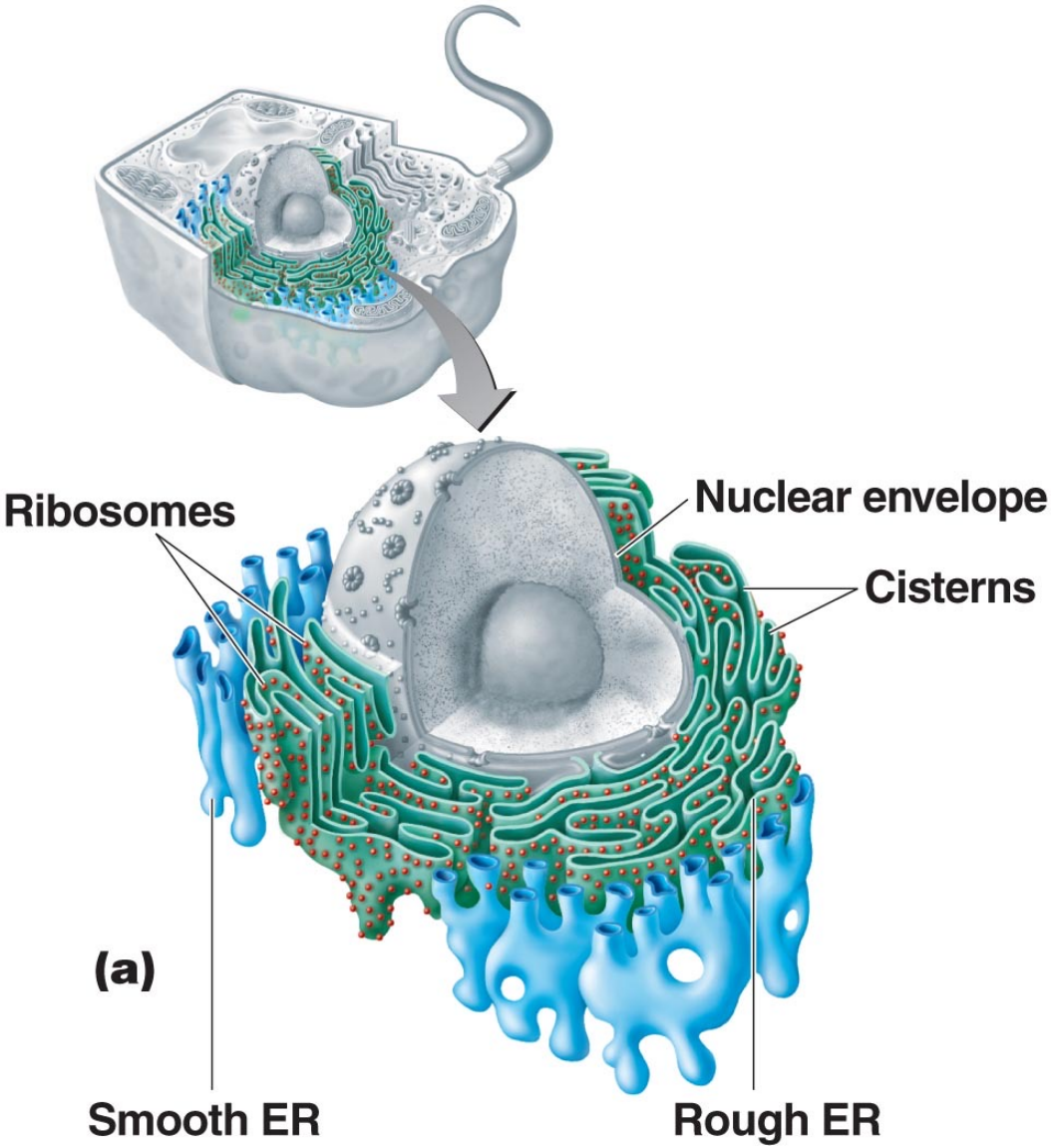


Figure 4.25a

Micrograph of Endoplasmic Reticulum

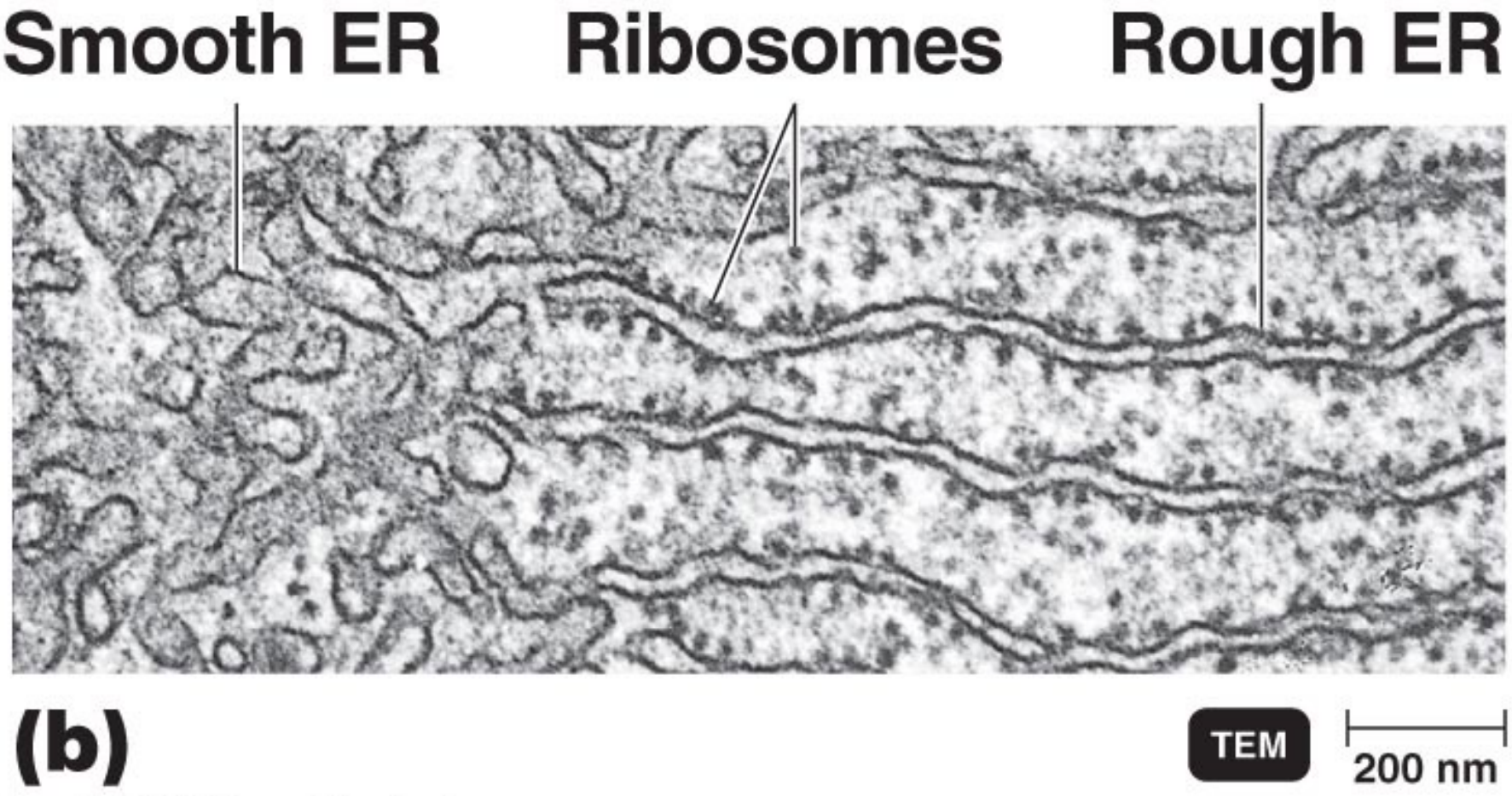


Figure 4.25b

Golgi Complex

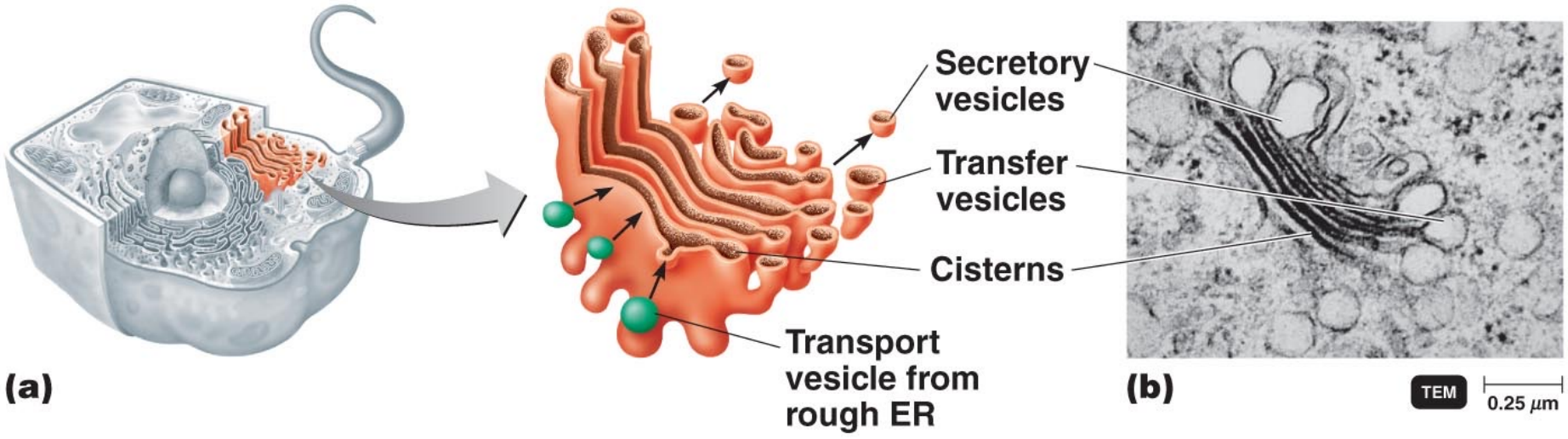
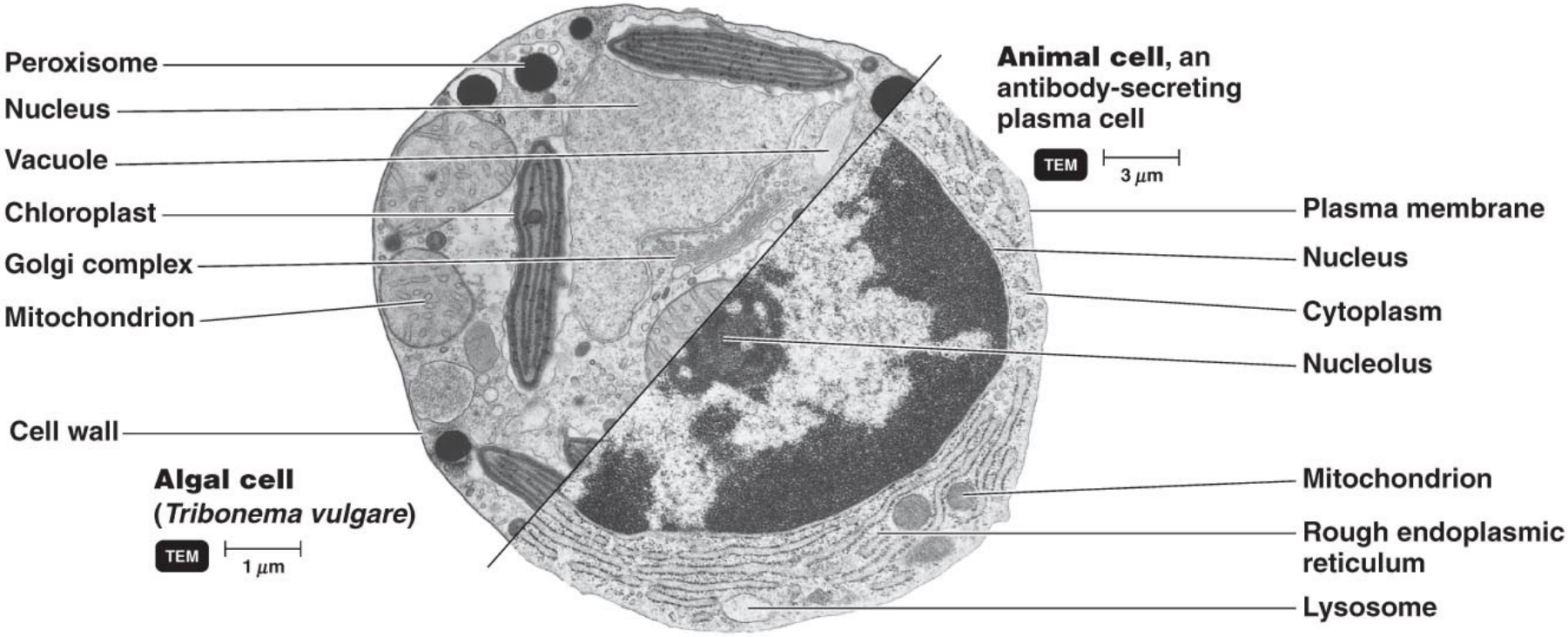


Figure 4.26

Lysosomes and Vacuoles



(b) Transmission electron micrographs of plant and animal cells.

Figure 4.22b

Mitochondria

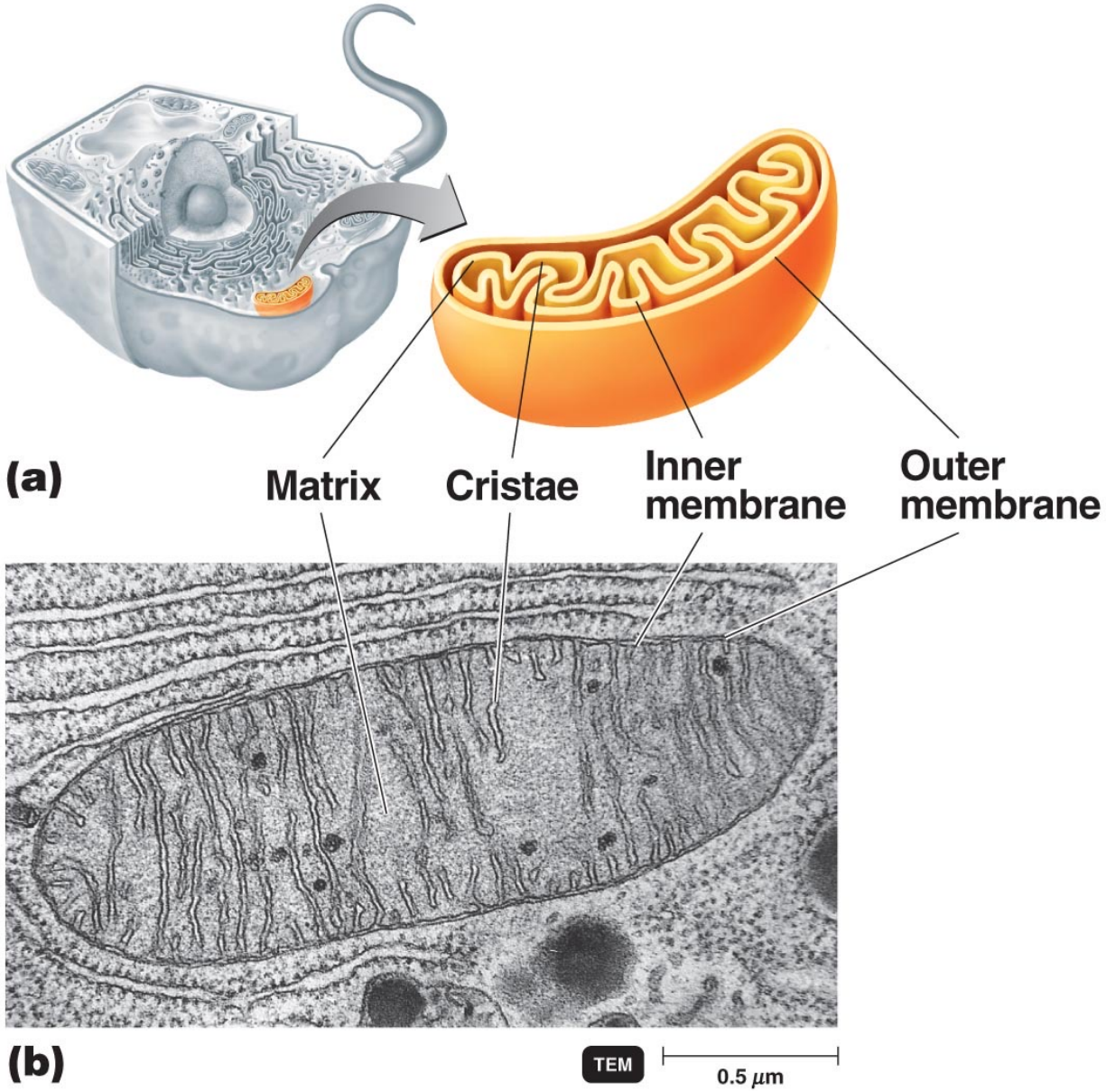


Figure 4.27

Chloroplasts

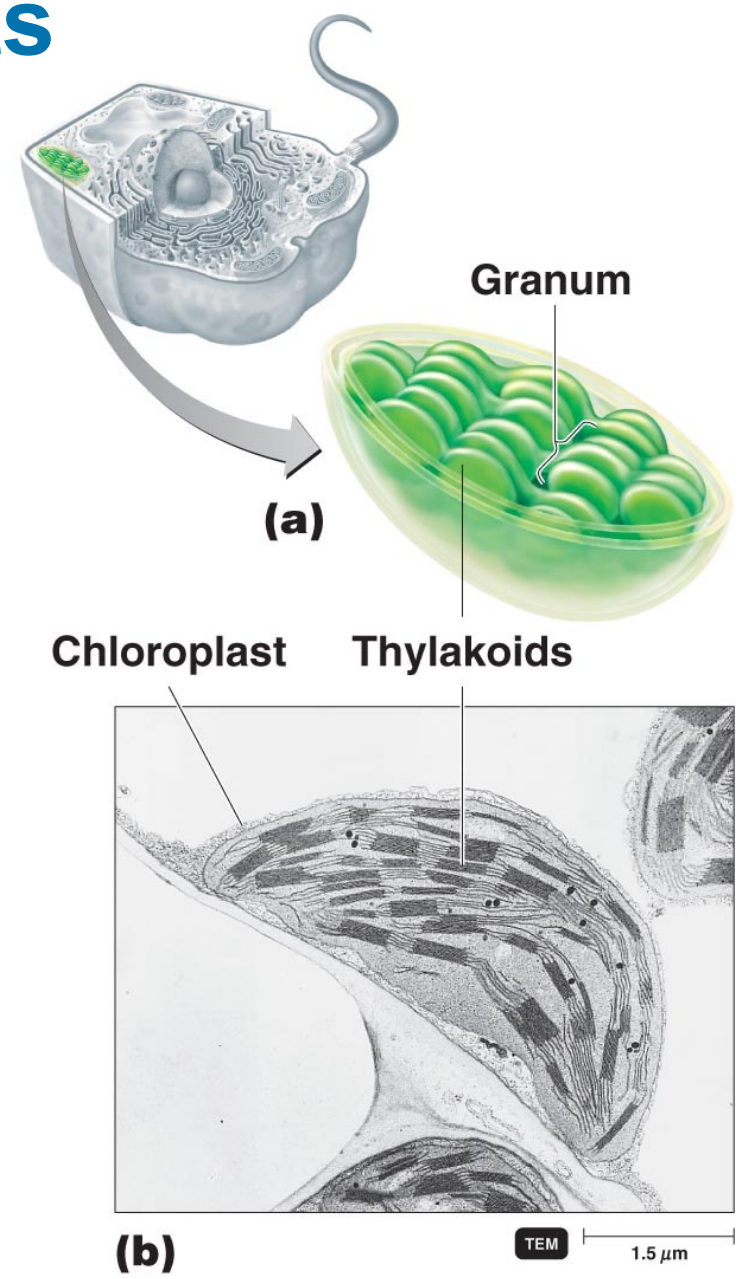


Figure 4.28

Chloroplasts

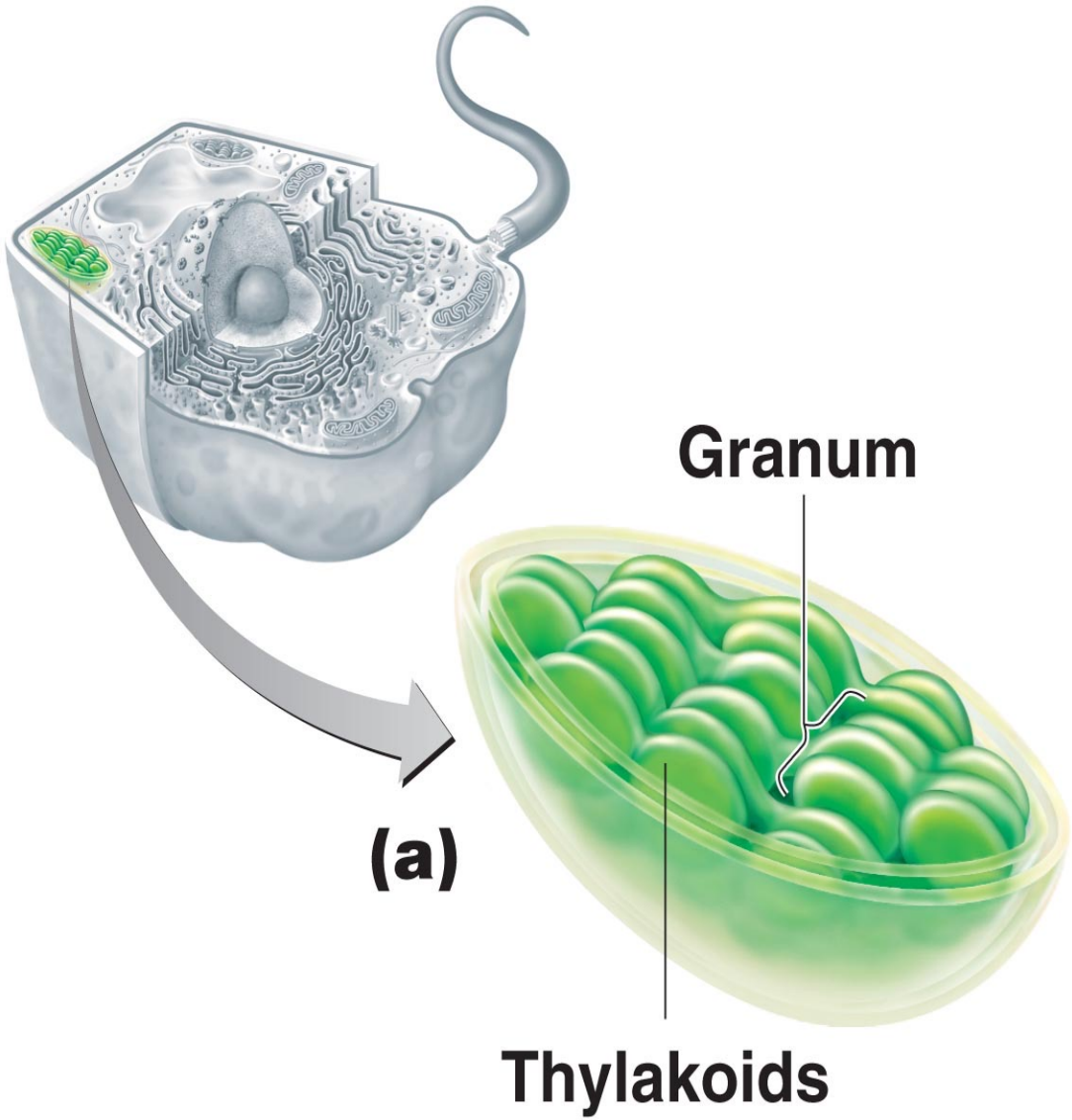


Figure 4.28a

Chloroplasts

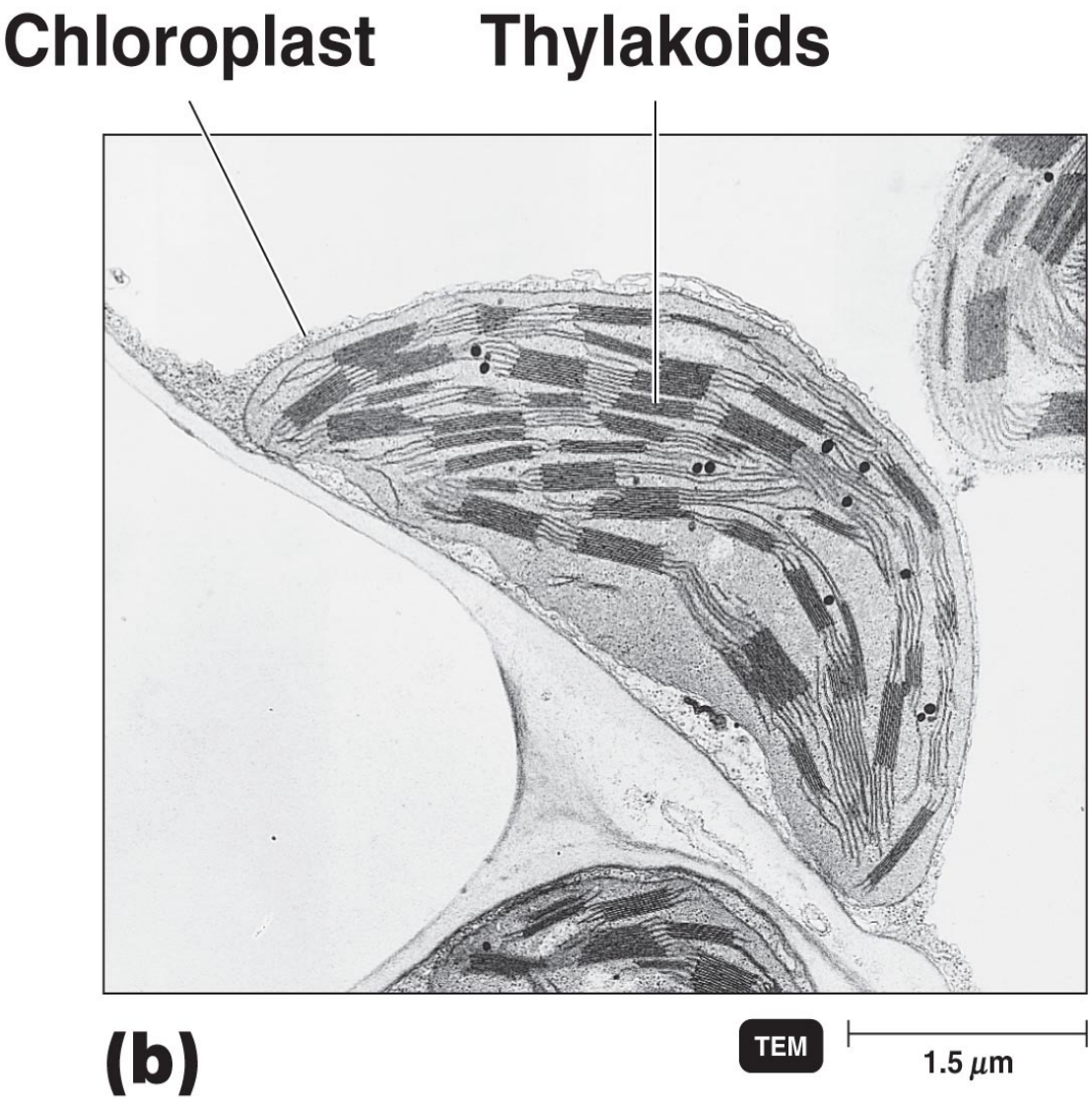
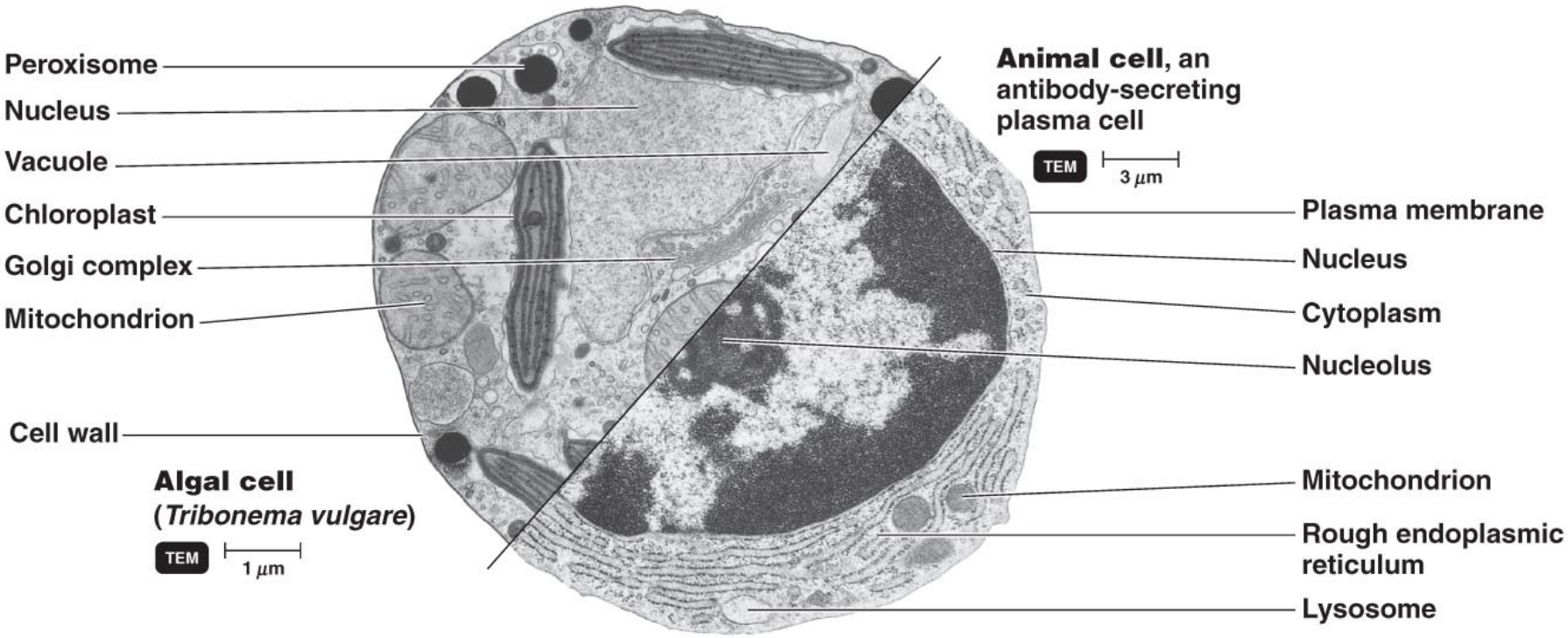


Figure 4.28b

Peroxisome and Centrosome



(b) Transmission electron micrographs of plant and animal cells.

Figure 4.22b

Endosymbiotic Theory

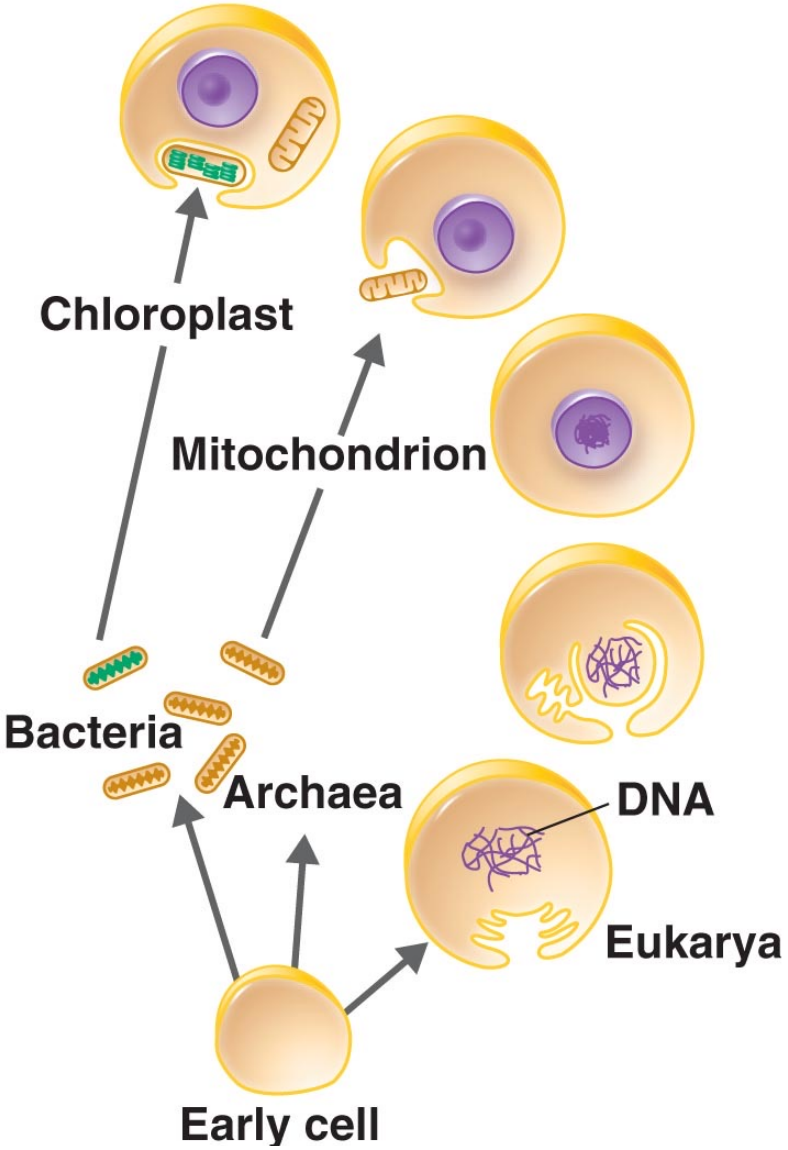


Figure 10.2

Endosymbiotic Theory

- What are the fine extensions on this protozoan?

Endosymbiotic Theory