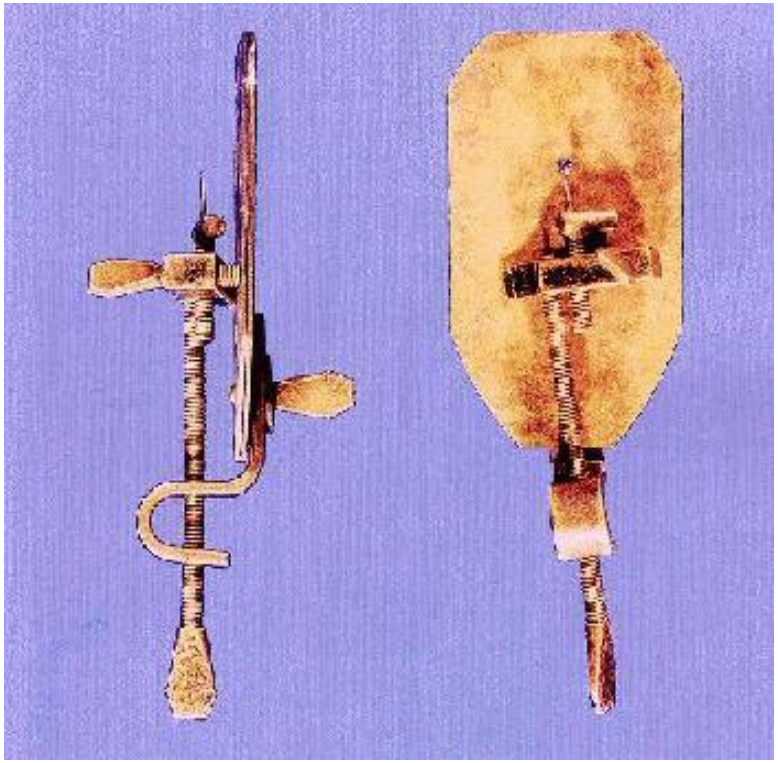
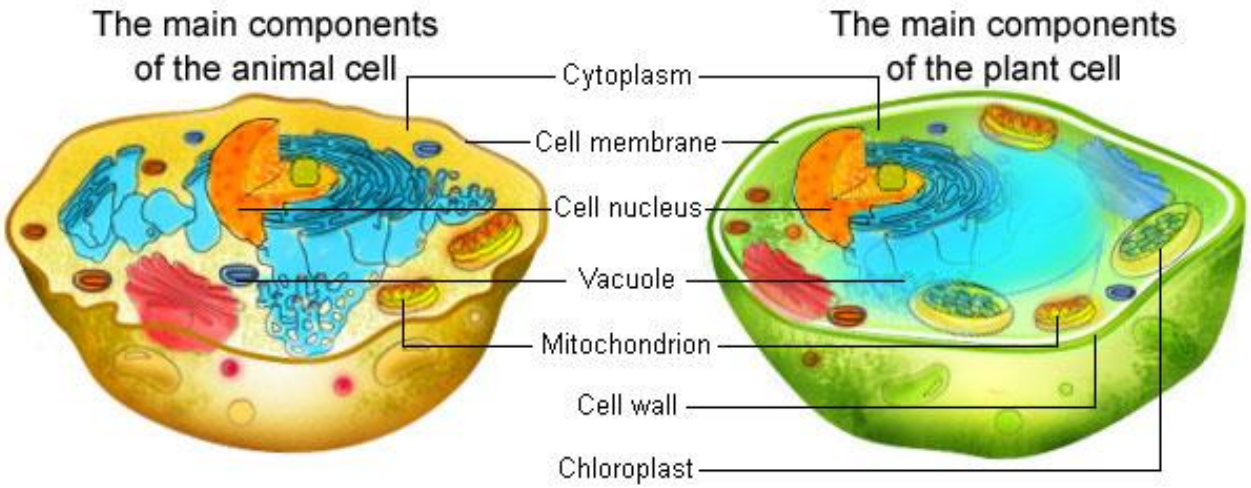
Chapter 4

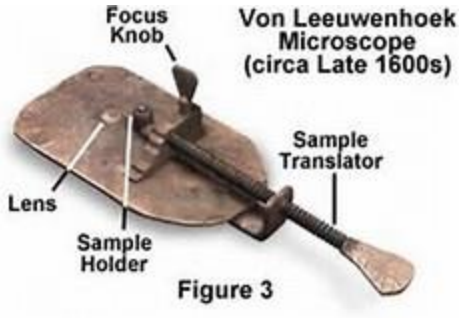
Tour of the Cell



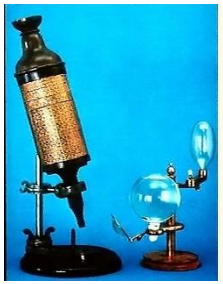


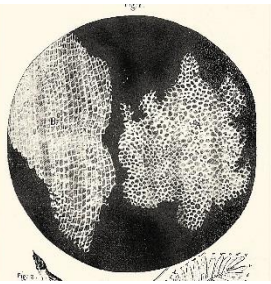
The Cellular Level of Organization

- The word “cell” entered biology in the 17th century.
- **Anton van Leeuwenhoek** is recognized for inventing one of the earliest microscopes and observing a first cell.



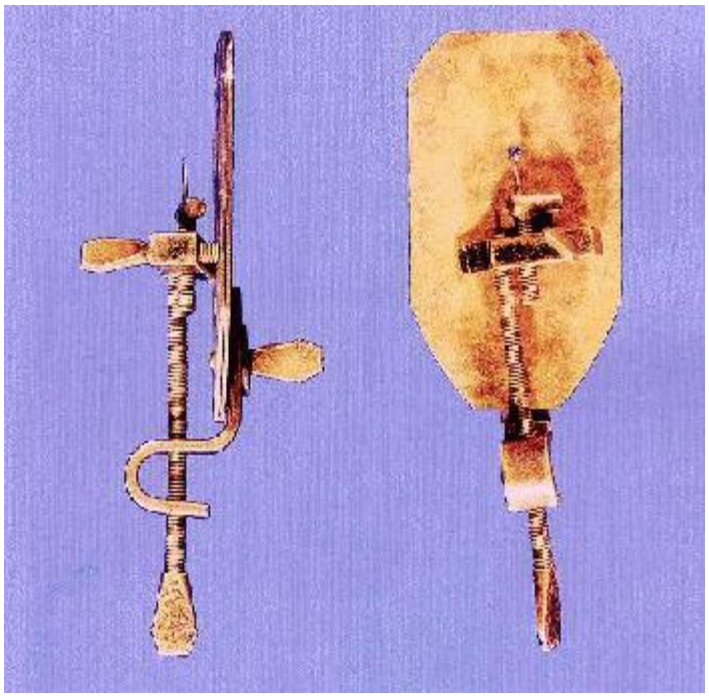
- **Robert Hooke** confirmed earlier findings and coined the term “cell.”

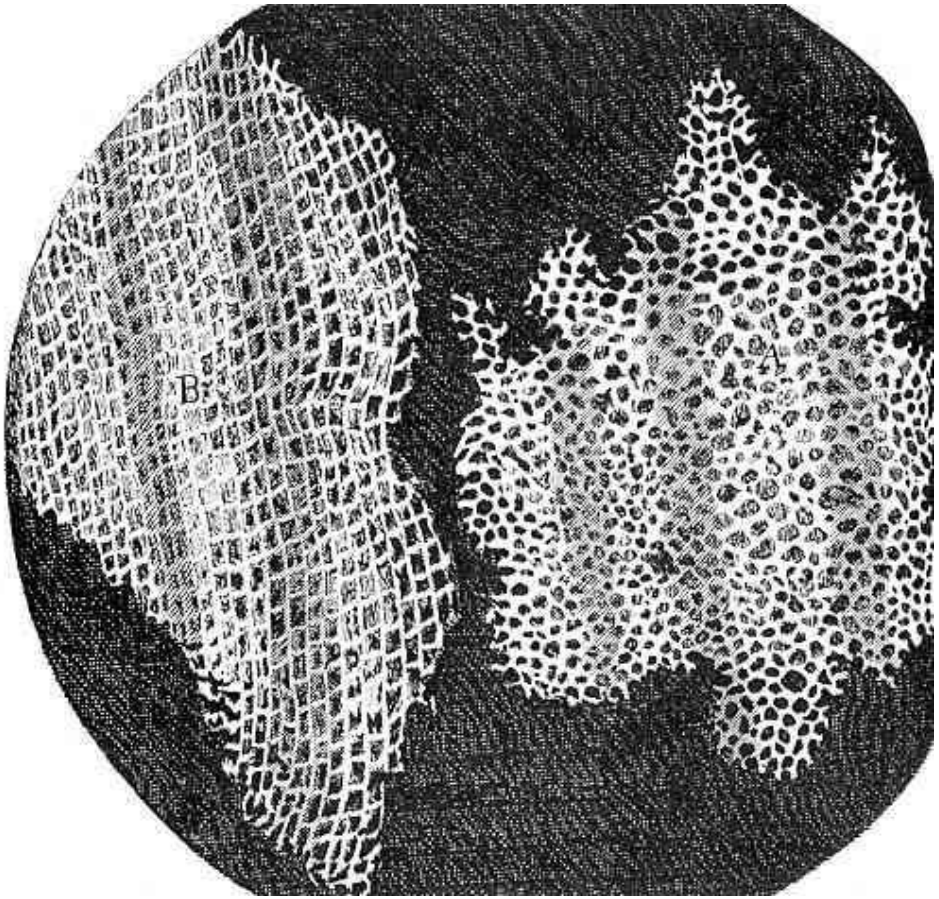




Early Microscopes

Antonie Van Leeuwenhoek (1632)

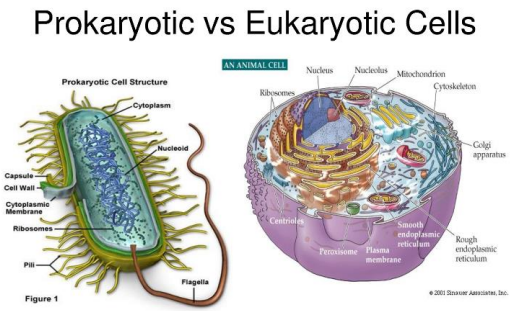




Robert Hooke (1635)

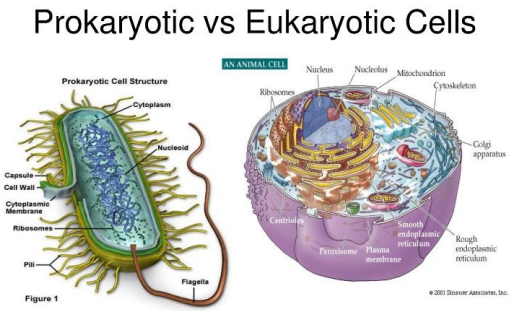
The Cell

- The cell marks the boundary between the nonliving and the living.
- It is the structural and functional unit of an organism.
- It is the smallest structure capable of performing all the functions necessary for life.



The Cell Theory

- All organisms are composed of one or more cells.
- Cells are the basic living unit of structure and function in organisms.
- All cells come only from other cells.



Microscopes as Windows on the World of Cells

- Two kinds of electron microscopes reveal different parts of cells.
- **Scanning electron microscopes (SEMs)** examine cell surfaces.
- **Transmission electron microscopes (TEMs)** are useful for studying the internal structure of a cell.

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Light Microscope

Figure 4.2

Scanning Electron Microscope (SEM)

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Figure 4.1a

Light Micrograph (LM)
(for viewing living cells)

Light micrograph of a protist, *Paramecium*

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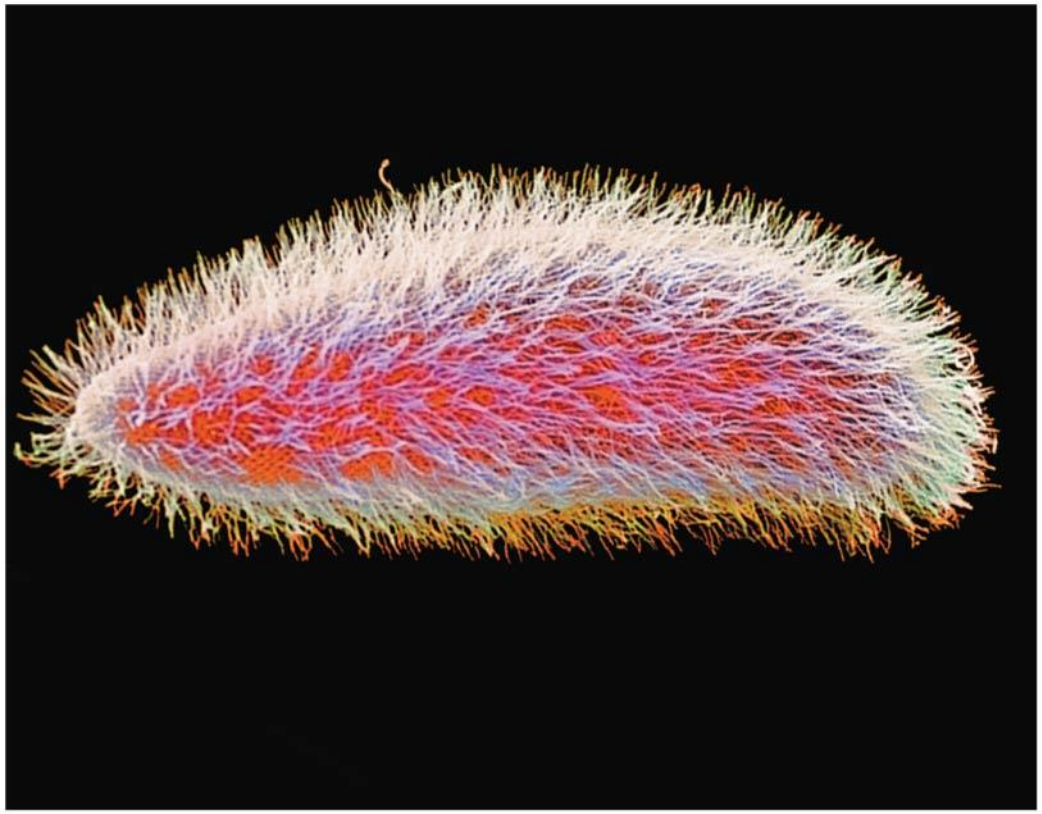
Figure 4.1b

Scanning Electron Micrograph (SEM) (for viewing surface features)



Scanning electron micrograph of *Paramecium*

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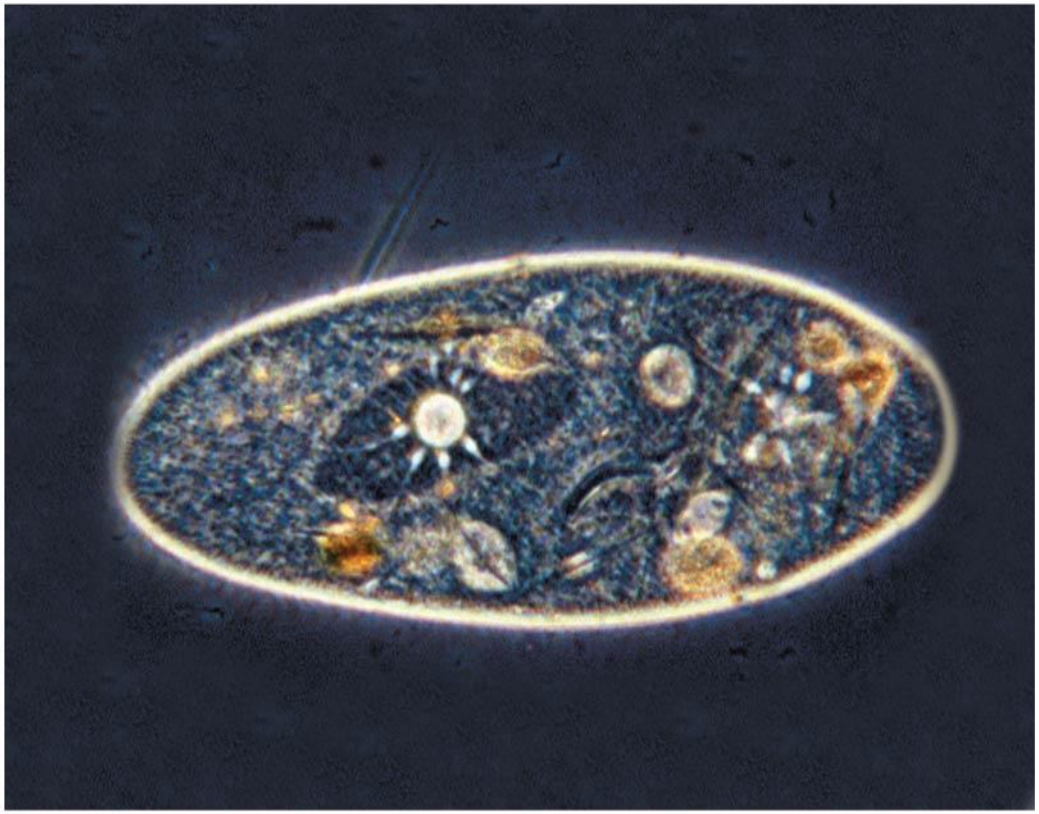
Figure 4.1c

Transmission Electron Micrograph (TEM) (for viewing internal structures)



Transmission electron micrograph of *Paramecium*

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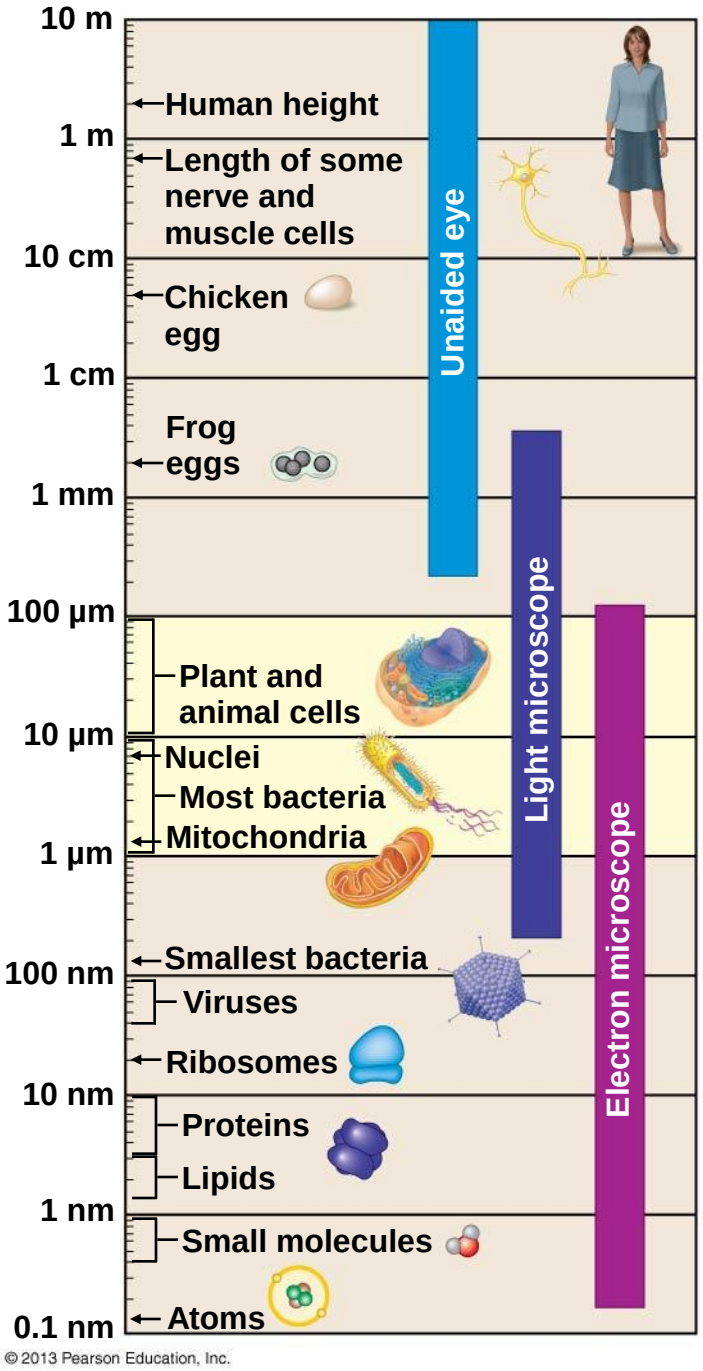
Figure 4.3



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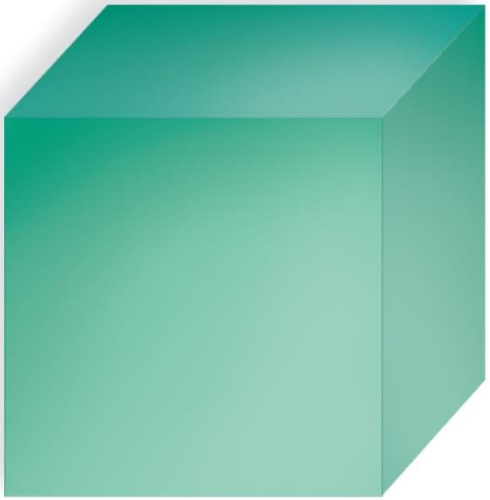
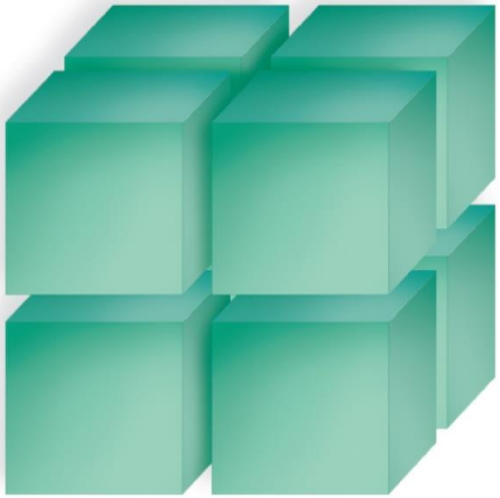
Why are Cells so Small?

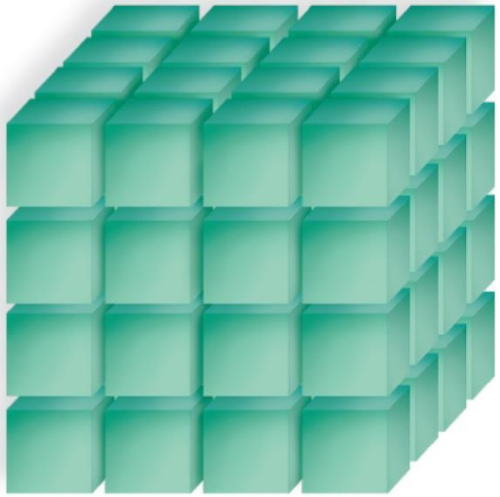
- Advantage for multicellular organisms:
- **Nutrients** can enter cell
- **Wastes** such as CO2 can exit cell.



One 4-cm cube



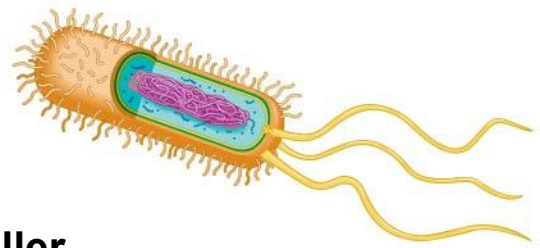
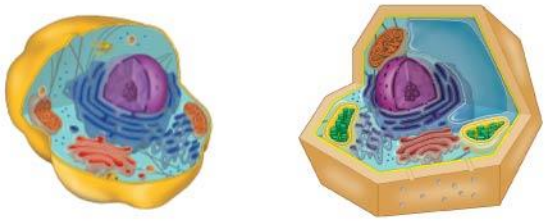
Eight 2-cm cubes



Sixty-four 1-cm cubes

Figure 4.UN11

The Two Major Categories of Cells (Chapter 1)

CATEGORIES OF CELLS	
Prokaryotic Cells	**Eukaryotic Cells**
	
• Smaller • Simpler • Most do not have organelles • Found in bacteria and archaea	• Larger • More complex • Have organelles • Found in protists, plants, fungi, animals

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The Two Major Categories of Cells

- All cells have several basic features.
  - **plasma membrane**, boundary of the cell
  - **cytosol**, in which cellular components are suspended.
  - **chromosomes** carrying genes made of DNA.
  - **ribosomes**, tiny structures that build proteins according to the instructions from the DNA.

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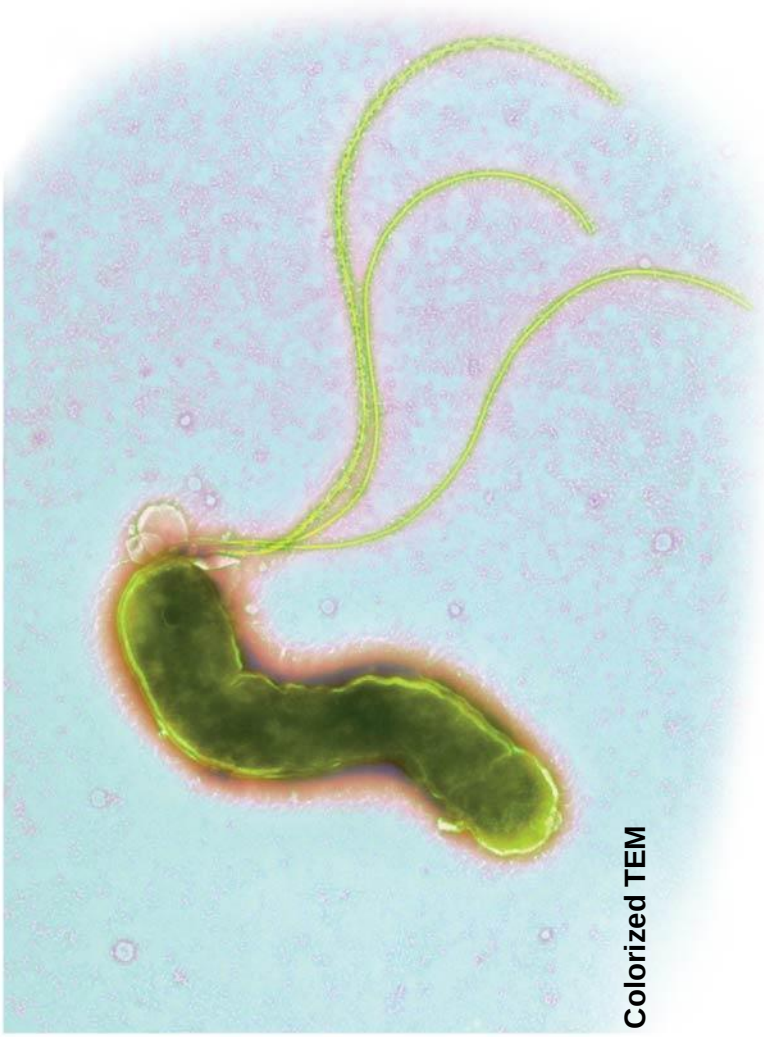
Figure 4.4

Prokaryotic Structure



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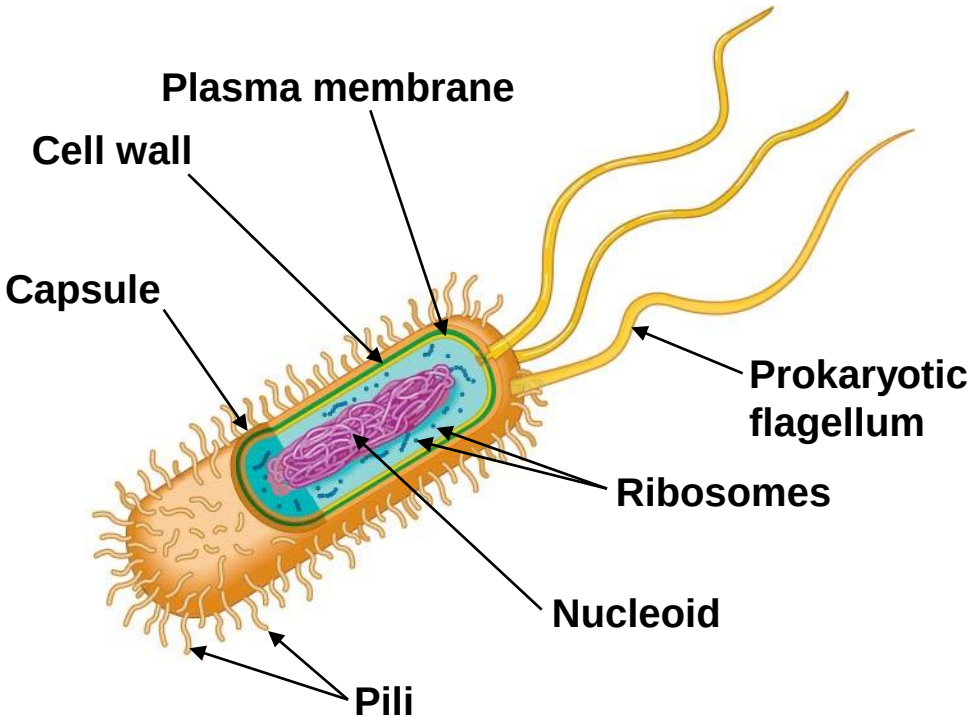

Figure 4.4a

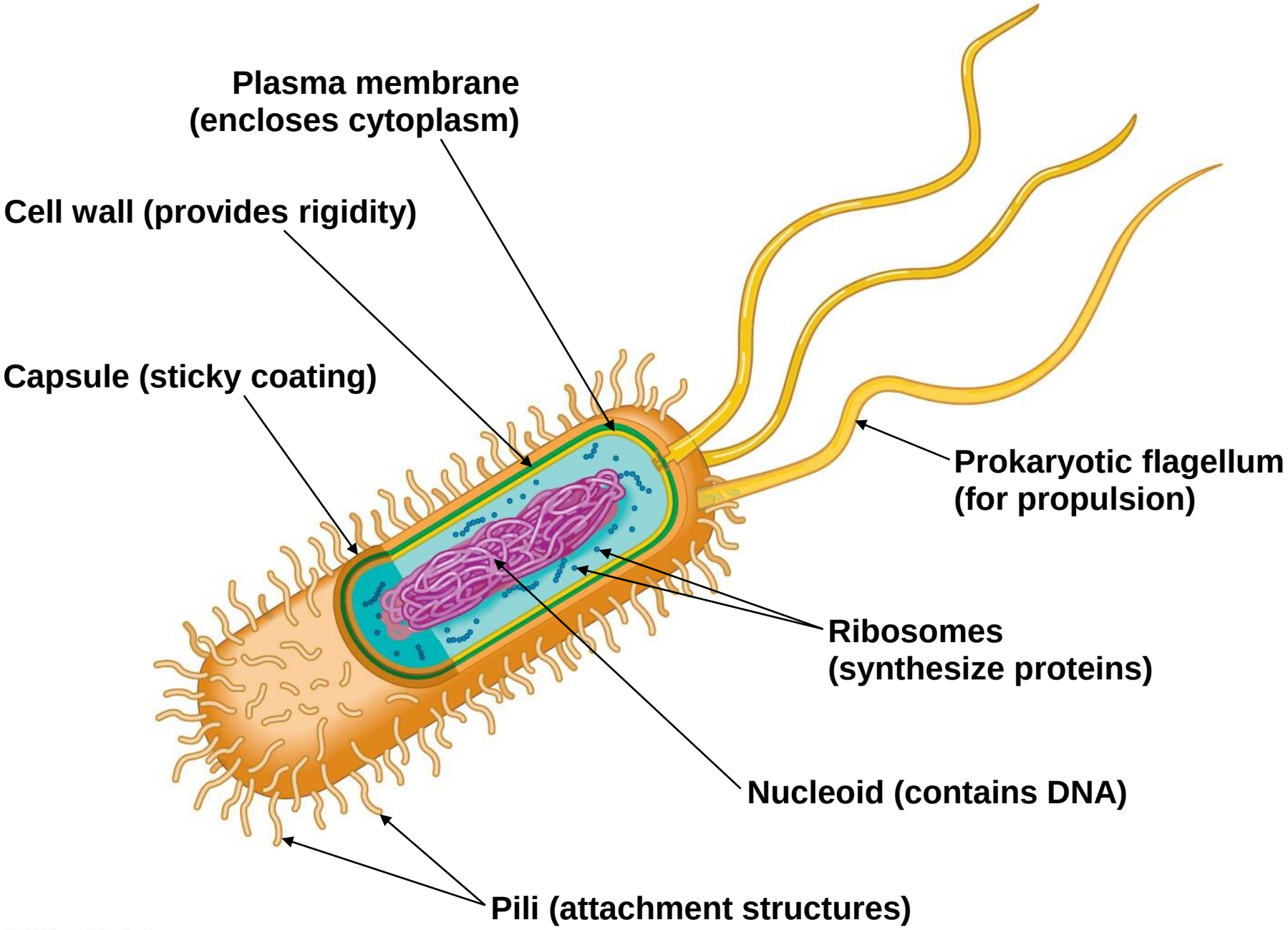

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Figure 4.5a

IDEALIZED ANIMAL CELL

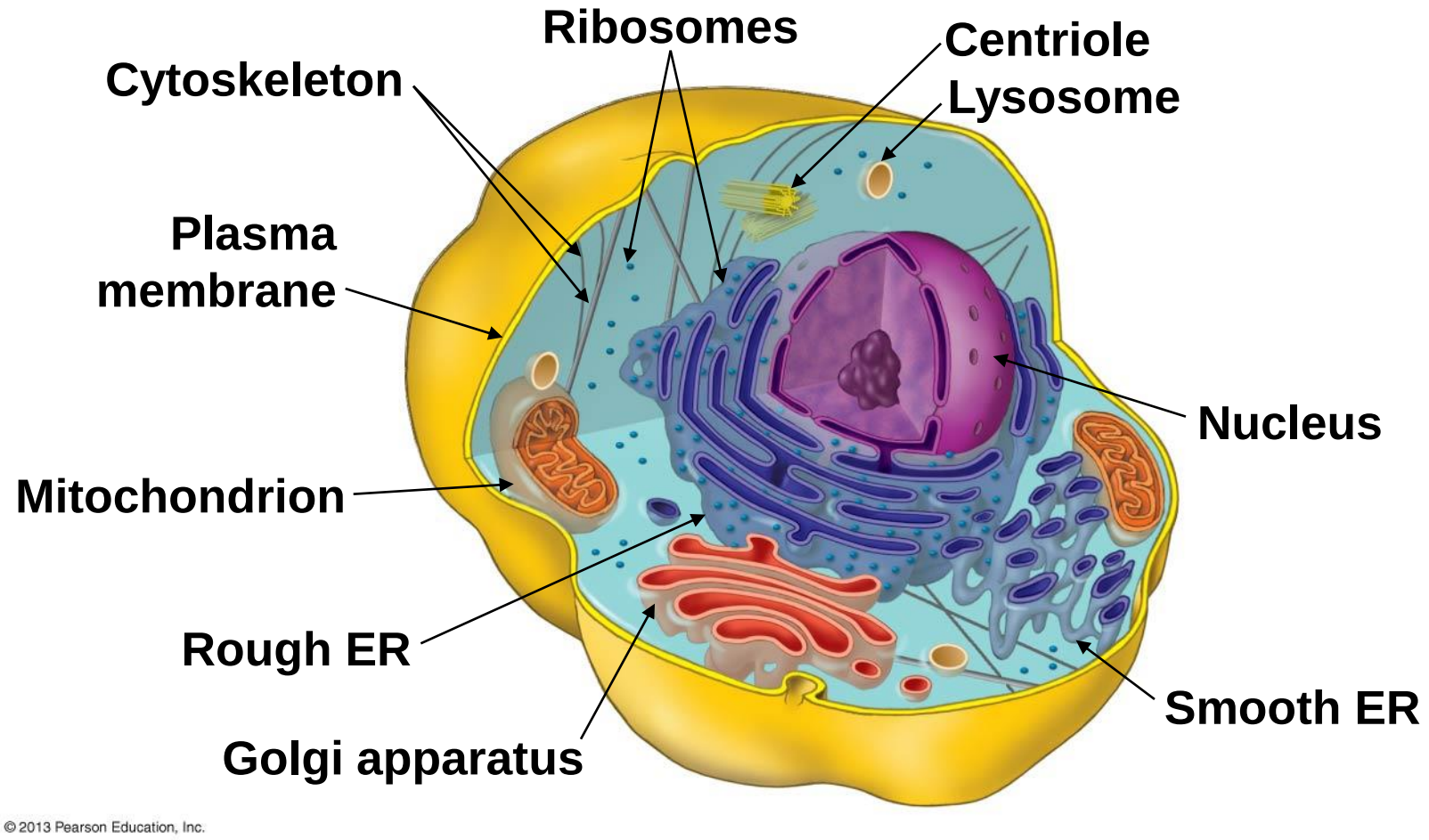

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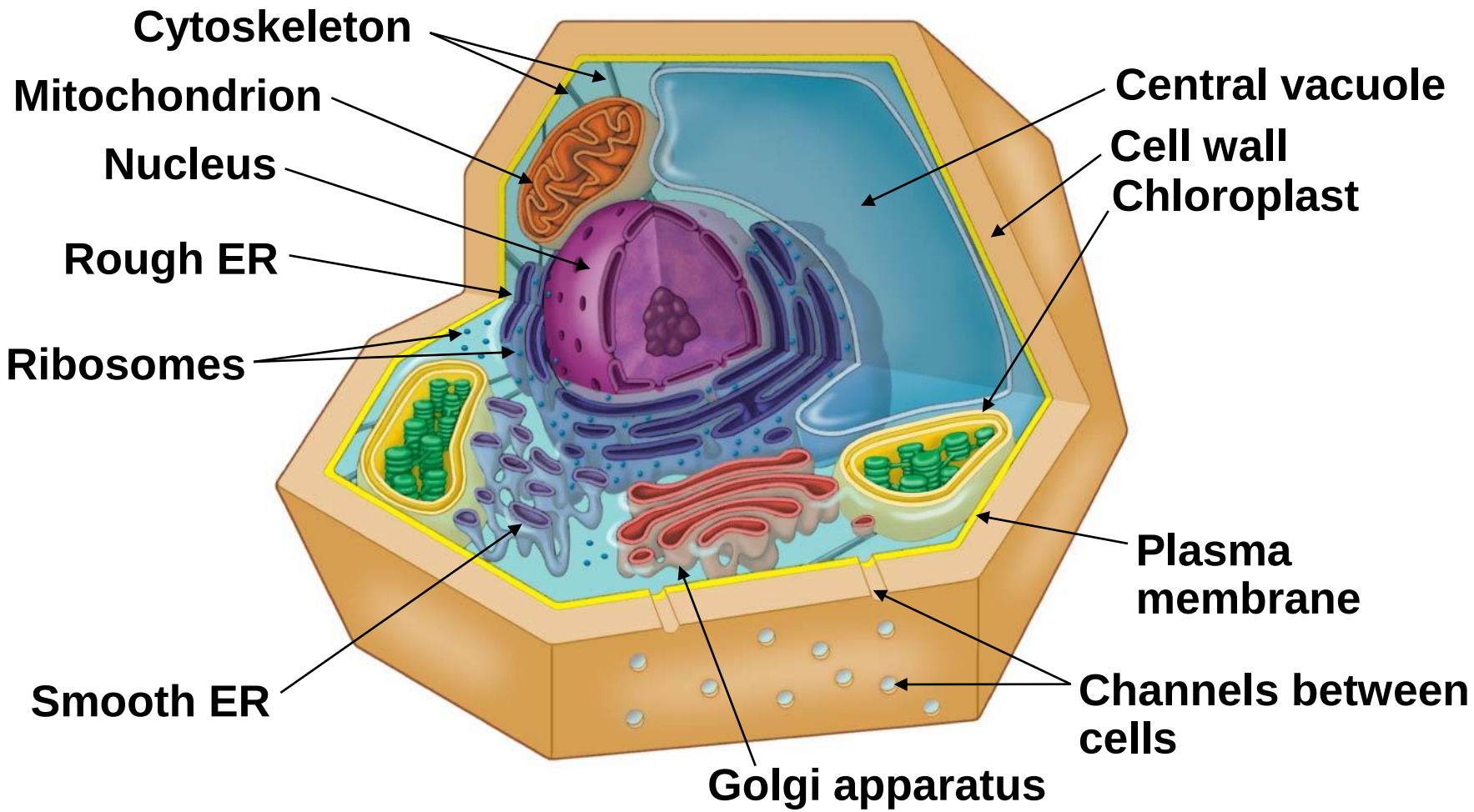
Figure 4.5b

IDEALIZED PLANT CELL



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MEMBRANE STRUCTURE

- The plasma membrane separates the living cell from its nonliving surroundings.
- Made up of :
  - Phospholipids
  - Proteins
  - Carbohydrates
  - Cholesterol

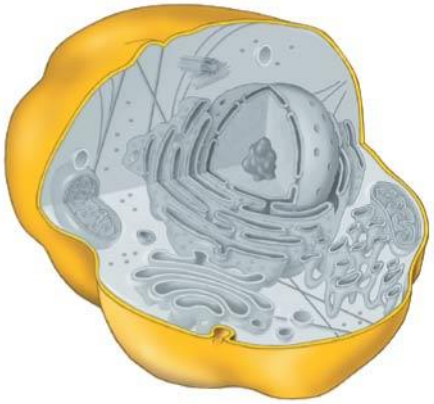

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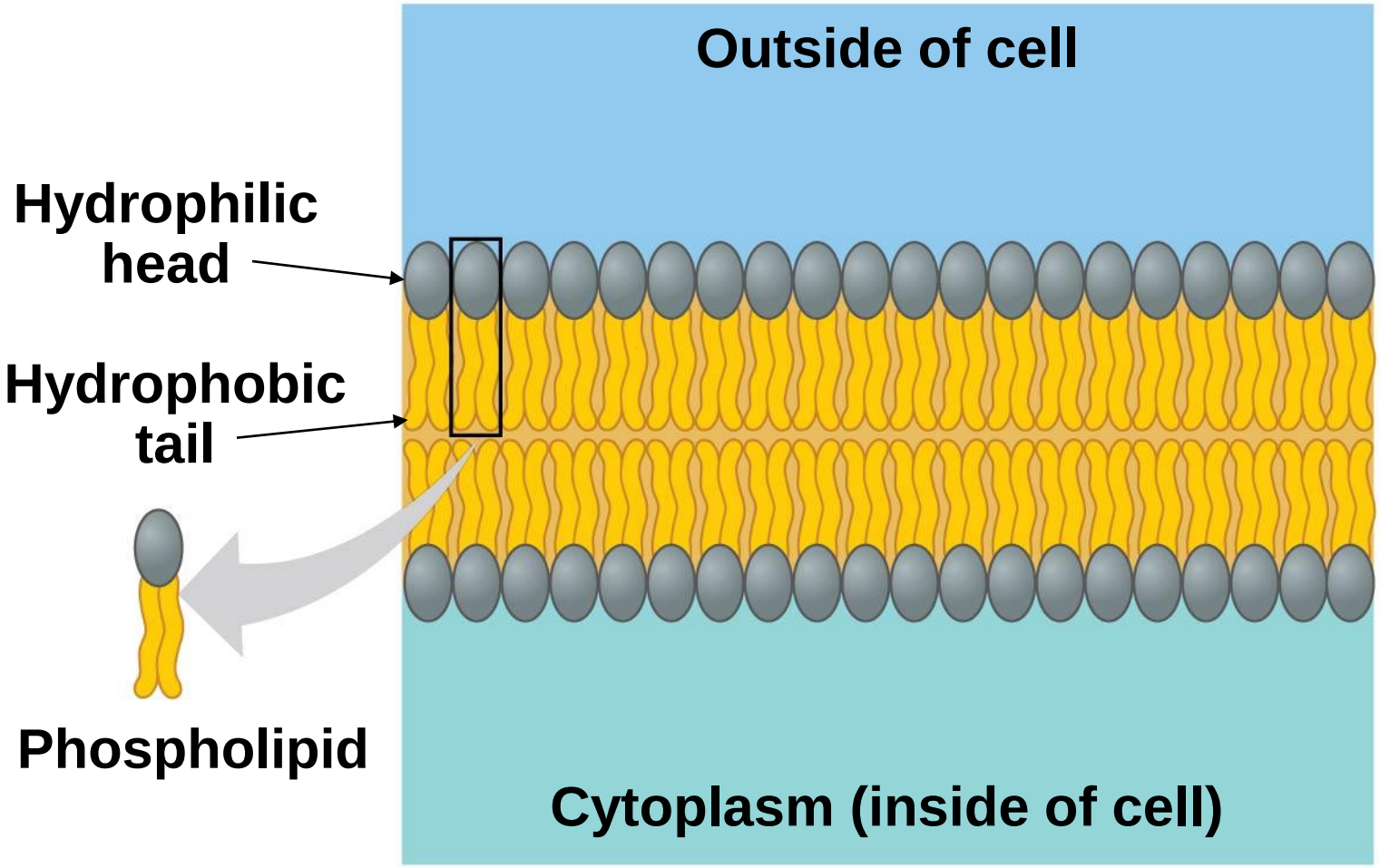
Figure 4.6a



(a) Phospholipid bilayer of membrane

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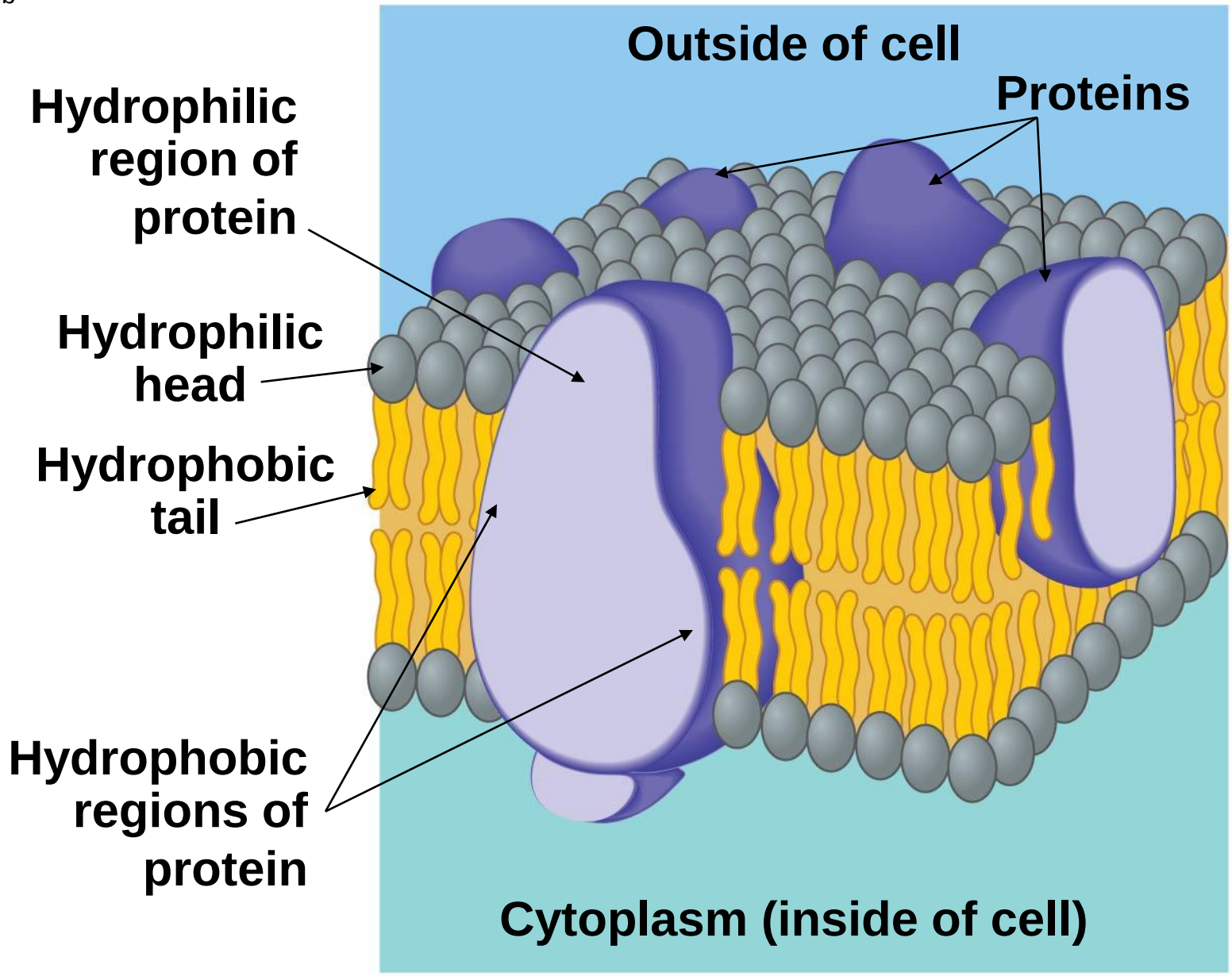
Figure 4.6b



(b) Fluid mosaic model of membrane

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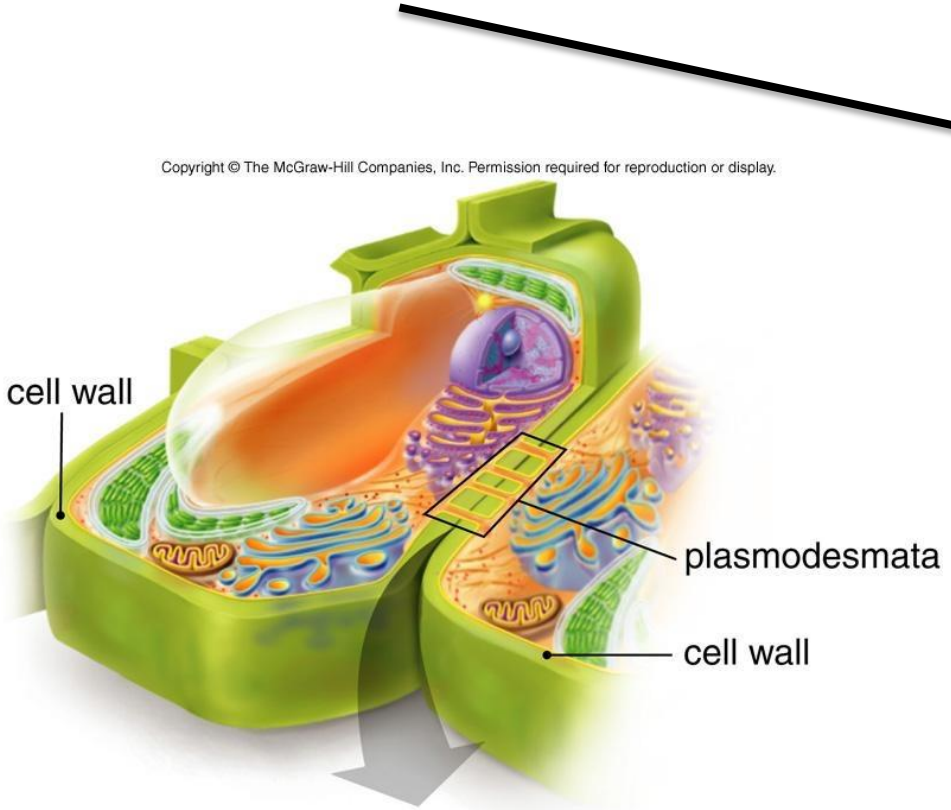
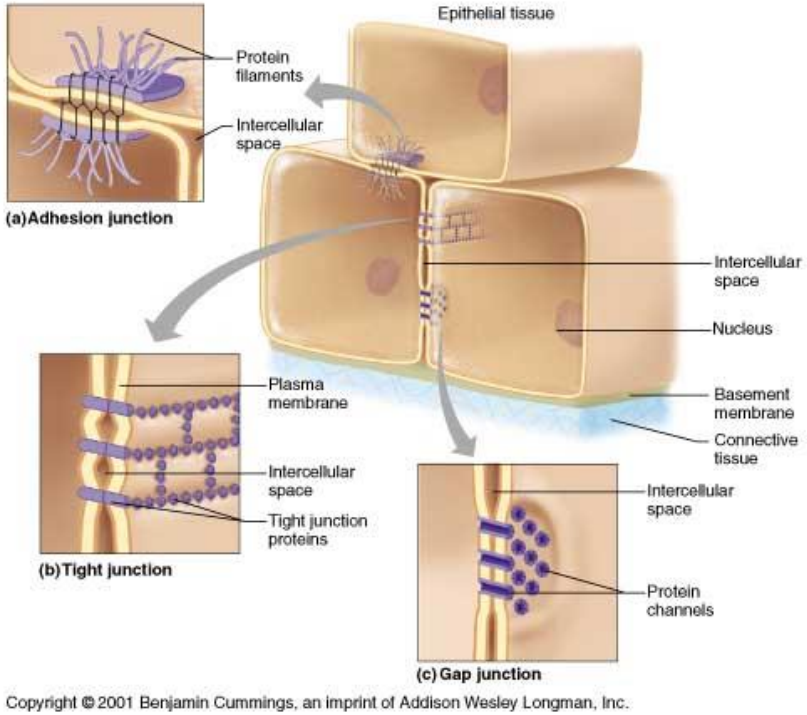
Cell Junction

- Plant cell walls have plasmodesmata
- Animal cells have extracellular matrix and junctions





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THE NUCLEUS AND RIBOSOMES: GENETIC CONTROL OF THE CELL

- The nucleus is the chief executive of the cell.
  - Genes in the nucleus store information necessary to produce proteins.
  - Proteins do most of the work of the cell.

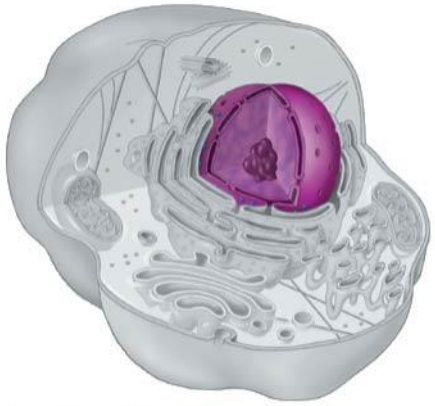

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Figure 4.8a

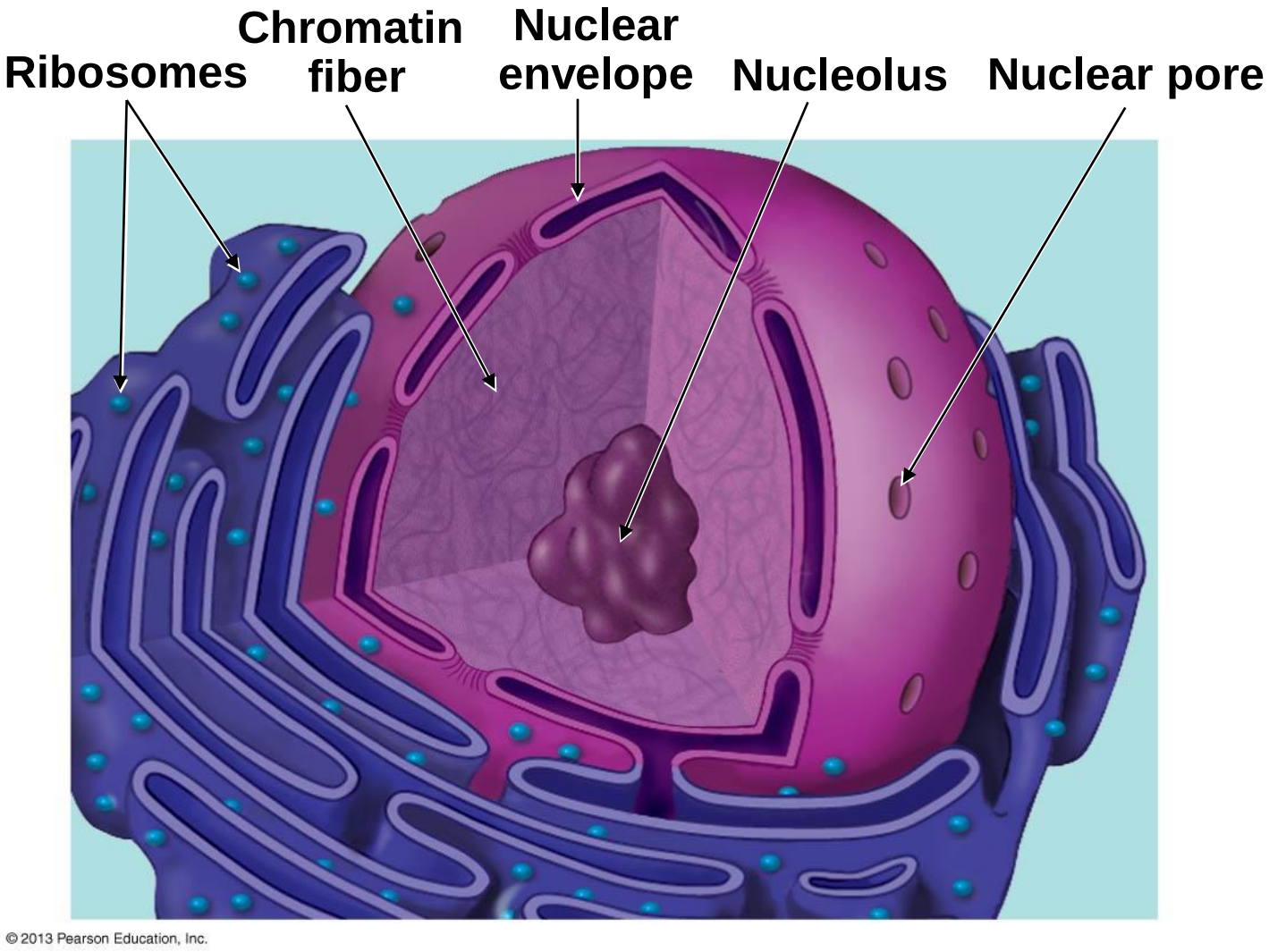

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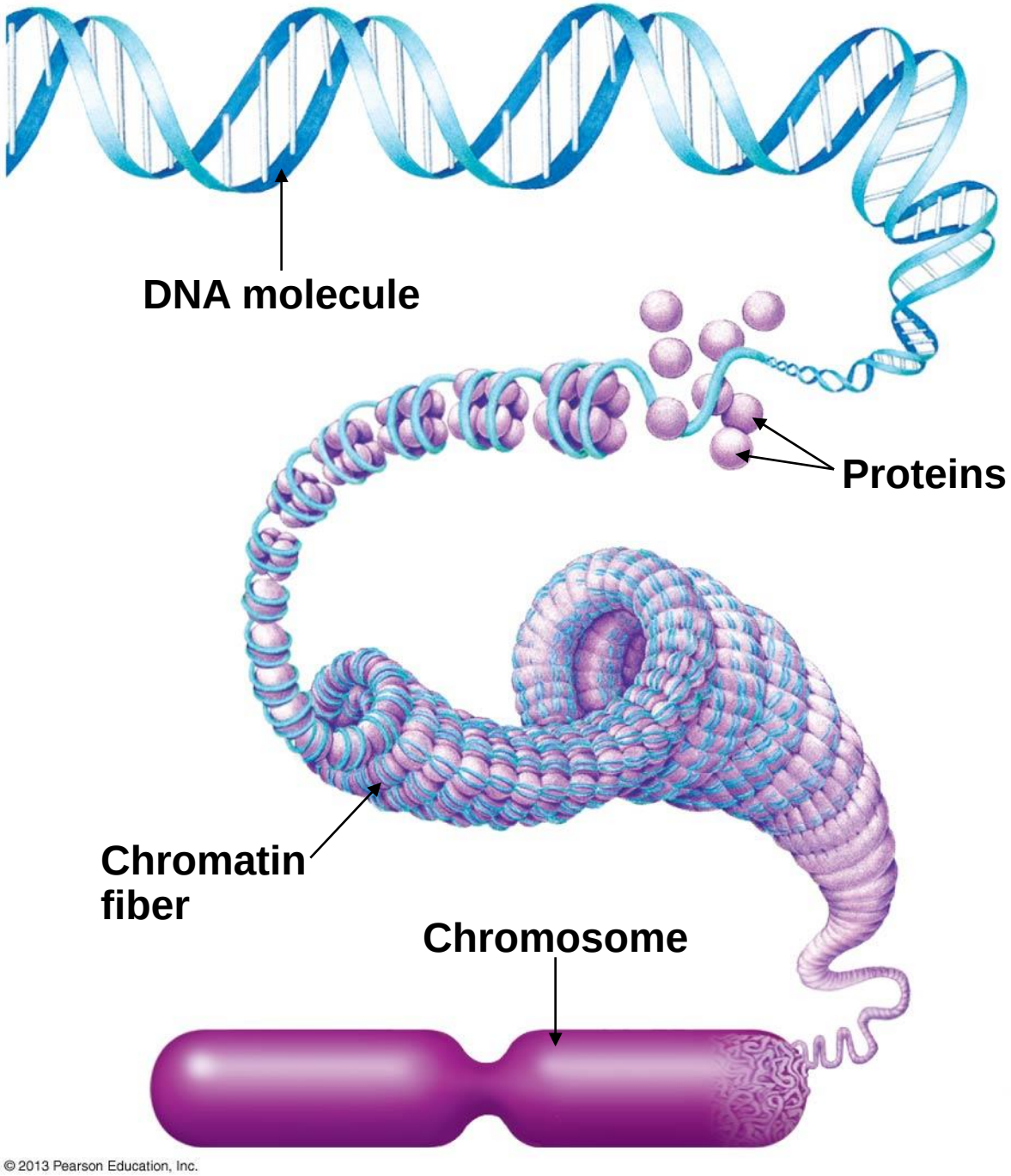
Figure 4.9



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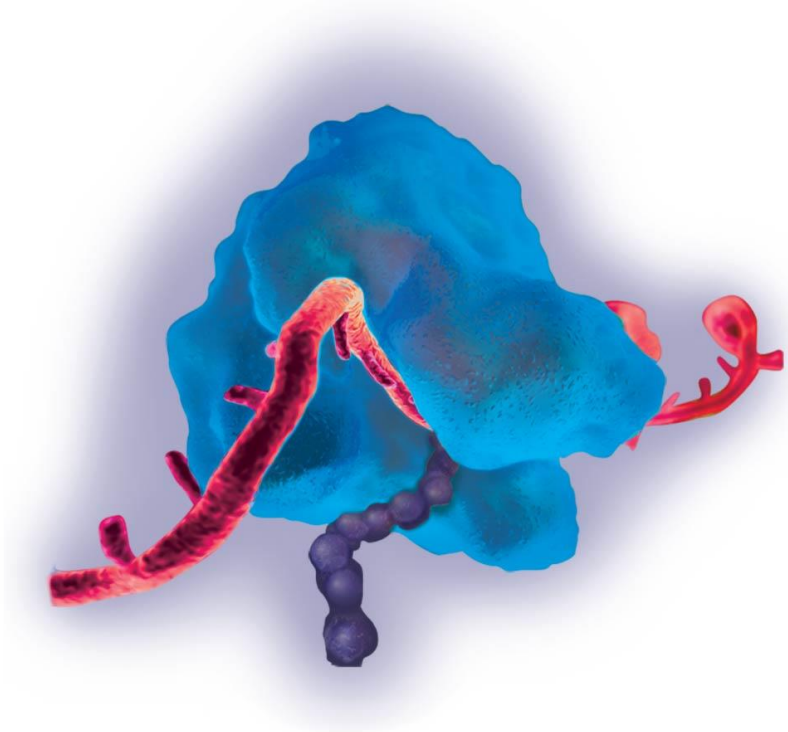
Ribosomes

- **Ribosomes** are responsible for protein synthesis.
- Ribosome components are made in the nucleolus but assembled in the cytoplasm.



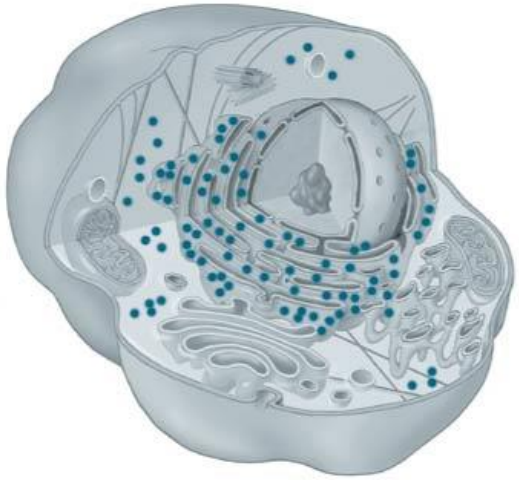


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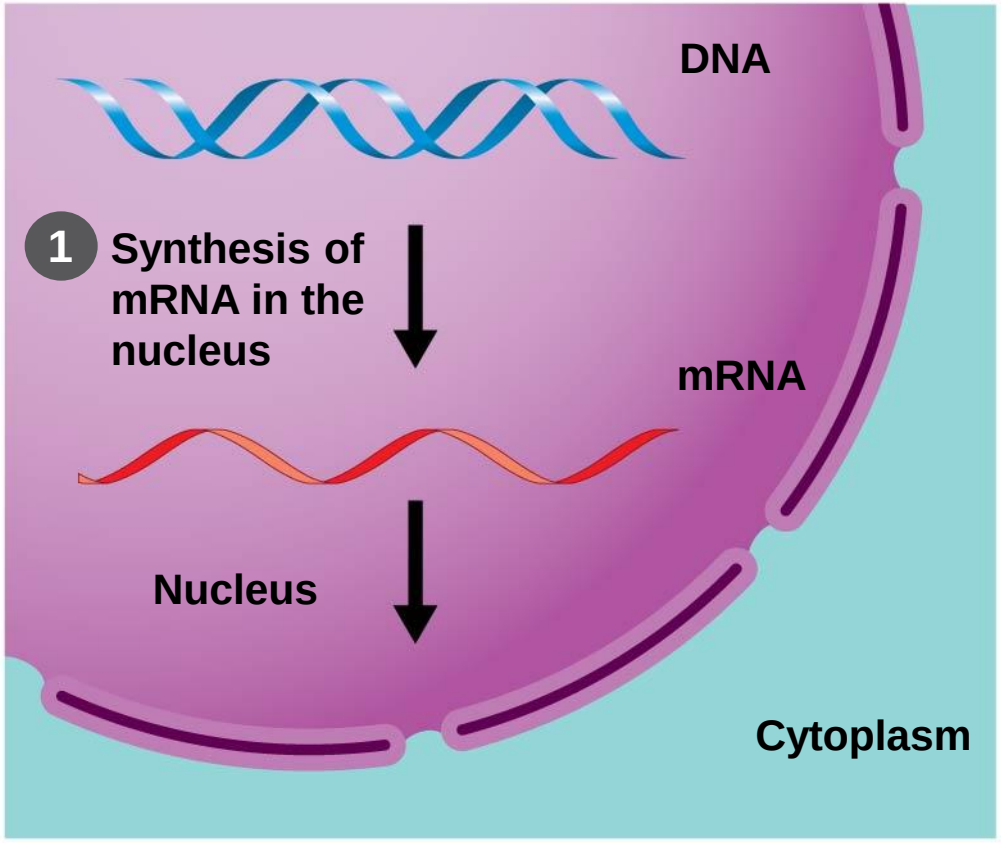
Figure 4.12-1



How DNA Directs the Information

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Figure 4.12-2

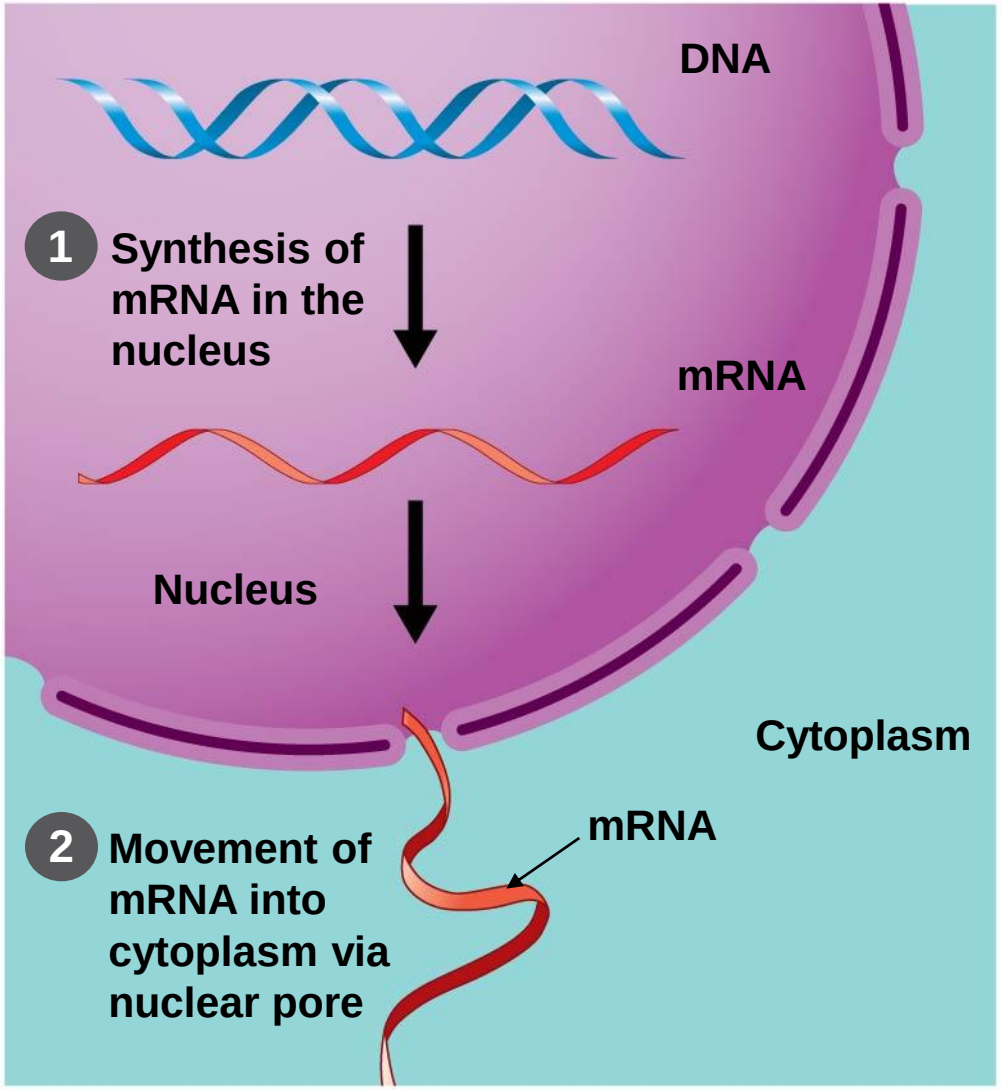

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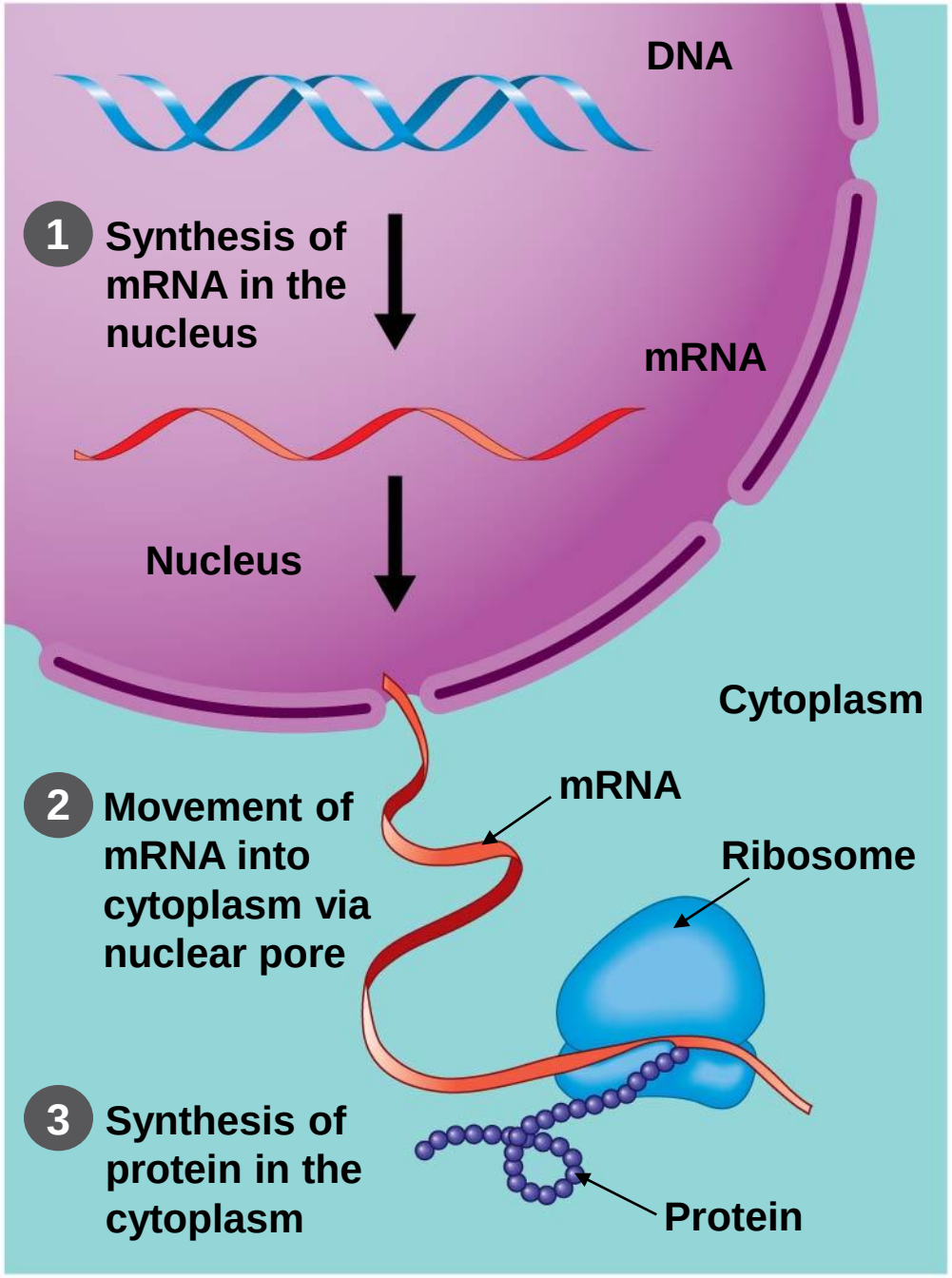
Figure 4.12-3



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THE ENDOMEMBRANE SYSTEM:

1. Nuclear envelope
2. Endoplasmic reticulum (Rough and smooth)
3. Golgi Apparatus
4. Lysosomes
5. Vacuoles
6. Vesicles

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The Endoplasmic Reticulum

- The ER
  - is connected to the nuclear envelope, and
  - is composed of smooth and rough ER.

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Figure 4.13a

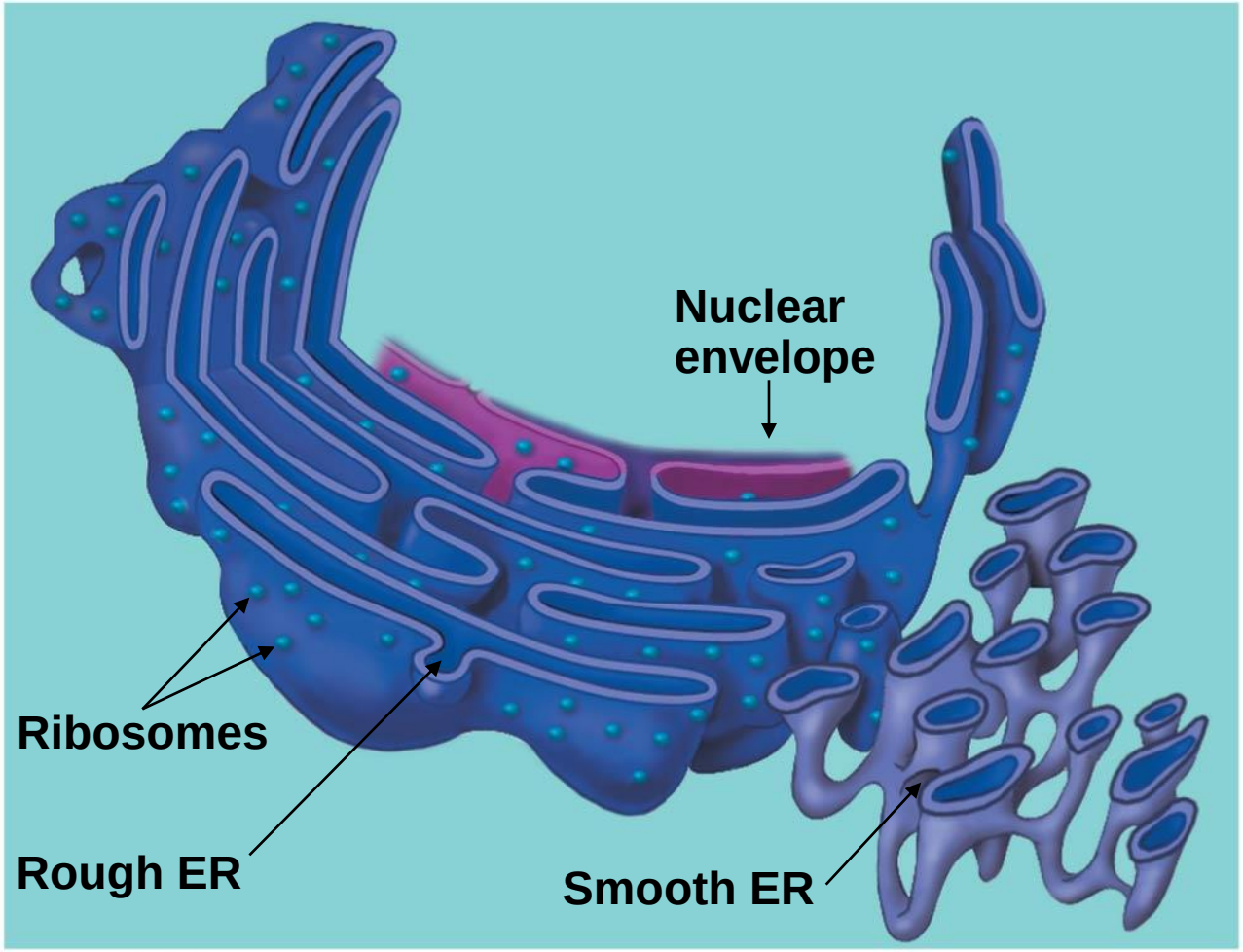

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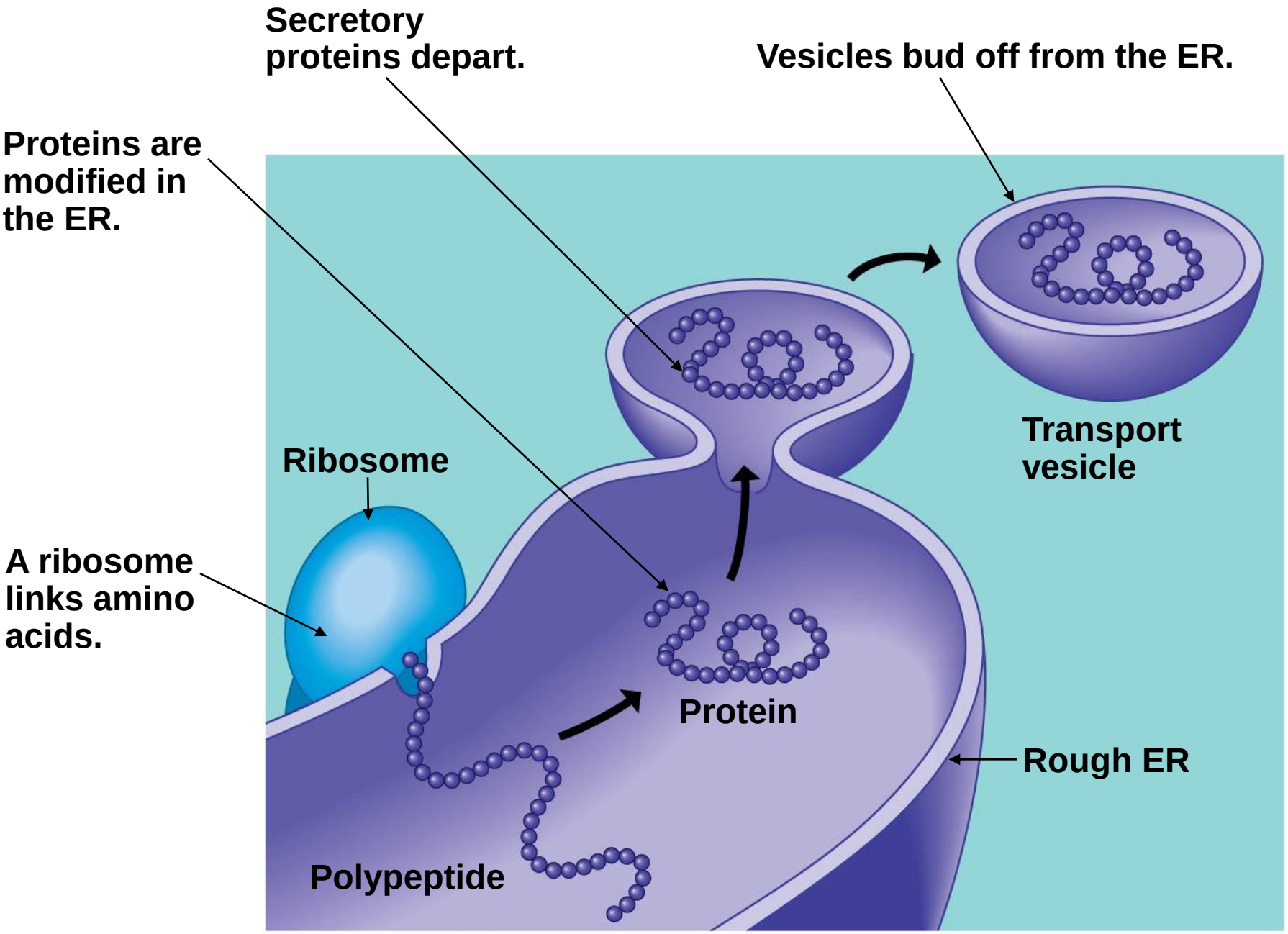
Figure 4.14



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The Golgi Apparatus

- The **Golgi apparatus**
  - works in partnership with the ER and
  - receives, refines, stores, and distributes chemical products of the cell.

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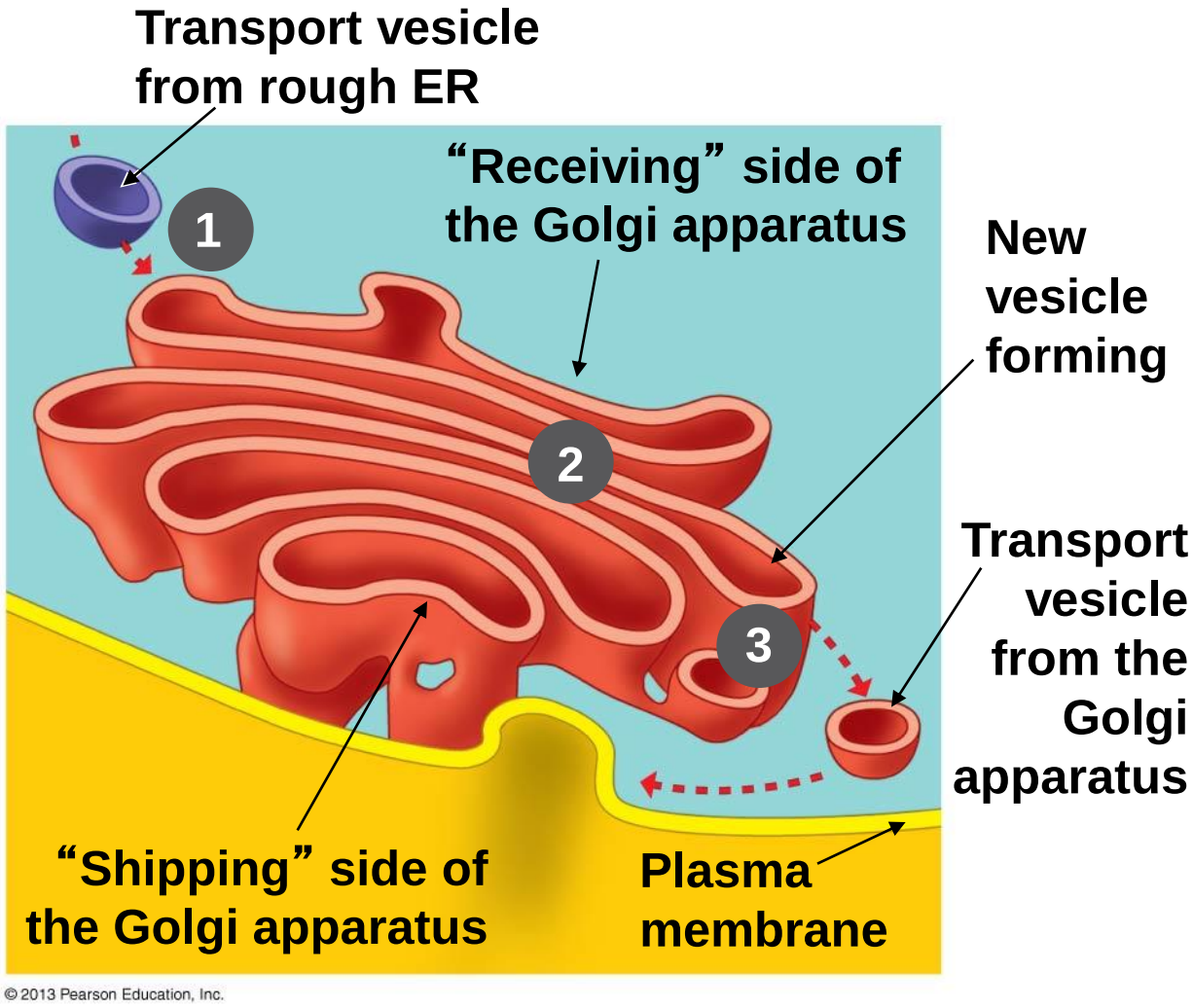
Figure 4.15a



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Lysosomes

- A **lysosome** is a membrane-bound sac of digestive enzymes found in animal cells.
- Enzymes in a lysosome can break down large molecules such as
  - proteins,
  - polysaccharides,
  - fats, and
  - nucleic acids.

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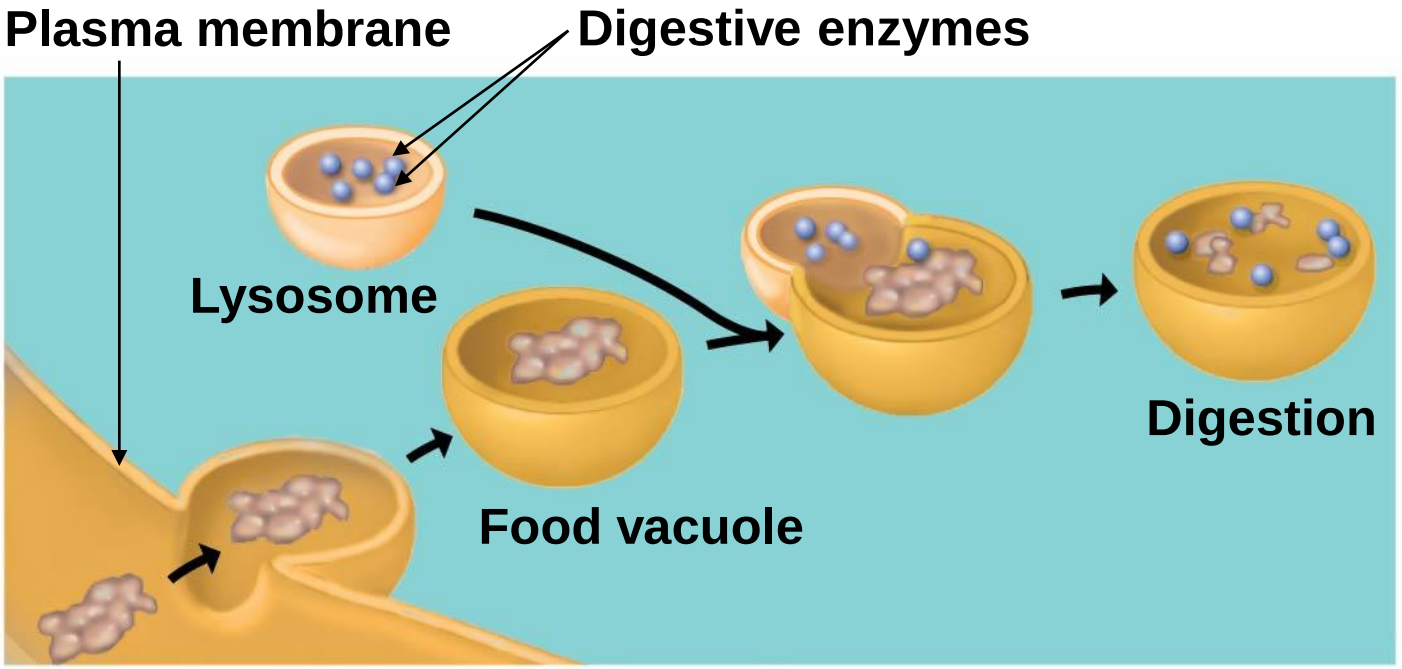
Figure 4.16a



(a) A lysosome digesting food

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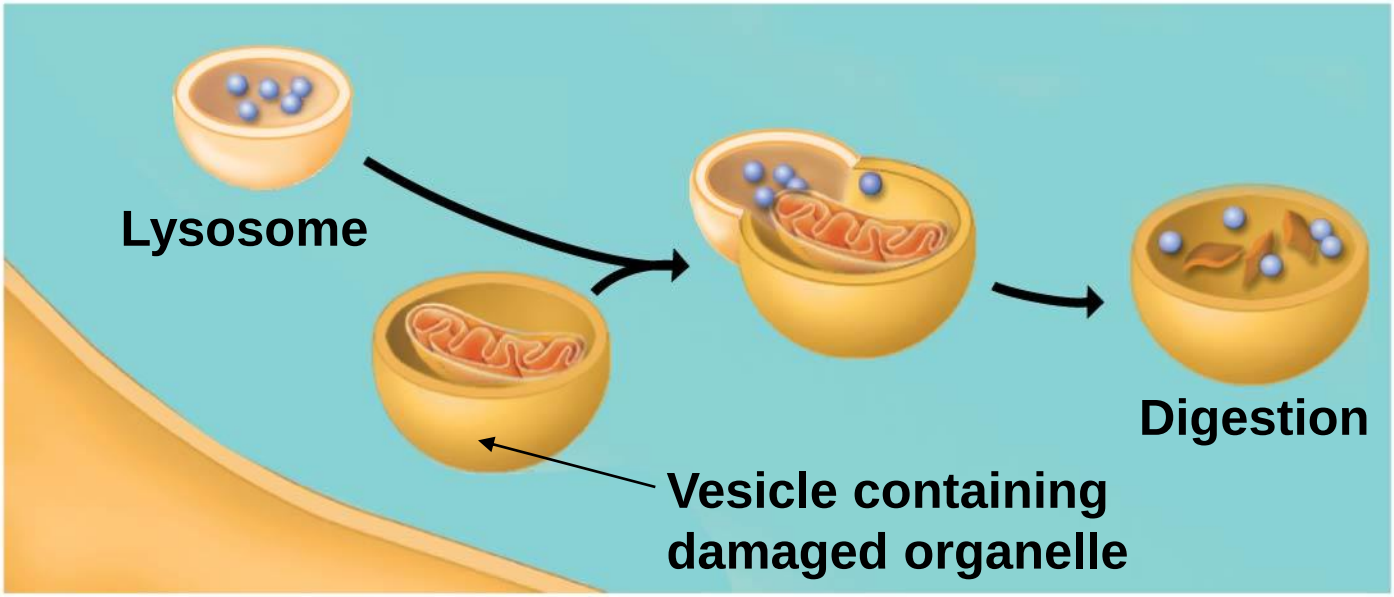
Figure 4.16b



(b) A lysosome breaking down the molecules of damaged organelles

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Vacuoles

- Vacuoles are large sacs of membrane that bud from the
  - ER,
  - Golgi apparatus, or
  - plasma membrane.
- Two kinds of vacuoles (Contractile and central)

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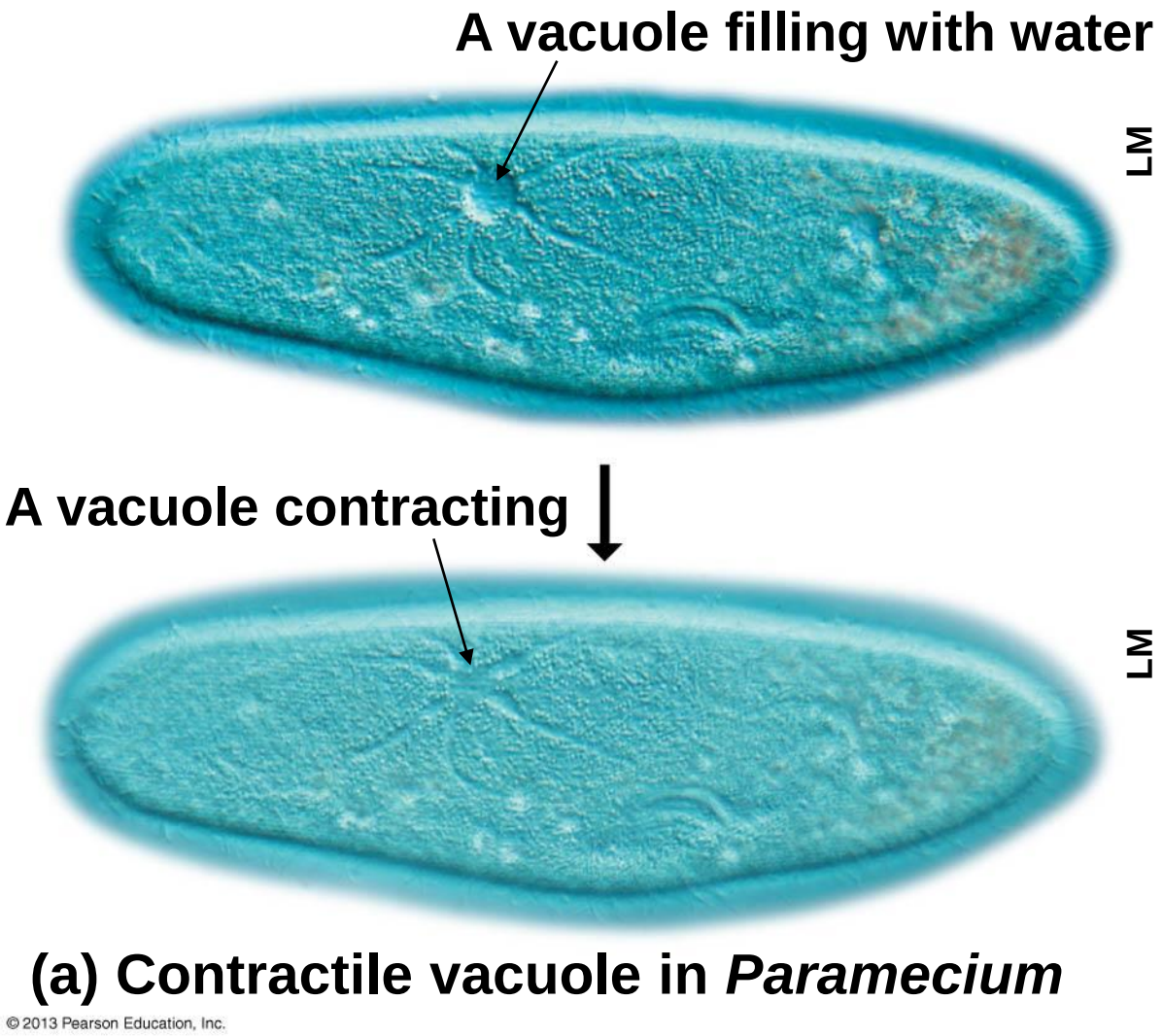
Figure 4.17a



(a) Contractile vacuole in *Paramecium*

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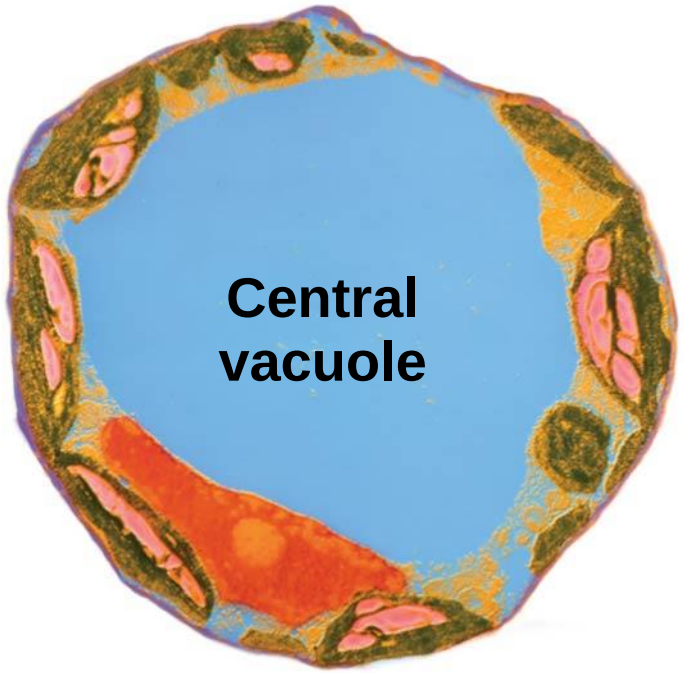
Figure 4.17b



(b) Central vacuole in a plant cell

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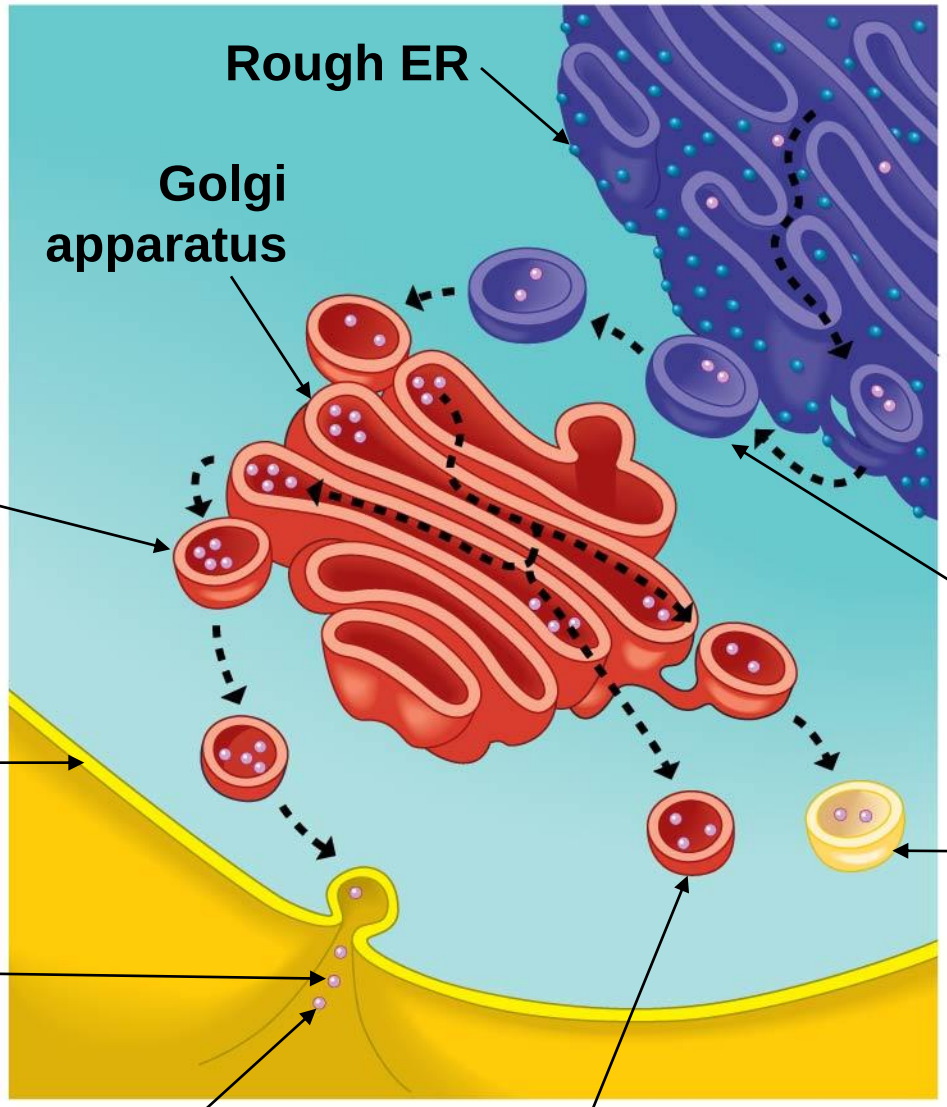
Figure 4.18a

Review: Endomembrane System



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CHLOROPLASTS AND MITOCHONDRIA: ENERGY CONVERSION

- Cells require a continuous energy supply to perform the work of life.
- Two organelles act as cellular power stations:
  1. chloroplasts and
  2. mitochondria.

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Figure 4.19

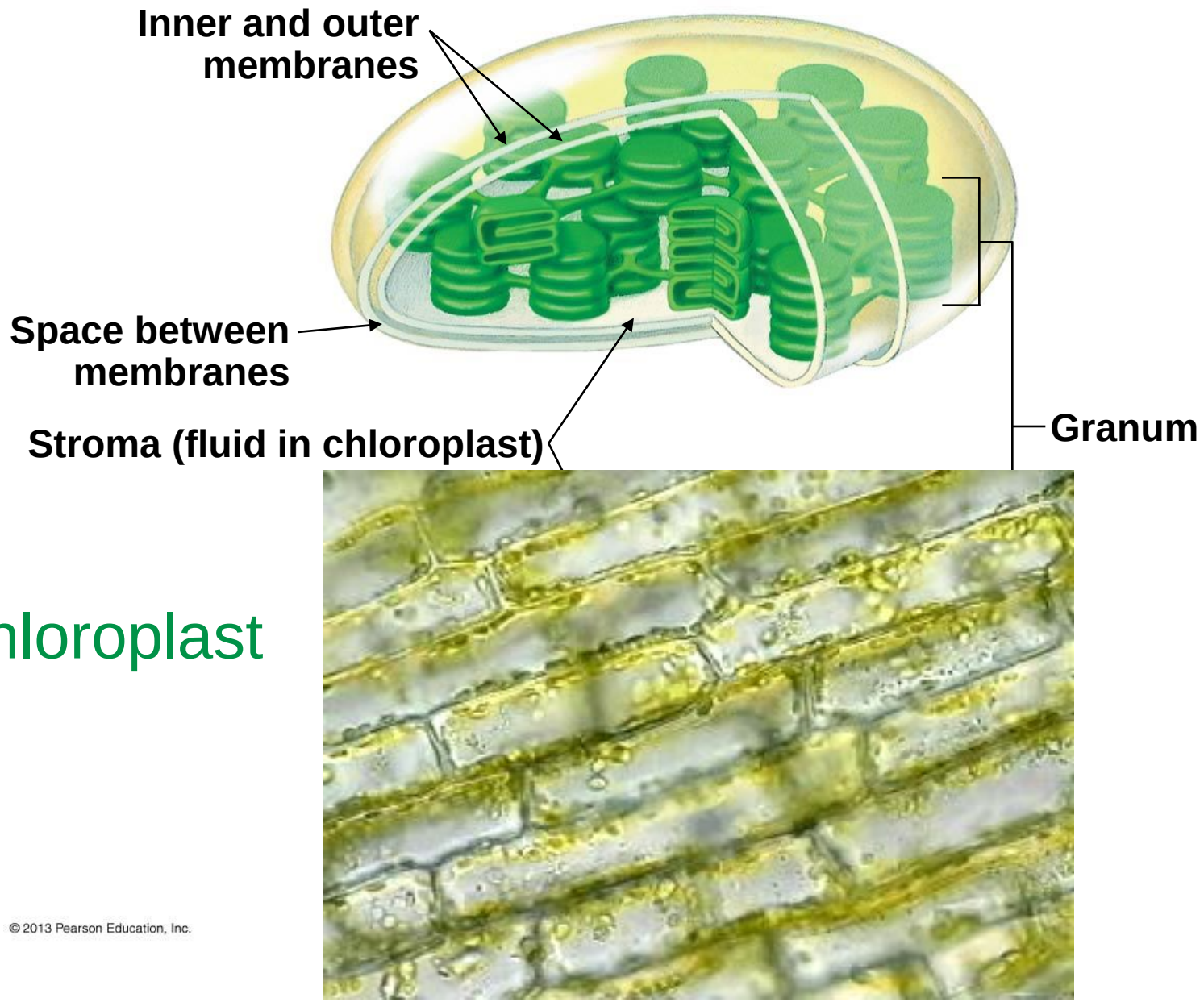

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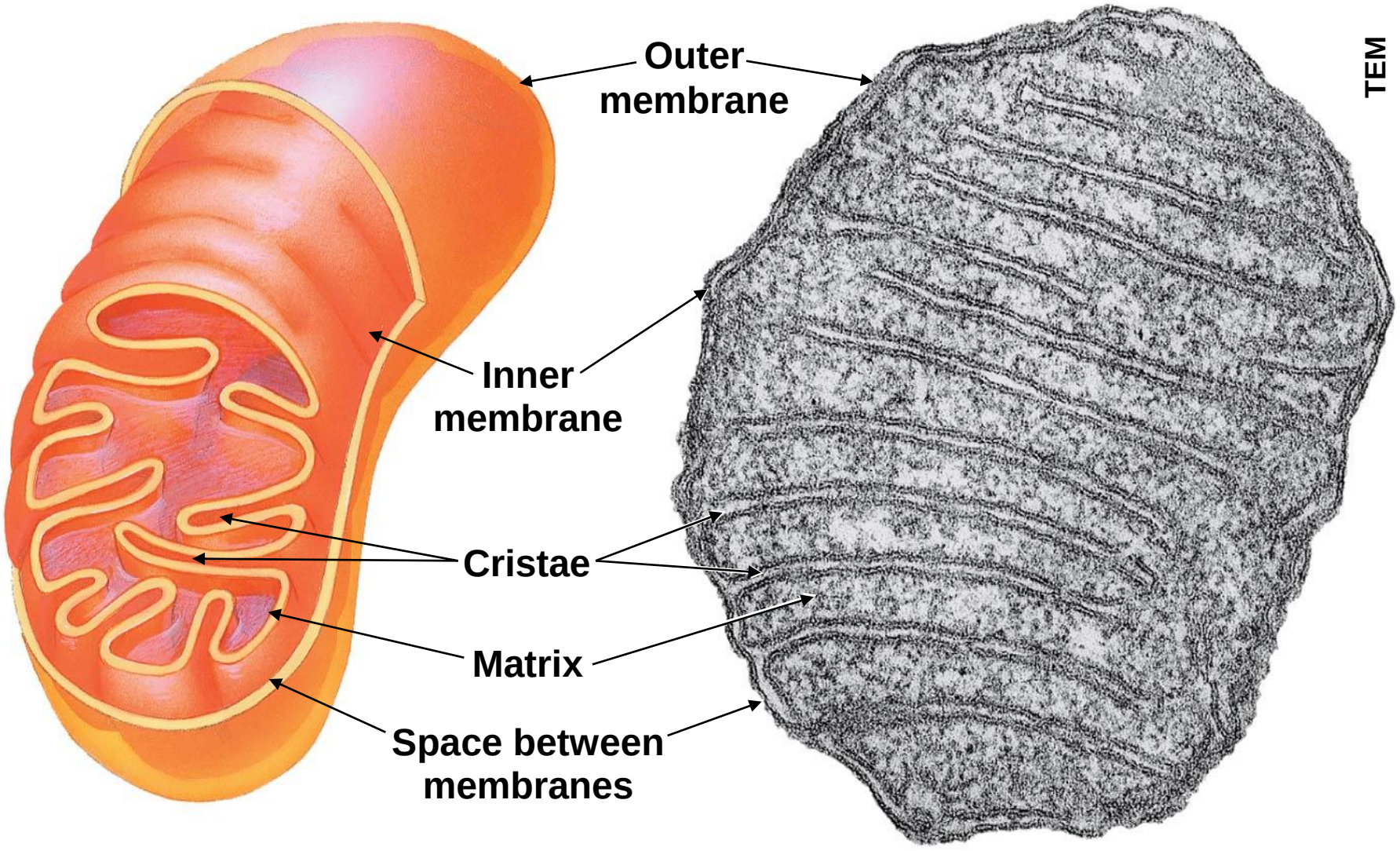
Figure 4.20

Mitochondrion



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THE CYTOSKELETON: CELL SHAPE AND MOVEMENT

- The **cytoskeleton** is a network of fibers extending throughout the cytoplasm.
  - provides mechanical support to the cell and
  - helps a cell maintain its shape.

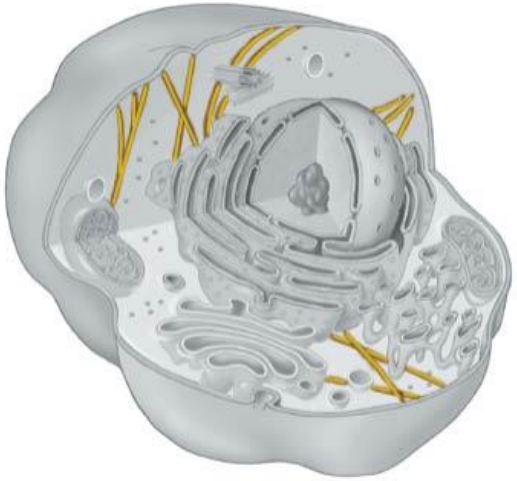

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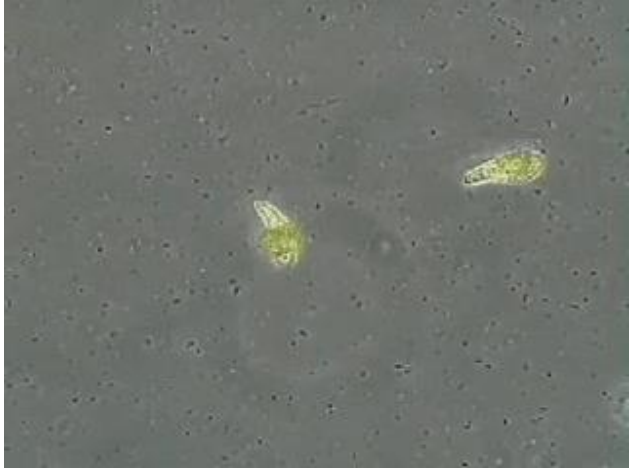
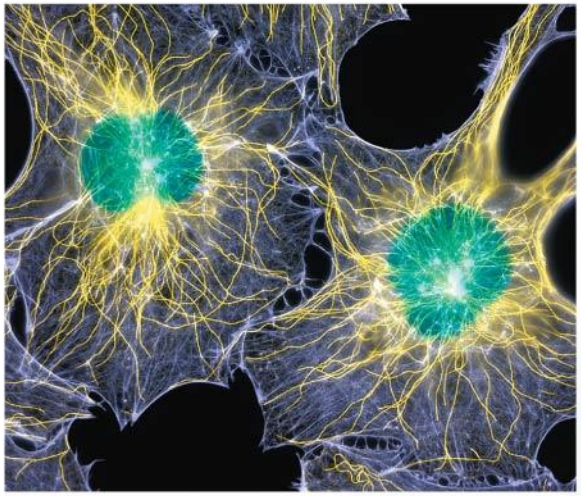
Figure





LM

(a) Microtubules in the cytoskeleton

(b) Microtubules and movement

LM

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Cilia and Flagella

- Cilia and flagella are motile appendages that aid in movement.
  - **Flagella** propel the cell through their undulating, whiplike motion.
  - **Cilia** move in a coordinated back-and-forth motion.
  - Cilia and flagella have the same basic architecture, but cilia are generally shorter and more numerous than flagella.

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Figure 4.22a

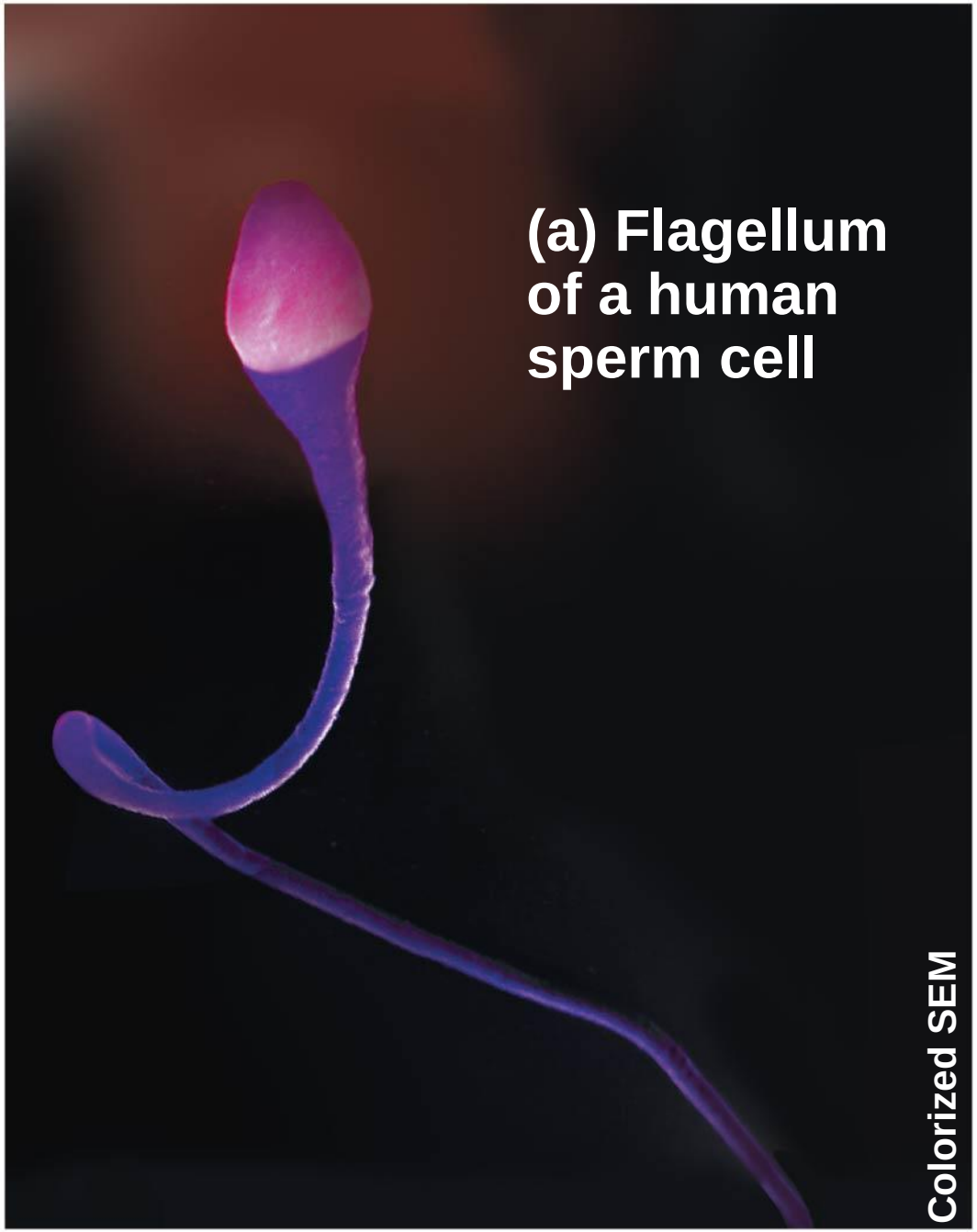

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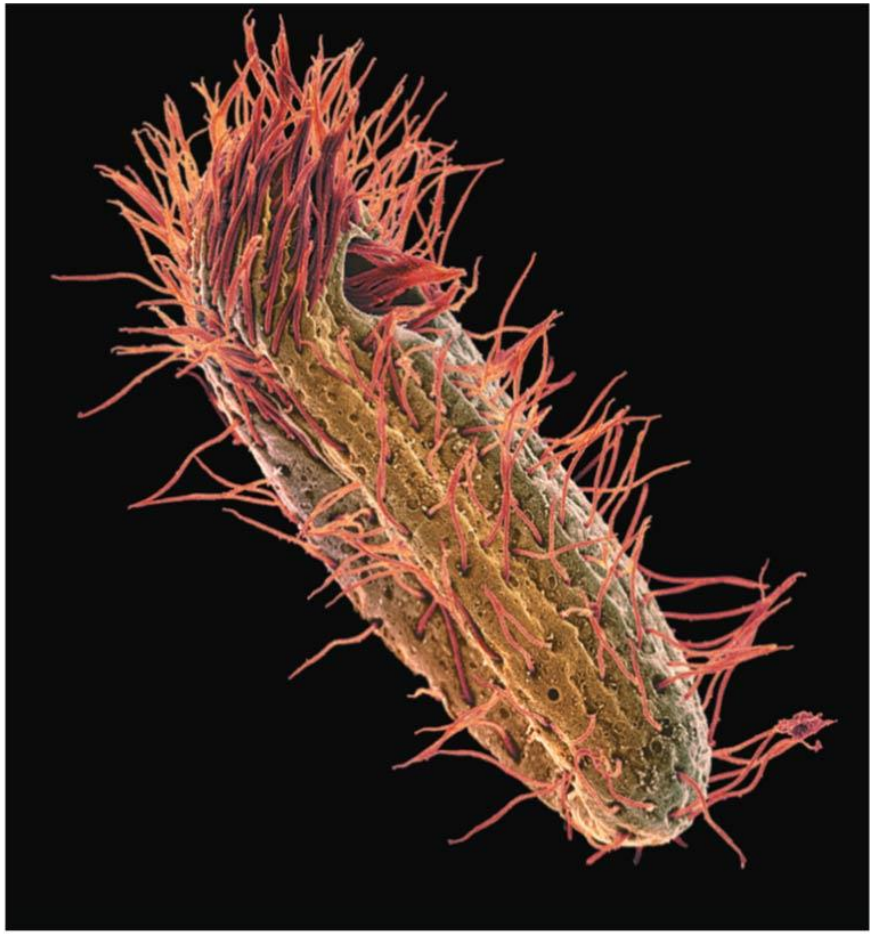
Figure 4.22b



(b) Cilia on a protist

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Figure 4.22c

(c) Cilia lining the respiratory tract

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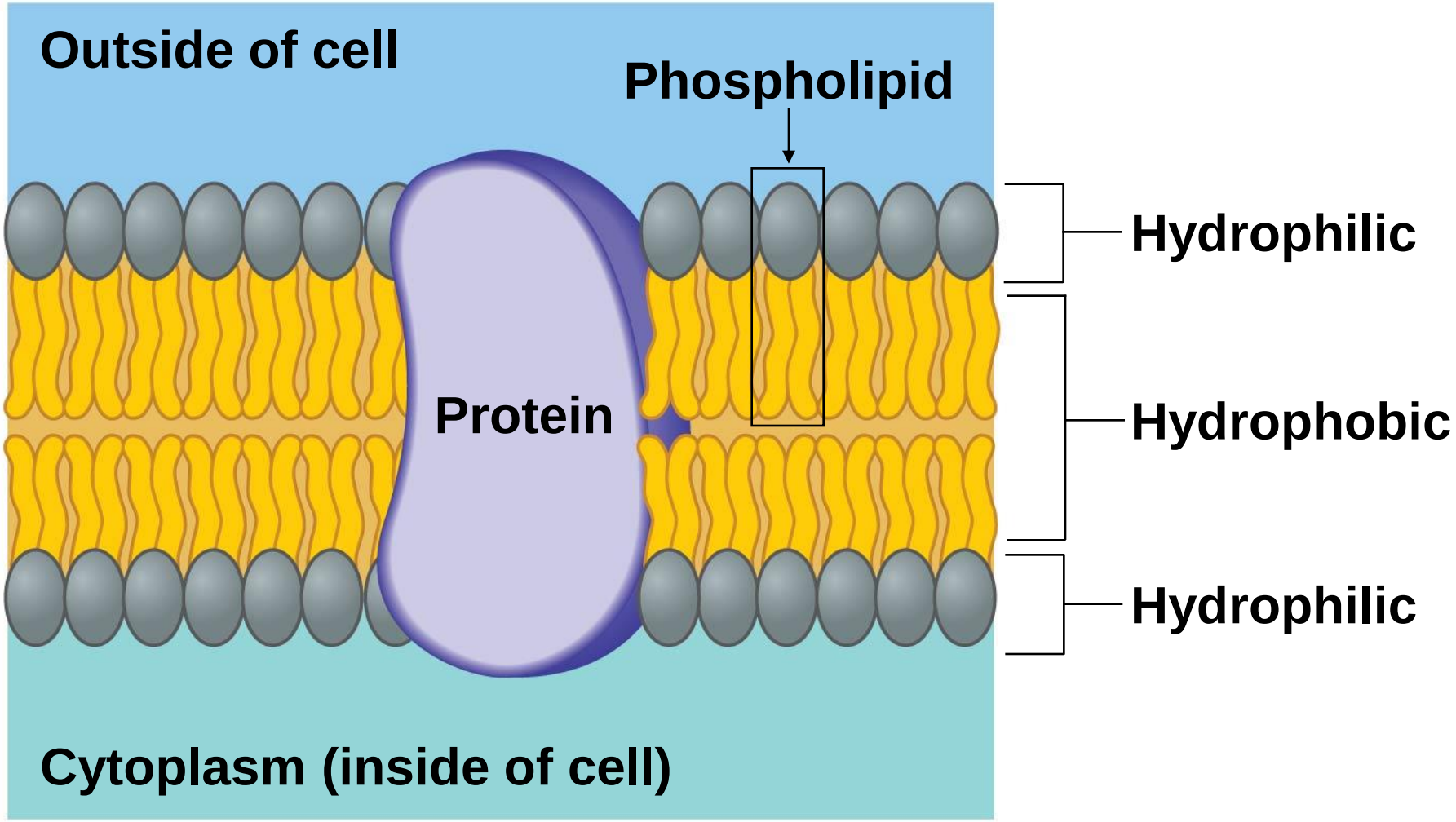
Figure 4.UN12



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Review

1. What type of microscope would be best for studying the detailed structure of the surface of a plasma membrane?

A) light microscope

B) transmission electron microscope

C) scanning electron microscope

D) both a light microscope and an electron microscope

2) You find a cell of a type you have never seen before. The cell has both a nucleus and a cell wall. Therefore, you conclude that it must be a _____ cell.

A) prokaryotic

B) animal

C) bacterial

D) plant

3) _____ are the major lipids of plasma membranes.

A) Steroids

B) Fatty acids

C) Mosaics

D) Phospholipids

4) What structures move proteins from the ER to the Golgi apparatus?

A) transport proteins

B) central vacuole

C) transport vesicles

D) Nucleolus

5) Plant cells, unlike animal cells, are characterized by the presence of a _____.

A) cell wall and contractile vacuole

B) cell wall and central vacuole

C) nucleus and cell wall

D) nucleus and contractile vacuole