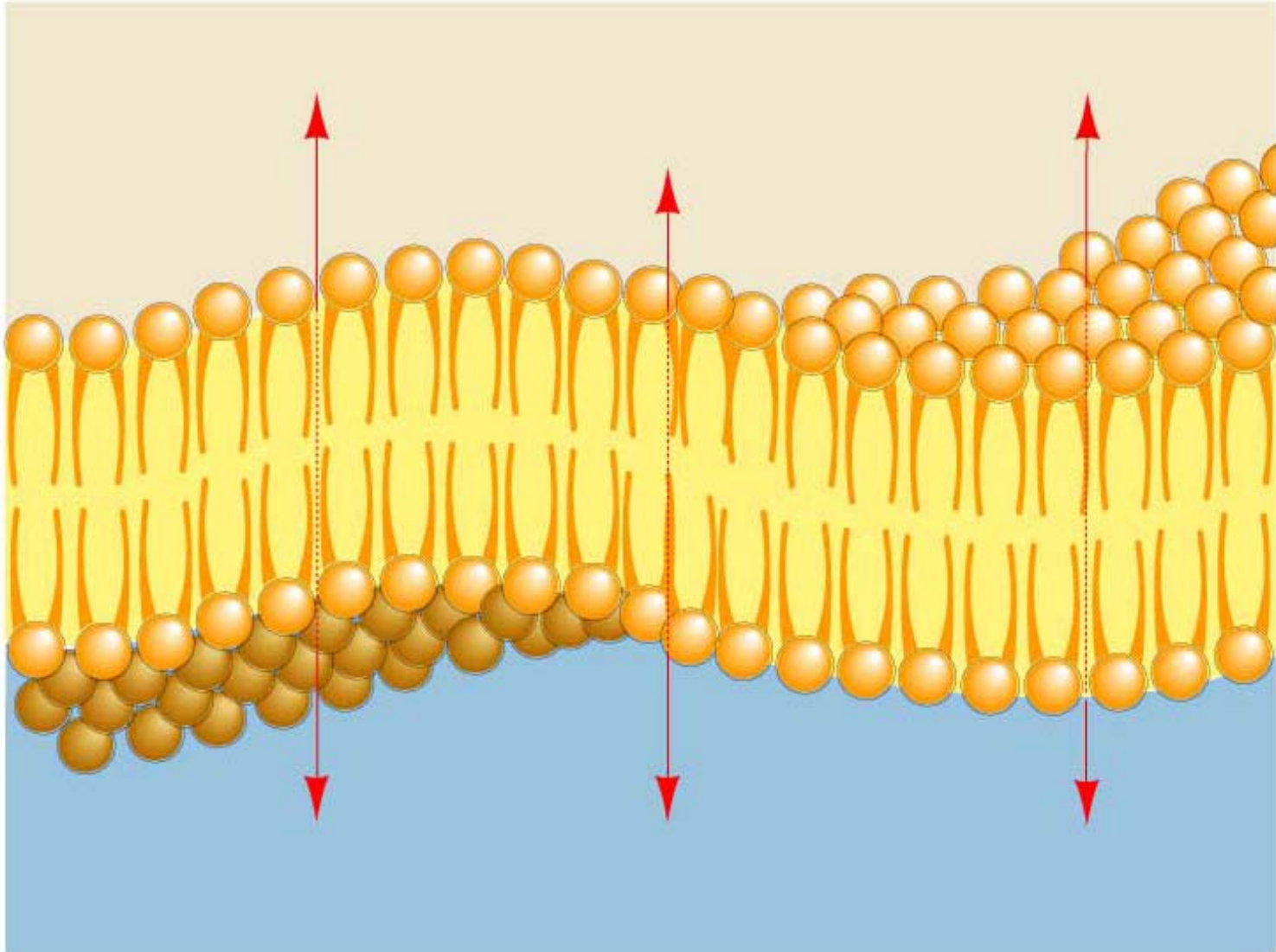


Chapter 4:

Cell Membrane Structure and Function



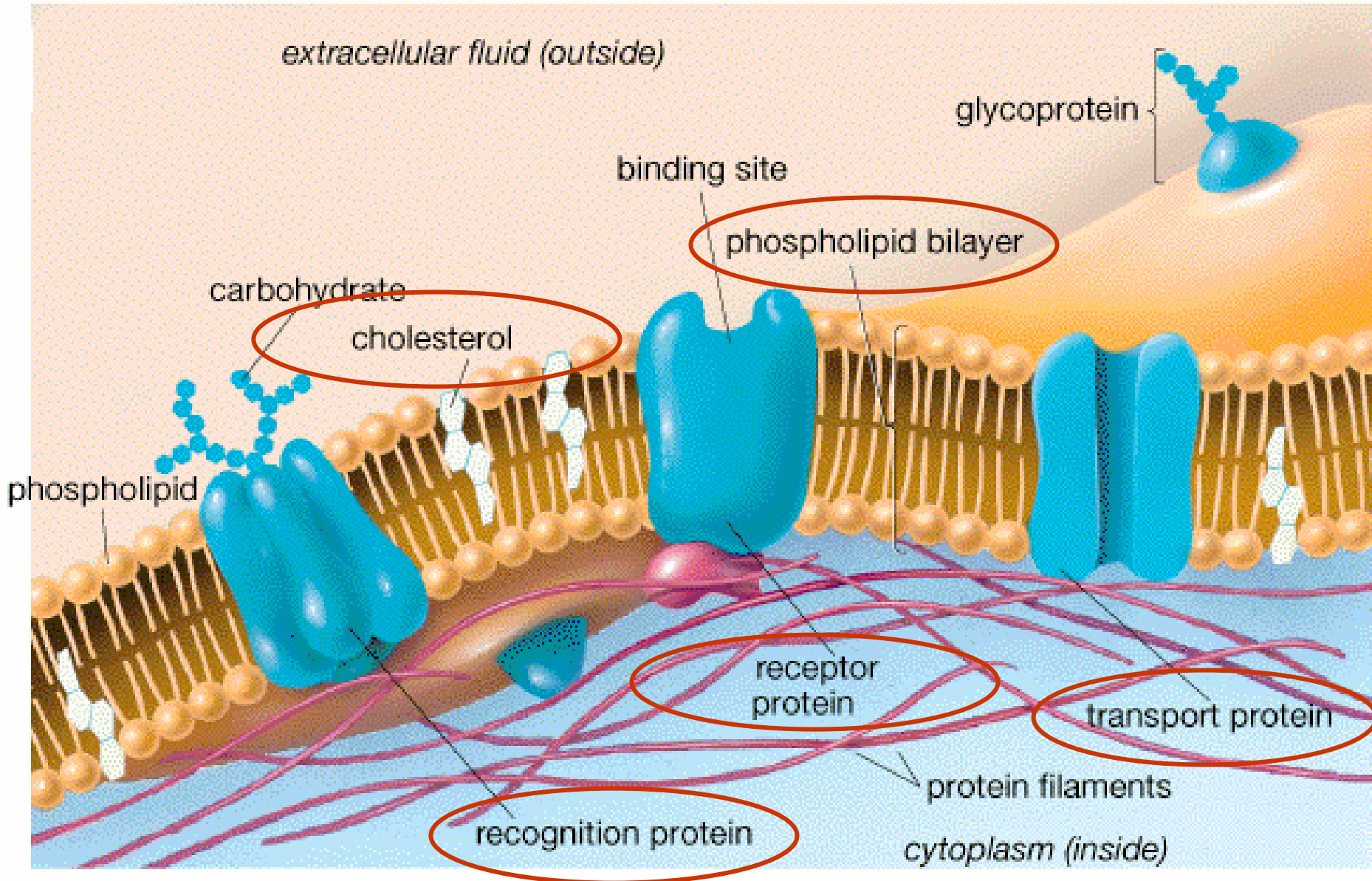
Plasma Membrane: Thin barrier separating inside of cell (cytoplasm) from outside environment

Function:

- 1) Isolate cell's contents from outside environment
- 2) Regulate exchange of substances between inside and outside of cell
- 3) Communicate with other cells

Note: Membranes also exist within cells forming various compartments where different biochemical processes occur

The Fluid Mosaic Model of Cellular Membranes:



Cell Membrane Proteins:

1) Transport Proteins:

- Regulate movement of hydrophilic molecules through membrane
 - A) Channel Proteins (e.g. Na⁺ channels)
 - B) Carrier Proteins (e.g. glucose transporter)

2) Receptor Proteins:

- Trigger cell activity when molecule from outside environment binds to protein

3) Recognition Proteins:

- Allow cells to recognize / attach to one another
- Glycoproteins: Proteins with attached carbohydrate groups

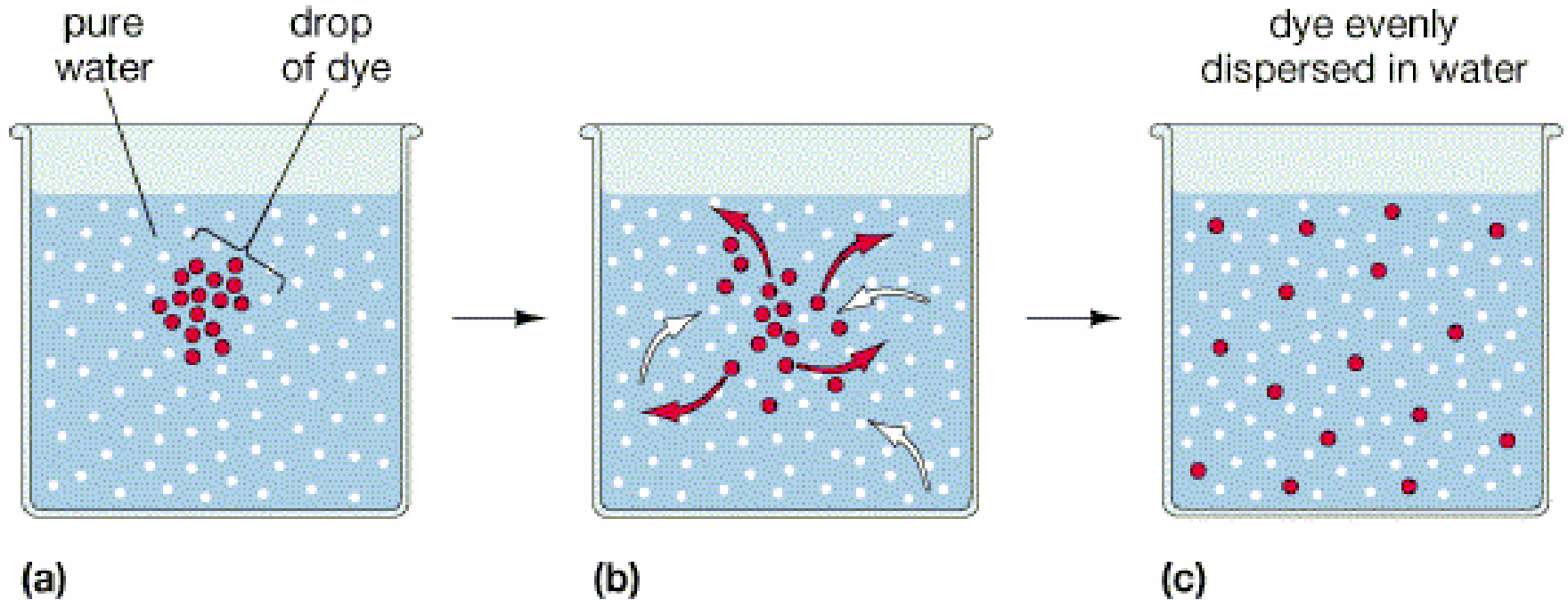
How are Substances Transported Across Membranes?

Answer: Concentration Gradients

Concentration = Number of molecules in a given unit of volume (e.g. grams / liter; moles / liter)

Gradient = Difference between two regions of space such that molecules move from one region to the other

Diffusion: Movement of molecules from an area of [high] to an area of [low]



- Greater the concentration gradient, the faster diffusion occurs
- Diffusion will continue until gradient is eliminated (**equilibrium**)
- Diffusion cannot move molecules rapidly over long distances

Types of Movement Across Membranes:

1) **Passive Transport**

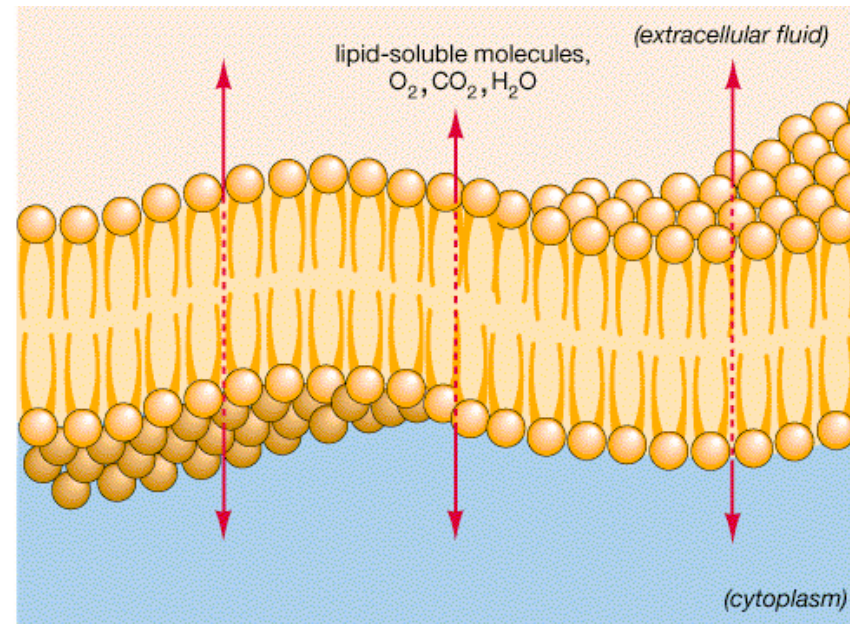
- Requires no energy
- Substances move down concentration gradients

A) **Simple Diffusion**

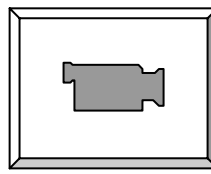
- Small molecules pass directly through the phospholipid bilayer (e.g. CO_2 , H_2O , O_2)

Rate depends on:

- 1) Molecule size
- 2) Concentration gradient
- 3) Lipid solubility



(Figure 4.3a)



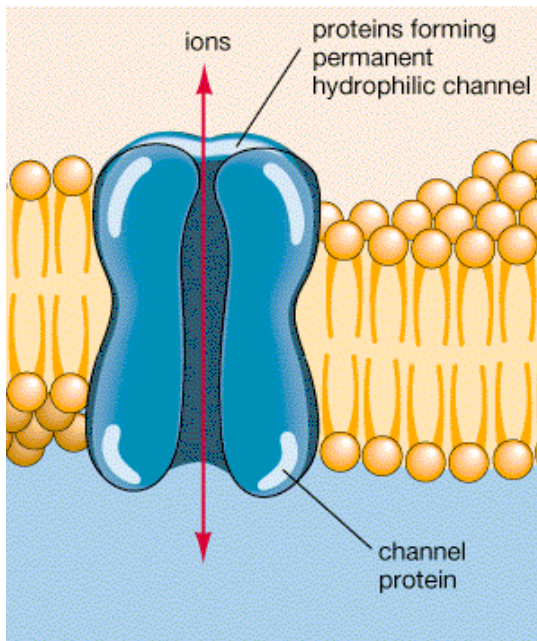
Types of Movement Across Membranes:

1) **Passive Transport**

- Requires no energy
- Substances move down concentration gradients

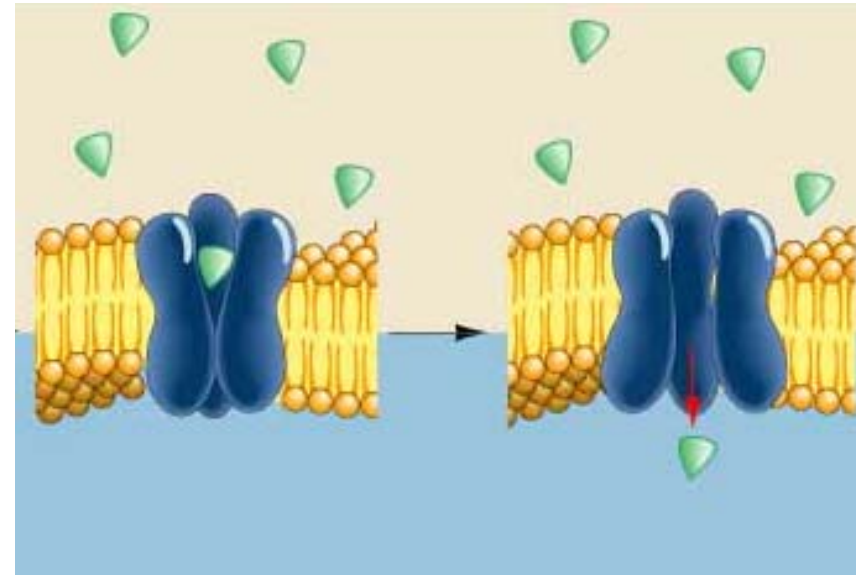
B) **Facilitated Diffusion**

- Molecules need assistance of channel proteins or carrier proteins (e.g. ions, amino acids, sugars)



Channel Proteins
(Figure 4.3b)

Carrier Proteins
(Figure 4.3c)



Types of Movement Across Membranes:

1) **Passive Transport**

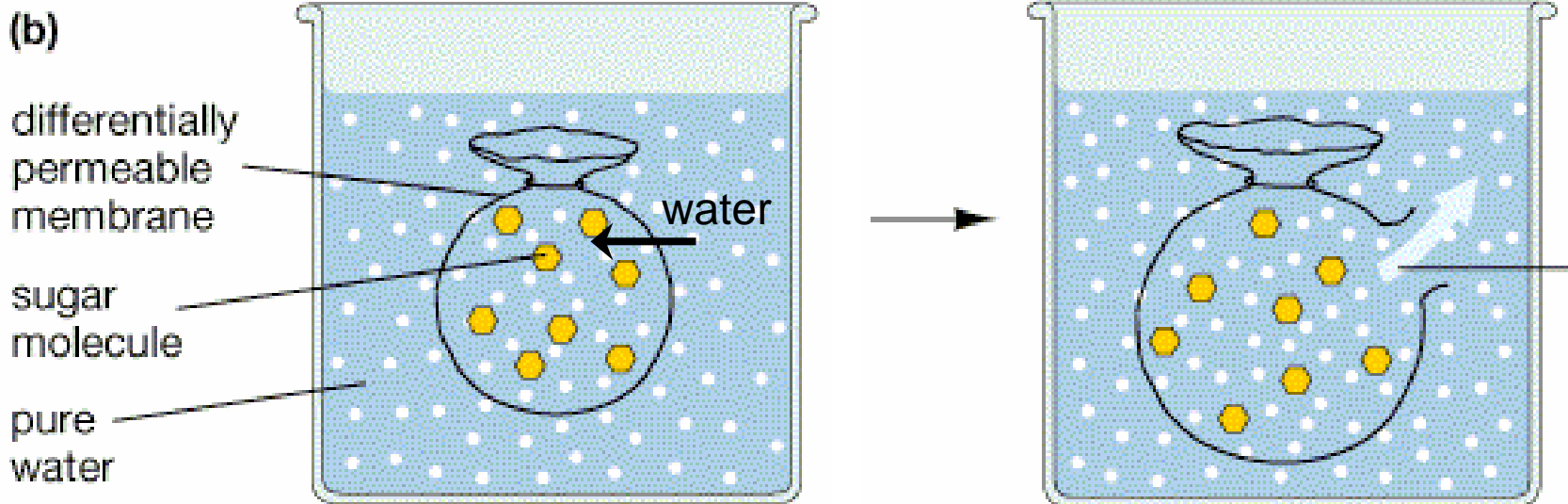
- Requires no energy
- Substances move down concentration gradients

A) **Simple Diffusion**

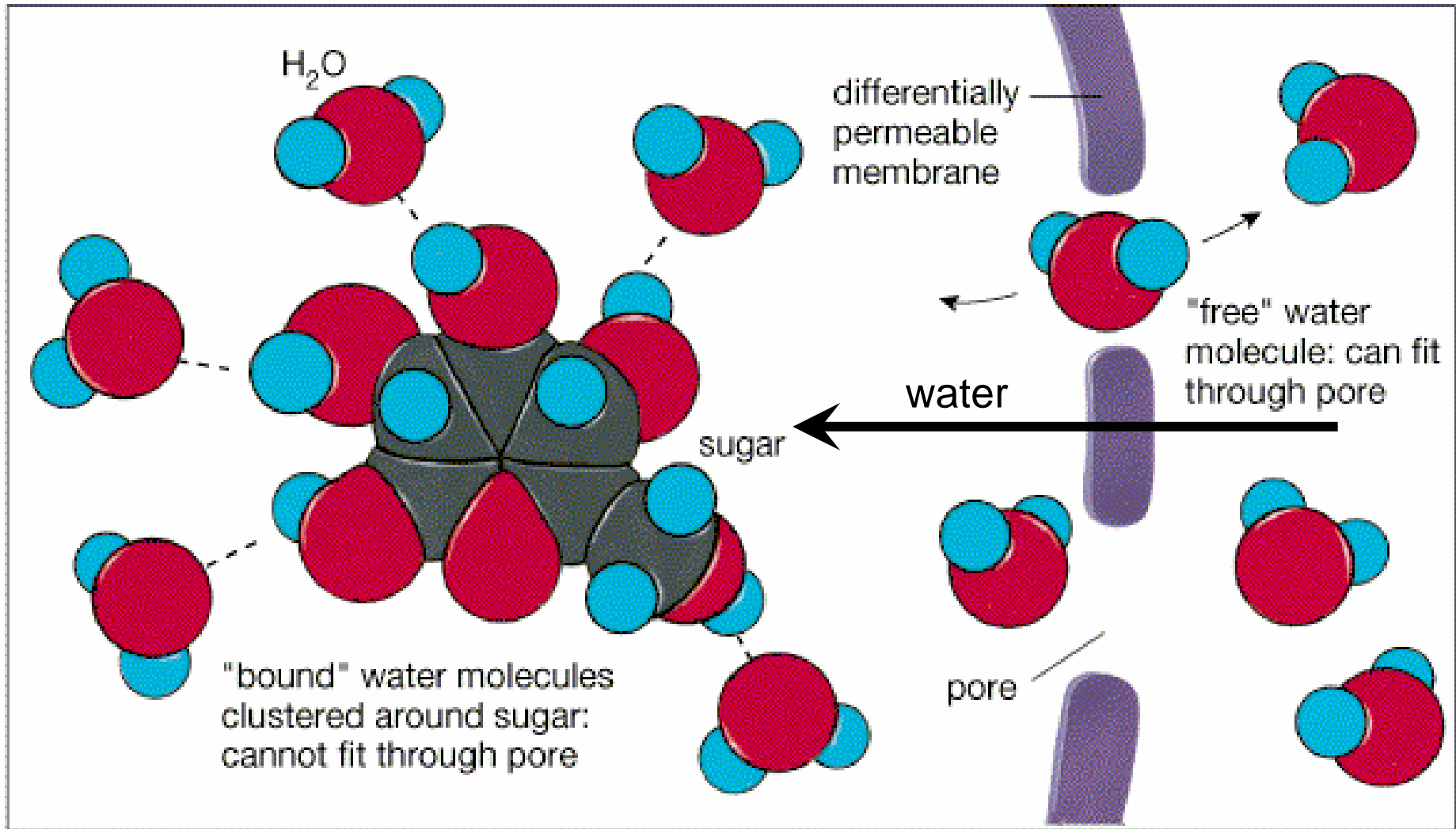
B) **Facilitated Diffusion**

C) **Osmosis**

- Movement of water from an area of high [water] to area of low [water] across semi-permeable membrane



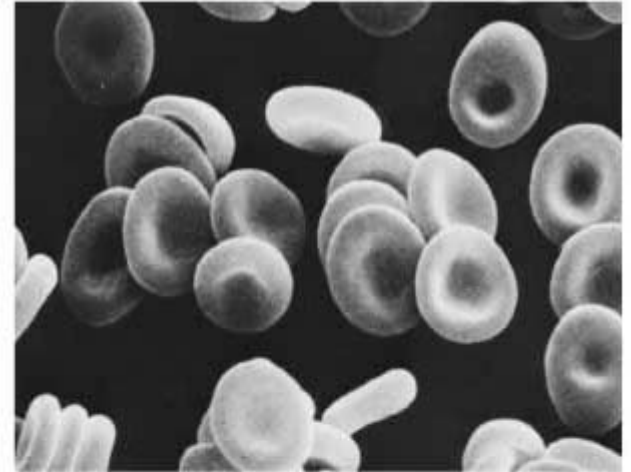
Osmosis:



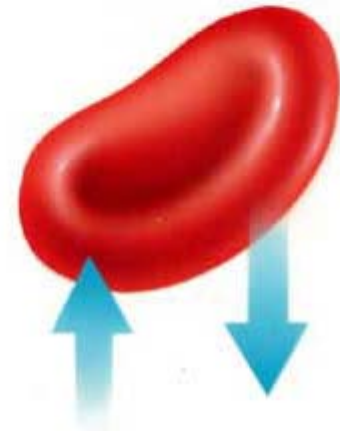
Osmosis and Living Cells:

Isotonic Solution:

- Outside of cell has same [solute] as inside of cell



isotonic solution



(no net water movement)

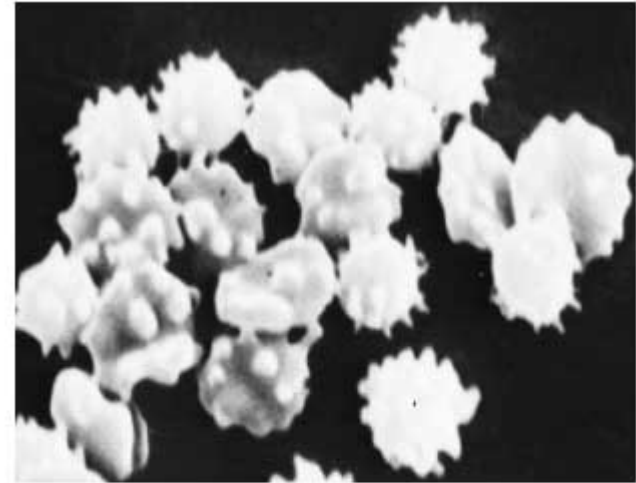
Osmosis and Living Cells:

Isotonic Solution:

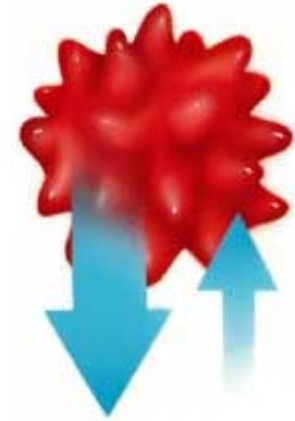
- Outside of cell has same [solute] as inside of cell

Hypertonic Solution:

- Outside of cell has higher [solute] than inside of cell



hypertonic solution



(net water movement
out of cell)

Osmosis and Living Cells:

Isotonic Solution:

- Outside of cell has same [solute] as inside of cell

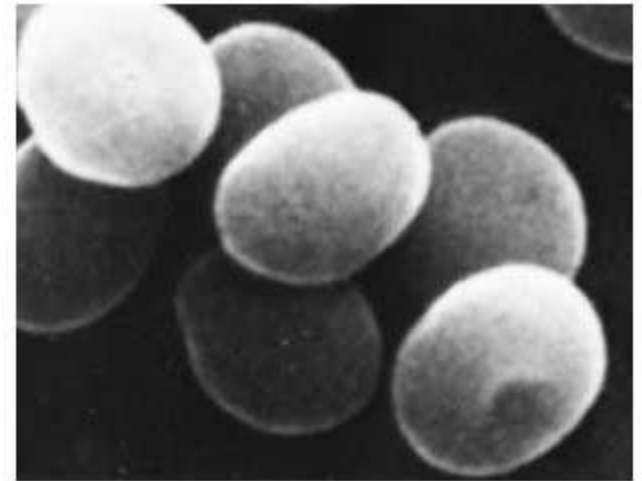
Hypertonic Solution:

- Outside of cell has higher [solute] than inside of cell

Hypotonic Solution:

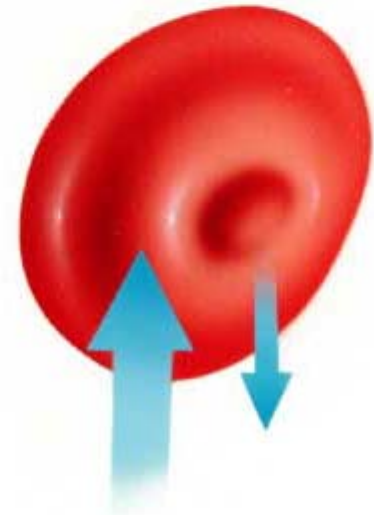
- Inside of cell has higher [solute] than outside of cell

Tonicity is relative
to the inside of the cell

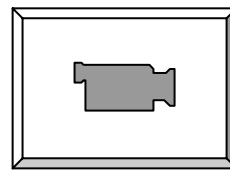


10 micrometers

hypotonic solution



(net water movement
into cell)

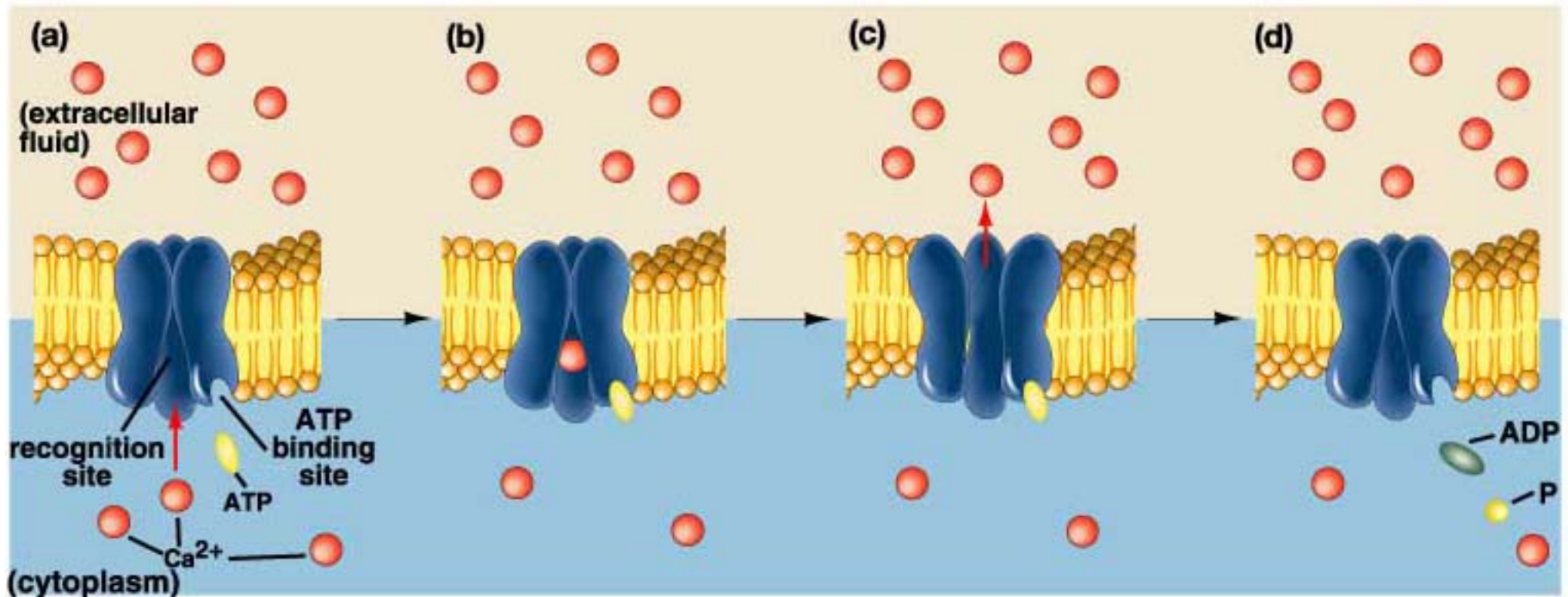


Types of Movement Across Membranes:

1) Passive Transport

2) **Active Transport**

- Requires energy (ATP)
- Substances move against concentration gradients



Types of Movement Across Membranes:

1) Passive Transport

2) Active Transport

3) **Endocytosis**

- Movement of large particles into cells (**vesicle** formation)

1) **Pinocytosis** (“cell drinking”)

- Uptake of fluid droplets

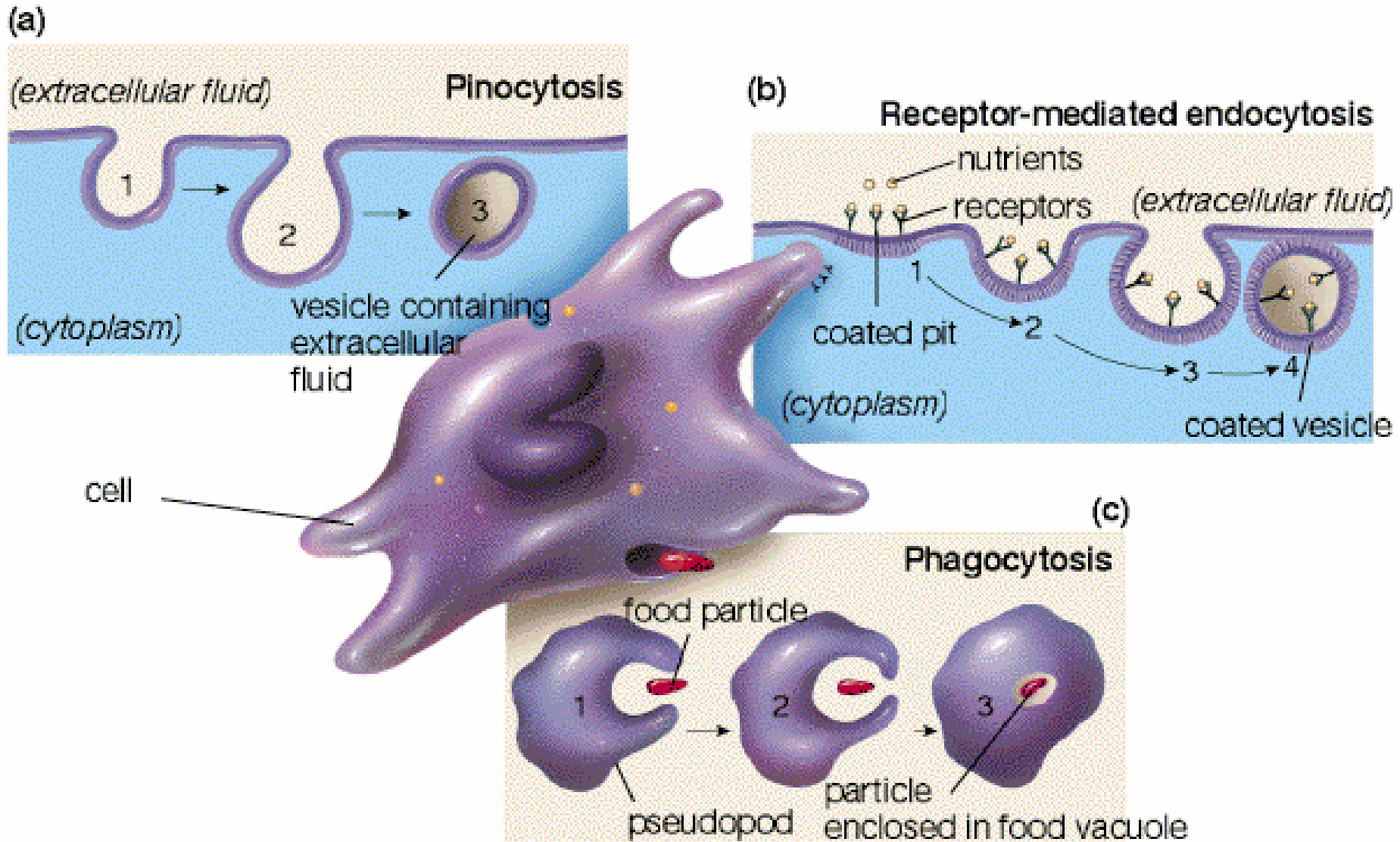
2) **Receptor-mediated Endocytosis:**

- Uptake of specific molecules via coated pits

3) **Phagocytosis** (“cell eating”)

- Uptake of large particles (e.g. bacteria)

Endocytosis:



(Figure 4.7)

Types of Movement Across Membranes:

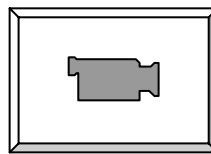
1) Passive Transport

2) Active Transport

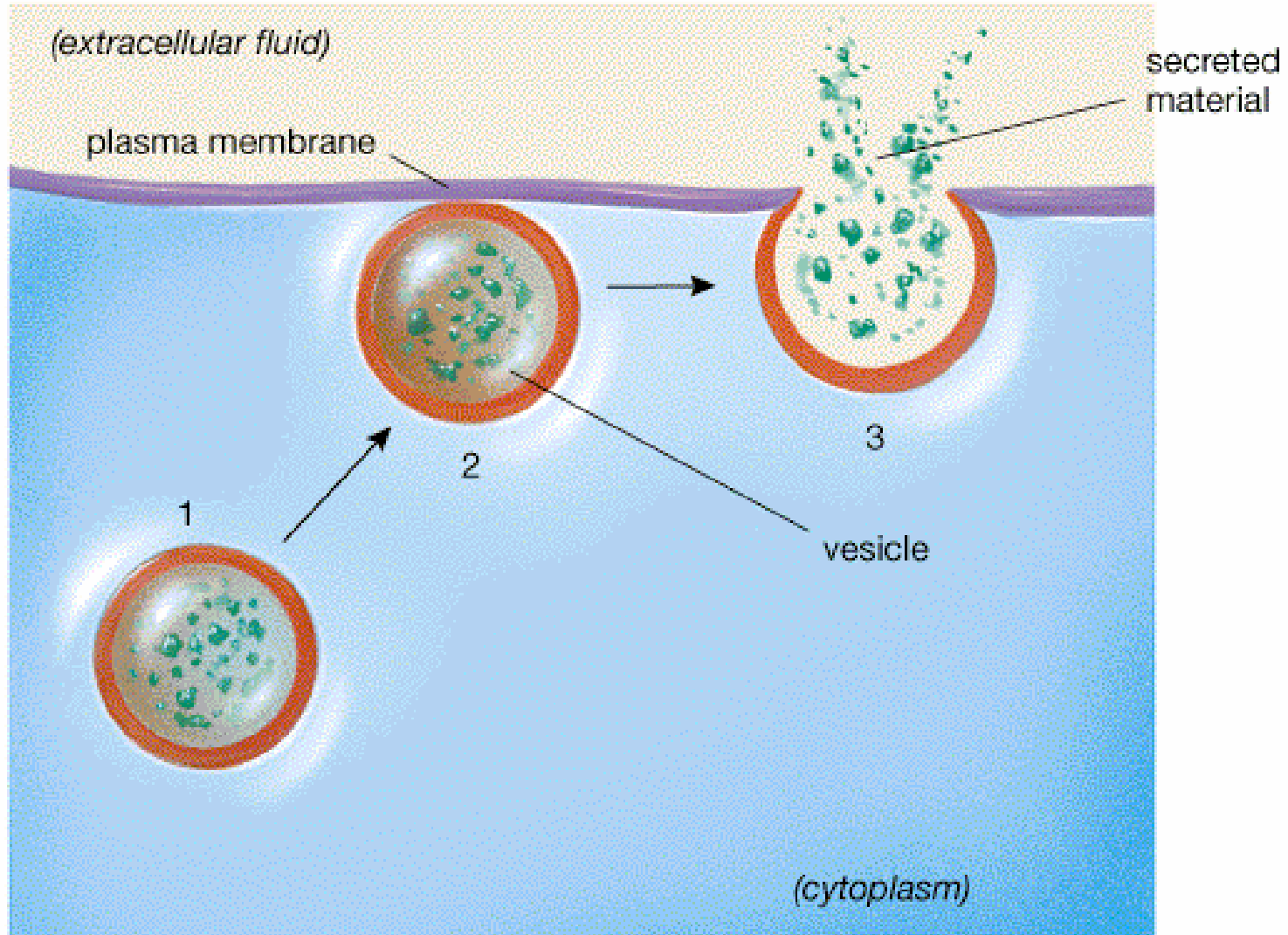
3) Endocytosis

4) **Exocytosis**

- Movement of large particles out of cells (e.g. hormones)



Exocytosis:



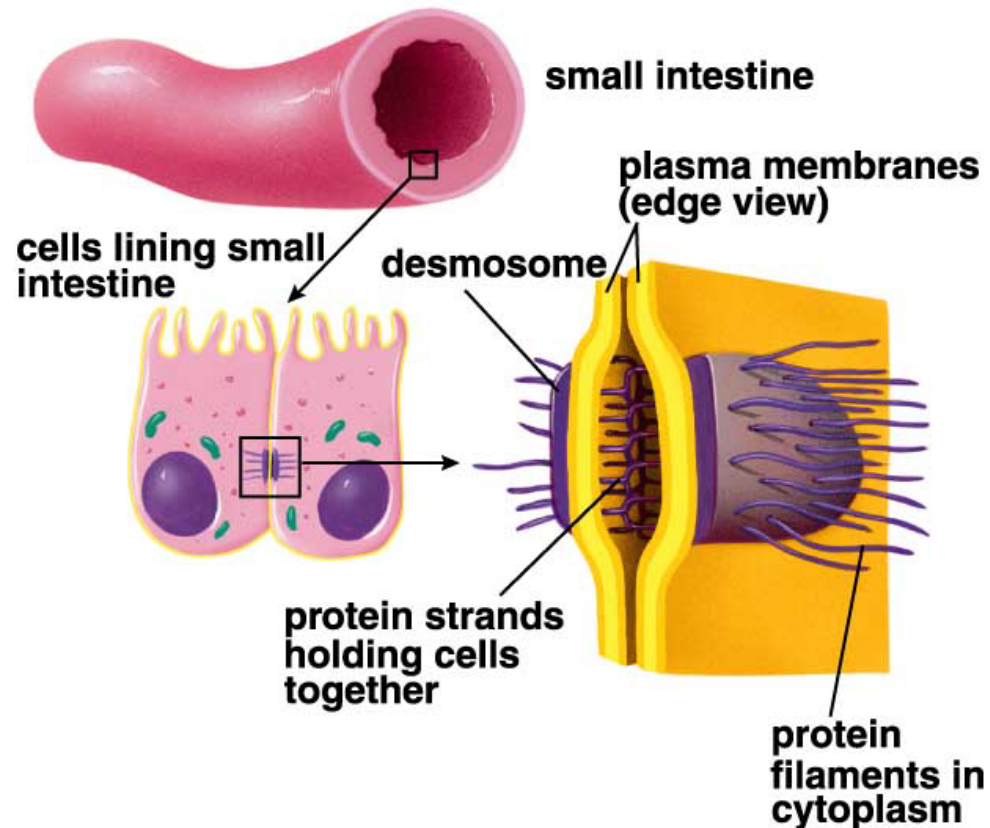
(Figure 4.9)

How are Cell Surfaces Specialized?

Answer: Junctions allow cells to connect and communicate

1) Connection Junctions:

A) **Desmosomes:** Hold cells together via protein filaments



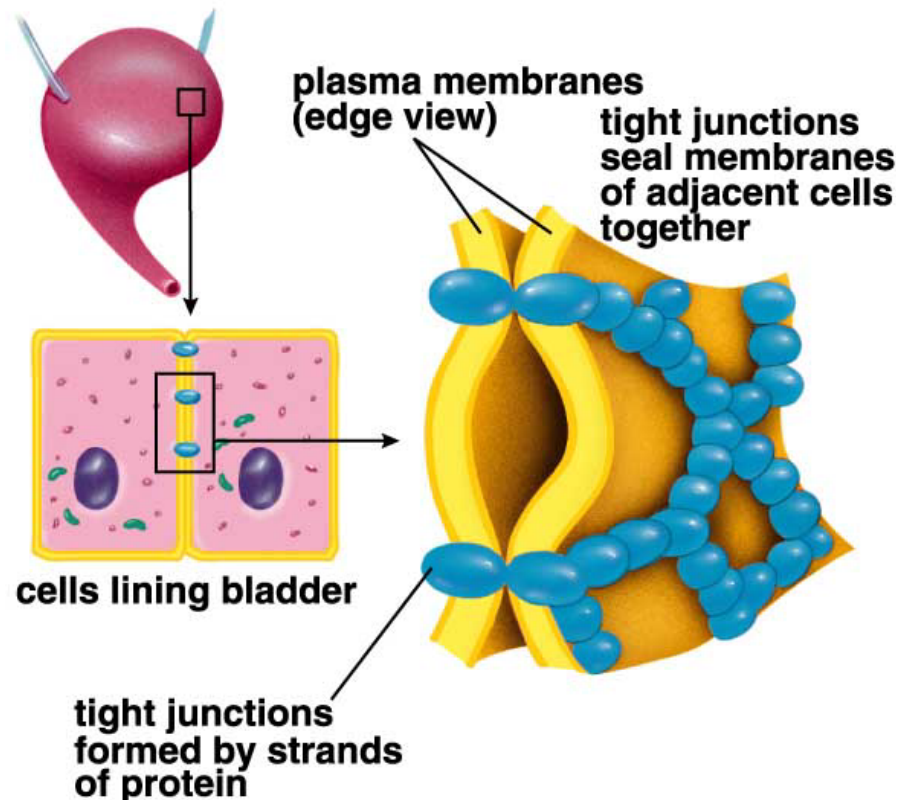
(Figure 4.10a)

How are Cell Surfaces Specialized?

Answer: Junctions allow cells to connect and communicate

1) Connection Junctions:

B) **Tight Junctions:** Protein “seals” prevent leakage (cell → cell)



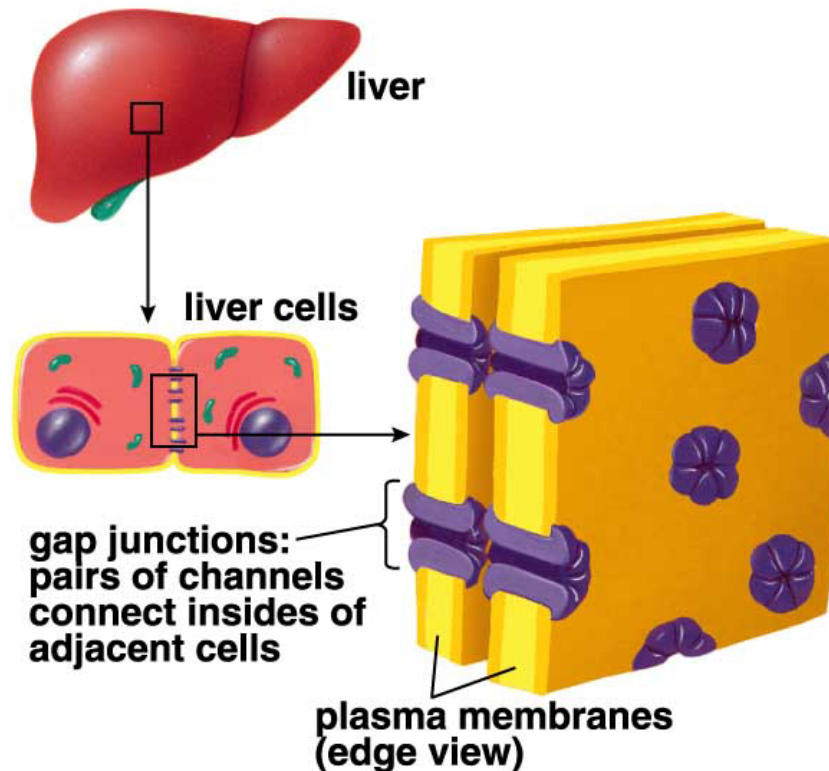
(Figure 4.10b)

How are Cell Surfaces Specialized?

Answer: Junctions allow cells to connect and communicate

2) Communication Junctions:

A) **Gap Junctions:** Protein channels allowing for signals to pass between cells (**animals**)



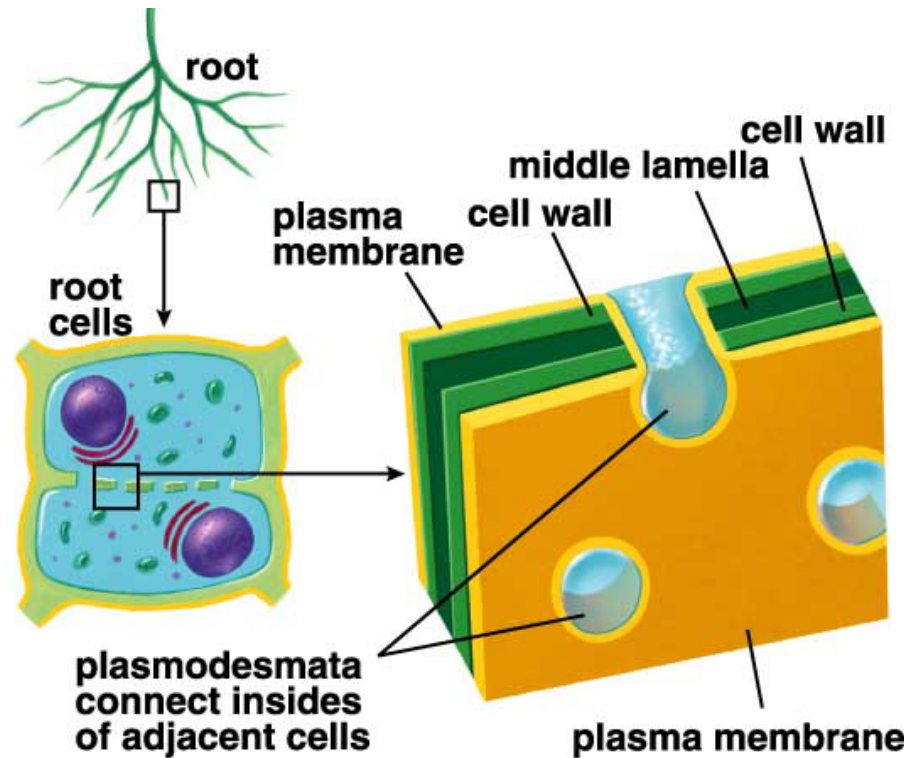
(Figure 4.11a)

How are Cell Surfaces Specialized?

Answer: Junctions allow cells to connect and communicate

2) Communication Junctions:

A) **Plasmodesmata:** Cytoplasmic bridges allowing for signals to pass between cells (**plants**)



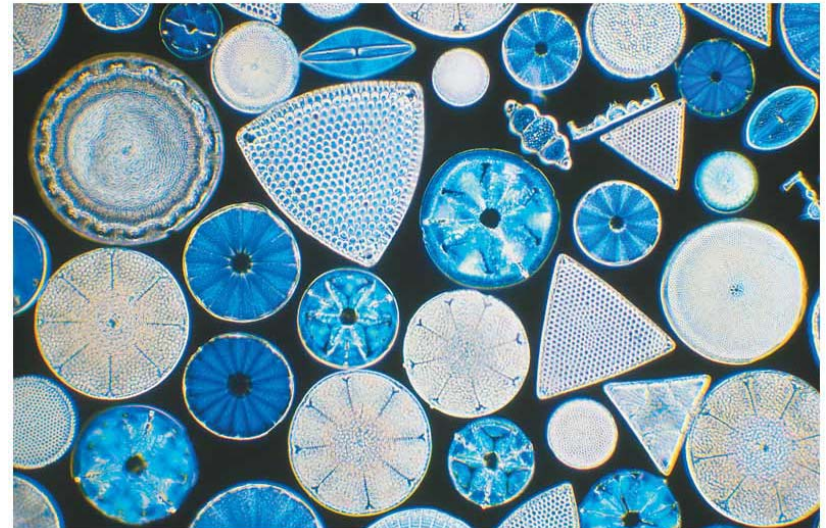
(Figure 4.11b)

How are Cell Surfaces Specialized?

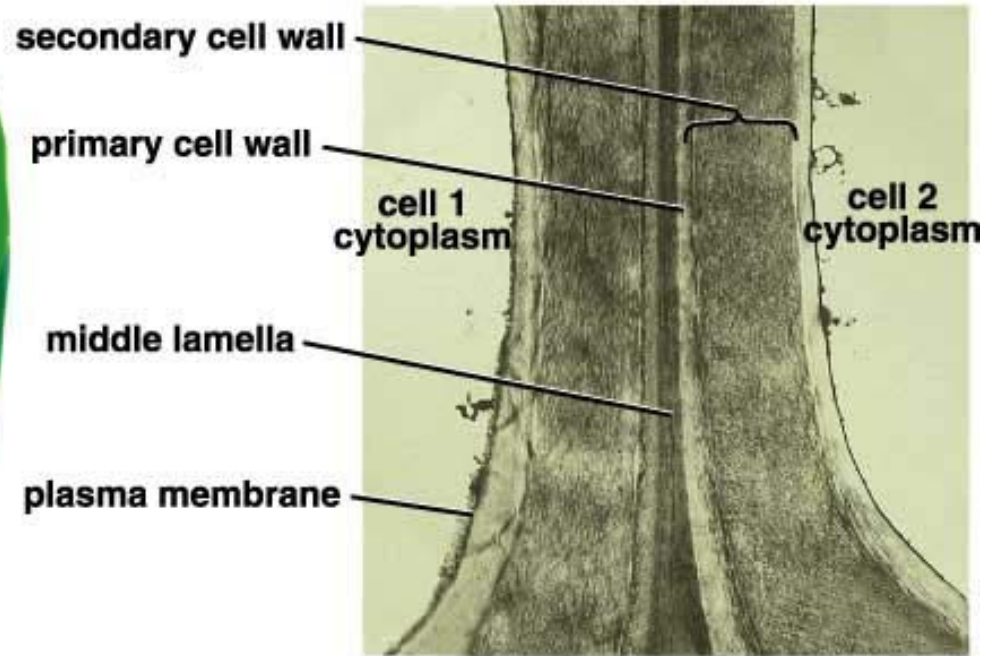
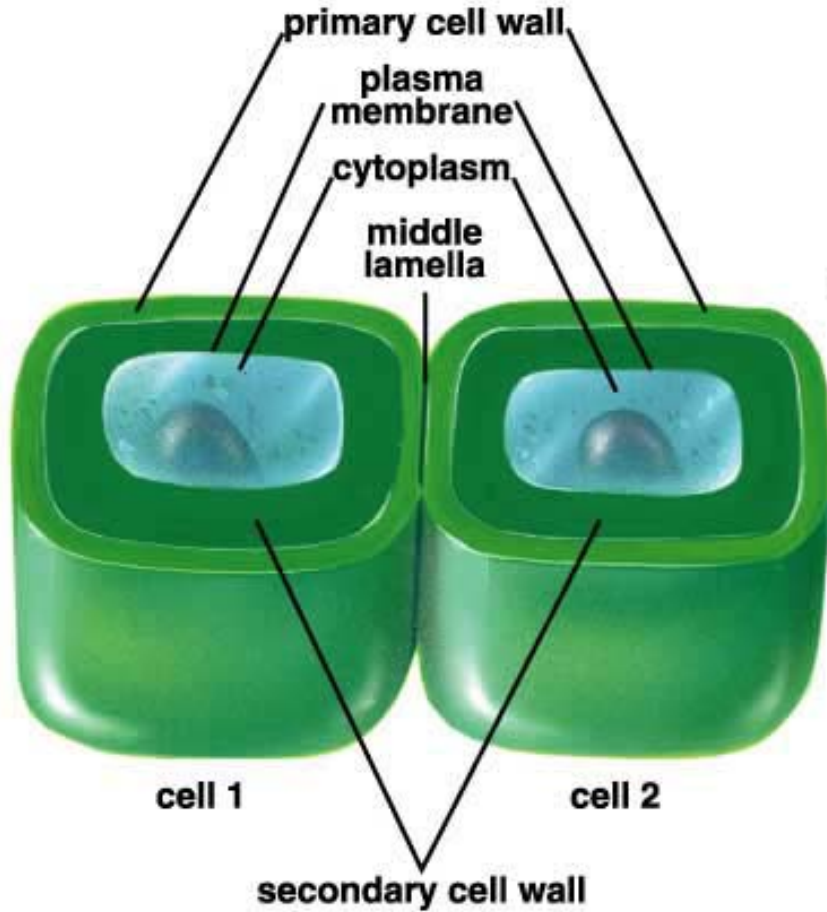
Answer: Cell walls offer support and protection

Cell Walls:

- Found in bacteria, plants, fungi, & some protists
- Composed of carbohydrates (e.g. cellulose, chitin), proteins, or inorganic molecules (e.g. silica)
- Produced by the cell it protects/supports



Cell Wall:



(Figure 4.12)