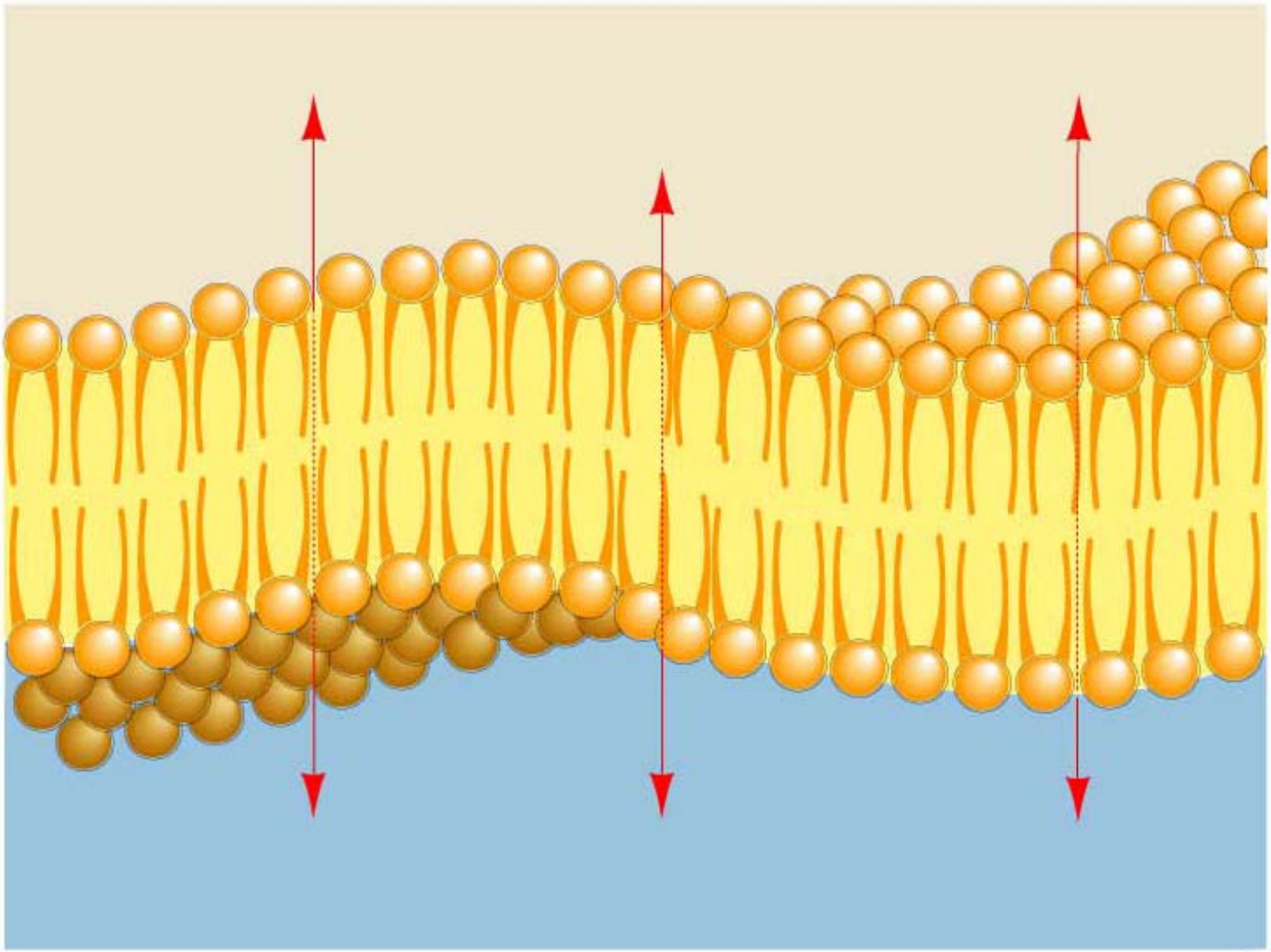
Chapter 4:

Cell Membrane Structure and Function



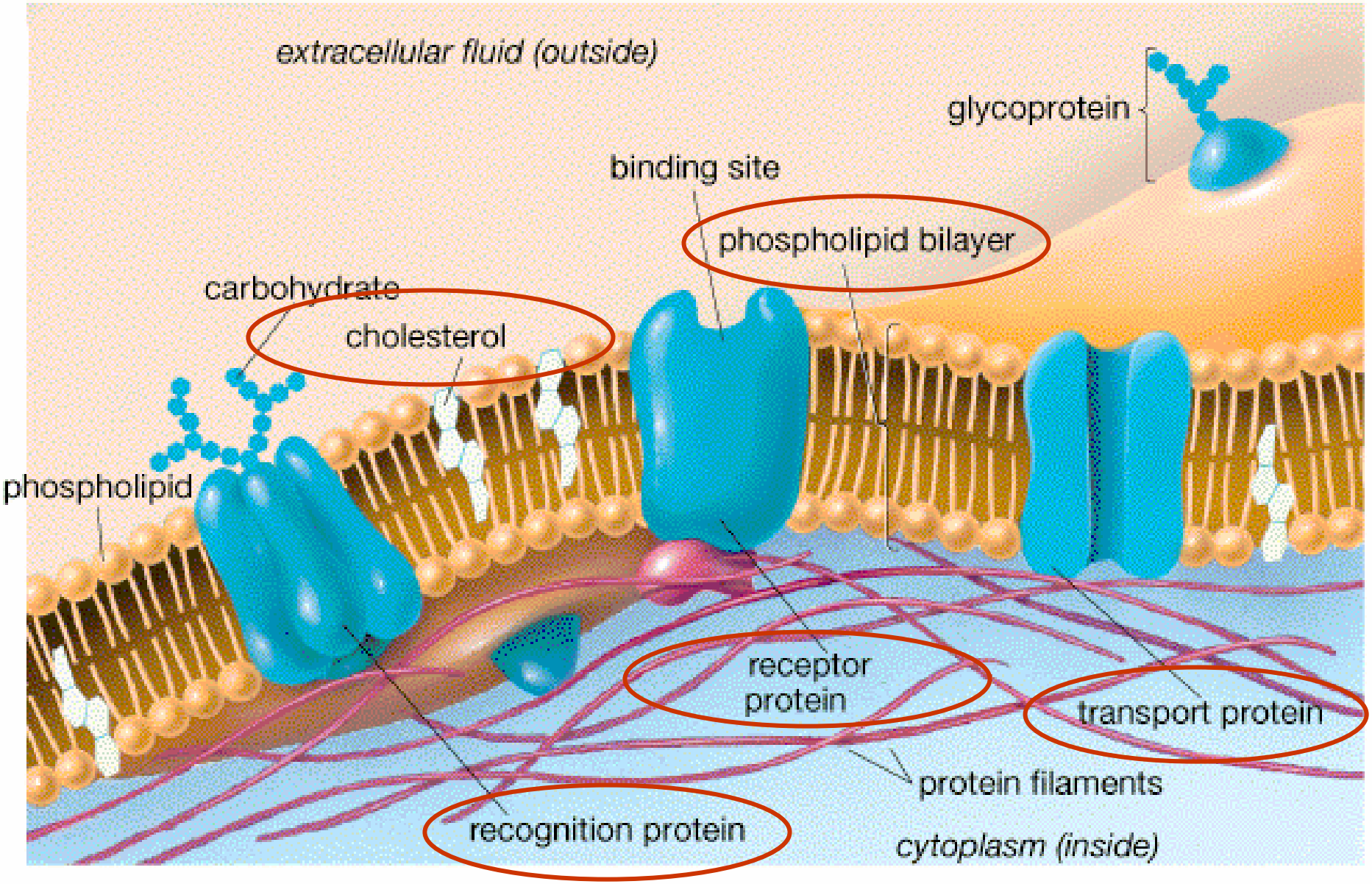
Plasma Membrane: Thin barrier separating inside of cell (cytoplasm) from outside environment

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

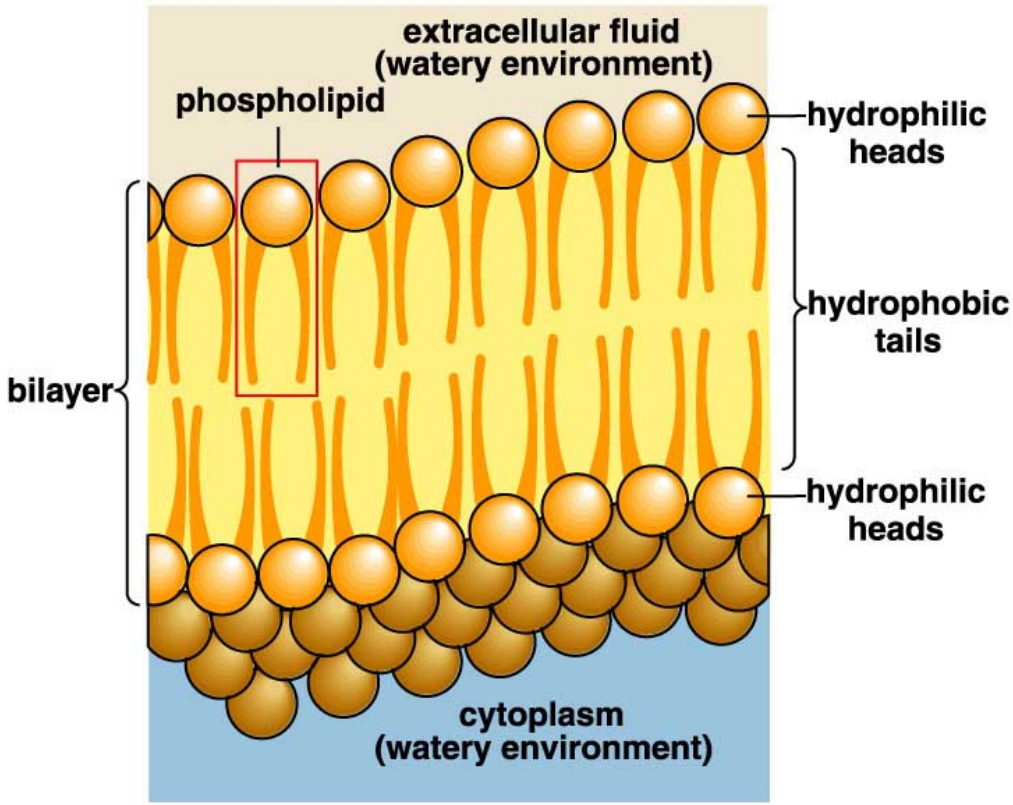
Note: Membranes also exist within cells forming various compartments where different biochemical processes occur

The Fluid Mosaic Model of Cellular Membranes:

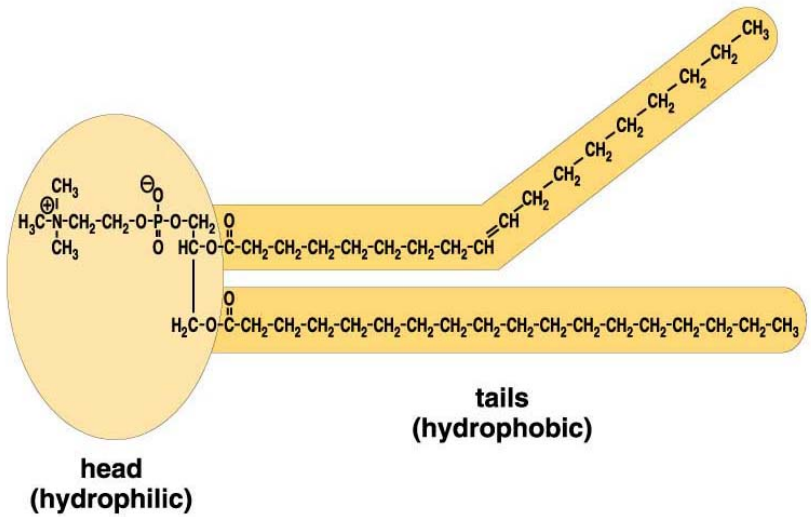


Phospholipid Bilayer: Double layer of phospholipids

- Hydrophilic ends form outer border
- Hydrophobic tails form inner layer



- Lipid tails of phospholipids are unsaturated (C = C)



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

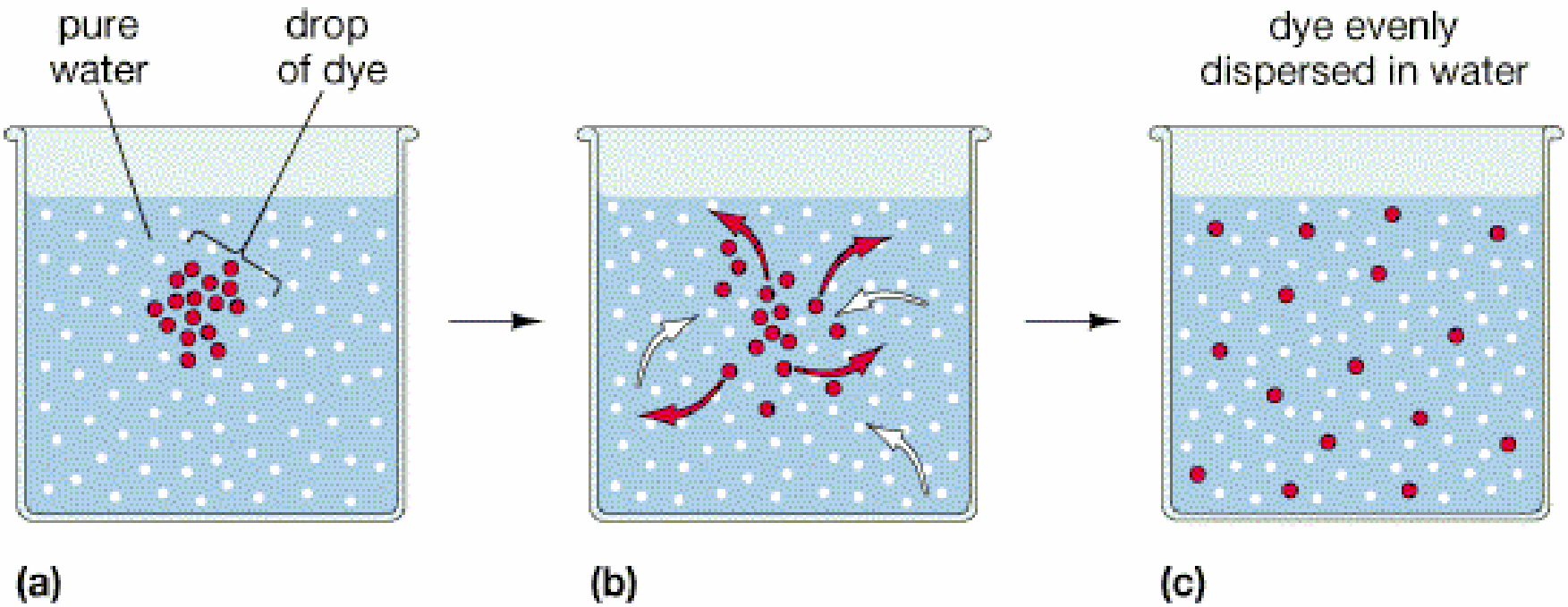
How are Substances Transported Across Membranes?

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

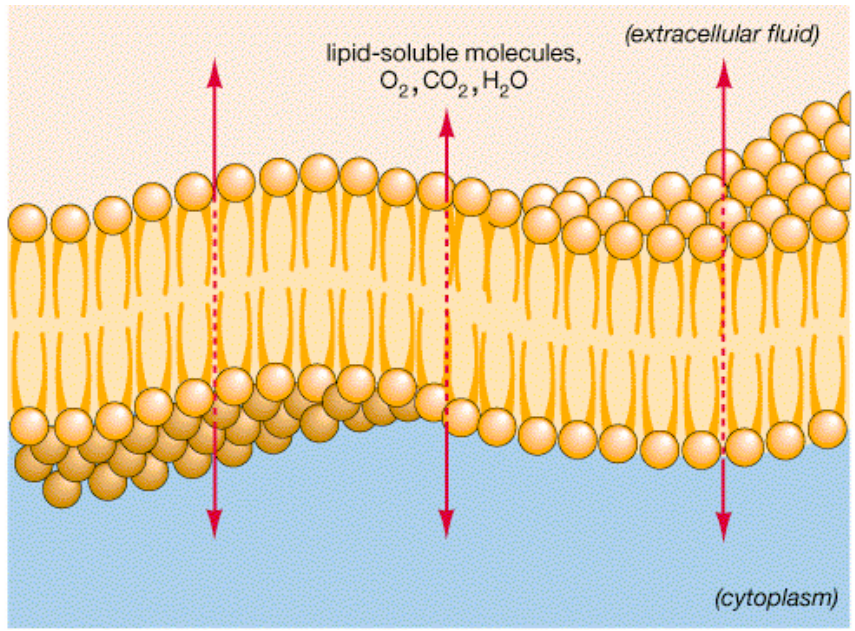
- Requires no energy
- Substances move down concentration gradients

A) Simple Diffusion

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

Rate depends on:

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



(Figure 4.3a)

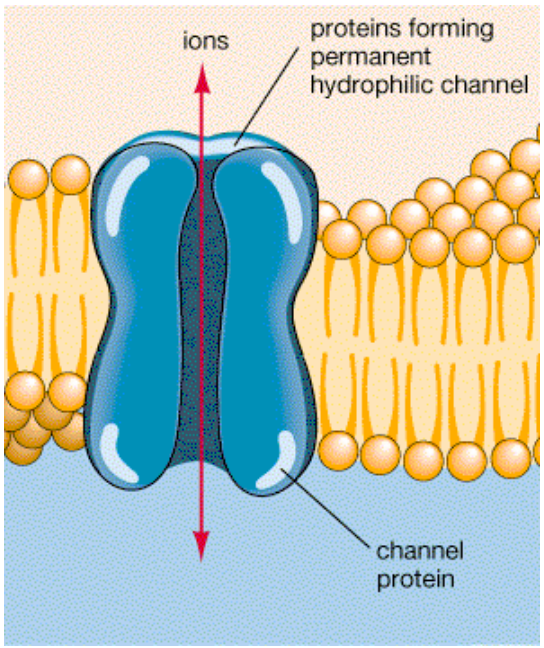
Types of Movement Across Membranes:

1) Passive Transport

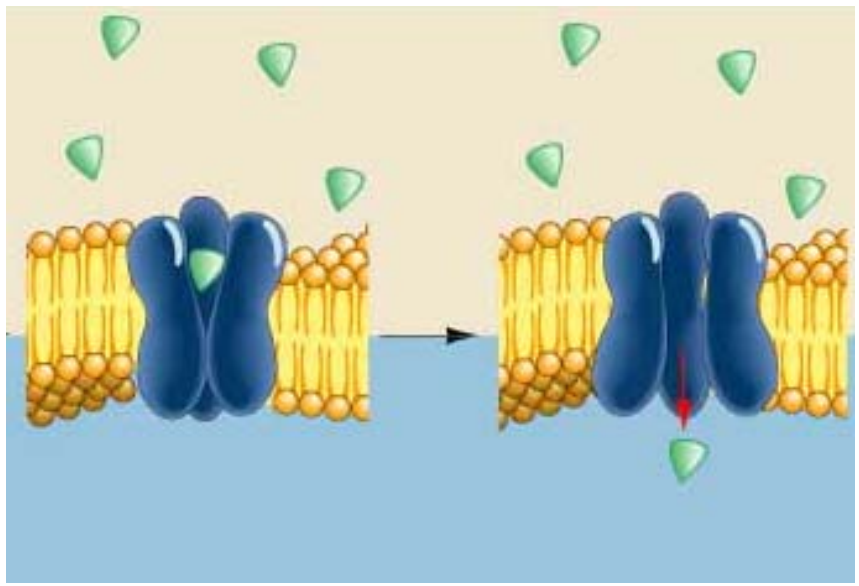
- Requires no energy
- Substances move down concentration gradients

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)

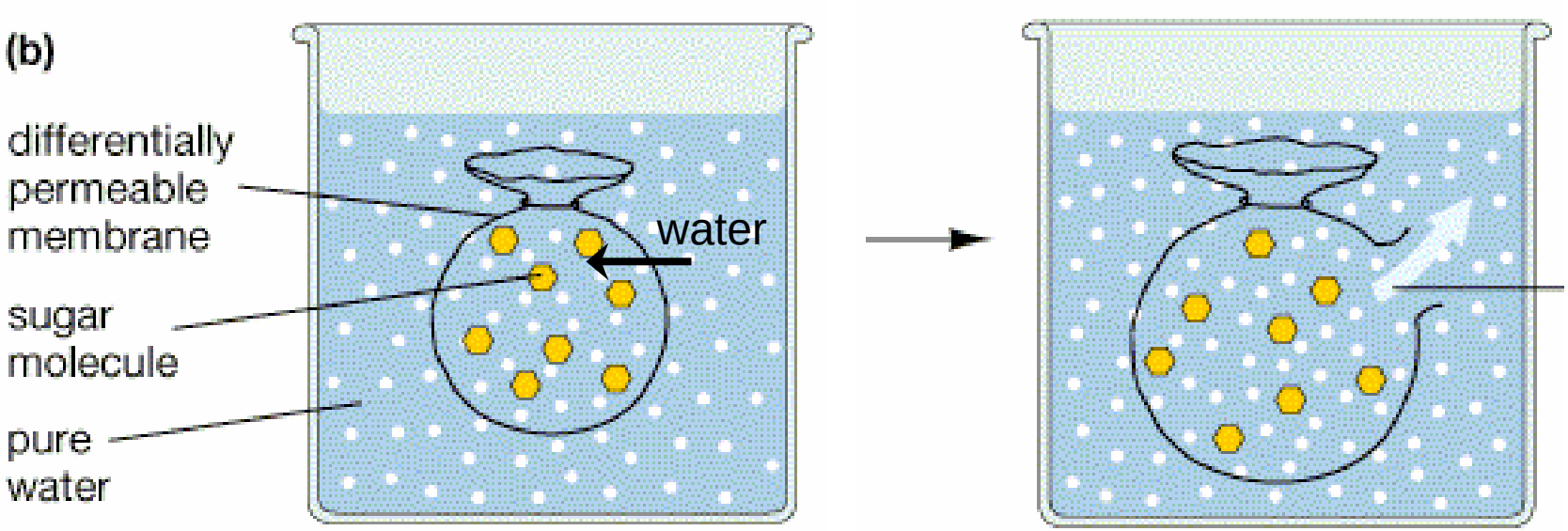
Types of Movement Across Membranes:

1) Passive Transport
   - Requires no energy
   - Substances move down concentration gradients

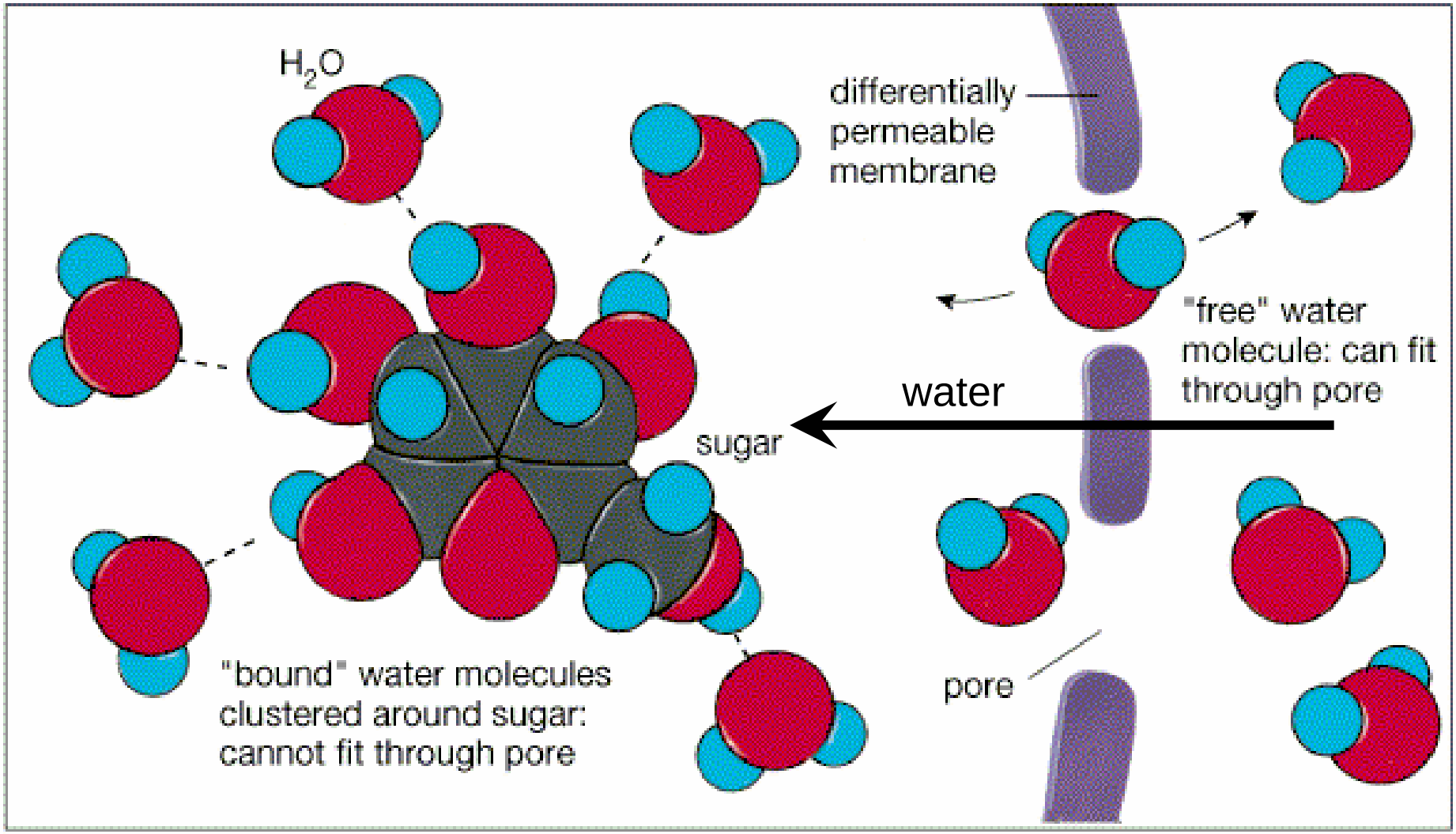
   A) Simple Diffusion

   B) Facilitated Diffusion

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



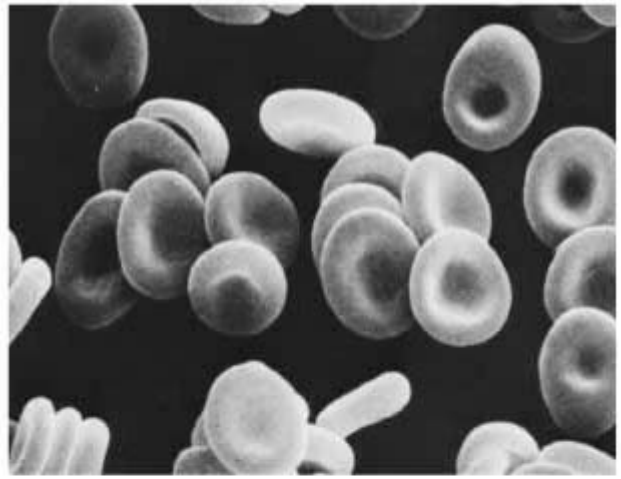
Osmosis:

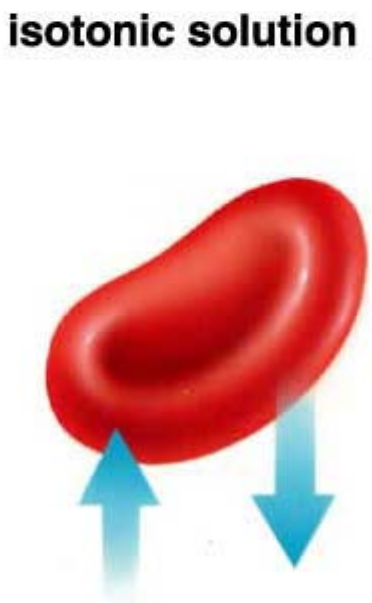

H_2O
differentially permeable membrane
"free" water molecule: can fit through pore
water
sugar
"bound" water molecules clustered around sugar: cannot fit through pore
pore

Osmosis and Living Cells:

Isotonic Solution:

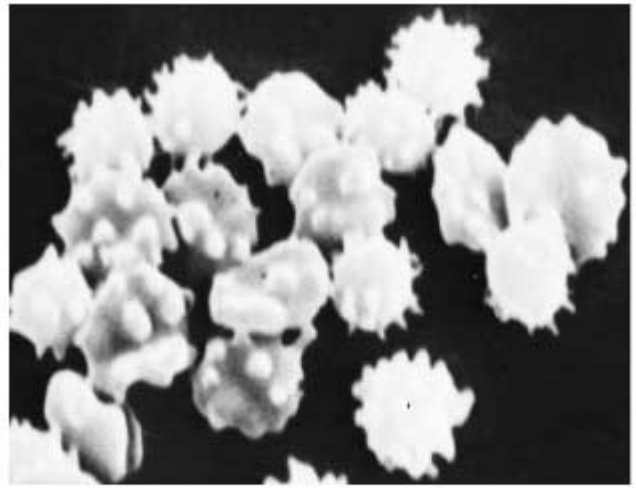
- Outside of cell has same [solute] as inside of cell





(no net water movement)

Osmosis and Living Cells:

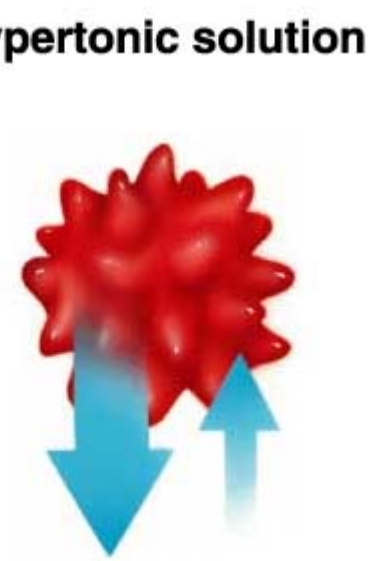


Isotonic Solution:

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

Hypertonic Solution:

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



(net water movement out of cell)

Osmosis and Living Cells:

Isotonic Solution:

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

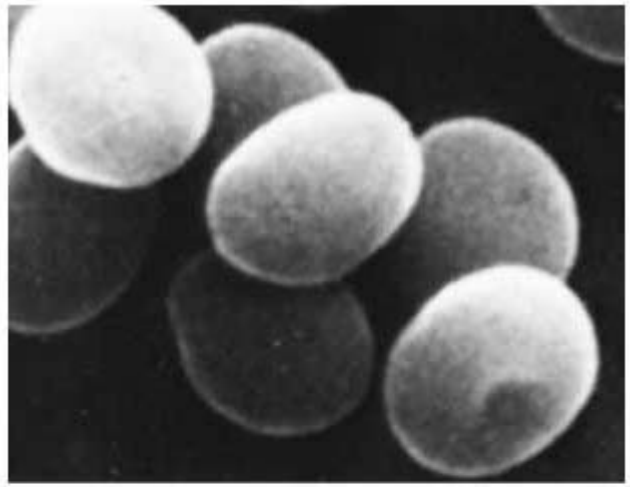
Hypertonic Solution:

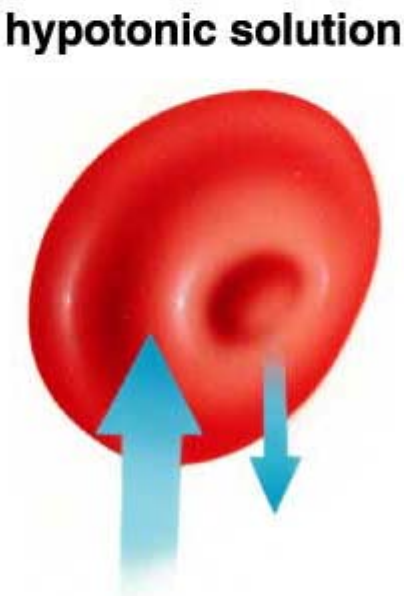
- Outside of cell has higher [solute] than inside of cell

Hypotonic Solution:

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

Tonicity is relative to the inside of the cell

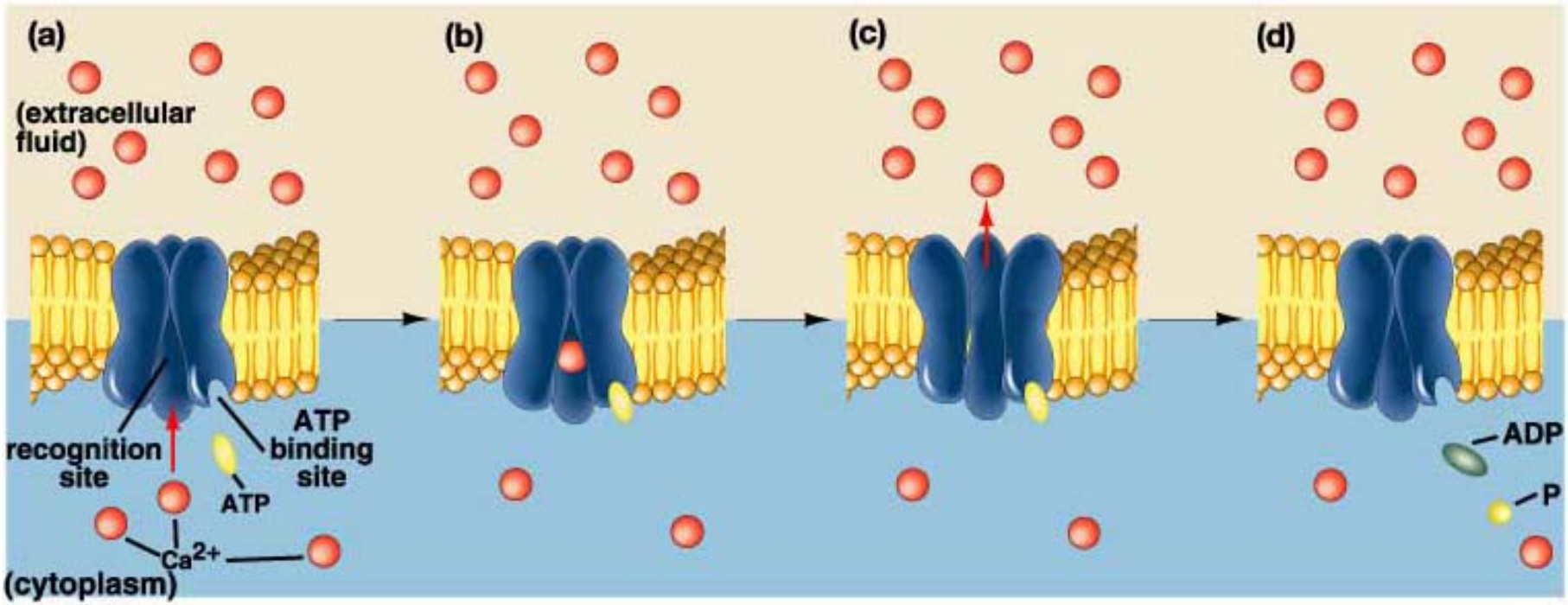




(net water movement into cell)

Types of Movement Across Membranes:

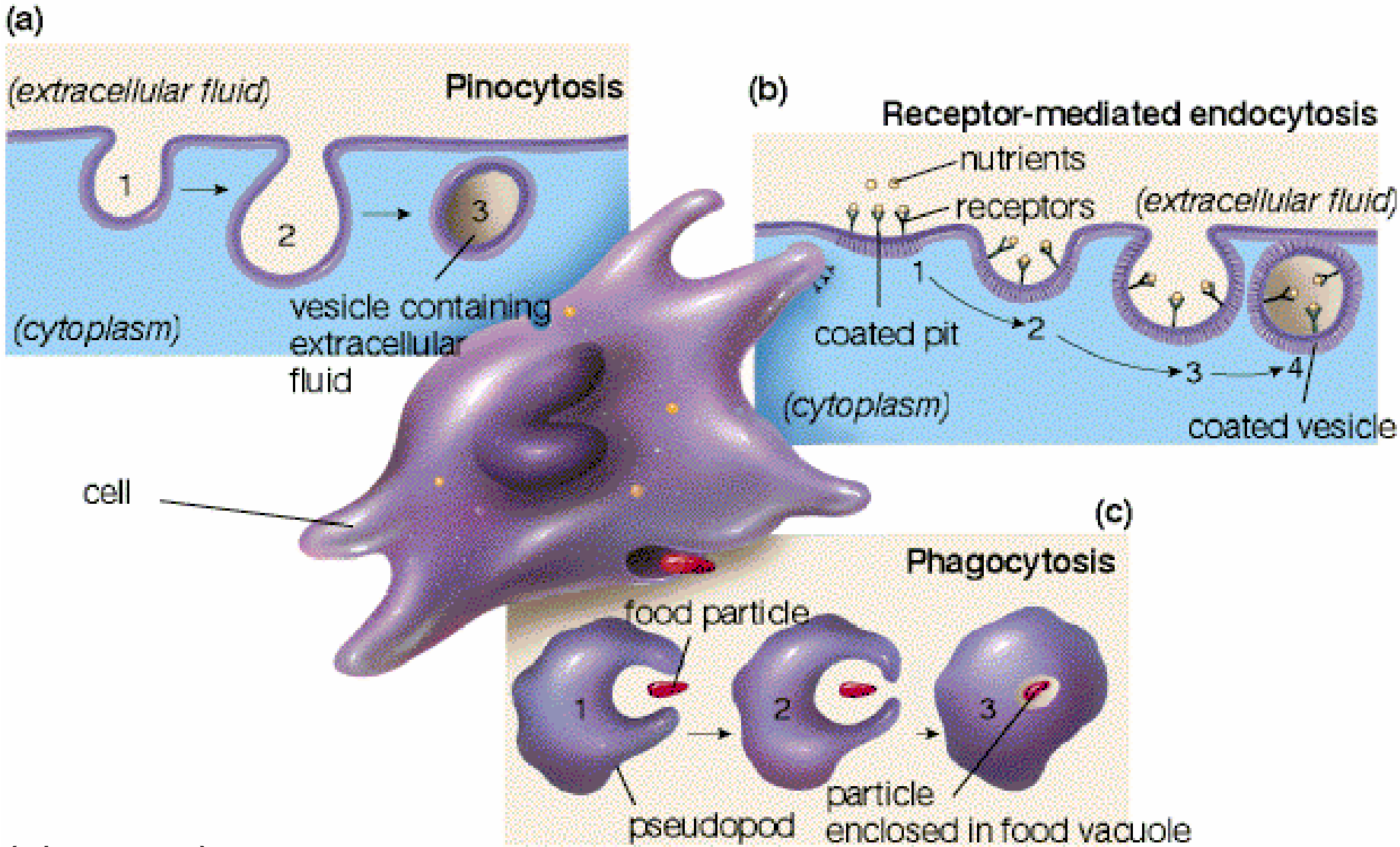
1) Passive Transport
2) Active Transport
   - Requires energy (ATP)
   - Substances move against concentration gradients



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:



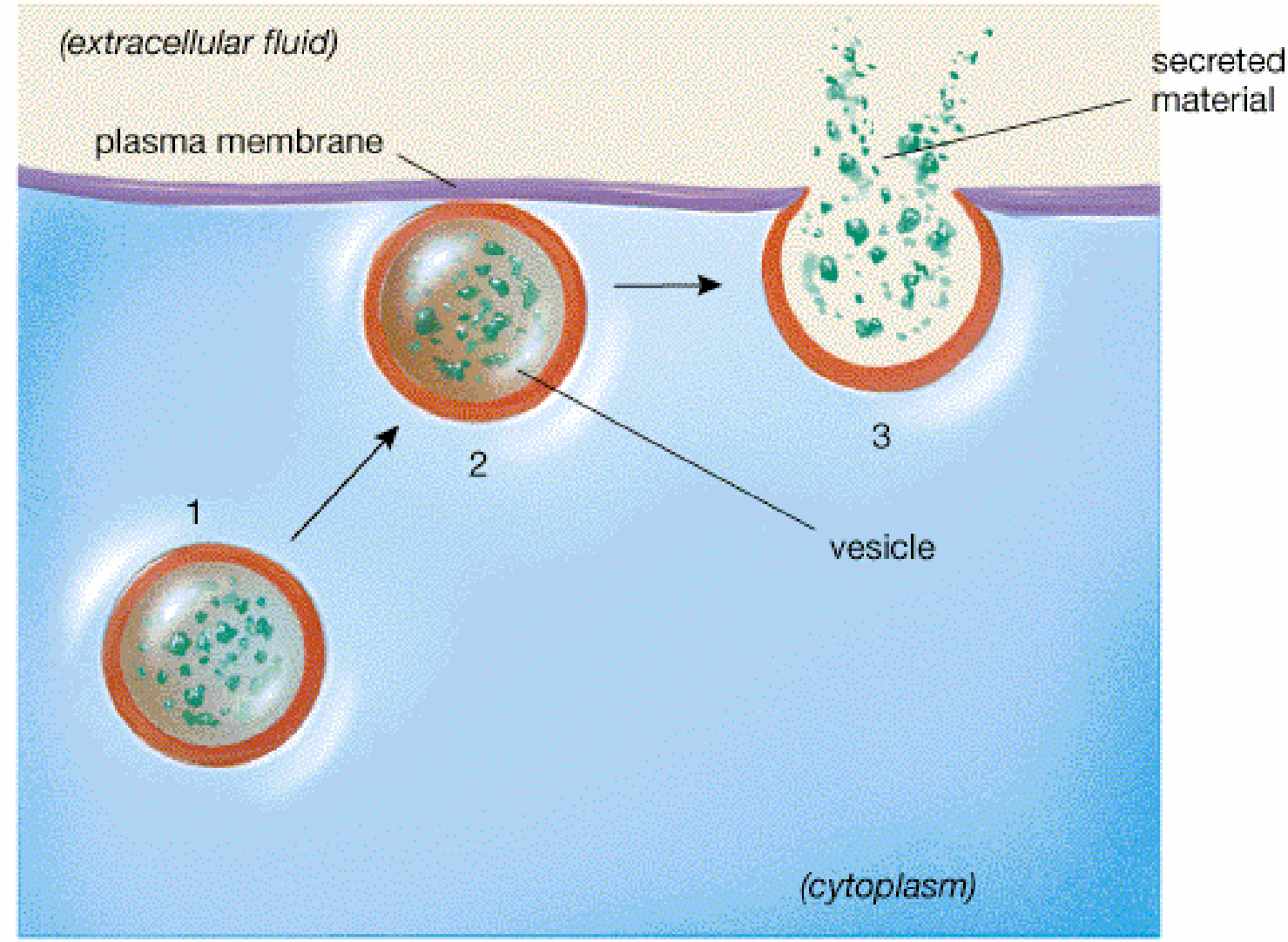
(Figure 4.7)

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:



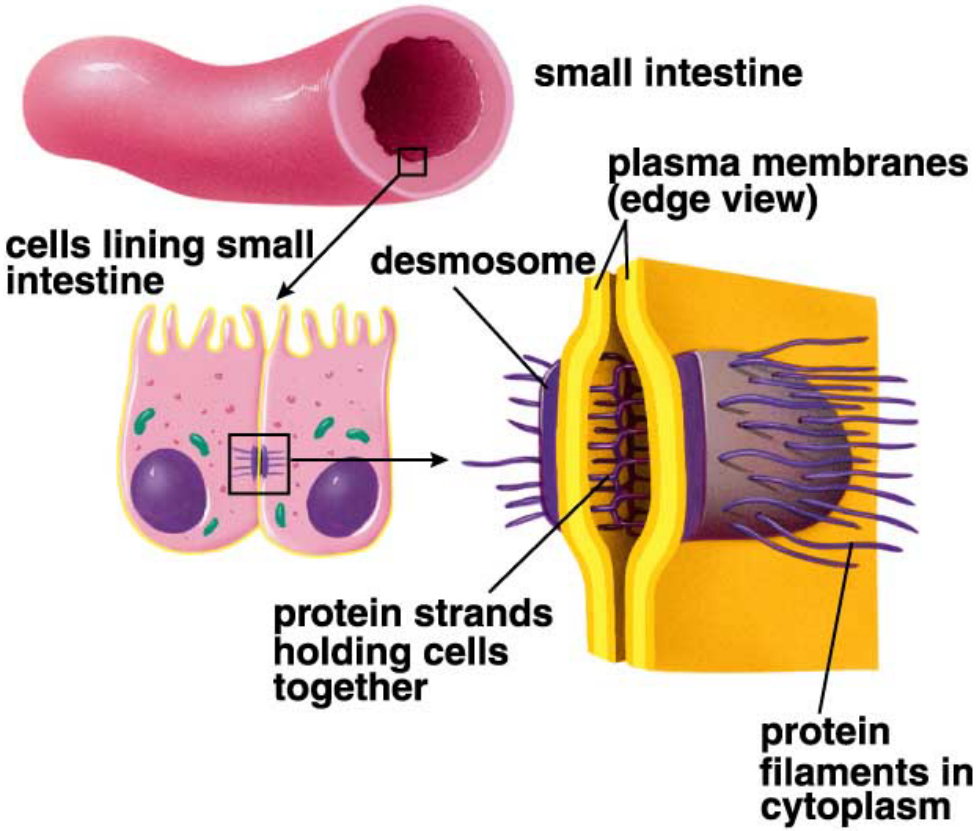
(Figure 4.9)

How are Cell Surfaces Specialized?

Answer: Junctions allow cells to connect and communicate

1) Connection Junctions:

   A) Desmosomes: Hold cells together via protein filaments



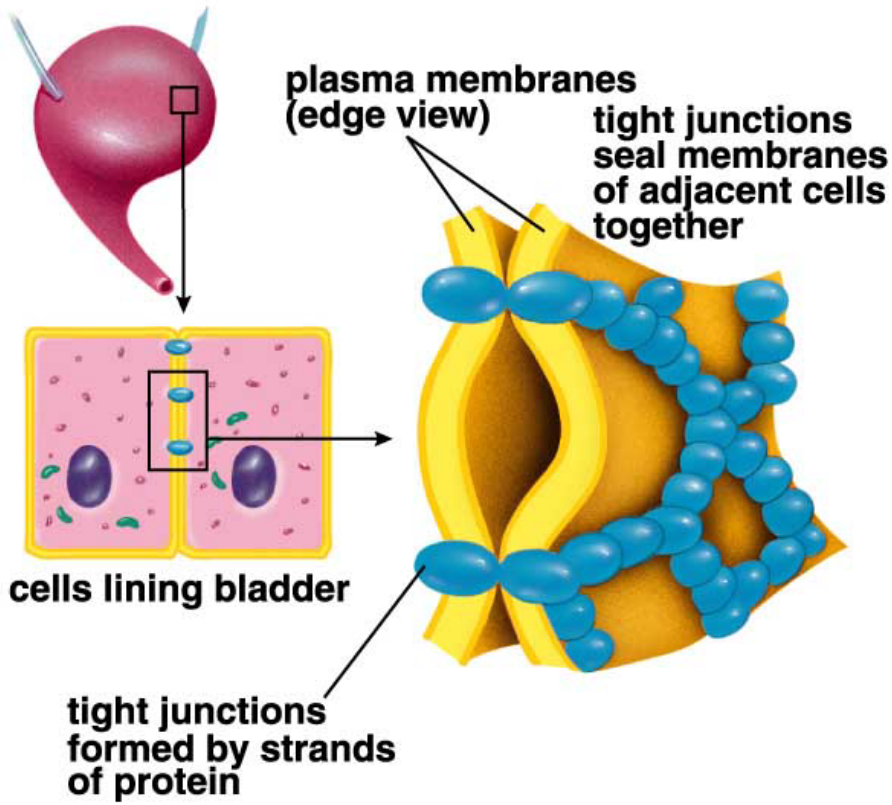
(Figure 4.10a)

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)



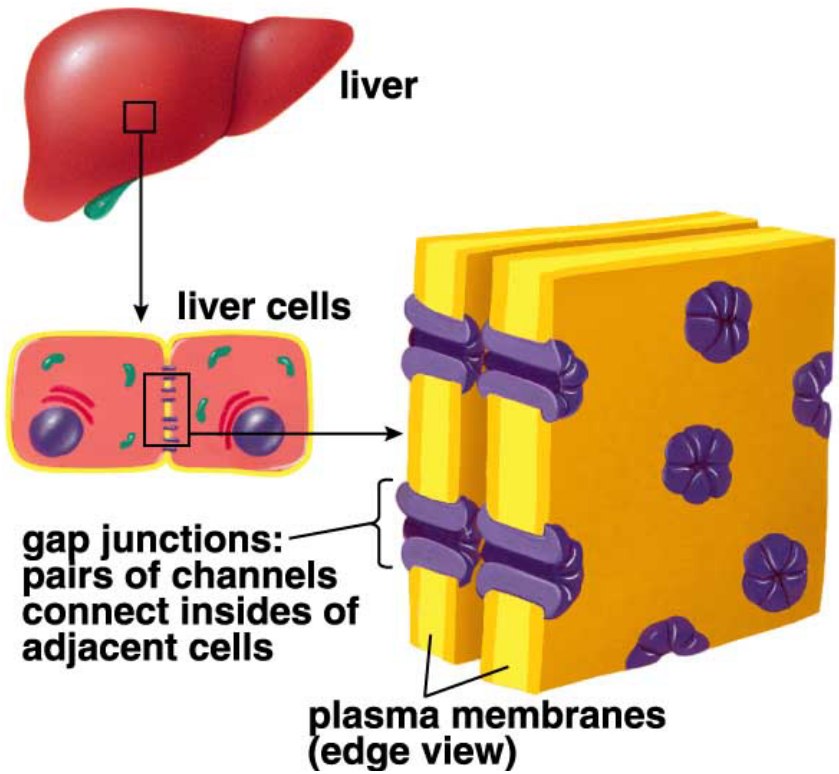
(Figure 4.10b)

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)



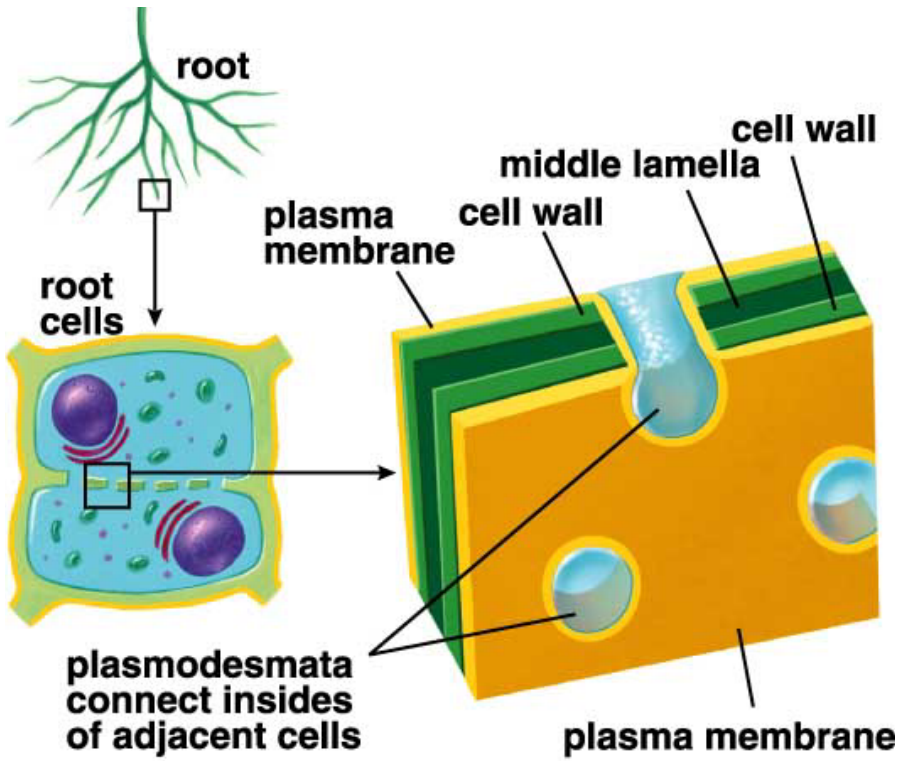
(Figure 4.11a)

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)



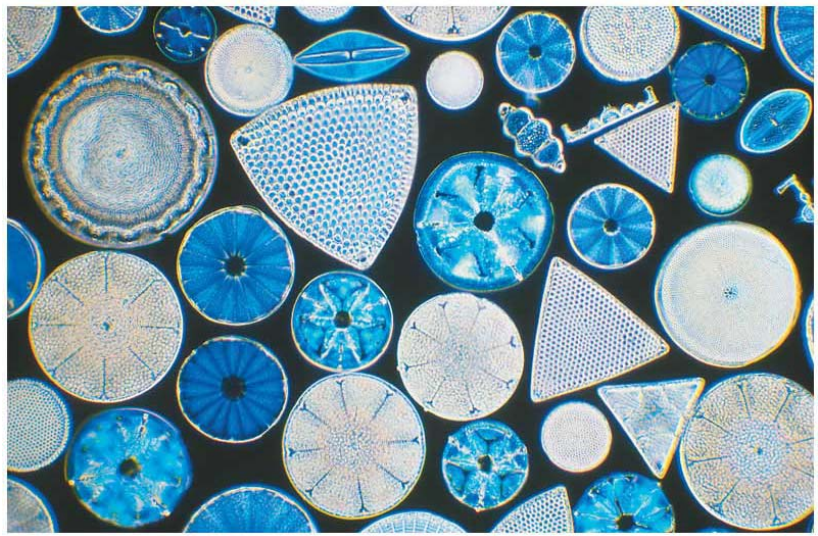
(Figure 4.11b)

How are Cell Surfaces Specialized?

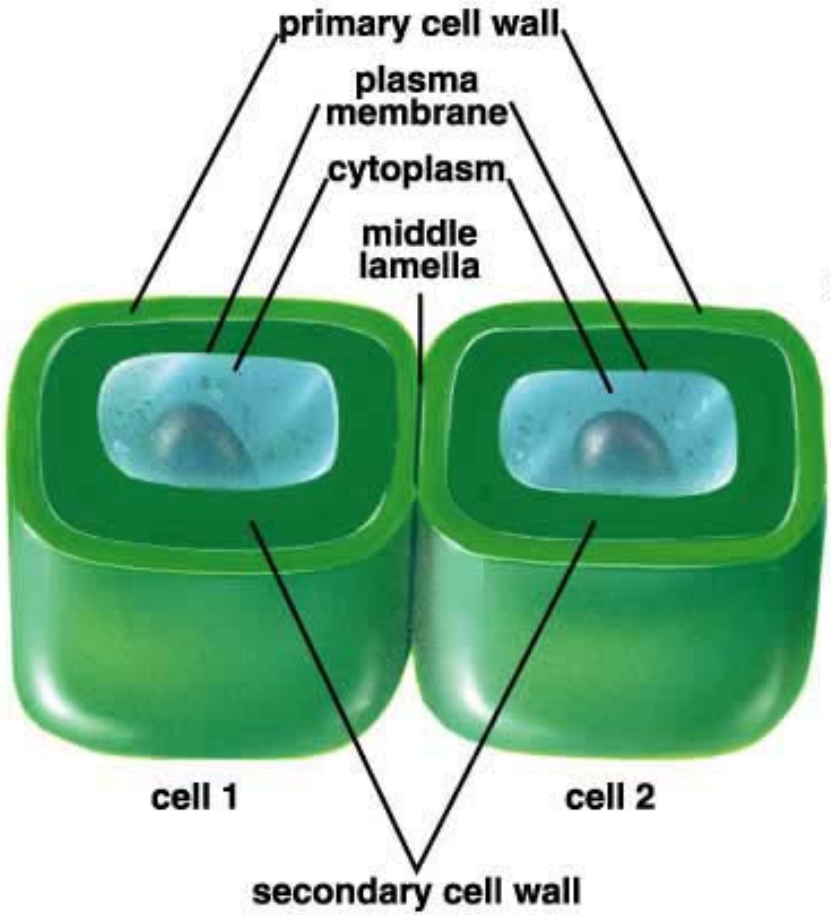
Answer: Cell walls offer support and protection

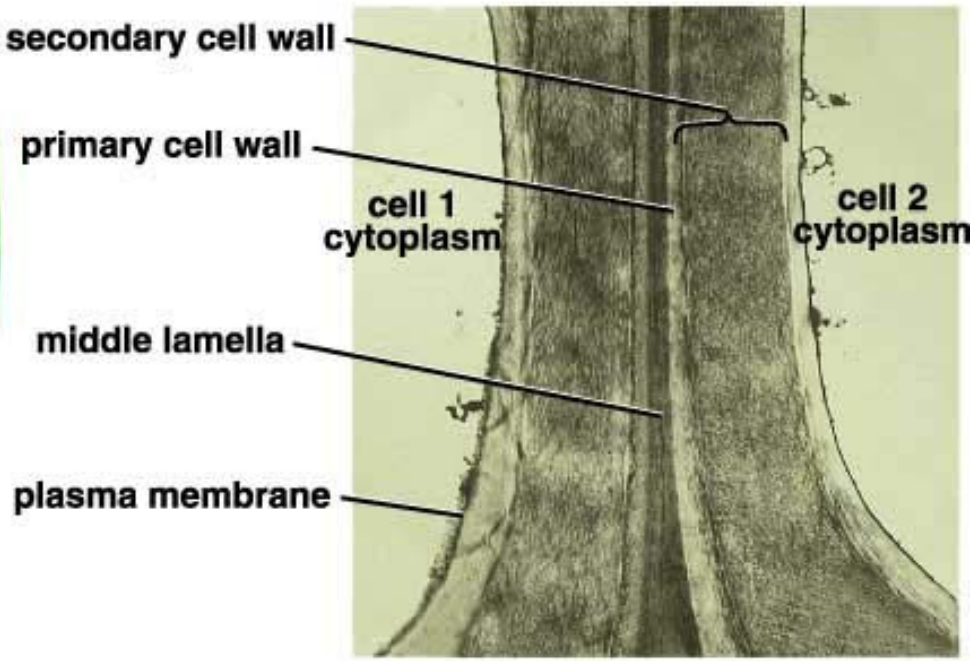
Cell Walls:

- 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)