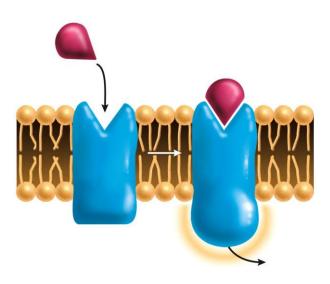
Chapter 5:
Cell Membrane Structure and Function



Chapter 5: Membrane Structure and Function

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

Note:

Membranes also exist within cells forming various compartments

Function: 1) Isolate cell's content from outside environment

- 2) Regulate exchange of substances between inside / outside cell
- 3) Communicate with other cells
- 4) Create attachments within / between cells
- 5) Regulate biochemical reactions

The Fluid Mosaic Model (Singer & Nicolson, 1972)

Membrane consists of embedded proteins that 'shift and flow' within a layer of phospholipids

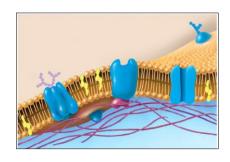


Figure 5.1 – Audesirk<sup>2</sup> & Byers



# Phospholipid Bilayer: Double layer of phospholipide

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

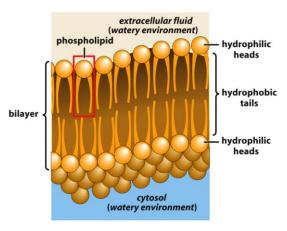
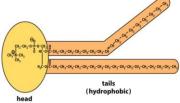


Figure 5.3 - Audesirk<sup>2</sup> & Byers



Lipid tails of phospholipids are unsaturated (C = C)





Chapter 5: Membrane Structure and Function

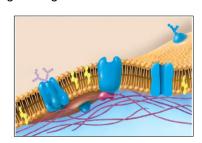
#### Cell Membrane Proteins:

- Receptor Proteins: Trigger cell activity when molecule from outside environment binds to protein
- Figure 5.5 Audesirk<sup>2</sup> & Byers

  (outside)

  (inside)

  reactions
- 2) Recognition Proteins: Allow cells to recognize one another
  - Glycoproteins = proteins with attached carbohydrate groups
- 3) Enyzmes: Catalyze chemical reactions on the inner surface of membranes
- 4) Attachment Proteins: Anchor membrane to internal framework and external surface of neighboring cells
- 5) Transport Proteins: Regulate movement of hydrophilic molecules through membrane



# What Drives the Movement of Substances Across Membranes?

# Answer: Concentration Gradients

For Example:

Definitions of Interest:

40 grams of NaCl / liter of water

Concentration = Number of molecules in a given unit of volume

Gradient = Physical difference in a property between two adjacent

regions of space

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 eliminated (dynamic equilibrium)
- · Diffusion cannot move molecules rapidly over long distances

Chapter 5: Membrane Structure and Function

Figure 5.7 – Audesirk<sup>2</sup> & Byers

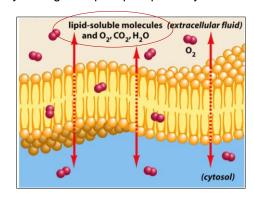
# Types of Movement Across Membranes (see Table 5.1):

#### 1) Passive Transport

- Requires no energy
- · Substances move down concentration gradients
- A) Simple Diffusion
  - · Small molecules pass directly through the phospholipid bilayer

#### Rate depends on:

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



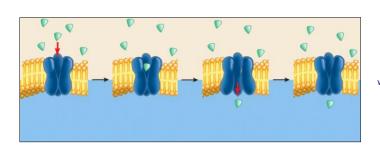
# Types of Movement Across Membranes (see Table 5.1):

# 1) Passive Transport

- · Requires no energy
- Substances move down concentration gradients

# B) Facilitated Diffusion

- · Molecules require assistance of transport proteins
  - Channel Proteins (form pores; e.g., ion channels / water channels)
  - Carrier Proteins (require shape change; e.g., glucose / amino acid carriers)



Protein has binding site where molecule attaches to trigger shape change

Figure 5.7 - Audesirk<sup>2</sup> & Byers

Chapter 5: Membrane Structure and Function

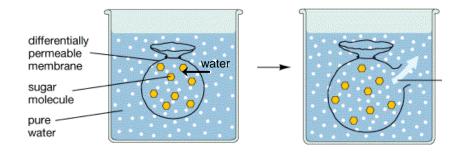
# Types of Movement Across Membranes (see Table 5.1):

#### 1) Passive Transport

- Requires no energy
- · Substances move down concentration gradients

#### C) Osmosis

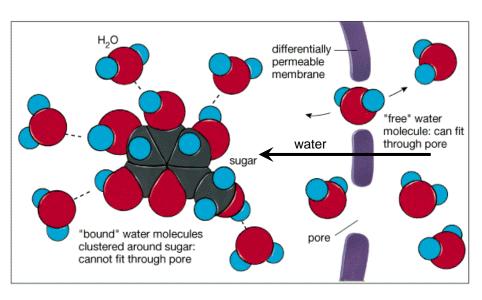
 Movement of water from an area of high [water] to an area of low [water] across a semi-permeable membrane



Protein forms a

hydrophilic passageway

#### Osmosis:



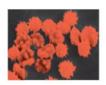
Chapter 5: Membrane Structure and Function

# Osmosis and Living Cells:

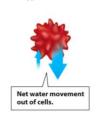
(a) Isotonic solution

Equal movement of water into and out of cells.

- a) Isotonic Solution:
- Outside of cell has SAME [solute] as inside of cell

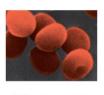


(b) Hypertonic solution



- b) Hypertonic Solution:
- Outside of cell has HIGHER [solute] than inside of cell

Tonicity is relative to the inside of the cell



(c) Hypotonic solution



- c) Hypotonic Solution:
- Outside of cell has LOWER [solute] than inside of cell

# Osmosis in Action:









Chapter 5: Membrane Structure and Function

# Types of Movement Across Membranes (see Table 5.1):

- 1) Passive Transport
- 2) Active Transport
  - Requires energy (in the form of ATP...)
  - Moves substances against concentration gradients (aka 'pumps')

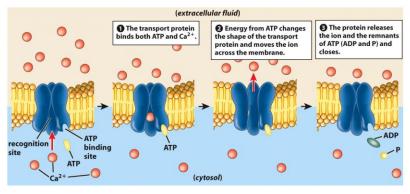
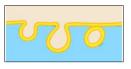


Figure 5.12 – Audesirk<sup>2</sup> & Byers

# Types of Movement Across Membranes (see Table 5.1):

- 1) Passive Transport
- 2) Active Transport
- 3) Endocytosis
  - Movement of large volumes into cells (via vesicle formation; requires ATP)





- a) Pinocytosis ("cell drinking")
  - · Uptake of fluid droplets







- b) Receptor-mediated Endocytosis
- Uptake of molecules via coated pits



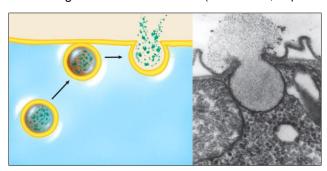


- c) Phagocytosis ("cell eating")
  - Uptake of large particles

Chapter 5: Membrane Structure and Function

# Types of Movement Across Membranes (see Table 5.1):

- 1) Passive Transport
- 2) Active Transport
- 3) Endocytosis
- 4) Exocytosis
  - Movement of large volumes out of cells (via vesicles; requires ATP)



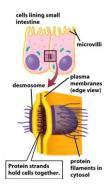
(e.g., hormones)

Figures 5.16 – Audesirk<sup>2</sup> & Byers

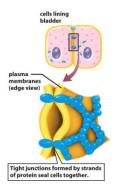
# How are Cell Surfaces Specialized?

# Answer: Junctions allow cells to connect and communicate

# 1) Connection Junctions:



- a) Desmosomes
- Hold cells together via protein filaments



# b) Tight Junctions

• Protein "seals" prevent leakage (cell to cell)

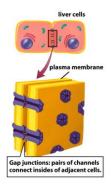
Chapter 5: Membrane Structure and Function

Figures 5.18 – Audesirk<sup>2</sup> & Byers

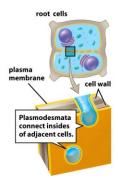
# How are Cell Surfaces Specialized?

# Answer: Junctions allow cells to connect and communicate

# 2) Communication Junctions:



- a) Gap Junctions (animals)
- Protein channels allow for signals to pass between cells



- b) Plasmodesmata (plants)
- Cytoplasmic bridges allow for signals to pass between cells

# 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

