Cell Transport Notes

- Diffusion and Osmosis
- Active Transport
Cell Membrane

- All cells are surrounded by a thin, flexible barrier known as the **cell membrane**.
  - The Cell Membrane has two major functions.
    - forms a boundary between inside and outside of the cell (provides protection and support)
    - regulates passage of materials into and out of the cell.
Components of the Cell Membrane

- Outside of cell
  - Protein channel
  - Carbohydrate chains
- Inside of cell (cytoplasm)
  - Proteins
  - Lipid bilayer
  - Phospholipid

Now...let's take a closer look at cell membrane!
Lipid Bilayers
(2 layers of phospholipids)

- Phospholipids arrange themselves in lipid bilayers to make the cell membrane!
- The lipid bilayer gives the cell membranes a flexible structure that forms a barrier between the cell and its surroundings.
Phospholipids are the major component of cell membranes.

- **Hydrophilic**
  - likes water
  - *polar*

- **Hydrophobic**
  - dislikes water
  - *non-polar*
Within the Layer

- Many different parts:
  - Sterols – Animal Cells that is the Cholesterol
  - Proteins
    - Markers
    - Receptors
    - Transporters
    - Enzymes
    - Anchoring
Fluid Mosaic Model

- Movement!
- Cholesterol/Sterols Purpose:
  - Keep the membrane firm and prevent freezing
Proteins
Marker Proteins

- **Purpose:** Identifies the cell type
- **How:** Has a carbohydrate attached to the outside
- **Can be called glycoprotein**

![Diagram of cell membrane with various proteins and carbohydrates](image)
Receptor Proteins

- **Purpose:** Recognizes and binds to substances outside of the cell and sends a signal to the cell
  - **Hormones**
Transport Proteins

- **Passive Diffusion:**
  - Channel Proteins
    - Purpose: Create a hole to allow larger molecules to pass through the membrane

- **Active Transport:**
  - Protein Pumps
    - Purpose: Uses energy to move molecules against the concentration gradient
Transport Proteins

- **Simple diffusion** (a): Molecules move from a region of higher concentration to a region of lower concentration without using energy.
- **Facilitated diffusion** (b): Molecules move from a region of higher concentration to a region of lower concentration with the help of a carrier protein, which requires no energy.
- **Active transport** (c): Molecules are transported against a concentration gradient, requiring the use of ATP and energy.

- **Carrier protein** and **Pump protein** assist in the transport of molecules across the cell membrane.
- **Extracellular fluid** (outside of cell) and **Cytoplasm** (inside cell) are indicated.
- **ATP** is used for active transport.
Active Transport

Extracellular space

Sodium $\text{Na}^+$

Potassium $\text{K}^+$

Cell membrane

ATP → ADP + $P_i$

Intracellular space

$\text{Na}^+$ concentration

$\text{K}^+$ concentration
Enzymes

- **Purpose:** Assists in chemical reactions inside of the cell
Anchoring

- Purpose: Hold the cells together
  - Intercellular Junctions #ftw
Main Function of the Cell Membrane

- Remember…one main function of the cell membrane is to regulate materials that enter and exist the cell.
- Do you think that the cell membrane lets all things in or out?
  - No… the cell membrane is considered Selectively Permeable!
Cell Transport: Diffusion and Osmosis
Cell Transport

Review Vocab

- Solute: Particle that is dissolved (Koolaid Sugar)
- Solvent: Liquid that does the dissolving (Water)

New VOCAB

- Permeable: Allows particles to pass through
- Impermeable: Does NOT allow particles to pass through
- Semipermeable: Allows certain particles to pass through ********
Selectively Permeable:

- Allows some molecules to cross the membrane, while others cannot.

In the picture, which molecules are let across the membrane? Which are not?
• Let across - Blue Molecules
• Not allowed across - Orange Molecules
Why must the membrane be selective?

- To maintain HOMEOSTASIS:
  - Organisms ability to maintain stability and adjust to environmental changes

- To let in only necessary molecules such as:
  - water molecules
  - food particles
  - ions

- To remove wastes such as:
  - Worn-out organelles
  - CO2
  - excess water
  - Undigested food
DEMO! Dialysis Tubing

Set Up: What do you think will happen?

What happened? Why?

Draw it and Describe this in your own words!
What is Diffusion?

- Diffusion:
  - Movement of particles from higher concentration to lower concentration.
  - When the concentration of the particles is the same throughout a system, the system has reached equilibrium.
  - Diffusion does not require the cell to use energy!
DIFFUSION

FLOW

NET FLOW
DIFFUSION

A diagram showing the process of diffusion. On the left, concentrated sugar solution and dilute sugar solution are separated by a permeable membrane. Sugar molecules (red) move from the concentrated solution to the dilute solution, causing a uniform distribution of water and sugar molecules on the right. This process is labeled as diffusion.
Diffusion Through Cell Boundaries
Factors that affect Diffusion

- **Heat:**
  - The hotter the solution, the quicker it will diffuse

- **Size of Particles**
  - Particles that are too large may not be able to diffuse because they can’t get through the semi permeable membrane

- **Concentration of Particles**
  - The larger the difference, the faster the diffusion will happen
Osmosis...a special type of Diffusion!

- Osmosis:
  - Osmosis is the diffusion of water through a selectively permeable membrane.
- In a cell, water always tries to reach an equal concentration on both sides of the membrane!
What happens if there is too little water?

- The cytoplasm shrinks!
  - PLASMOLYSIS
Osmosis

How Osmosis Works

Movement of water

Dilute sugar solution (Water more concentrated)

Concentrated sugar solution (Water less concentrated)

Sugar molecules

Selectively permeable membrane

Movement of water
Three Types of Solutions

- A cell can be in three types of solutions:
  - **Isotonic** (same strength”)
  - **Hypertonic** (“above strength”)
  - **Hypotonic** (“below strength”)

- Let’s examine each a little closer!
Isotonic Solutions

- Concentration of dissolved substances in solution is the same as concentration of dissolved substances inside the cell. (same strength).

- Water inside the cell is equal to water in solution.

- Cells in isotonic solution do not experience osmosis and retain their normal shape.

- EX:
  - Immunizations are isotonic solutions so they do not damage the cells by gain or loss of water.
Isotonic

Amount of water transported into the cell equal to the amount of water transported out from the cell.

Solute concentration inside the cell is Equal to the solution outside the cell.

Solution is Isotonic.

Water goes in both directions.

Water Molecules
Hypertonic Solutions (Hyper kids)

- Concentration of dissolved substances in solution is higher than concentration of dissolved substances inside cell.

- There is more water inside cell than outside.

- Cells in hypertonic solutions experience osmosis in which water moves through membrane to outside of cell.

- Ex:
  - In plant cells, membrane and cytoplasm shrink away from cell wall and plant wilts.
  - In animal cells, the pressure decreases and the cells shrivel.
Hypotonic Solutions (Hippo)

- Concentration of dissolved substances in solution is lower than concentration of dissolved substances inside the cell.

- There is more water outside the cell than inside.

- Cells in hypotonic solutions experience osmosis in which water moves through membrane into cell.

- EX:
  - In animal cells, the pressure inside cell increases causing the cells to swell and sometimes burst!
  - In plant cells, the rigid cell wall prevents bursting, but the cells become more firm.
There are three types of solutions.

- **isotonic**
- **hypertonic**
- **Hypotonic**

1. **ISOTONIC SOLUTION**
   - isotonic
   - A solution is isotonic to a cell if it has the same concentration of solutes as the cell. Equal amounts of water enter and exit the cell, so its size stays constant.

2. **HYPERTONIC SOLUTION**
   - hypertonic
   - A hypertonic solution has more solutes than a cell. Overall, more water exits a cell in hypertonic solution, causing the cell to shrivel or even die.

3. **HYPOTONIC SOLUTION**
   - hypotonic
   - A hypotonic solution has fewer solutes than a cell. Overall, more water enters a cell in hypotonic solution, causing the cell to expand or even burst.
Passive Transport: Mosey on through…

- Molecules pass through the cell membrane requiring **no energy** input from the cell.

- The molecules just mosey on through!
Facilitated Diffusion

- The *passive transport* of specific molecules across cell membranes through protein channels is known as **facilitated diffusion**.
  - Essentially, the molecules are being helped across the membrane!

- If facilitated diffusion is considered Passive Transport, is there any energy used?
  - NO
Facilitated Diffusion

Glucose molecules

Protein channel
Facilitated Diffusion

- Although facilitated diffusion is fast and specific, it is still diffusion.
- Therefore, facilitated diffusion will only occur if there is a higher concentration of the particular molecules on one side of a cell membrane as compared to the other side.
Active Transport

- Sometimes cells move materials in the opposite direction from which the materials would normally move—that is against a concentration difference. (from low to high concentrations)

- This process is known as active transport.

- Active transport requires energy!
Active Transport

- Molecular Transport
  - In active transport, small molecules and ions are carried across membranes by proteins in the membrane.
  - These Proteins need ENERGY
Active Transport

Molecule to be carried

Energy
Cellular Transport

- **Diffusion through lipid bilayer**
- **Facilitated diffusion**
- **Passive transport**
- **Active transport**

- ATP
What about the big boys?

- **ENDOCYTOSIS**: cells surrounds and takes in material from environment by engulfing the material! YUMMY!

- **EXOCYTOSIS**: cells expel materials from cell, such as waste or indigestible particles. GROSS!

- Both endo and exocytosis are moving large masses of material and require energy (ACTIVE TRANSPORT!)
Endocytosis

- Phagocytosis: Pseudo arms take in food particles
- Pinocytosis: NO pseudo arms are made as the cell takes in fluid.
Endocytosis and Exocytosis

- **ENDOCYTOSIS**

- **EXOCYTOSIS**
Unlike a cell wall, a cell membrane:

- is composed of a lipid bilayer.
- provides rigid support for the surrounding cell.
- allows most small molecules and ions to pass through easily.
- is found only in plants, fungi, algae, and many prokaryotes.
The concentration of a solution is defined as the

- volume of solute in a given mass of solution.
- mass of solute in a given volume of solution.
- mass of solution in a given volume of solute.
- volume of solution in a given mass of solute.
If a substance is more highly concentrated outside the cell than inside the cell and the substance can move through the cell membrane, the substance will

- move by diffusion from inside the cell to outside.
- remain in high concentration outside the cell.
- move by diffusion from outside to inside the cell.
- cause water to enter the cell by osmosis.
The movement of materials in a cell against a concentration difference is called

- facilitated diffusion.
- active transport.
- osmosis.
- diffusion.
The process by which molecules diffuse across a membrane through protein channels is called

- active transport.
- endocytosis.
- facilitated diffusion.
- osmosis.