Cell Membrane
Overview

- The cell membrane forms a barrier around the cell and separates it from the outside environment.
- What is the main function of the cell membrane?
  - Allows certain materials **in** and **out** of the cell.
- The cell membrane is **selectively permeable**.
  - Some substances cross the membrane easily while others can’t cross at all.
- The cell membrane is made of phospholipids and proteins, some with carbohydrates attached.
Phospholipids

- Fatty acid “tails”
  - **Hydrophobic** – move away from water (polar)
- Phosphate group “head”
  - **Hydrophilic** - move towards water (nonpolar)
- Form two layers called a lipid bilayer
Phospholipid Bilayer

- **Polar** hydrophilic heads
- **Nonpolar** hydrophobic tails
- **Polar** hydrophilic heads
Membrane Proteins

- **Peripheral Proteins**
  - Attached to the interior and exterior surface of the membrane by weak bonds
  - Can serve as ID tags for the cell

- **Integral Proteins**
  - Embedded in the bilayer and stick out of the interior and exterior surface
  - Provide a pathway through the membrane
    - Channels and Pumps (permeases)
How Proteins Stay in the Membrane

- Membrane proteins have polar and nonpolar ends
- In the membrane
  - Nonpolar amino acids anchor the protein in the membrane
- Outside the membrane
  - Polar amino acids are attracted to the fluid inside and outside the membrane
Marker Proteins

- Allows cells to recognize each other
- Important for the development of tissue and organs
- Helps the immune system by recognizing cells that do not belong (bacteria) and attacking them
- Have carbohydrate chains attached which serve as the markers
Movement Across the Cell Membrane
Passive Transport
Overview

- The cell needs to let some substances in and out in order to maintain **homeostasis**
  - **Homeostasis** is the stable internal conditions of a living thing
- **Passive transport** is the movement of substances across a membrane that requires **no** energy from the cell to occur
- **3 Types of Passive Transport**
  - Diffusion
  - Osmosis
  - Facilitated Diffusion
Diffusion

- Diffusion is the movement of substances from **HIGH** to **Low** concentration
- Diffusion happens along the **concentration gradient**, which is the difference in concentration across a space
  - Molecules move **down** the concentration gradient
- Molecules diffuse until they reach **equilibrium**, where the concentration is **equal** on both sides
  - Molecules will continue to diffuse, but they will move back and forth equally
Not all molecules can diffuse

- Large molecules are too big to diffuse
  - Starches, proteins
- Ions – atoms with a positive or negative charge
  - Salt, ammonia
- Polar molecules – molecules with positive and negative ends
  - water

Fats & other lipids can diffuse through the membrane
Osmosis

- Water is special because it is a polar molecule that can diffuse across the cell membrane because it is a solvent
- **Osmosis** is the diffusion of water across a membrane
  - Moves from high concentration of water to low concentration of water
Direction of Water Movement

- The direction of water movement depends on solute concentrations
  - **Isotonic** – equal solute, equal water
  - **Hypertonic** – more solute, less water
  - **Hypotonic** – less solute, more water

Solute is a substance that is dissolved, like salt, or sugar.
Effect of Osmosis on Cells

- If a cell is in an **isotonic** environment, it stays the same.
- If a cell is in a **hypertonic** environment, water diffuses **out of** the cell and the cell **shrinks**.
- If a cell is in a **hypotonic** environment, water diffuses **into** the cell and the cell **grows** and can burst.
How Cells Deal with Osmosis

- Single-celled organisms, like paramecium, that live in freshwater live in a **hypotonic** environment
  - These cells use a **contractile vacuole** to pump excess water out of the cell
  - This requires energy
- Plant cells usually live in a **hypotonic** environment
  - Their cell wall’s are usually strong enough to resist the pressure from the excess water inside the cell
    - The pressure that water molecules exert against the cell wall is called **turgor pressure**
- In a **hypertonic** environment, water leaves a plant cell and the cell shrinks
  - The cell membrane pulls away from the cell wall
  - This is called **plasmolysis** and is the reason plants wilt when they do not have enough water
Facilitated Diffusion

- Some molecules that cannot diffuse across the membrane on their own are helped through the membrane.
- Special protein channels called **carrier proteins** help move molecules across the membrane.
  - Each protein is specific to the molecule it moves.
  - No energy is required, so it is still **passive transport**.
  - Molecules such as glucose and other sugars, amino acids, salt, and ammonia are diffused by facilitated diffusion.
**Diffusion of Ions**

- Ions can diffuse through the membrane by passing through special proteins called **ion channels**.
- Some ion channels are always open.
- Others have “gates” that open or close.
- Gates will open or close in response to 3 kinds of stimuli:
  - Stretch
  - Electronic signals
  - Chemicals in the cytosol
Movement Across the cell Membrane

Active Transport
Overview

- Sometimes cells need to move substances from low concentration to high concentration
  - These substances move up the concentration gradient
- Sometimes cells need substances that are too large to diffuse
- To move these substances, cells must use energy
- **Active transport** – the movement of materials across the cell membrane up the concentration gradient that requires energy by the cell
Sodium-Potassium Pump

- Sodium-Potassium pump is a carrier protein that moves Na+ and K- ions up the concentration gradient
  - Pump helps maintain the concentration of Na+ higher outside the cell and the concentration of K- higher inside the cells
  - Cells need this in order to function properly
Endocytosis

Endocytosis is the process by which cells ingest fluid, macromolecules, and large particles.

2 Types of Endocytosis

- Phagocytosis
- Pinocytosis
Phagocytosis

- Means “cell eating”
- Moves large particles, such as food, from outside to inside the cell
- Cell forms a “pouch” around the substance, which then pinches off and moves into the cell
Pinocytosis

- Means “cell drinking”
- Fluid is taken into the cell in a process similar to phagocytosis
Exocytosis

- **Exocytosis** is the process where the cell releases large substances, such as proteins
  - Substances are moved **out of** the cell
- Vesicles move to the cell membrane, fuse with it, and release the contents