



Cell Membrane

Functions of the Cell Membrane:

- Physical isolation (homeostasis – the existence of a stable internal environment)
- Regulation of exchange with the environment
- Sensitivity to the environment
- Structural support

Properties of the Cell Membrane:

Phospholipid Bilayer

- Forms most of the surface of the cell membrane but makes up only 42% of the cell membrane's weight
- Consists of:
 - Hydrophilic "heads" – love to interact with water due to their polar nature
 - In contact with interstitial fluid & cytosol
 - Hydrophobic "tails" – cannot interact with water and other water soluble substances due to their nonpolar nature
 - Tend to interact with each other and other nonpolar substances
 - Do not allow ions & water soluble compounds to pass through, isolating cytoplasm from surrounding fluid environment

Carbohydrates

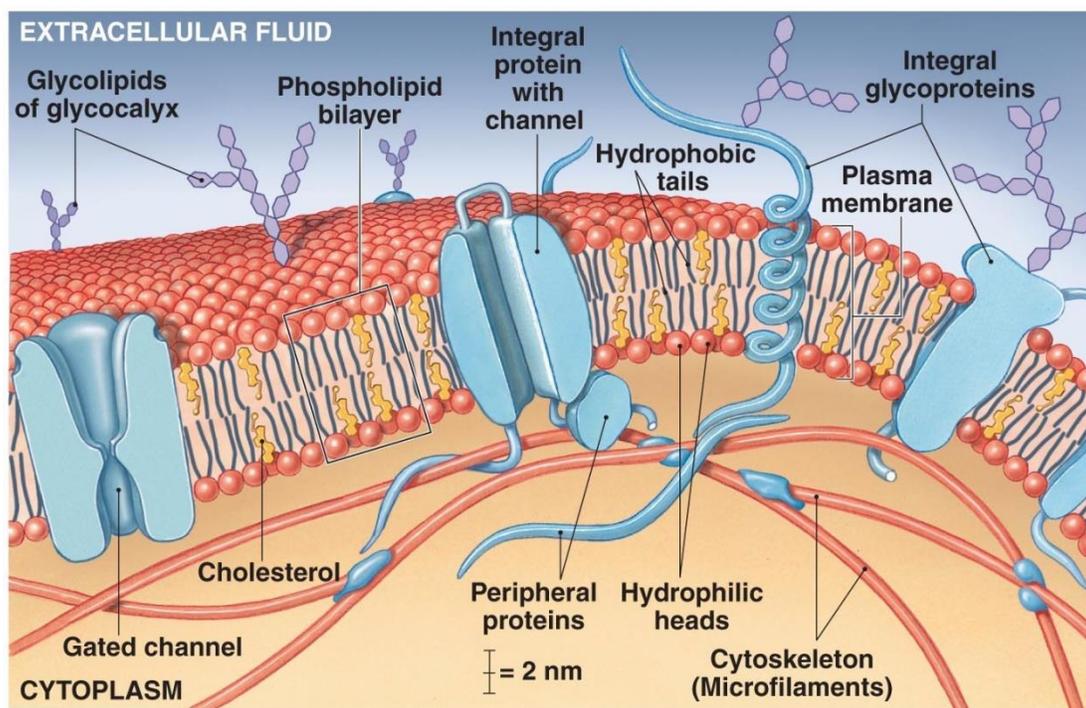
- Make up only 3% of the cell membrane's weight
- Found in the form of glycoproteins (carbohydrates attached to proteins) and glycolipids (carbohydrates attached to lipids)
- Function:
 - Lubrication and protection –form a hydrophilic layer that lubricates and protects the cell membrane
 - Anchoring –are sticky and can help keep a cell in place
 - Binding –can act as receptors to bind specific extracellular substances
 - Recognition –form a recognizable outer surface allowing the body's immune system to differentiate against foreign substances

Proteins

- Make up 55% of the cell membrane's weight
- Types of proteins:
 1. Anchoring – stabilize the cell's position



2. Recognition – special features on the membrane used as identifiers allowing the immune system to determine whether the cell is normal or abnormal (e.g. infected by a virus)
3. Enzymes – catalyze reactions in the extracellular fluid or cytosol
4. Receptor – bind to specific substance to trigger activities in cells (e.g. bind to insulin to increase rate of glucose absorption)
5. Transport – allow specific substances to cross the membrane
 - Carrier proteins – bind specific solutes and undergo a conformational (shape) change to transfer solute through the membrane
 - Channels – have an aqueous pore – when open, allows certain substances to cross through the membrane (e.g. water and small solutes)



Membrane Permeability

- Due to the makeup of the cell membrane, certain substances can pass through the membrane with ease where others cannot.
- Whether a substance can cross the membrane freely depends on its size, polarity and charge.
 - Nonpolar substances (e.g. O₂, CO₂, and lipids) and small uncharged polar substances (e.g. H₂O and glycerol) can cross through the lipid bilayer easily. These substances do not disrupt the hydrophobic interactions between the hydrophobic tails.
 - Charged substances (e.g. Na⁺, K⁺, and Ca²⁺) and larger polar molecules (e.g. glucose, sucrose, and amino acids) cannot cross the lipid bilayer



easily. These substances will disrupt the hydrophobic interactions between the hydrophobic tails. For these substances to cross the membrane, a transport protein is required.

Helpful animation: http://www.uic.edu/classes/bios/bios100/lectures/cross_memb.htm

Transport In/Out of the Cell Through the Cell Membrane:

Passive Transport (no ATP is expended)

- **Diffusion** – The net movement of a substance (atoms, molecules, or ions) down its own concentration gradient to reach equilibrium (an evenly distributed state).
- **Osmosis** – The net movement of water through a semi-permeable (or selectively permeable) membrane down its concentration gradient (from dilute to concentrated solution).
 - Isotonic solution – solution contains the **same** concentration of solutes compared to the cytosol – solution does not cause a net osmotic flow of water into or out of a cell
 - e.g. normal saline
 - Hypotonic solution – solution contains a **lower** concentration of solutes compared to the cytosol – net movement of water into the cells
 - Hypertonic solution – solution contains a **higher** concentration of solutes compared to the cytosol – net movement of water out of the cells
- **Facilitated Diffusion** – The net movement of substance down its own concentration gradient with the help of a transport protein (can be carrier or channel proteins) to reach an evenly distributed state.

Helpful animation: <http://bcs.whfreeman.com/thelifewire/content/chp05/0502001.html>

Active Transport (Requires ATP)

- Transport of substance across the membrane regardless of the concentration gradient with the help of a carrier protein and energy
 - **Sodium-Potassium Exchange Pump** – Hydrolysis of ATP allows the carrier protein to exchange intracellular Na^+ for extracellular K^+ . Na^+ ions are transported out of the cell while K^+ ions are transported in against its concentration gradient

Helpful animation: <http://bcs.whfreeman.com/thelifewire/content/chp05/0502002.html>

