The Cell Membrane
Today we will study the cell membrane.

A. Cell membrane composition. The Fluid Mosaic Model.
   - Function of the Phospholipids.
   - Function of the proteins.

B. What is the function of the cell membrane? How does the cell membrane perform this task?
   - Types of transport across the membrane.
Membranes organize the chemical activities of cells and all the chemical reactions involved in metabolism.

They control the flow of substances into and out of a cell.
How does the cell membrane look?

- The structure of the cell membrane is explained by the Fluid Mosaic Model: This model establishes that:
  - The Phospholipid Bilayer Is the Fluid Portion of the Membrane
  - A Mosaic of Proteins Is Embedded in the Membrane
What Is the composition of the Plasma Membrane?

- The Cell Membrane is composed of

  80% phospholipids
  15% proteins
  5% steroids.
The plasma membrane of an animal cell
The distribution of the different molecules follows the so called the **Fluid Mosaic Model**:

The Phospholipid Bilayer forms the fluid portion of the membrane.

And a mosaic of proteins and steroids is embedded in the membrane.
Membrane phospholipids form a bilayer

- Phospholipids are the main structural components of membranes
- They each have a hydrophilic head and two hydrophobic tails
Membrane phospholipids form a bilayer

Phospholipids are the main structural components of membranes. They each have a hydrophilic head and two hydrophobic tails.

They each have a hydrophilic head and two hydrophobic tails.
extracellular fluid (watery environment)

phospholipid

bilayer

hydrophilic heads

hydrophobic tails

hydrophilic heads

cytoplasm (watery environment)

extracellular fluid (watery environment)
Proteins make the membrane a mosaic of function. Membrane proteins

- Function as enzymes
- Function as receptors for chemical messages from other cells
- Moving substances across the membrane
What are the functions of the cell membrane?

- It controls the flow of substances into and out of a cell. The cell membrane is selectively permeable.

- In addition, the proteins in the membranes can be enzymes, receptor proteins, or anchoring proteins (for the cytoskeleton organelles).
Diffusion is the movement of molecules from an area of high concentration to an area of low concentration.
Passive Transport

Small uncharged molecules like O2 and CO2 diffuse across the plasma membrane between the tails of the phospholipids. The movement follows the concentration gradient (from high concentration to low concentration.)
(a) Simple diffusion

lipid-soluble molecules
\((O_2, CO_2, H_2O)\)

(extracellular fluid)

(cytoplasm)
Charged and large molecules such as ions ($\text{Na}^+$, $\text{Cl}^-$, $\text{Mg}^+$, $\text{Ca}^{+2}$), sugars, amino acids, etc. cannot diffuse across the plasma membrane between the tails of the phospholipids.
Facilitated Diffusion

The transport of charged and large molecules such as ions (Na\(^+\), Cl\(^-\), Mg\(^+\), Ca\(^{+2}\)), sugars, etc. is facilitated by transport proteins that acts like “tunnels”. The movement follows the concentration gradient (from high concentration to low concentration.)
(b) Facilitated diffusion through a channel
Facilitated diffusion through a carrier protein for amino acids, sugars, or small proteins.
Osmosis
The transport of Water across a selectively permeable membrane. The movement follows the concentration gradient (from high concentration to low concentration.)
How Do Molecules Move against a Concentration Gradient?

- Active Transport Uses Energy to Move Molecules against Their Concentration Gradients
- Membrane Proteins Regulate Active Transport

(Figure 3.6 Active transport (p. 48)
Active Transport

Active transport uses energy (ATP) to move molecules against their concentration gradients (from low to high). Membrane Proteins Regulate Active Transport (Figure
3.6 Active transport (p. 48).
A solution with higher amount of solute than the cells is hypertonlic.

A solution with the same amount of solute than the cells is isotonic.

A solution with lower amount of solute than the cells is hypotonic.
Let’s Practice

What happens when the cell is in these environments?

- **Hypertonic (10% NaCl)**: The cell shrinks
- **Isotonic (1% NaCl)**: The cell stays the same
- **Hypotonic (0% NaCl)**: The cell swells
Red Blood Cells in Isotonic solution

10 micrometers
Red Blood Cells in Hypertonic solution
Red Blood Cells in Hypotonic solution
Salt Water!!! My cells are shrinking!!!!

Zao (Rick Yune) gets all wet in MGM Pictures and Eon Productions' "Die Another Day." Photo Credit: Keith Hamshere
<table>
<thead>
<tr>
<th>Compound</th>
<th>Inside</th>
<th>Outside</th>
<th>Movement (in or out)</th>
<th>Mechanism of Transport</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glucose</td>
<td>0.01%</td>
<td>0.05%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fructose</td>
<td>0.02%</td>
<td>0.02%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oxygen</td>
<td>0.05%</td>
<td>0.1%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbon Dioxide</td>
<td>1.5%</td>
<td>1%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water</td>
<td>75%</td>
<td>80%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calcium (Ca++)</td>
<td>0.03%</td>
<td>0.05%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cl⁻</td>
<td>0.01%</td>
<td>0.05%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Na ++</td>
<td>0.01%</td>
<td>0.005%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
How Do Molecules Move against a Concentration Gradient?

- Cells Engulf Particles or Fluids by Endocytosis.
- There are two ways of Endocytosis:
- Pinocytosis and Fagocytosis
A dimple forms in the plasma membrane, which deepens and surrounds the extracellular fluid. The membrane encloses the extracellular fluid, forming a vesicle.
The plasma membrane extends pseudopods toward an extracellular particle (for example, food). The ends of the pseudopods fuse, encircling the particle. A vesicle called a food vacuole is formed containing the engulfed particle.
How Do Molecules Move against a Concentration Gradient?

- Exocytosis Moves Material out of the Cell