

CELL TRANSPORT & HOMEOSTASIS

Big Picture

The cell membrane regulates what goes in and out of the cell by only allowing certain substances to pass through. Substances can cross the membrane by either passive or active transport. Passive transport includes diffusion and osmosis. In passive transport, molecules move from areas of high concentration to areas of low concentration in order to reach homeostasis. An example of active transport is the sodium-potassium pump, which plays an important role in moving sodium and potassium ions in and out of the cell.

Key Terms

Homeostasis: Process of maintaining a stable environment inside a cell or an entire organism.

Concentration Gradient: A measurement of how much the concentration of a substance changes across a distance.

Passive Transport: Substances cross the cell membrane without the cell providing energy.

Diffusion: A substance moves through a membrane from an area of high concentration to an area of low concentration.

Osmosis: The diffusion of water molecules across a membrane.

Facilitated Diffusion: Diffusion with the help of transport proteins.

Transport Protein: Special proteins in the membrane.

Active Transport: A substance moves against the concentration gradient (uses energy from cells).

Sodium-Potassium Pump: When this pump is in operation, sodium ions are pumped out of the cell, and potassium ions are pumped into the cell. Both ions move from areas of lower to higher concentration.

Vesicle Transport: Type of transport in which very large molecules cross the cell membrane.

Endocytosis: Type of vesicle transport that moves a substance into the cell. The plasma membrane completely covers the substance, a vesicle pinches off from the membrane, and the vesicle carries the substance into the cell.

Exocytosis: Type of vesicle transport that moves a substance out of the cell. A vesicle containing the substance moves through the cytoplasm to the cell membrane. Then, the vesicle membrane fuses with the cell membrane, and the substance is released outside the cell.

Transport Across Membranes

Homeostasis is one of the unifying principles of biology. The concentration of various substances, such as salts and nutrients, needs to be within a certain range in order for a cell to function normally. To maintain this balance, a cell needs to be able to move substances in and out.

Cell membranes are selectively permeable (semipermeable), so some molecules can go in while others can't.

- Hydrophobic (water-repelling) molecules like oxygen can pass easily through the phospholipid bilayer.
- Hydrophilic (easily dissolvable in water) molecules can't pass through as easily. Examples of hydrophilic molecules include ions and polar molecules like water.
- Molecules like sugars and proteins are too big to go through.

Three ways for substances to move across a cell membrane: **passive transport**, **active transport**, and **vesicle transport**.

- **Transport proteins** or vesicle transports are needed to move hydrophilic and large molecules.

Notes

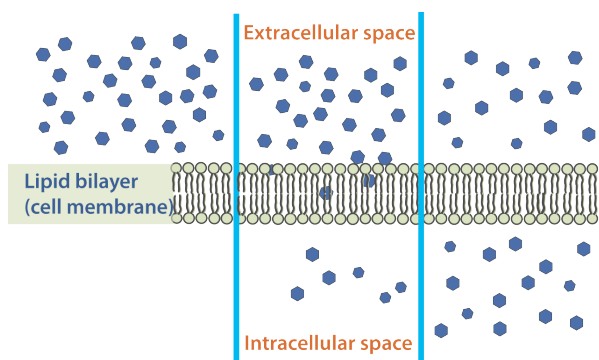
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Passive Transport

Passive transport refers to the movement of substances across the membrane without any input of energy from the cell. Three main types of passive transport include:

Diffusion, where molecules “move down the **concentration gradient**” from an area of high concentration to an area of low concentration until equilibrium is reached (the concentration of molecules on both sides of the membrane are equal).

- Substances have a tendency of moving from an area of high concentration to an area of low concentration, so this process does not require an input of energy from the cell.



Time

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Active Transport

Active transport refers to the movement of substances across the membrane that requires an input of energy from the cell. Energy for active transport comes from an energy-carrying molecule called ATP.

Energy is required to move substances against the concentration gradient from areas of low concentration to areas of high concentration (contrary to the natural process of diffusion). Energy is also needed to move very large molecules across the membrane.

Like in passive transport, transport proteins are used to move smaller substances.

- The **sodium-potassium pump** is an example of active transport where sodium ions are pumped out and potassium ions are pumped in.

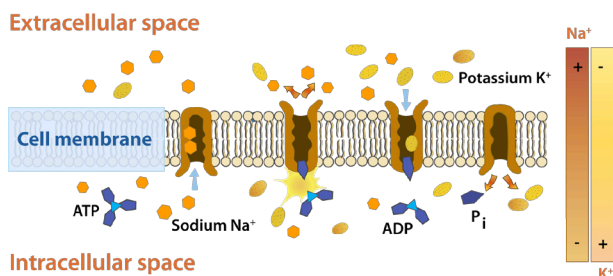


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Osmosis, a special type of diffusion specifically referring to the movement of water across a membrane.

- If there is a higher concentration of salt (or any other solute) outside a cell than inside it, there is a lower concentration of water outside the cell than inside it. As a result, water inside the cell will diffuse out of the cell. For animal cells, this will cause the cell to shrivel. In plant cells, the cell wall is rigid but the plasma membrane will shrink and pull away from the wall.
- If there is a lower concentration of salt (or any other solute) outside a cell than inside it, there is a higher concentration of water outside the cell than inside it. As a result, water outside the cell will diffuse into the cell. This will cause animal cells to swell and eventually burst. Plant cells will fill up with water until they're turgid (firm) before they stop taking in water.

Facilitated diffusion, a type of diffusion assisted by transport proteins.

Examples of transport proteins:

- Channel proteins allow small ions and water to go through very quickly.
- Carrier proteins change shape as they carry specific ions across the membrane.

Larger molecules are transported by vesicle transport.

- **Endocytosis** moves a substance into the cell. First, the cell membrane surrounds the substance. The vesicle then pinches off from the membrane and carries the substance into the cell.
- **Exocytosis** is the reverse process that moves a substance out of the cell. Vesicle containing the substance moves through the cytoplasm to the cell membrane. The vesicle membrane then fuses with the cell membrane, allowing the substance to be released outside of the cell.

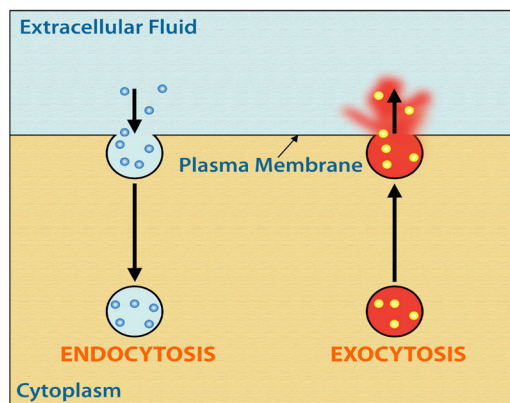


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