Diffusion and Passive Transport

by Regina Bailey

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Diffusion is the tendency of molecules to spread into an available space. This tendency is a result of the intrinsic thermal energy (heat) found in all molecules at temperatures above absolute zero.

A simplified way to understand this concept is to imagine a crowded subway train in New York City. At rush hour most want to get to work or home as soon as possible so lots of people pack onto the train. Some people may be standing not more than a breath's distance away from each other. As the train stops at stations, passengers get off. Those passengers who had been crowded up against each other start to spread out. Some find seats, others move further away from the person they had just been standing next to.

This same process happens with molecules. Without other outside forces at work, substances will move or diffuse from a more concentrated environment to a less concentrated environment. No work is performed for this to happen. Diffusion is a spontaneous process. This process is called passive transport.

Diffusion and Passive Transport

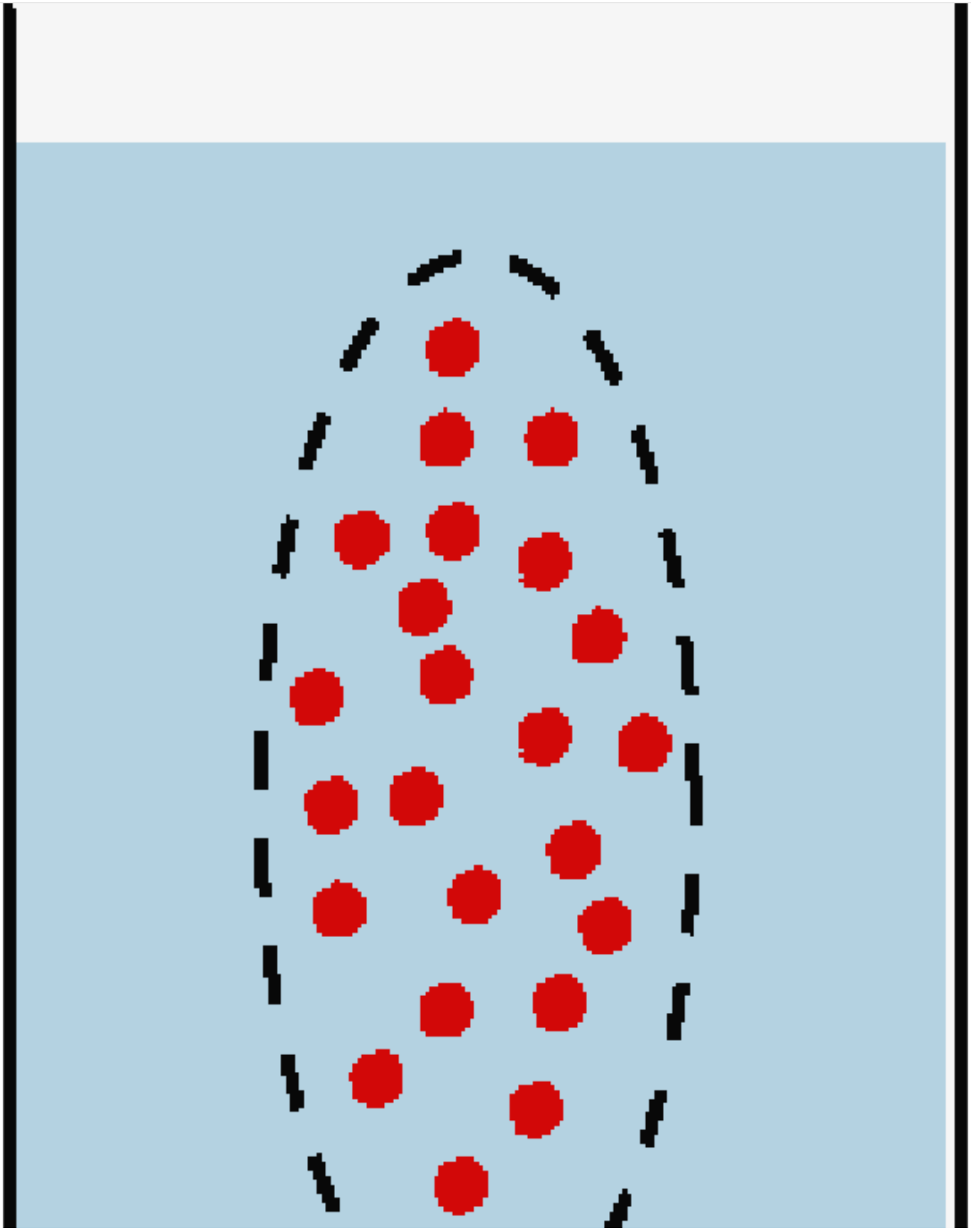


Illustration of passive diffusion. Steven Berg

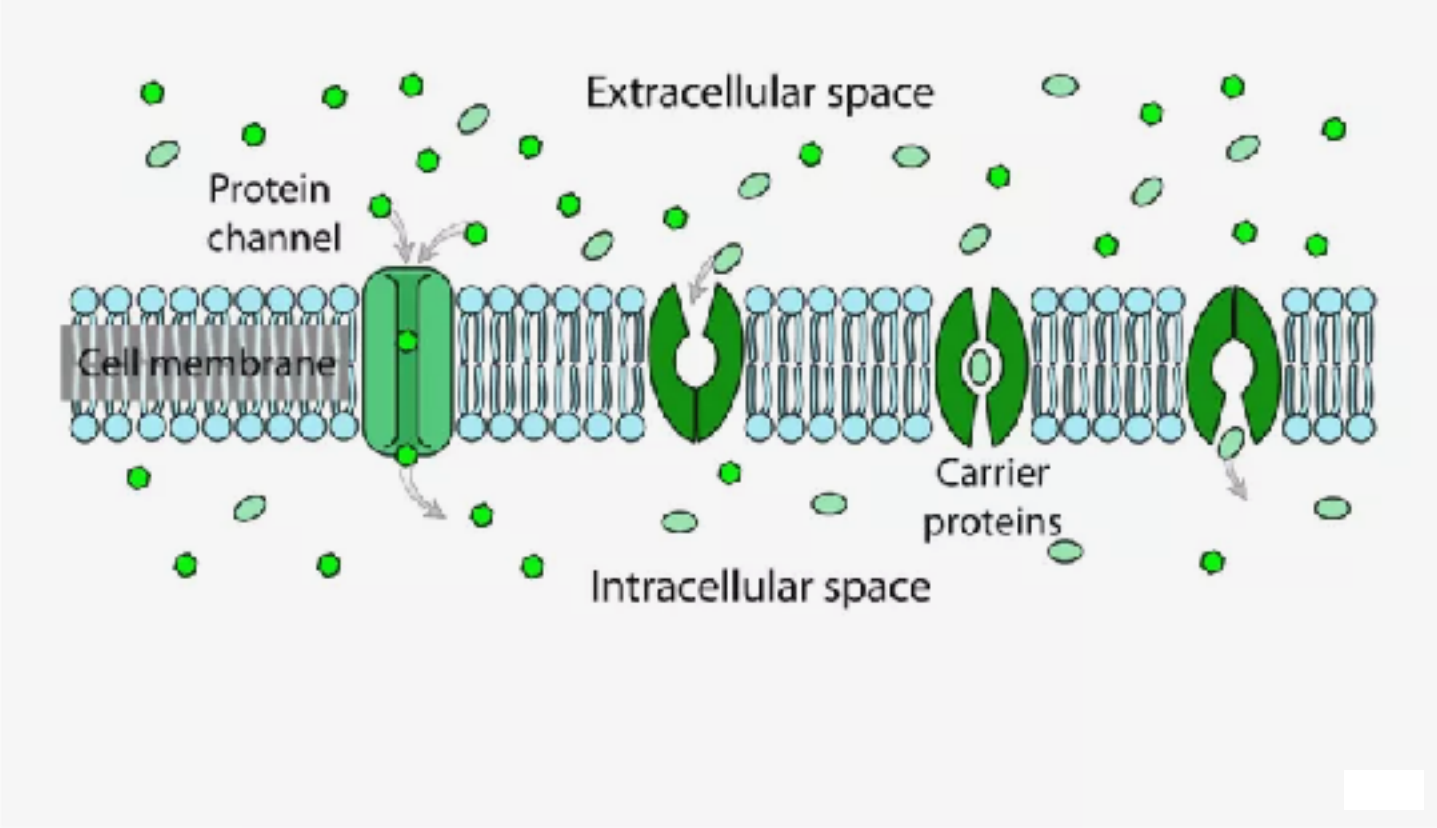
Passive transport is the diffusion of substances across a membrane. This is a spontaneous process and cellular energy is not expended. Molecules will move from where the substance is more concentrated to where it is less concentrated.

> "This cartoon illustrates passive diffusion. The dashed line is intended to indicate a membrane that is permeable to the molecules or ions illustrated as red dots. Initially, all of the red dots are within the membrane. As time passes, there is net diffusion of the red dots out of the membrane, following their concentration gradient. When the concentration of red dots is the same inside and outside of the membrane the net diffusion ceases. However, the red dots still diffuse into and out of the membrane, but the rates of the inward and outward diffusion are the same resulting in a net diffusion of O."—Dr. Steven Berg, professor emeritus, cellular biology, Winona State University.

Although the process is spontaneous, the rate of diffusion of different substances is affected by membrane permeability. Since cell membranes are selectively permeable (only some substances can pass), different molecules will have different rates of diffusion.

For instance, water diffuses freely across membranes, an obvious benefit for cells since water is crucial to many cellular processes. Some molecules, however, must be helped across the phospholipid bilayer of the cell membrane through a process called facilitated diffusion.

Facilitated Diffusion



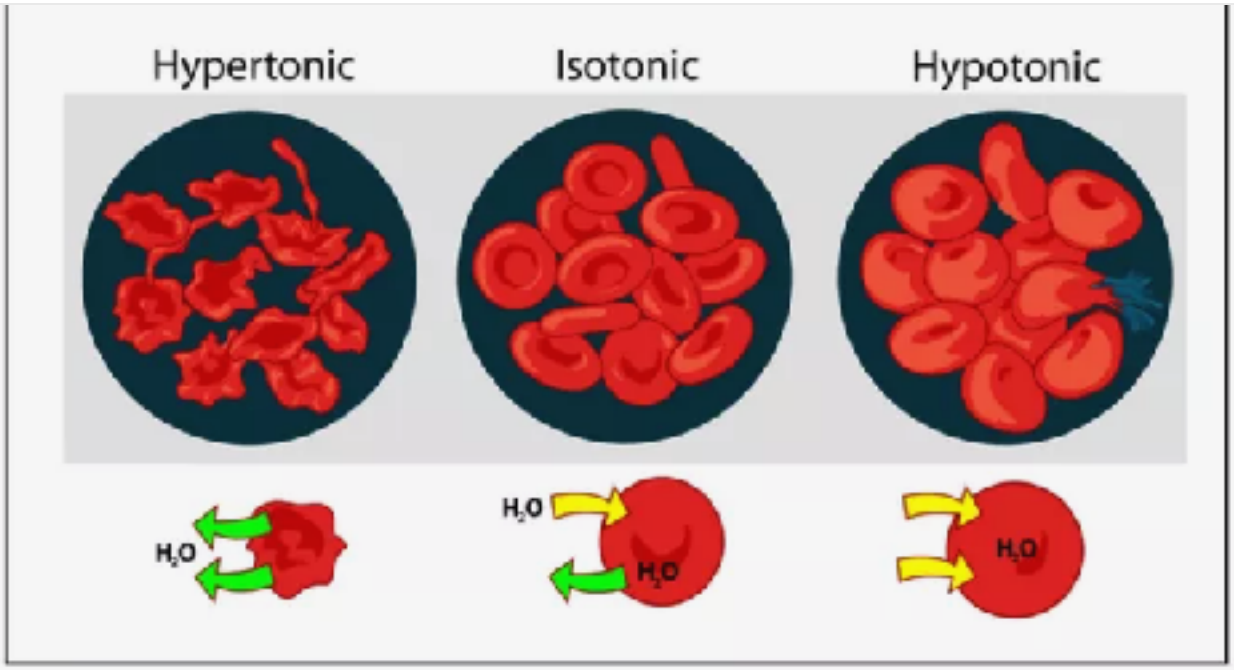
Facilitated diffusion involves the use of a protein to facilitate the movement of molecules across the membrane. In some cases, molecules pass through channels within the protein. In other cases, the protein changes shape, allowing molecules to pass through.
Mariana Ruiz Villarreal

Facilitated diffusion is a type of passive transport that allows substances to cross membranes with the assistance of special transport proteins. Some molecules and ions such as glucose, sodium ions, and chloride ions are unable to pass through the phospholipid bilayer of cell membranes.

Through the use of ion channel proteins and carrier proteins that are embedded in the cell membrane, these substances can be transported into the cell.

Ion channel proteins allow specific ions to pass through the protein channel. The ion channels are regulated by the cell and are either open or closed to control the passage of substances into the cell. Carrier proteins bind to specific molecules, change shape, and then deposit the molecules across the membrane. Once the transaction is complete the proteins return to their original position.

Osmosis



Osmosis is a special case of passive transport. These blood cells have been placed in solutions with different solute concentrations.
Mariana Ruiz Villarreal

sport. In osmosis, water diffuses from a hypotonic (low
rtonic (high solute concentration) solution.

er flow is determined by the solute concentration and
s themselves.

hat are placed in salt water solutions of different
d hypotonic).

A **hypertonic** concentration means that the salt water solution contains a higher concentration of solute and a lower concentration of water than the blood cells. Fluid would flow from the area of low solute concentration (the blood cells) to an area of high solute concentration (water solution). As a result, the blood cells will shrink.

If the salt water solution is **isotonic** it would contain the same concentration of solute as the blood cells. Fluid would flow equally between the blood cells and the water solution. As a result, the blood cells will remain the same size.

blood cells. Fluid would flow from the area of low solute concentration (water solution) to an area of high solute concentration (the blood cells). As a result, the blood cells will swell and may even burst.

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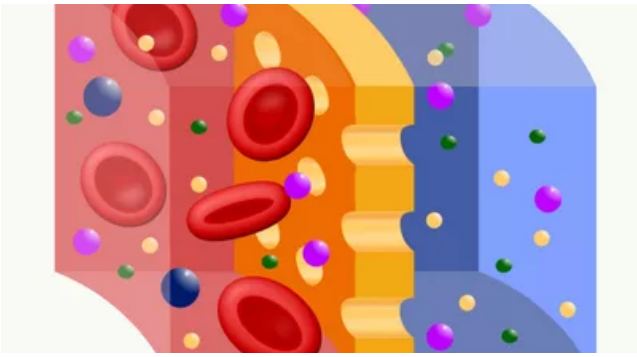
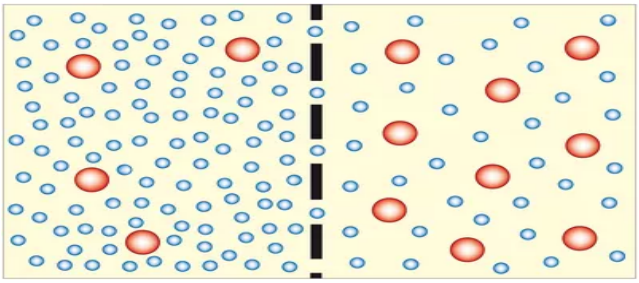
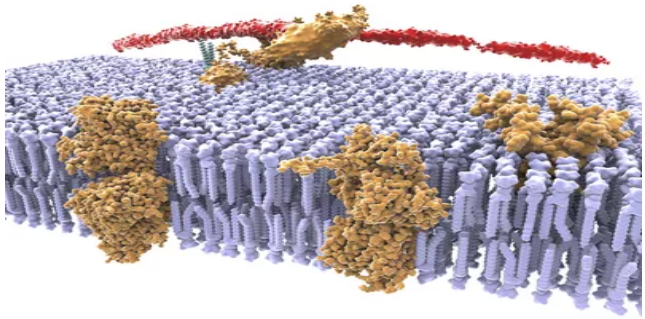


What Is Diffusion?



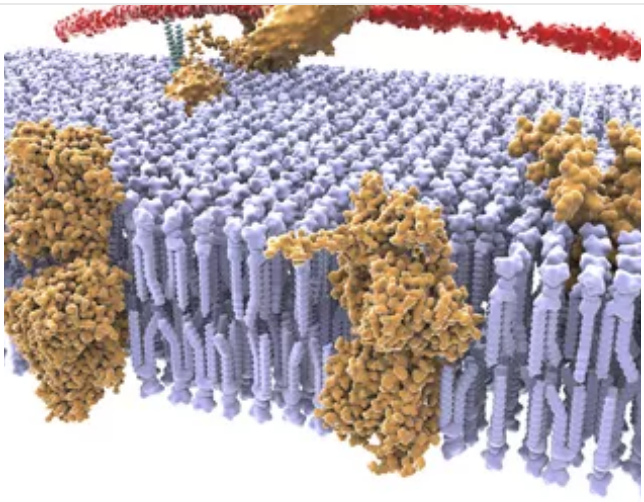
Compare and Contrast Active and Passive Transport

Understand the Difference Between Osmosis and Diffusion

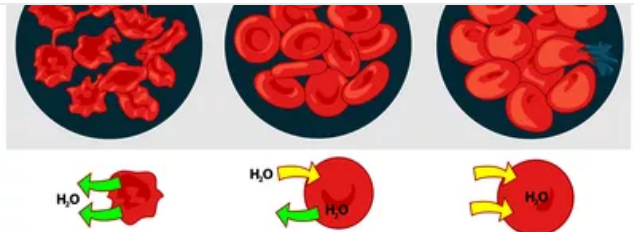


What Selectively Permeable Means (With Examples)

What Is Does Hypertonic Mean?

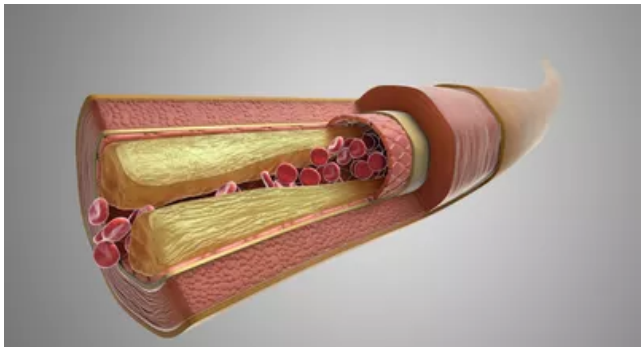


Function, Structure, and Composition of the Cell Membrane



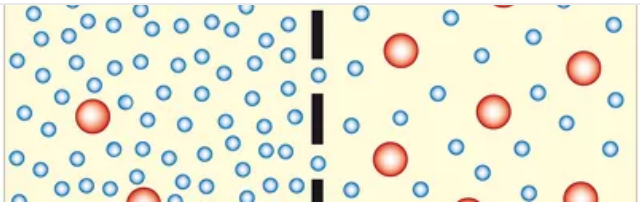
Understand Osmotic Pressure and Tonicity

What Reverse Osmosis Is and How It Works



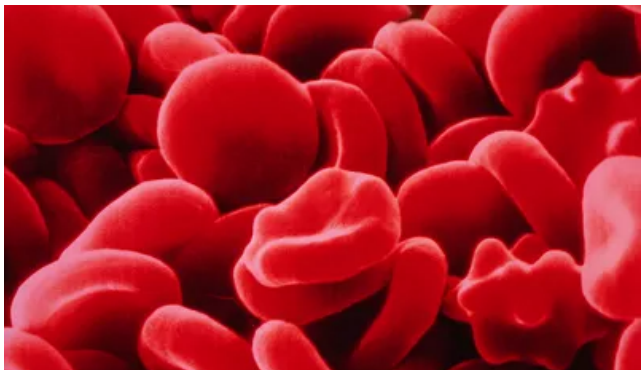
Biology Prefixes and Suffixes: -Osis Definiton

Find Chemistry Definitions From A to Z

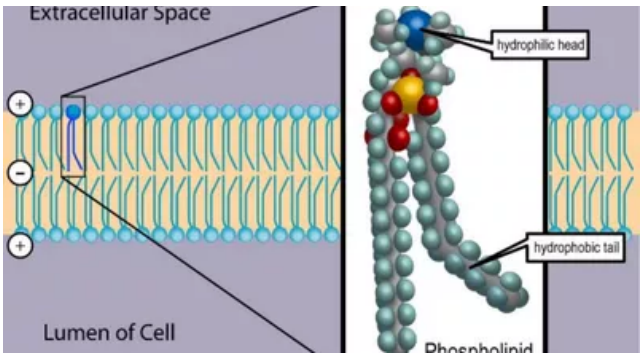


What Osmosis Is and How It Works

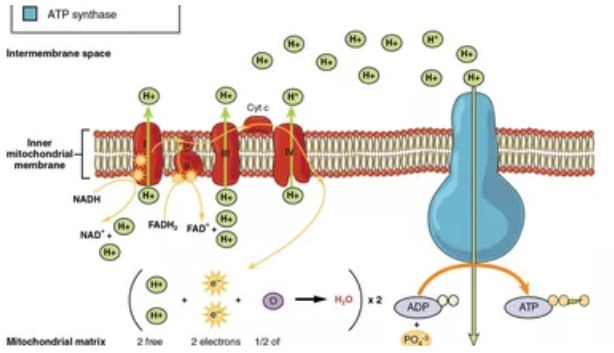
Types of Hormones in the Body and How They Work



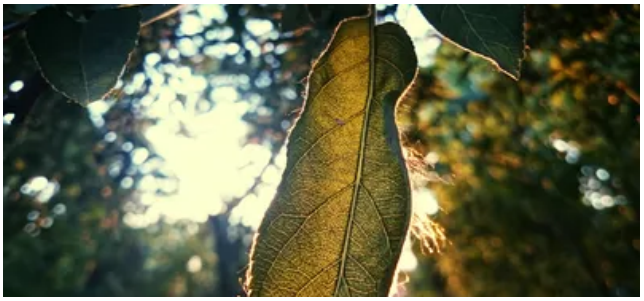
Review Osmotic Pressure with This Chemistry Sample Problem



How Phospholipids Help Hold a Cell Together



How Your Body Makes Energy



Cellular Process of Turgidity Essential for a Tree's Life