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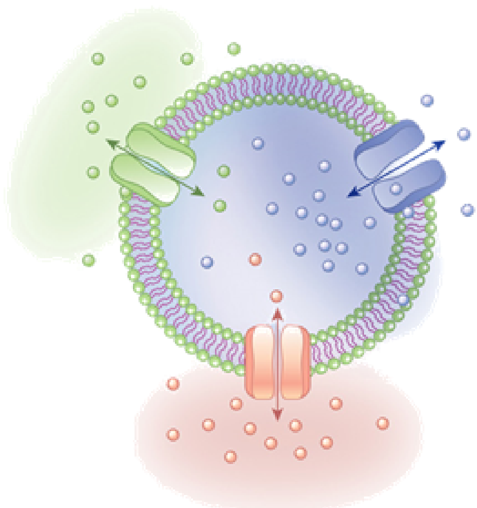
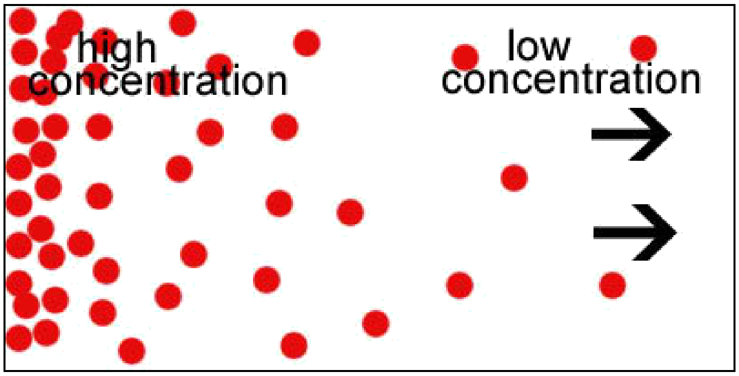


CELL TRANSPORT

In the last unit you learned about the plasma (cell) membrane. The last unit looked at the parts of the plasma membrane and how the plasma membrane is put together. We already discussed how small, nonpolar substances can pass directly through the membrane, and how other substances, which need help to pass through, make use of membrane proteins. In this unit we will look at how the plasma membrane allows substances to move through it in order to maintain homeostasis. The plasma membrane is described as a *Selectively Permeable Membrane* or *Semi-Permeable Membrane*, because of its nature to allow some substances to pass through but not others.

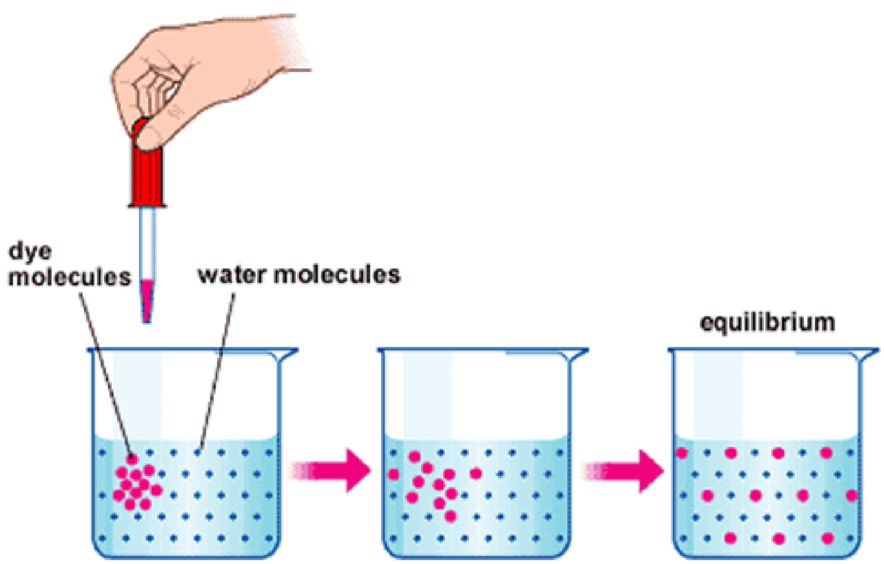
Active and Passive Transports

There are two types of transport which all movement through the membrane can be classified into: Active Transport and Passive Transport. A couple terms you need to understand before discussing the differences between the two transports are *concentration* and *concentration gradient*. **Concentration** is the amount of a particular substance in a given volume. In other words, how much you have of something in a certain area or space. **Concentration gradient** is the difference in the concentration of a substance across a distance or space. When speaking of gradient you will be comparing the concentrations of two different locations.



Passive Transport Introduction

In order to fully understand passive transport, you need to understand *diffusion* and *equilibrium*. **Diffusion** is the movement of particles from regions or areas of high concentration (where there is more) to regions or areas of low concentration (where there is less). Diffusion can occur through a membrane, through a



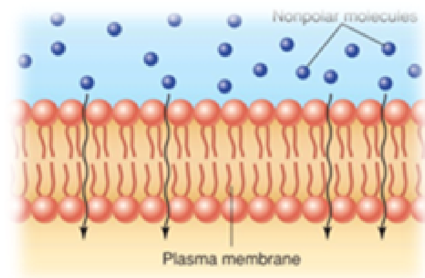
liquid, or through the air. Diffusion occurs when perfume is sprayed in the corner of a room and the smell spreads to the other corners of the same room. The perfume molecules go from an area of higher concentration, which is the bottle and the corner of the room it is in, to an area of lower concentration, which is the other corners of the room. Diffusion also occurs when a drop of food coloring is dropped in the center of a glass of water. The food coloring goes from the center of the drop in the water (high concentration) to the other parts of the water in the glass (low concentration). In both examples mentioned you notice the substances are moving from areas of high concentration to areas of low concentration, so diffusion is said to go "*down the concentration gradient*". **Equilibrium** is reached when the space, where the substance is moving, is evenly filled with that substance. In the above examples, eventually the sprayed perfume will evenly spread within the room it was sprayed, and the food coloring will evenly spread through the glass of water. Nowhere in the room or glass will there be more perfume molecules or food coloring, unless a door or window is opened in the room, or the glass is spilled or more water is added. This idea of substances being evenly distributed or naturally spread throughout a space is the goal of diffusion. One idea to keep in mind is that even though equilibrium may be reached the particles of the substance are still moving. They continue to move and bounce off each other in this evenly distributed state so that high and low concentrations will not occur again once equilibrium is reached unless the space or container is changed. There are four different methods of increasing the rate (speed) of diffusion.

1. **Increasing the concentration of the substance**. Having more of the substance will speed up diffusion.
2. **Agitation**. Shaking or stirring a solution will speed up diffusion.
3. **Increasing the temperature**. Increasing the temperature will increase the motion of the substance's particles therefore speeding up diffusion.
4. **Increasing the pressure**. Increasing pressure will also increase the motion or collisions of the substance's particles therefore speeding up diffusion.

Passive Transport

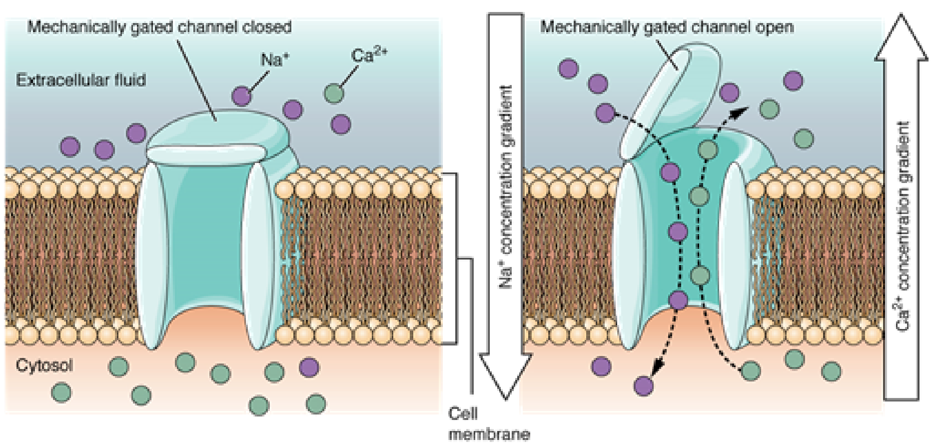
Passive transport is the "diffusion" of particles through the plasma membrane without the use of energy. The particles move "down the concentration gradient" from an area of high concentration to an area of low concentration. An important point of passive transport to remember is that passive transport does not require energy.

Simple Diffusion is a type of passive transport in which small, nonpolar molecules pass directly through the phospholipid bilayer without the help or use of any membrane proteins.



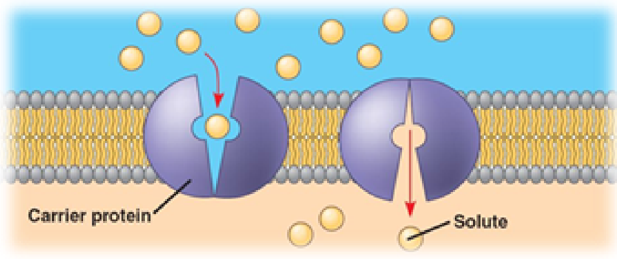
Facilitated Diffusion

Facilitated Diffusion is also a type of passive transport. Facilitated Diffusion uses transport proteins in the membrane to help move substances that are not small and nonpolar through the membrane. The two types of transport proteins, as mentioned in the last unit, are **channel** and **carrier proteins**.



A *channel protein* may be one of two types: Non-gated (pore) or gated. A non-gated channel protein is permanently opened and a gated channel protein opens and closes with the help of another molecule being present to open the gate.

Keep in mind, that both of these membrane proteins, as well as all membrane proteins, are dependent on shape and charge. These proteins will only allow substances of a certain shape or certain charge to pass through them. Not just anything can pass through any membrane protein, the proteins are very specific in what they allow to pass through.

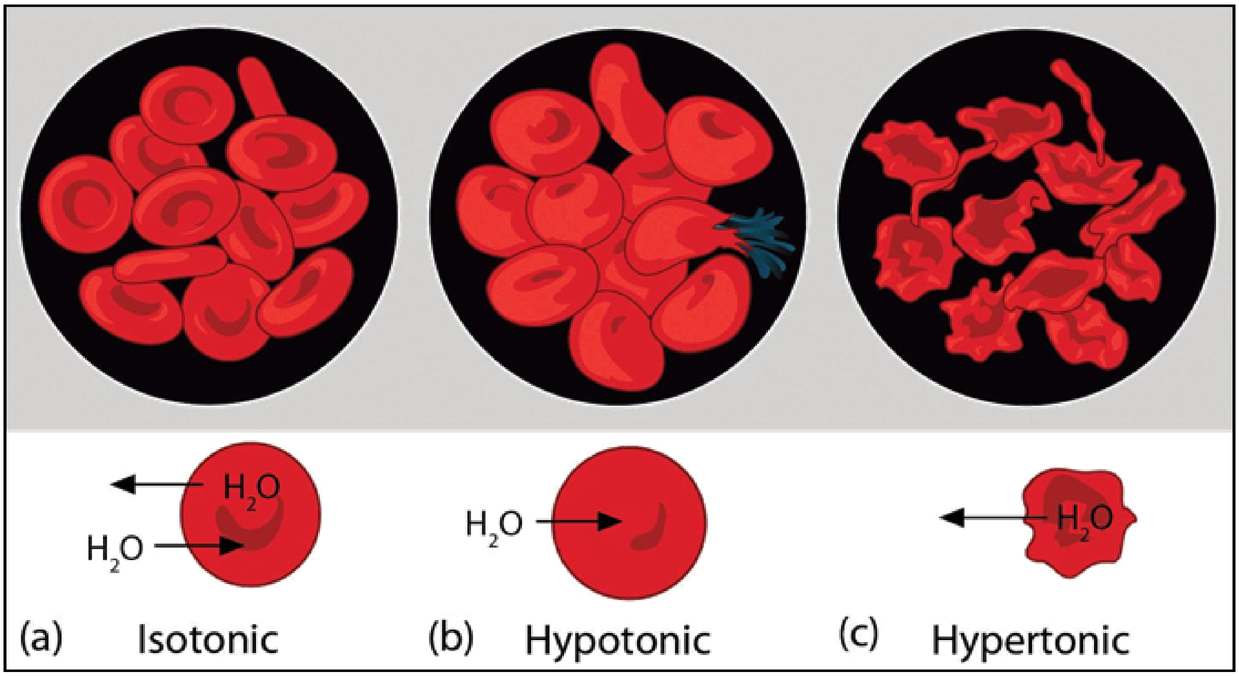


A *carrier protein* is a protein that will transport a substance that can fit into the carrier protein's binding site. After a specific substance that can fit on the binding site attaches, the carrier protein then changes shape moving the substance to the other side of the membrane. (Remember this is still passive transport, no energy is needed for this process.)

Osmosis is another type of passive transport. Osmosis is the diffusion of water across a *selectively permeable membrane*. Osmosis is very important to the cell as it attempts to maintain the water balance in the cell as the environment is always changing. Because water is a polar molecule, the water molecules pass through channel proteins (pores) to move in and out of the cell. When predicting the direction of water movement through a membrane, there are three different solutions to consider.

Physical Science Review*: All solutions are made of two basic parts, a solute and solvent. Solute is whatever is dissolved in the solution and solvent is whatever caused the solute to dissolve. Example: A spoonful of salt in a glass of water to make a salt water solution. Salt is dissolved and is the solute, and the water caused the salt to dissolve and is the solvent.*

Animal Cells (Red Blood Cell)



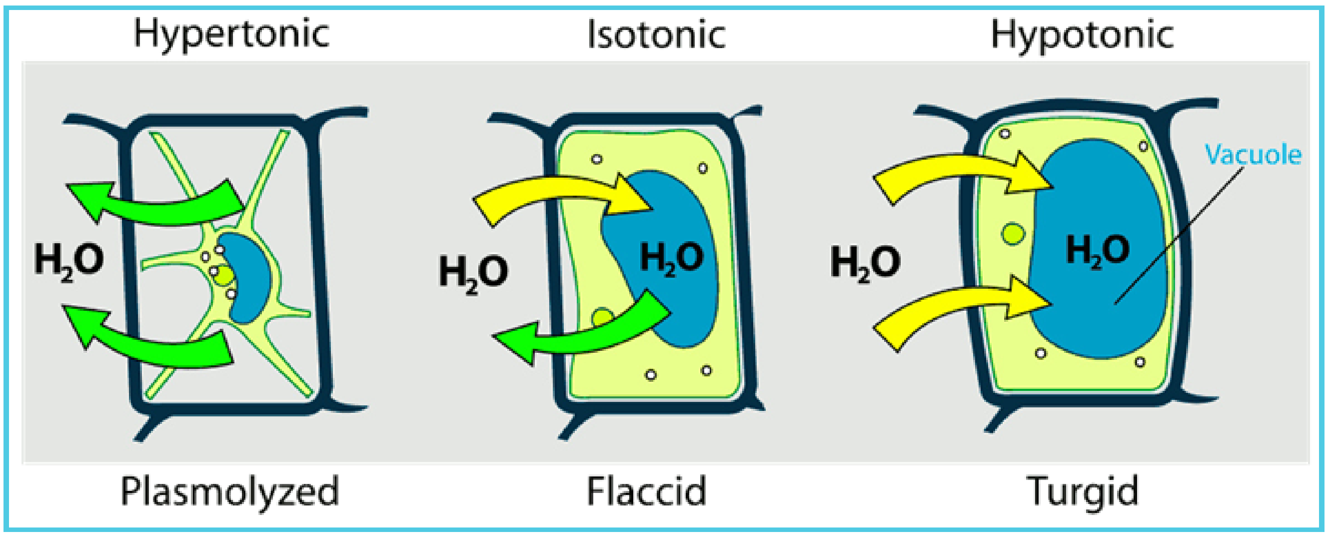
Isotonic Solution
An isotonic solution is a solution where the solute concentration outside the cell is equal to, or the same as, the solute concentration inside the cell, or cytoplasm. In this situation, the water is already equal, or in equilibrium, on both sides of the membrane (inside the cell and outside the cell). Since the water is in equilibrium, there is no need for the water to move to either side of the membrane and the cell stays the same size.

Hypertonic Solution
A hypertonic solution is a solution where the solute concentration outside the cell is higher than the solute concentration inside the cell. In this situation, since the solute concentration is higher outside the cell that means there is less water outside. Because the water concentration is higher inside the cell, water will leave the cell through the membrane to reach equilibrium (or even out) and that will cause the cell to shrink, shrivel, or wilt which is called plasmolysis. The water pressure inside a cell with a cell wall is called Turgor Pressure. When any cell with a cell wall

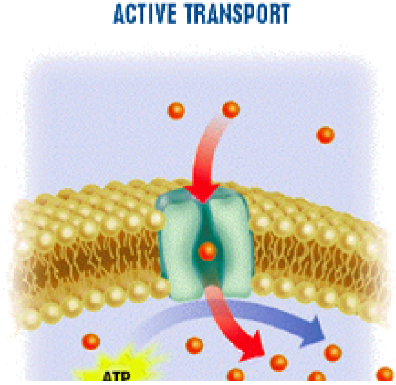
is placed in a hypertonic solution the cell loses water, undergoes plasmolysis, and falls away from the cell wall making it lose its rigidity.

Hypotonic Solution
A hypotonic solution is a solution where the solute concentration outside the cell is lower than the solute concentration inside the cell. In this situation, since the solute concentration is lower outside the cell that means there is more water outside. Because the water concentration is lower inside the cell, water will rush into the cell through the membrane to reach equilibrium and that will cause the cell to expand or swell. When a cell takes in so much water that the cell bursts that is called cytolysis. Cells with cell walls will not burst due to the strength of the cell wall, however, cells without a cell wall may burst. This is a concern for unicellular eukaryotes. These unicellular organisms may have an organelle called a contractile vacuole which will collect the excess water and pump it out to avoid possibly bursting.

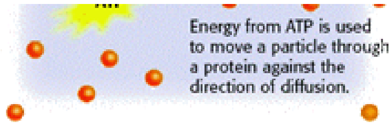
Plant Cells



Active Transport



Active transport is the movement of particles through proteins against the normal direction of diffusion. In other words, particles are moved from an area of low concentration to an area of high concentration or "up/against the concentration gradient". The cell must use energy to make this happen. This energy comes from the molecule **ATP**, which stores energy in a form that cells can use. An important point of active transport to remember is that active transport does require energy.

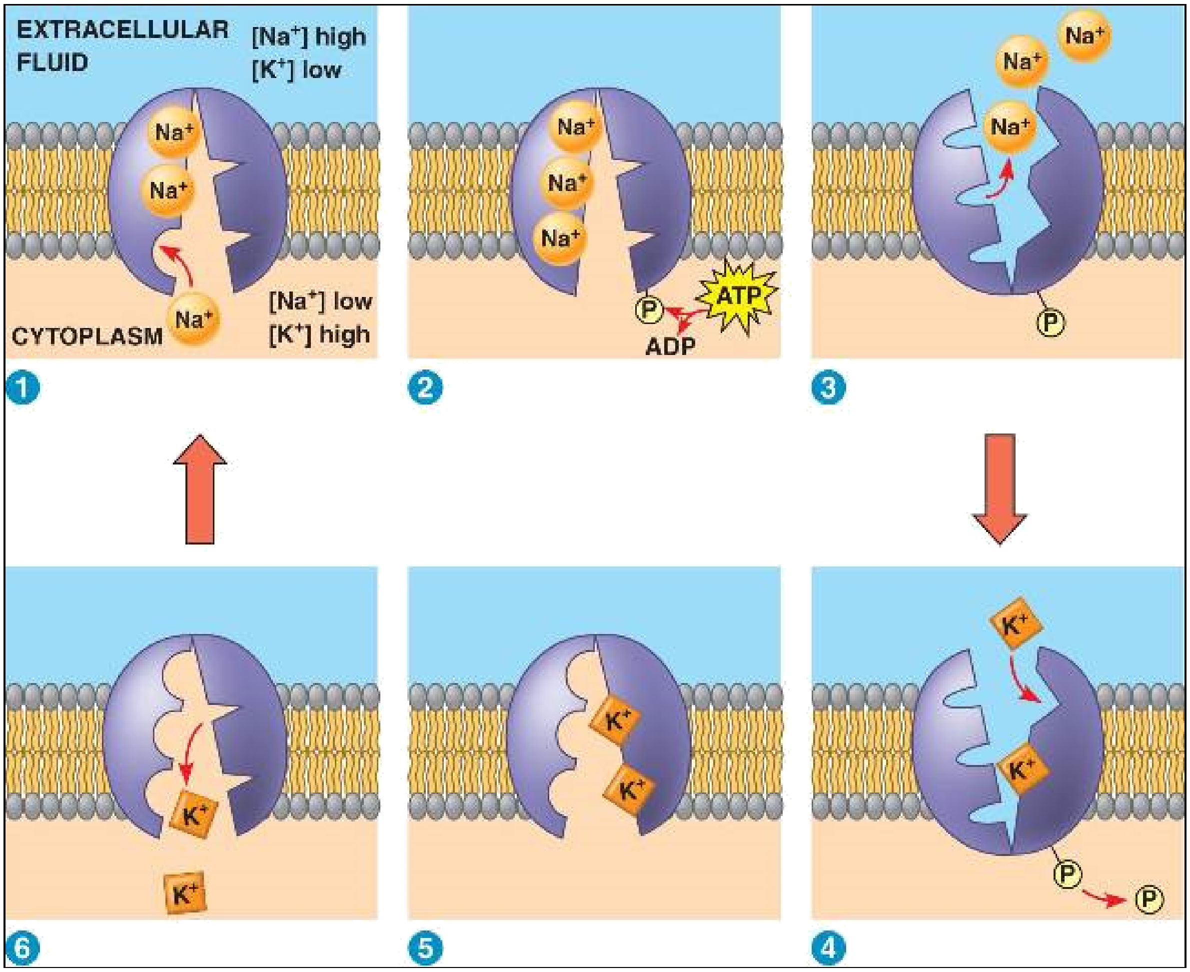


Many active transport processes use carrier proteins to actively move substances through the membrane. We mentioned carrier proteins already under passive transport. Those carrier proteins did not require energy to change shape and move substances across the membrane. These carrier proteins, in active transport, do require energy to change shape and move substances across the membrane and are called **pumps**.

One of the most important active transport carrier proteins in animal cells is the sodium-potassium pump. The sodium-potassium pump creates an electrochemical gradient across cell membranes which means the cell membranes, like those of nerve cells and muscle cells, can carry an impulse throughout the body as in nerve cells and throughout a muscle contraction as in muscle cells. The sodium-potassium pump also helps transport glucose and amino acids into the cell.

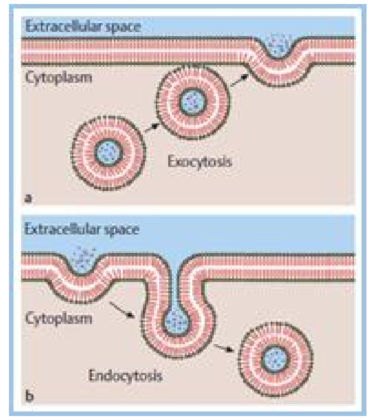
Sodium-Potassium Pump

The sodium-potassium pump actively pumps sodium (Na^+) out of the cell while pumping potassium (K^+) into the cell. Three sodium ions from inside the cell attach to the carrier protein (pump) along with a phosphate from an ATP molecule. The ATP molecule releases energy in the form of the phosphate which changes the shape of the pump and releases the three sodium ions outside the cell. Two potassium ions from the outside then attach to the pump and are transported into the cell when the pump returns to its original shape after releasing the phosphate.



Endocytosis and Exocytosis

Sometimes substances are too large to enter or exit the cell by fitting through the membrane or membrane protein. **Endocytosis** is the process of moving a large substance into a cell by means of a vesicle. Recall a vesicle is a membrane-bound sac that transports substances around the inside of a cell. There are three types of endocytosis. Phagocytosis brings in solid substances, pinocytosis brings in liquid substances, and receptor-mediated endocytosis brings in substances that are specifically recognized by receptor proteins in the membrane. **Exocytosis** is the process of moving a large substance out of the cell by means a vesicle. The vesicle with its large substance will fuse with the plasma membrane of the cell. The cell membrane will pull the vesicle open releasing is contents to the outside.



[Cell Transport Worksheet]

UNIT VOCABULARY REVIEW

Click card to see term

high concentration (where there is more) to regions

View this study set

Choose a Study Mode