

Osmosis, Diffusion and Cell Transport

Types of Transport

There are 3 types of transport in cells:

1. **Passive Transport**: does **not** use the cell's energy in bringing materials in & out of the cell
2. **Active Transport**: does use the cell's energy in bringing materials in & out of the cell
3. **Bulk Transport**: involves the cell making membrane bound vesicles to bring materials in & out of the cell

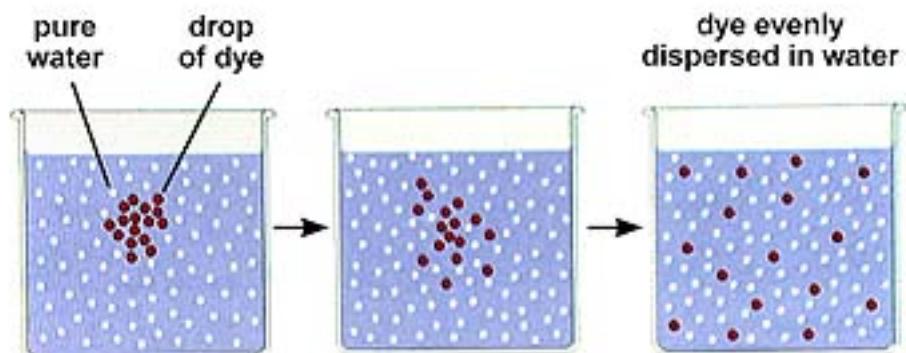
Passive Transport

There are 3 types of passive transport:

1. **Diffusion**: involves small or uncharged molecules entering & leaving the cell
2. **Osmosis**: involves water entering & leaving the cell
3. **Facilitated Diffusion**: involves large or charged molecules that need a protein helper to get in & out of the cell

Diffusion

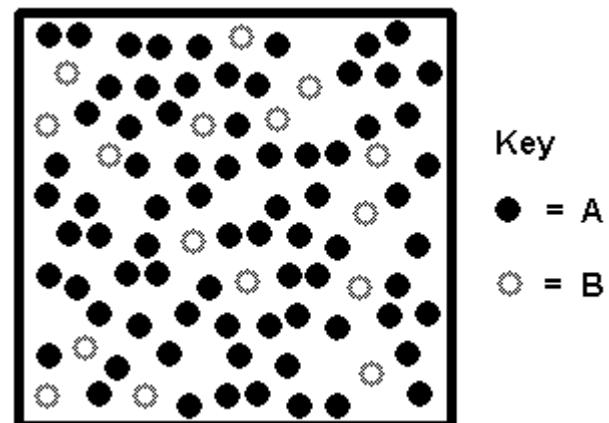
Diffusion is the net movement of a substance (liquid or gas) from an area of higher concentration to one of lower concentration. A drop of dye in water is concentrated but then begins to disperse through out the water moving from an area of high to an area of low concentration.



Diffusion

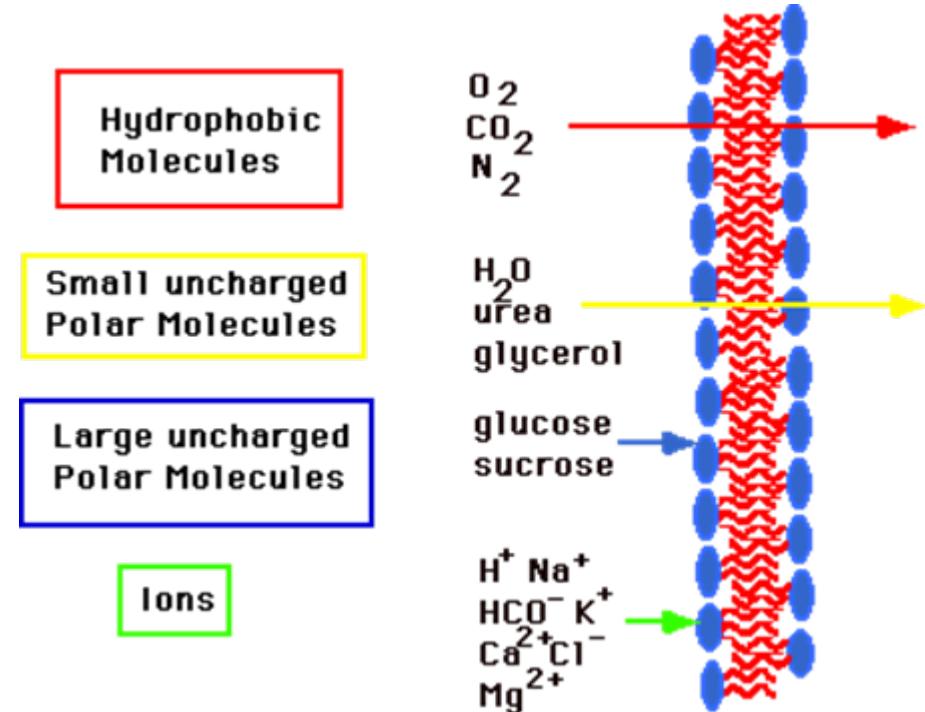
When the substance has fully dispersed through out the container, it has reached **equilibrium**.

Notice in the picture below how molecules A and B are evenly distributed through out the container. When equilibrium has been reached, there is no longer a concentration gradient. A **concentration gradient** is the difference in concentration between two areas.



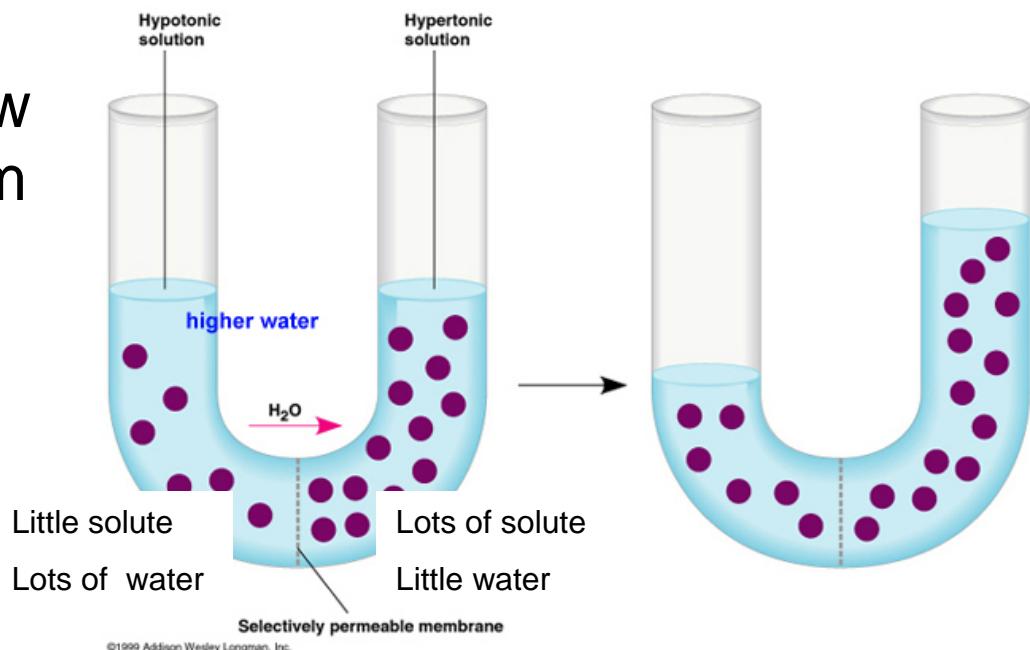
Diffusion

Certain molecules can freely diffuse across the cell membrane. Look at the picture below- hydrophobic molecules and small uncharged molecules can diffuse through the membrane but large molecules or ions (atoms with a positive or negative charge) can not move through the membrane.



Osmosis

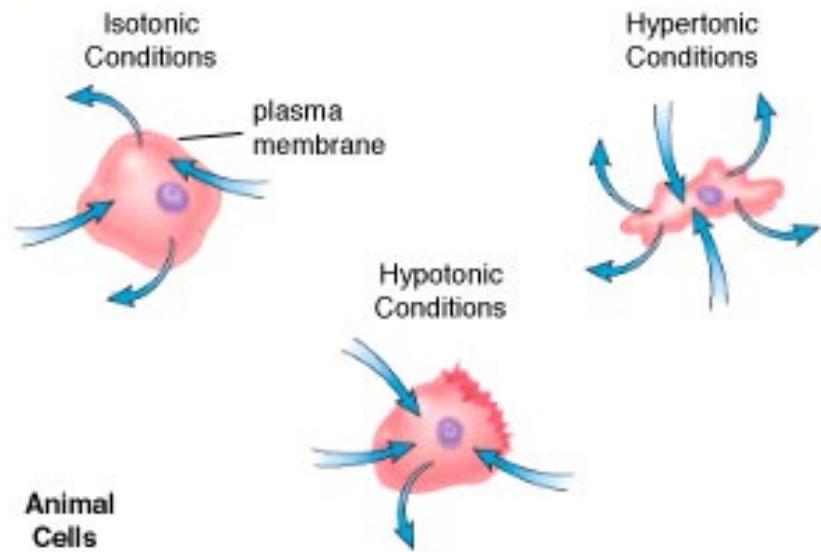
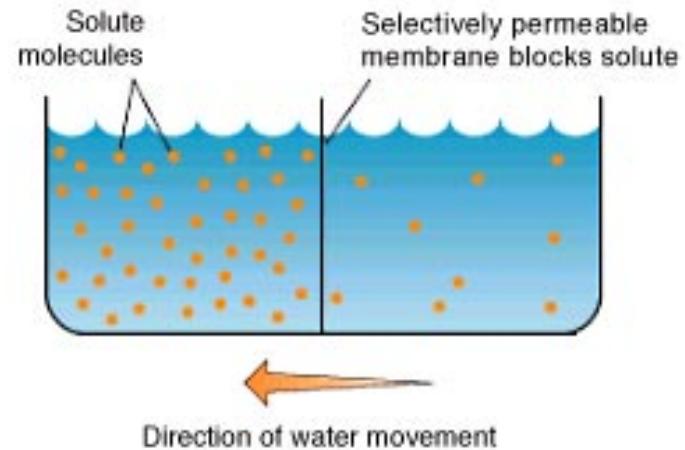
Osmosis is the diffusion of water from an area of high concentration to an area of low concentration across a membrane. Cell membranes are completely permeable to water and the amount of water in the environment has a large effect on the survival of a cell. The picture shows a tube separated by a membrane and how the water moves from an area of high concentration to an area of low.



Osmosis

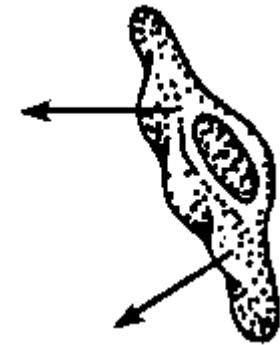
There are 3 types of solutions that involve water and how they affect the cell. They are:

1. **Hypertonic Solution**: the solution the cell is placed in has less water than the cell
2. **Hypotonic Solution**: the solution the cell is placed in has more water than the cell
3. **Isotonic Solution**: the solution the cell is placed in has equal amount of water as the cell

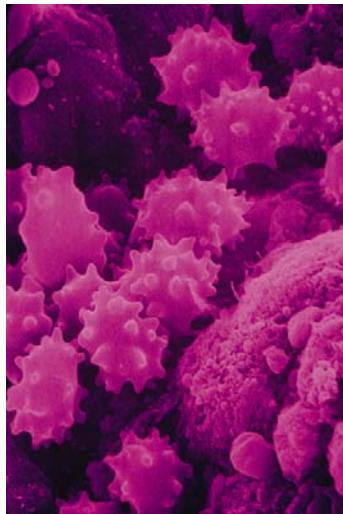


Hypertonic Solution

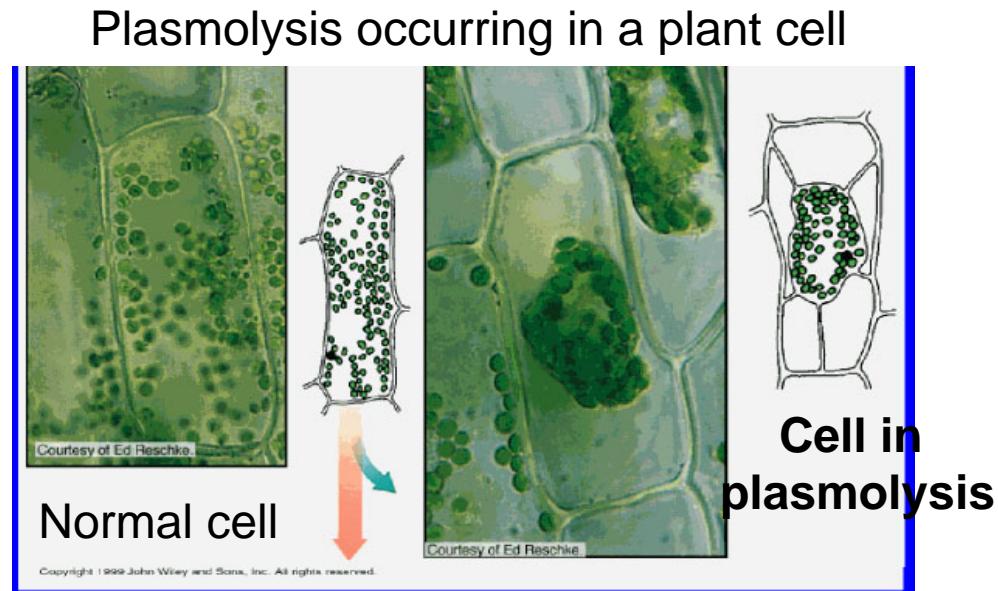
In a hypertonic solution, there is a higher concentration of water inside the cell than outside the cell. A hypertonic solution has more solute (salt, sugar, etc.) than the cell and this causes there to be less water in the solution. Water flows from an area of high concentration to an area of low and leaves the cell. This loss of water causes the cell to shrivel.



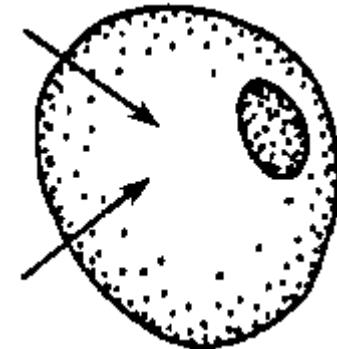
In animal cells, the shriveling is called crenating. The red blood cells in the picture to the left have crenated. In plant cells, plasmolysis occurs and the cell membrane shrinks away from the cell wall. Death will result in both cells.



Crenated red blood cells



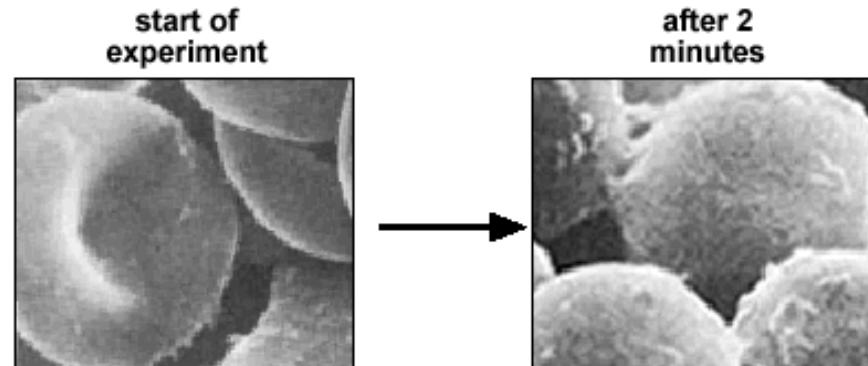
Hypotonic Solution



In a hypotonic solution, the solution contains a higher percentage of water than the cell. A hypotonic solution has less solute than the cell and this causes the solution to have more water than the cell. When a cell is placed in a hypotonic solution, water flows from an area of high concentration to an area of low and rushes into the cell. This causes the cell to expand and possibly burst.

In animal cells, the cell bursts or will lyse, killing the cell. In plant cells, the cell membrane is pressed up against the cell wall but the cell wall does not allow the cell to expand anymore and the plant cell does not die.

Plant cell in a Hypotonic solution



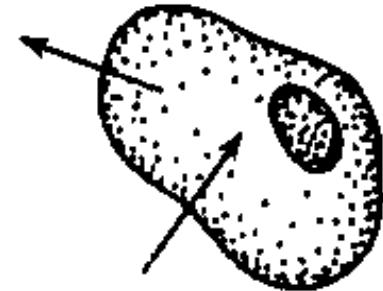
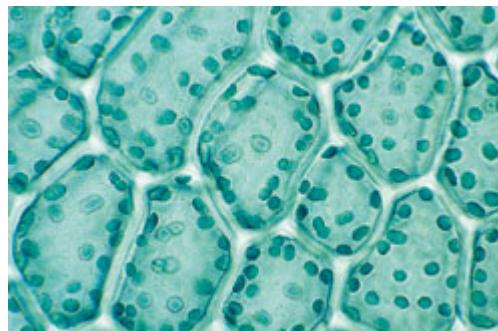
Red blood cells beginning to lyse

Isotonic Solution

In an isotonic solution, there is the same percentage of water on the outside of the cell as the inside of the cell. An isotonic solution has the same amount of solute as the inside of the cell. Water moves at a constant rate in and out of the cell and the cell maintains its original shape.

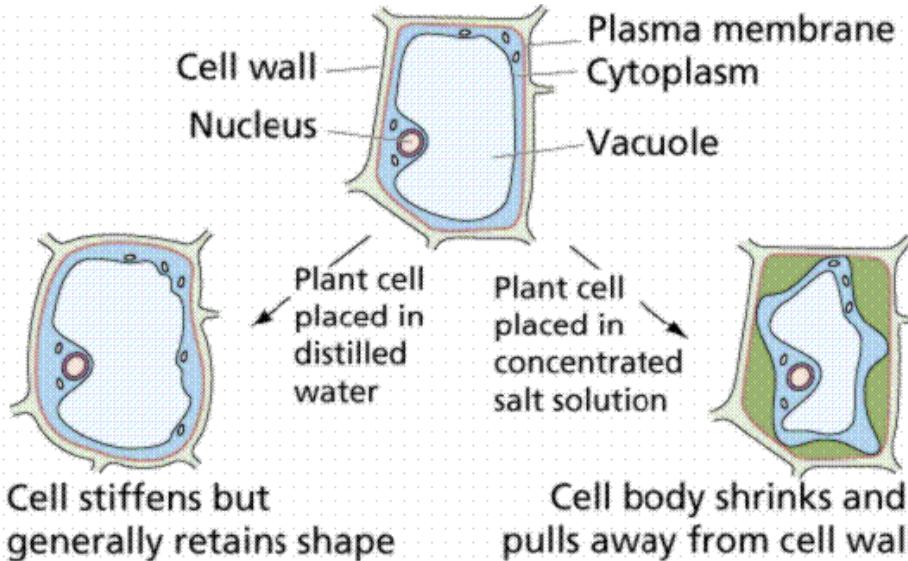
In animal and plant cells, the cell keeps its shape when in an isotonic solution. Most cells live in an isotonic environment and they are able to maintain their shape and survive.

Plant cells in an isotonic solution



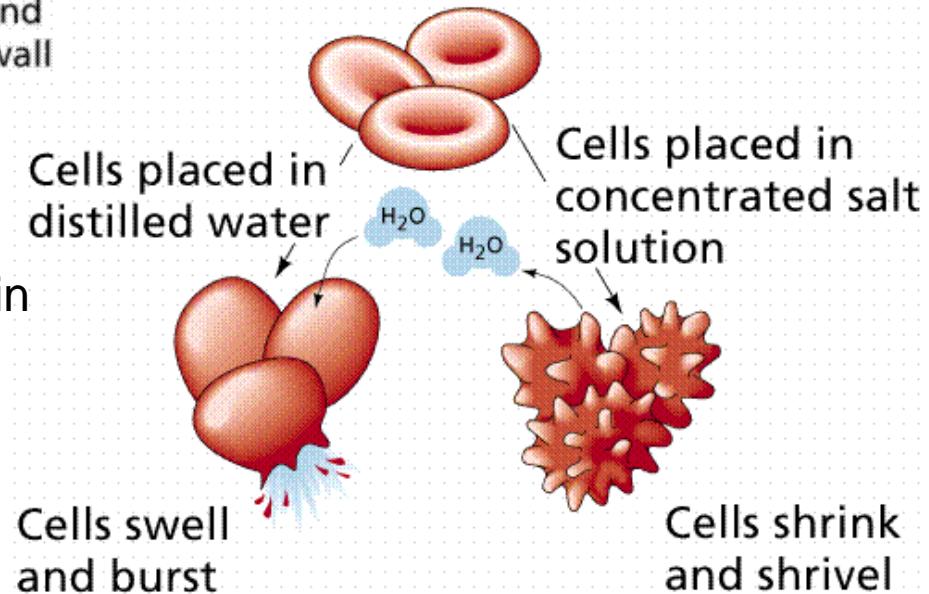
Red blood cell in an isotonic solution

Hypertonic and Hypotonic Solutions



The plant cell to the left is placed in distilled water and salt solution. Notice what happens to the cell in the different types of solutions.

The red blood cell to the right is placed in distilled water and salt solution. Notice what happens to the cell in the different types of solutions.



Facilitated Diffusion

Some molecules are too large to pass through the cell membrane by diffusion and need help to cross. These molecules use facilitated diffusion.

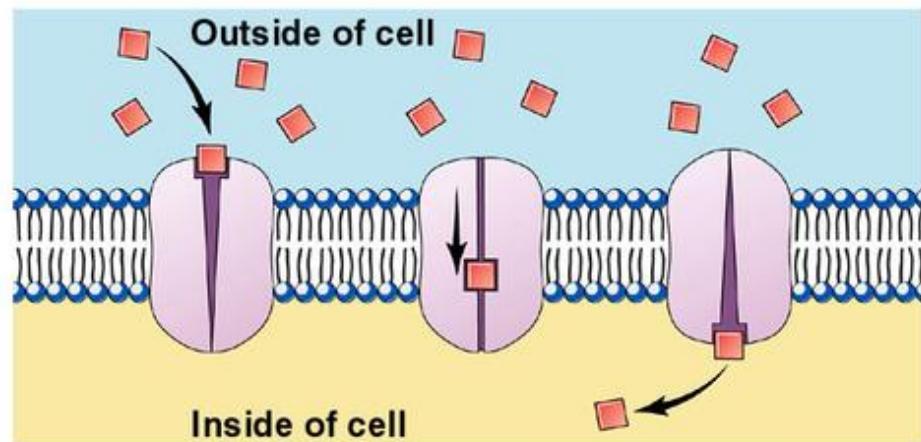
Facilitated diffusion is the flow of large molecules from an area of high concentration to an area of low using proteins in the cell membrane.

Glucose is able to enter our cells

from the blood stream by facilitated diffusion. A glucose molecule is too big to squeeze through the phospholipid bilayer and needs protein channels to help it pass into the cell. These protein "helpers" are extremely important because they allow much needed molecules to enter our cells. Without them, our cells would not have glucose and our cells would not be able to make energy.

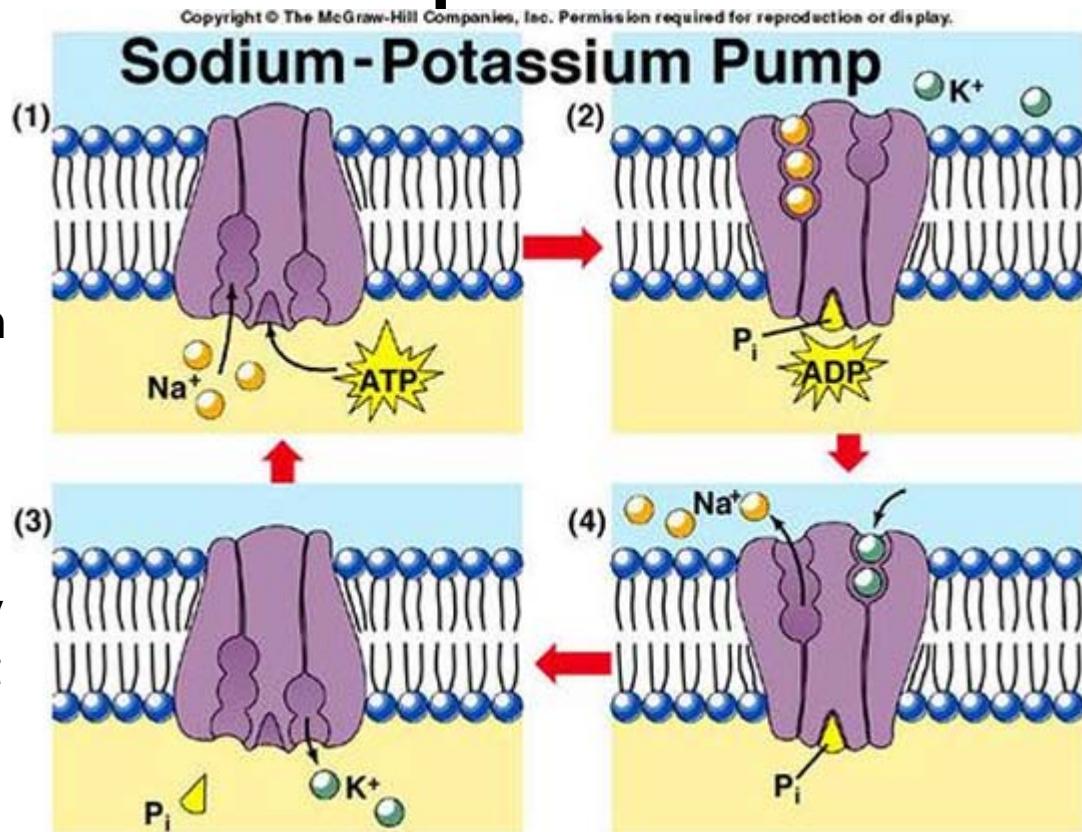
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Facilitated Diffusion



Active Transport

The types of transport discussed so far are passive transport and do NOT require a cell to use its energy- the molecules flow **with** the concentration gradient. There are times when the cell wants to pump **against** the gradient and to do so, it must use energy. The use of energy to pump molecules against the gradient is called **active transport**. A cell uses energy in the form of ATP (adenosine tri-phosphate). When energy is taken from ATP, it turns into ADP.



The sodium-potassium pump in nerve cells is an example of active transport. Sodium and potassium atoms are pumped against the gradient using ATP. By pumping against the gradient, the cell builds an even bigger gradient (difference between concentrations across the membrane) that helps nerve impulses.

Bulk Transport

The last kind of cell transport is bulk transport. Bulk transport involves the cell membrane making vesicles to bring materials in and out of the cell. There are two kinds of bulk transport:

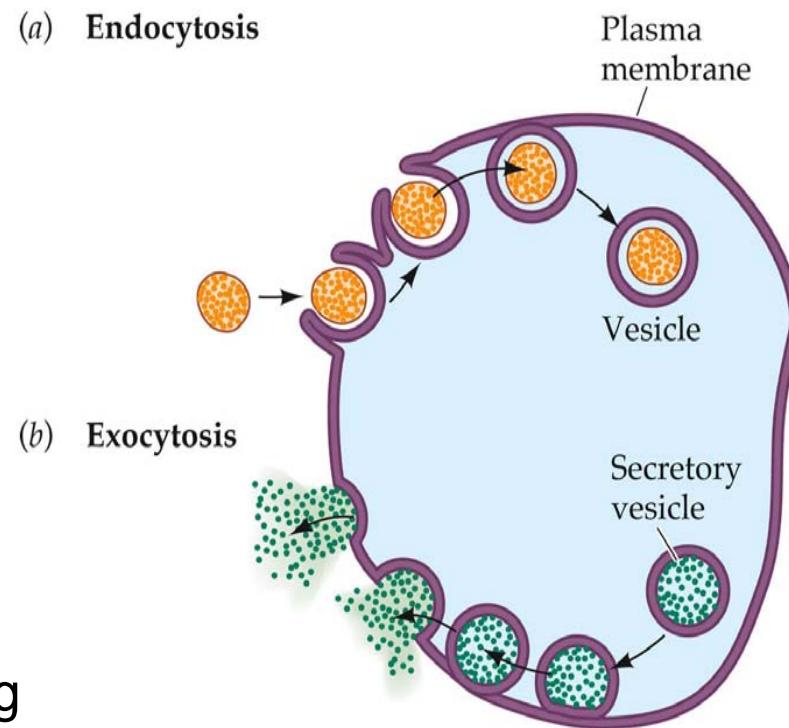
1. **Exocytosis**: moving materials OUT of the cell.

2. **Endocytosis**: moving materials INTO the cell.

There are 2 types of endocytosis:

1. **Pinocytosis**: bringing small molecules or liquids into the cell

2. **Phagocytosis**: bringing large molecules into the cell

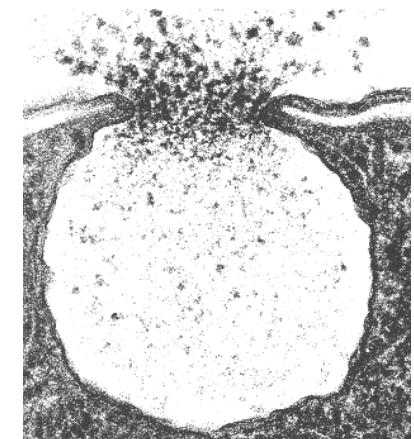
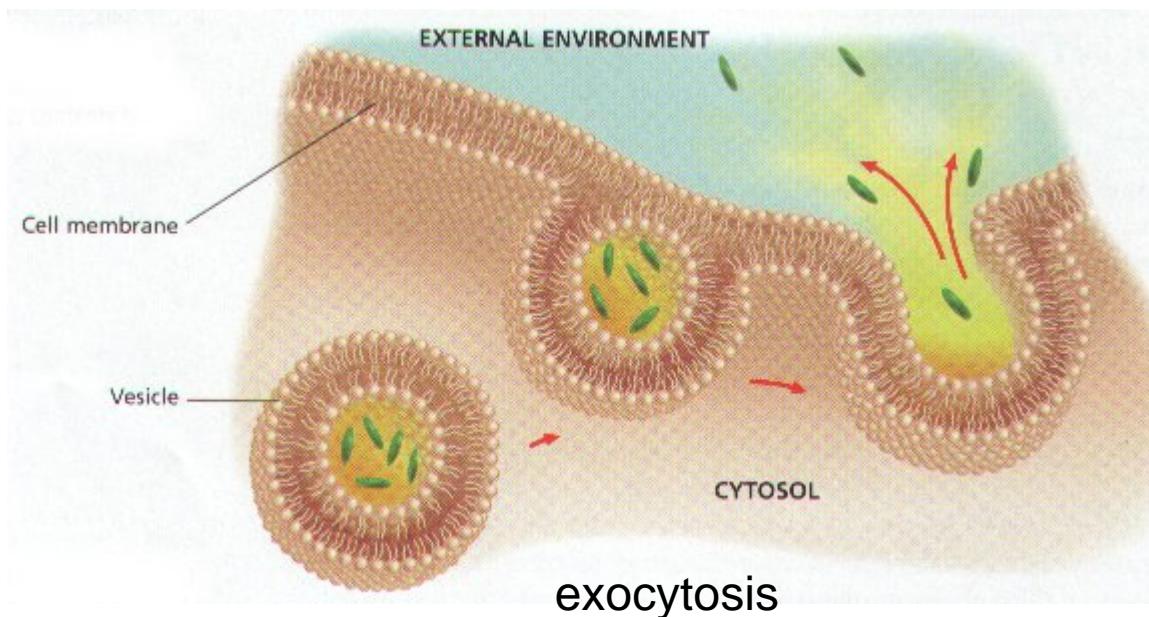


LIFE: THE SCIENCE OF BIOLOGY, Seventh Edition, Figure 5.15 Endocytosis and Exocytosis
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Exocytosis

Exocytosis is the process of exporting materials out of the cell by forming a membrane bound vesicle around the materials. The cell uses exocytosis to get rid of cell waste or to export proteins made in the cell to give to other cells.

The proteins or waste are taken to the golgi body where the materials are packaged into a membrane bound vesicle. The vesicle then merges with the cell membrane and the materials are released into the outside environment.

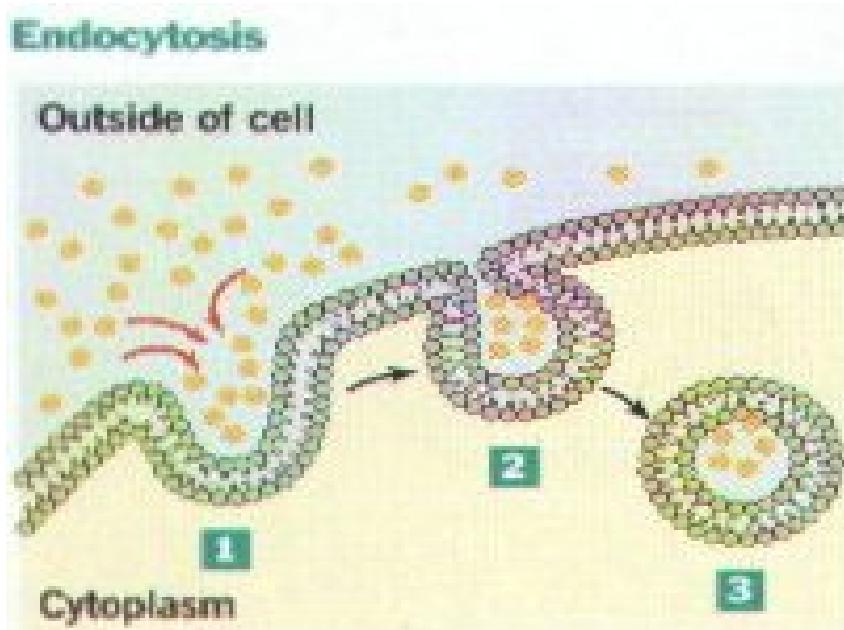


Micrograph of a vesicle expelling its contents

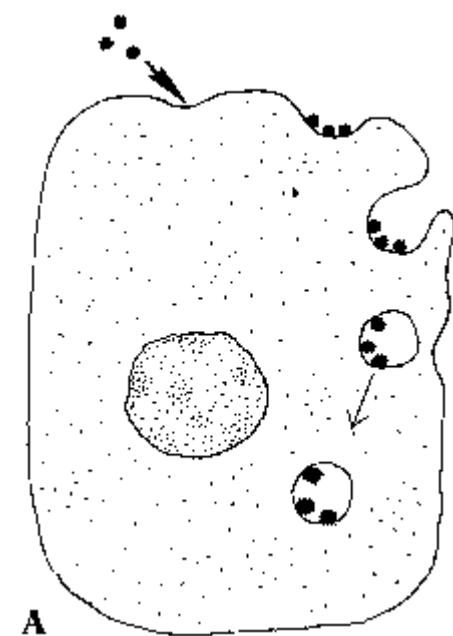
Endocytosis-Pinocytosis

Endocytosis is the movement of materials into the cell through membrane bound vesicles. One type of endocytosis is called pinocytosis, or “cell drinking”. **Pinocytosis** is the movement of small molecules or liquids into the cell through bulk transport.

The small molecules make contact with the cell membrane and the cell membrane pinches off around the molecules. Pinocytosis is how animal cells make vacuoles (water filled sacs).

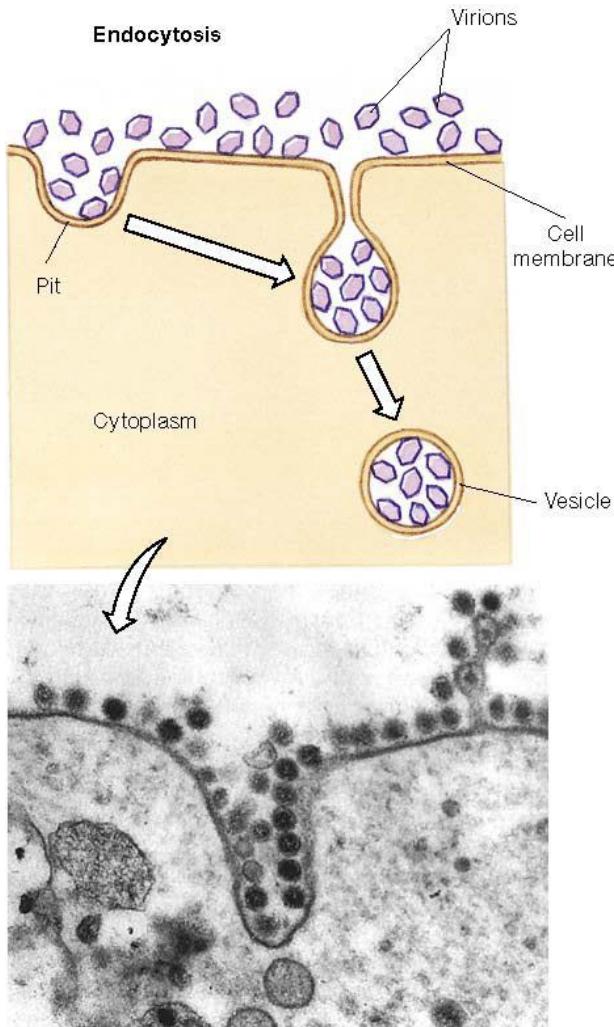


Pinocytosis occurring in two separate cells



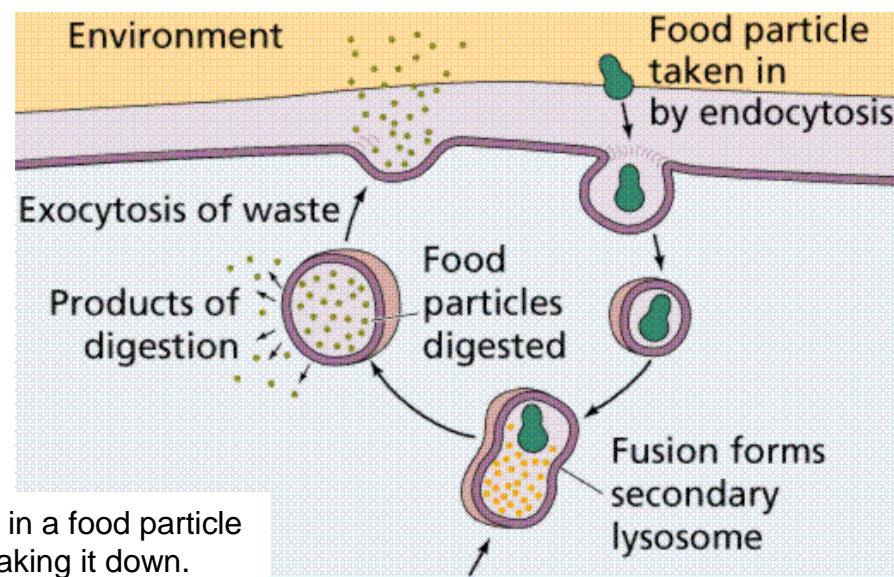
Endocytosis-Phagocytosis

The other type of endocytosis is phagocytosis, or “cell eating”.



Micrograph of a white blood cell engulfing virus particles.

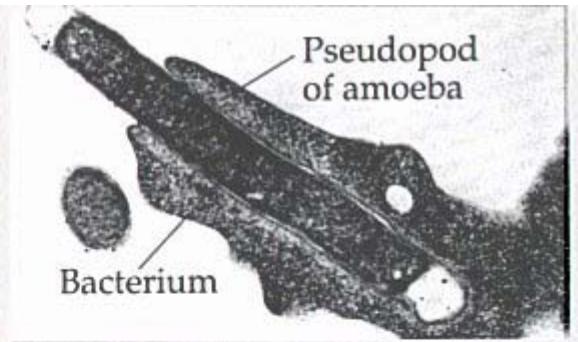
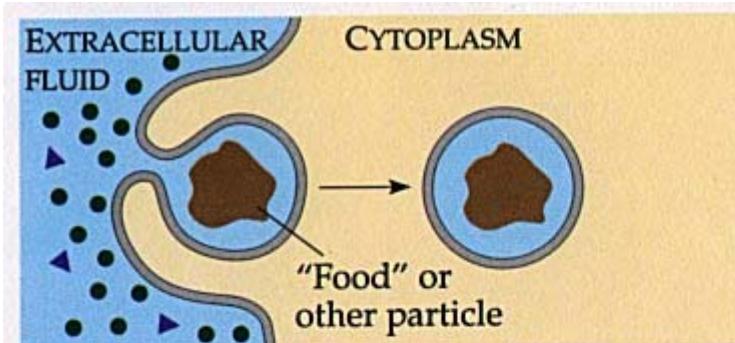
Phagocytosis is the movement of large molecules into the cell through bulk transport. The large molecules make contact with the cell membrane and the cell membrane pinches off around the molecules. The lysosomes then fuse with the vesicle and break down the large molecules into nutrients. Phagocytosis is how white blood cells engulf bacteria and break them down.



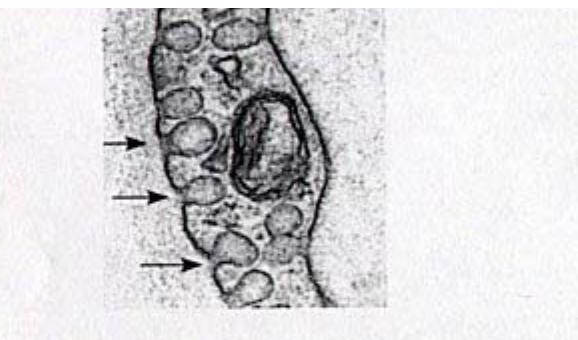
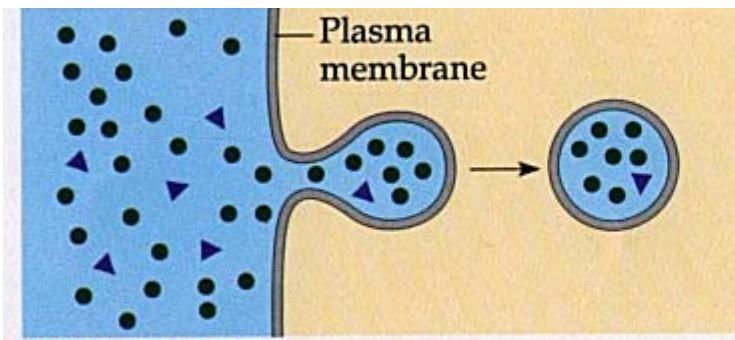
A cell taking in a food particle and breaking it down.

Endocytosis

A



B



Above are examples of endocytosis. Determine what type of endocytosis is shown in each situation. Notice the micrograph of actual cells performing the different types of endocytosis.