

Homeostasis

Section 7.3

Passive Transport: Osmosis



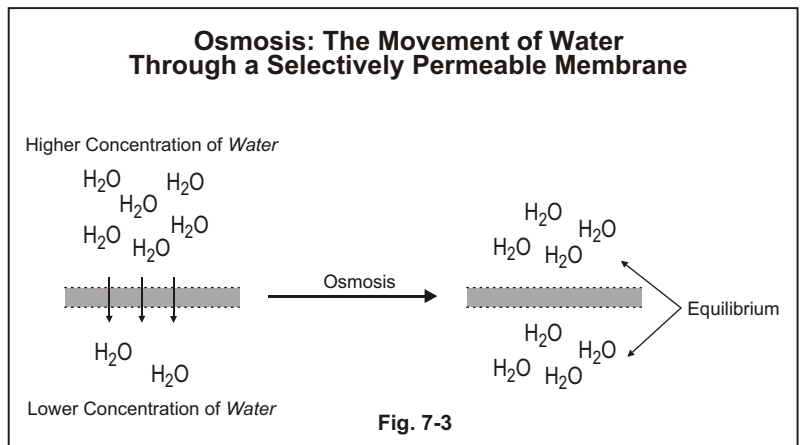
Pre-View 7.3

- **Osmosis** – the movement of water across a membrane
- **Solute** – dissolved particles
- **Hypertonic** – having a higher solute concentration outside the cell and causing the cell to shrink
- **Hypotonic** – having a higher solute concentration inside the cell and causing the cell to swell
- **Isotonic** – having equal solute concentrations inside and outside the cell

Osmosis is also a type of passive transport since it does not use the cell's energy. Like diffusion, it moves molecules from a higher concentration to a lower concentration. So, you may be wondering what makes osmosis different from diffusion. There are two important things to remember about osmosis.

1. It is always the movement of *water* molecules.
2. It moves water molecules across a selectively permeable membrane through which the **solute** (dissolved particles) cannot cross.

Osmosis occurs when the concentration of a solute (particles other than water) is greater on one side of a membrane than on the other side of the membrane, **BUT** the solute particles **CANNOT** diffuse through the membrane. If the solute particles could move through the membrane, they would do so by diffusion. If the solute particles cannot diffuse, water will move through the membrane in order to equalize the concentration on each side of the membrane. The end result is that water molecules move through the membrane from an area of *higher water concentration* to an area of *lower water concentration* (figure 7-3).



When we are talking about osmosis, we use three words to describe the solutions: *hypertonic*, *hypotonic*, and *isotonic*. Here are what those terms mean.

Hypertonic Solution

Have you ever poured salt on a snail or slug in your yard, and then watched as it seemed to melt before your eyes? Adding the salt caused the cells of the slug to be surrounded by a hypertonic solution. **Hypertonic** means that the solution outside the cell membrane contains less water and more solute than the solution inside the cell membrane. Water rushes out of the cell through the cell membrane, and the cell shrivels up. This movement of water out of the cells makes it look as if the slug is melting.

Section 7.3, continued

Passive Transport: Osmosis

Hint: In a hypotonic solution, will a cell shrink or swell? It will swell. A simple word association may help you to remember this answer. Associate “hypo” with an “o” with “hippo.” Hippos are large animals. Remember that cells in a hypotonic solution will swell up to the size of a hippo.

Effects of Osmosis on Animal Cells

Since an animal cell has only its cell membrane around it, the cell is very vulnerable to the effects of osmosis.

Hypertonic solutions will cause animal cells to shrink. If the concentrations are very different inside and outside the cell, an animal cell in a hypertonic solution will shrivel and die. For example, **salt water** is hypertonic to the cells of most vertebrates that live in the ocean. To avoid dehydration that could be fatal to them, these animals constantly drink sea water and then desalt it by pumping the salt out of their gills using *active transport*. (We’ll get to that next.) You may have seen pictures of marine turtles that blow salt out of special glands on their noses for the same reason. If a freshwater animal, however, is put in saltwater for an extended period of time, its cells will lose too much water in the hypertonic solution, and the animal will die of dehydration.

In a hypotonic solution, animal cells swell. If the cell membrane is not strong enough, the cells will burst. For example, a red blood cell that contains almost 1% solutes will burst if it is put in pure water (0% solute). A saltwater fish that is put in freshwater will eventually die because its cells will gain too much water.

Effects of Osmosis on Plant Cells

Plant cells have a rigid cell wall in addition to the cell membrane, so the effects of osmosis on plant cells are a little different.

In a hypertonic solution, the plant cell loses water. The contents of the cell will shrink some, but the cell wall will still give the cell some shape and structure. Because of the cell wall, a plant cell in a hypertonic solution may not appear smaller. In this condition, however, the plant may wilt. In a highly hypertonic solution, for example if you put a plant in salt water, the contents of the cell will completely shrink away from the rigid cell wall in a process called **plasmolysis**. In extreme conditions, the cell wall may collapse and the cell will die.

In an isotonic solution, a plant cell may not have enough water in it to fully fill the cell wall cavity. Plants in an isotonic solution may appear wilted or **flaccid** (limp).

In a hypotonic solution, plant cells take in water, but their rigid cell walls keep them from bursting. The cell walls allow pressure to build up within the cells. When the pressure equals the osmotic pressure, osmosis ceases. This pressure is called **turgor pressure**. Turgor pressure gives plants **turgor**, rigidity so that they can “stand up” and not wilt. Have you ever put wilted vegetables in fresh water? If so, you put them in a hypotonic solution. What happens to the vegetables? The water goes into the cells and makes them puff up so they are no longer wilted.

