

Tutorial 12: Solutions, Concentration and Osmosis

Goals:

- ✓ Know the definition of a solution, and be able to explain how a solute dissolves into a solvent.
- ✓ Be able to express solution concentration in M, % w/v and % v/v.
- ✓ Be able to use the dilution equation.
- ✓ Understand the terms semipermeable, osmosis, isotonic, hypotonic and hypertonic.
- ✓ Be able to express a solution concentration in osmolarity.

Solutions

- **Solution:** A homogeneous mixture of two or more substances.
- **Solute:** The substance that is dissolved in a liquid.
- **Solvent:** The liquid that is dissolving another substance(s).
- **Aqueous solution:** When water is the solvent.
- The extent to which a solute will dissolve in a solvent is dependent upon the attraction between solute and solvent particles. Like dissolves like!

Dissolving

- **Ionic compounds:** When ionic compounds dissolve, the cations are attracted to the partial negative end of the solvent and the anions are attracted to the partial positive end of the solvent. NOTE: You can use a solubility chart to determine which ionic compounds are soluble in water.
- **Polar molecules:** The partial positive end of a polar molecule will be attracted to the partial negative end of a polar solvent, and the partial negative end of a polar molecule will be attracted to the partial positive end of a polar solvent.
- **Nonpolar molecules:** Instantaneous dipoles form between nonpolar solutes and nonpolar solvents.
- **Solubility** refers to how much solute can dissolve in a given amount of solvent under certain conditions. Solubility varies with temperature, and for gas solutes solubility will also vary with pressure.

Concentration

- **Molarity:** refers to the number of moles of solute per liter of solution.
- **m/v %:** refers to the number of grams of solute per 100 mL of solution.
- **v/v %:** refers to the number of milliliters of solute per 100 mL of solution.
- It is more convenient to refer to the concentration of bodily fluids in **osmolarity** since there are many ions and molecules involved. **Osmolarity** refers to the number of moles of dissolved particles (ions or molecules) in 1 L of total solution.
- **Dilutions:** Solutions often come in a concentrated mixture that has to be diluted to the desired concentration. The following equation is used for dilutions: $C_1V_1 = C_2V_2$

Osmosis

- A porous material that allows water and small particles to pass while blocking other larger particles is said to be **semipermeable**.
- **Osmosis** refers to the passage of solvent through a semipermeable membrane. Solvent will flow from the side of the membrane that has the lower solute concentration to the side with the higher solute concentration. This flow of solvent will continue until sufficient osmotic pressure builds up.
- Blood and red blood cells are 0.30 osmol. A solution that is **isotonic** will have the same osmolarity. A solution that is **hypotonic** has a lower osmolarity, and a solution that is **hypertonic** has a higher osmolarity.