Solution Concentrations

$$mass - to - mass \ ratios \ (e.g., \frac{1mg}{1kg})$$

$$ppm: \frac{1mg}{1kg} = \frac{10^{-3}g}{10^3 \ g} = \frac{1g}{10^6 \ g} = 1 \ ppm$$

$$M(molarity) = \frac{\text{moles of solute}}{\text{volume of solution [L]}} = \frac{n}{V}$$

$$\Rightarrow n(solute) = M \cdot V$$

$$\Rightarrow mass(solute) = n \cdot molar \ mass \ (solute)$$

$$mass(solute) = n \cdot M \cdot V$$

$$m(molality) = \frac{\text{moles of solute}}{\text{mass of solvent [kg]}} = \frac{n}{mass}$$

Calculations with Solution Concentrations

Example 1: If you dissolve 25.5g KBr in enough water to make 1.75L of solution, what is the molarity of the solution?

Example 2: How many liters of a 0.125 M NaOH solution contain 0.255 mol of NaOH?

Example 3: What is the molarity of a 150 ppm aqueous solution of NaCl (d = 1 g/cm³; assume the density of water and the solution are the same).

Dilution
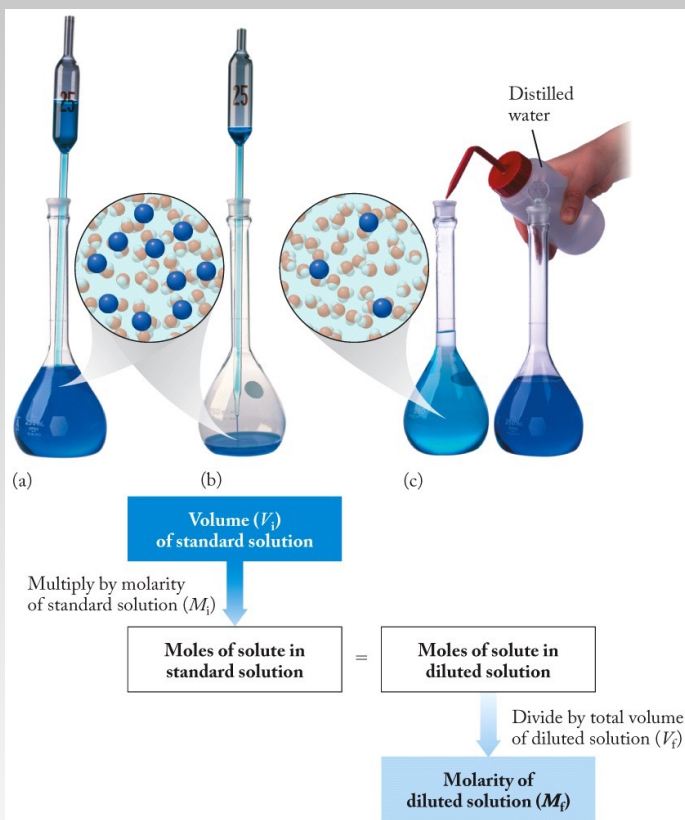
Stock Solution:

$$\mathbf{M}_i = \frac{n}{V_i} \Leftrightarrow n = M_i \cdot V_i$$

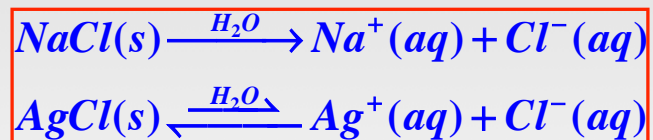**Final Solution:**

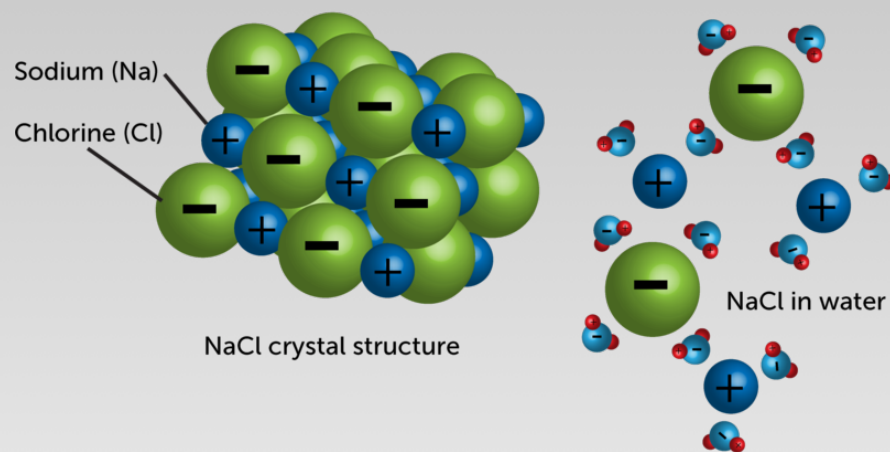$$n = M_f \cdot V_f$$

Combine

$$M_i \cdot V_i = M_f \cdot V_f$$

Dilution

Example 1: To what volume should you dilute 0.200L of a 15.0 M NaOH solution to obtain a 3.00 M NaOH solution?

Example 2: You have a 1M HCI solution. What volume of this stock solution do you need to make 500 mL of a 0.01 M HCI solution?

Dissolution of an Ionic Compound in Water

Sodium (Na)

Chlorine (Cl)

NaCl crystal structure

NaCl in water

$$NaCl(s) \xrightarrow{H_2O} Na^+(aq) + Cl^-(aq)$$

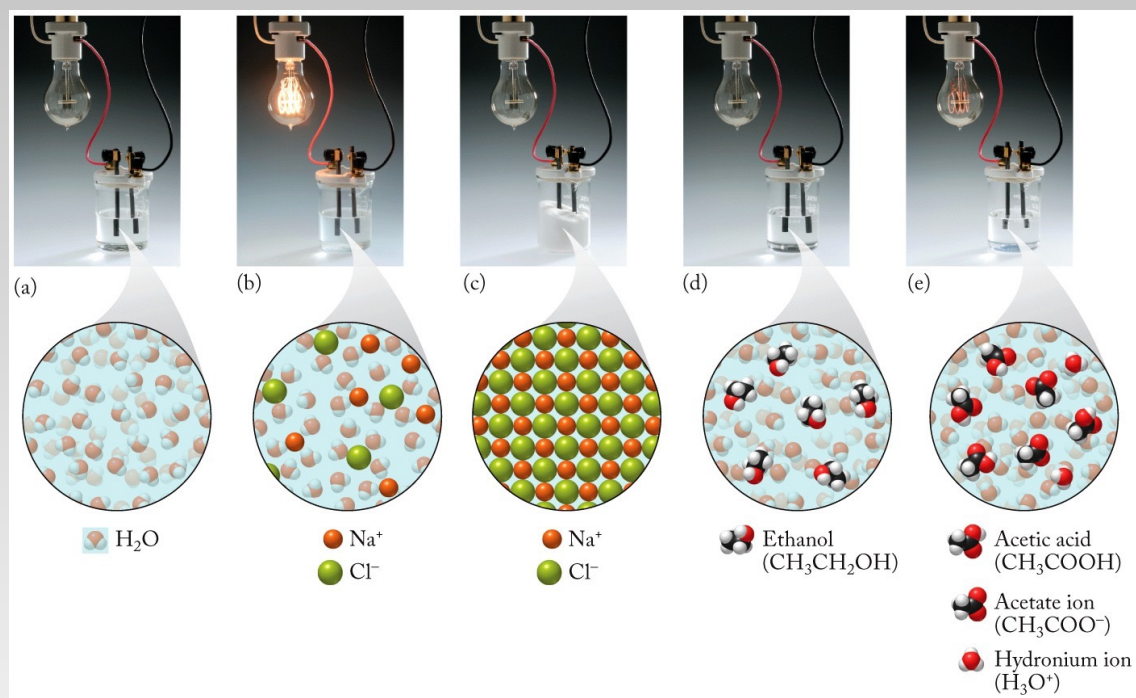$$AgCl(s) \underset{\longleftarrow}{\xrightarrow{H_2O}} Ag^+(aq) + Cl^-(aq)$$

A soluble ionic compound completely dissociates in aqueous solution into cations and anions; a partially soluble ionic compound dissociates in water only to a certain degree

http://cimg2.ck12.org/

Dissolution of Non-Ionic Compounds in Water (e.g., Sugar)

$$C_{12}H_{22}O_{11}(s) \xrightarrow{H_2O} C_{12}H_{22}O_{11}(aq)$$
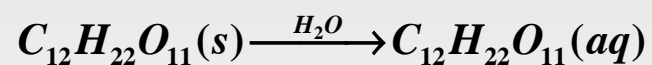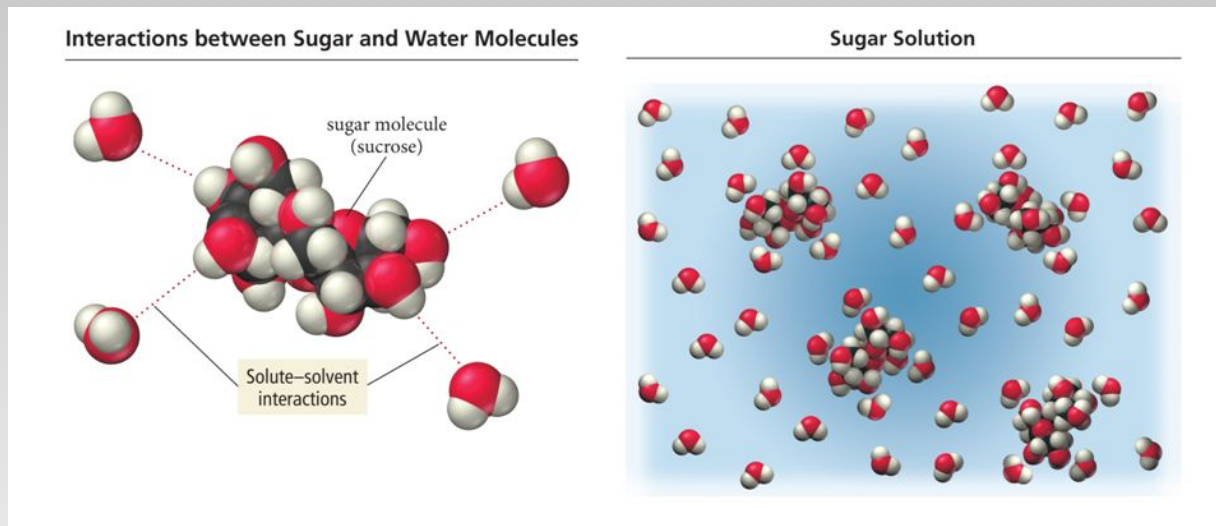
Summary: Electrolytes, Weak Electrolytes and Nonelectrolytes

Electrolyte:

$$NaCl(s) \xrightarrow{H_2O} Na^+(aq) + Cl^-(aq)$$

Weak Electrolyte:

$$CH_3COOH(aq) + H_2O \rightleftharpoons CH_3COO^-(aq) + H_3O^+(aq)$$

A weak electrolyte dissolves only partially in water