

## Aqueous Solutions

**Solute**      dissolves in      **Solvent**  
Substance being dissolved      Substance doing the dissolving

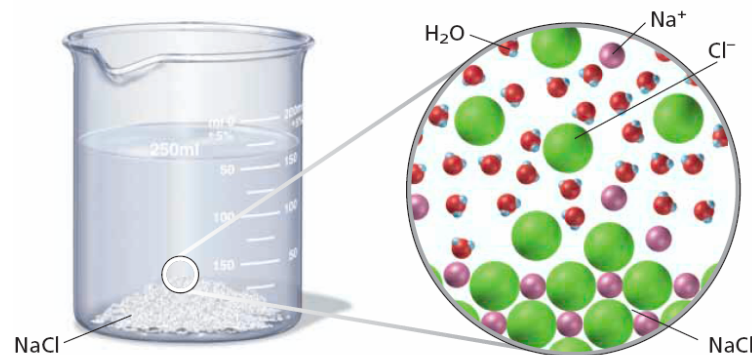


### Solution

2 or more substances  
in a single phase

**Soluble** – Ability for a substance to be dissolved

## Dissociation of NaCl



## Solubility Rules

The following guidelines are generalizations. A substance is classified as insoluble if it precipitates when equal volumes of 0.1 M solutions of its components are mixed.

- All compounds containing alkali metal cations and the ammonium ion ( $\text{NH}_4^{+1}$ ) are **soluble**
- All compounds containing  $\text{NO}_3^{-1}$ ,  $\text{ClO}_4^{-1}$ ,  $\text{ClO}_3^{-1}$ , and  $\text{C}_2\text{H}_3\text{O}_2^{-1}$  anions are **soluble**
- All chlorides, bromides, and iodides are **soluble except** those containing  $\text{Ag}^{+1}$ ,  $\text{Pb}^{+2}$ , or  $\text{Hg}_2^{+2}$ .
- All sulfates ( $\text{SO}_4^{-2}$ ) are **soluble except** those containing  $\text{Pb}^{+2}$ ,  $\text{Hg}_2^{+2}$ ,  $\text{Sr}^{+2}$ ,  $\text{Ca}^{+2}$ , or  $\text{Ba}^{+2}$ .
- All hydroxides ( $\text{OH}^{-1}$ ) are **insoluble except** compounds of the alkali metals,  $\text{Ca}^{+2}$ ,  $\text{Sr}^{+2}$ , or  $\text{Ba}^{+2}$ .
- All compounds containing  $\text{PO}_4^{-3}$ ,  $\text{S}^{-2}$ ,  $\text{CO}_3^{-2}$ ,  $\text{SO}_3^{-2}$  ions are **insoluble except** those containing alkali metals or  $\text{NH}_4^{+1}$



Ionic compounds can be soluble or insoluble in water.  
 $\text{NiCl}_2$ ,  $\text{KMnO}_4$ ,  $\text{CuSO}_4$ , and  $\text{Pb}(\text{NO}_3)_2$  are soluble in water.  
 $\text{AgCl}$  and  $\text{CdS}$  are insoluble in water.

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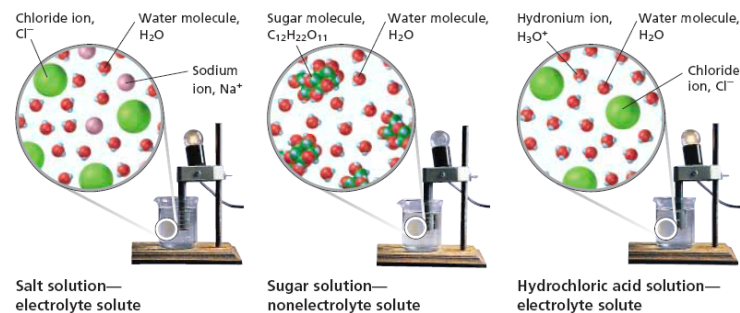
**Electrolyte** – a substance in solution that conducts electricity

- Ionic compounds dissolve by forming charged ions that carry charge
- Example: NaCl

**Nonelectrolyte** – a substance in solution that does not conduct electricity

- Molecules that dissolve do not form charged particles to carry charge
- Example: Sugar

### Particle Models for Electrolytes and Nonelectrolytes in Solution



## Aqueous Solutions

### Factors that Effect Rate of Dissolving

1. **Surface area of particles**  
More surface area increases rate. Grinding substance will make smaller particles with more total area
2. **Agitation**  
Stirring will allow better mixing
3. **Heat**  
Raising Temperature can increase rate with faster moving molecules.

Raising temperature will also increase solubility

