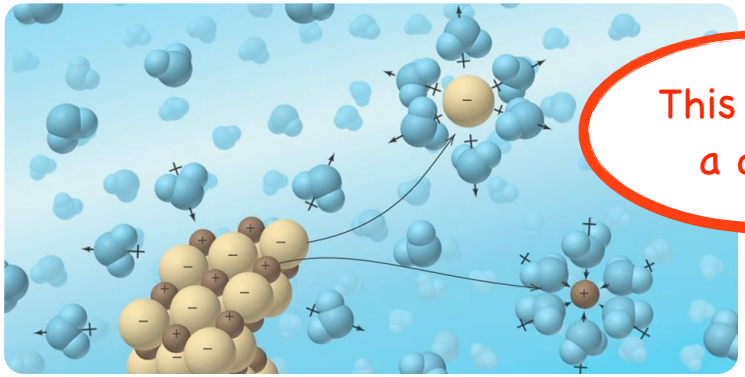
Exp 07: Electrolytes

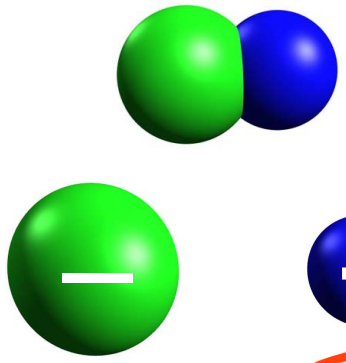
Part A: Solubility & Polarity

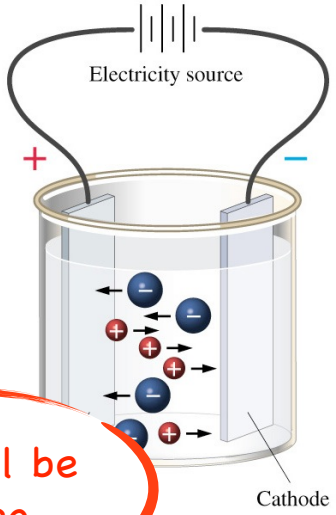
Why things are solid or dissolve?



This will be a demo.

Part B: Electrolytes





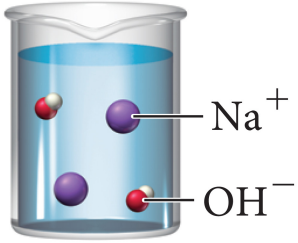
This will be a demo.

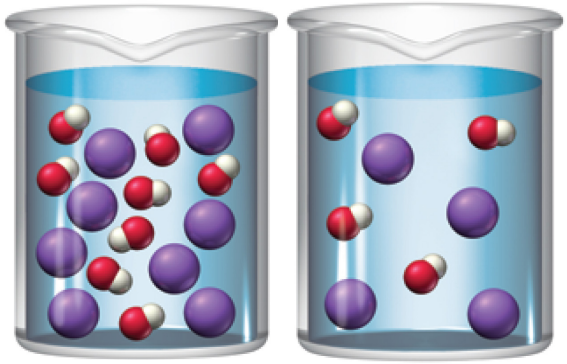
Part C: Imbalance

We will be skipping this part.

Part D: Concentration

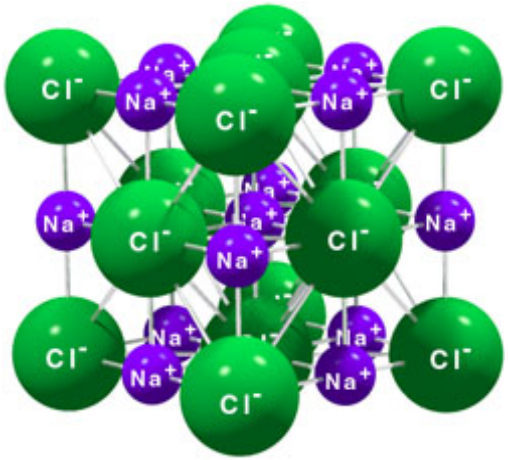
Your goal:
- Determine the concentration of a solution.

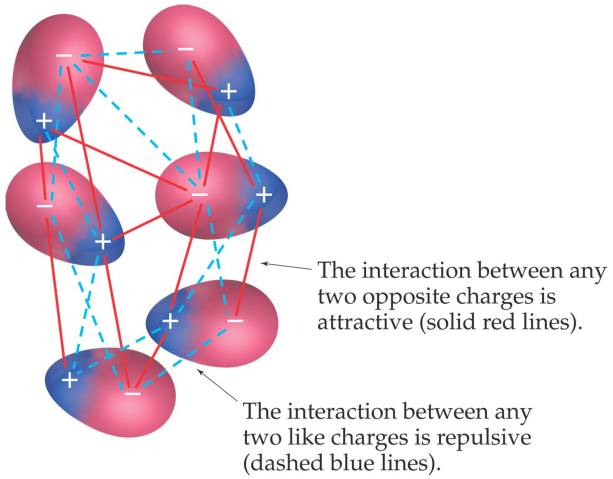


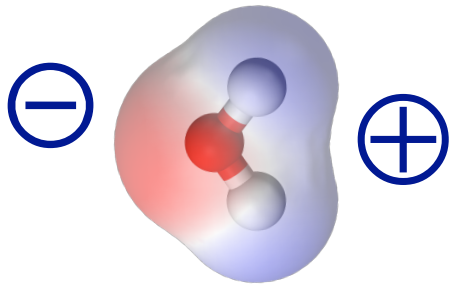


Why solids are solid.

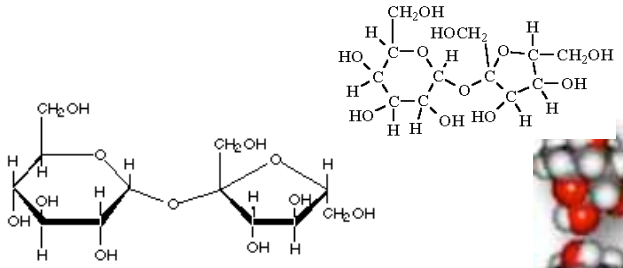
- Intermolecular forces hold solids together.
  - It's usually about plus being attracted to minus (electrostatic attraction).
  - Molecular Solids are held together by many types of intermolecular forces.
    - The quick story is molecules have a negative end and a positive end.
    - The negative end of one molecule sticks to the positive end of another.
    - We'll discuss the rest in Chapter 11.
  - Ionic Solids are held together by one type of intermolecular force.
    - It's a simpler story.
    - The cations stick to a bunch of anions.
    - Those anions stick to more cations.
    - The result is a big clump of particles.

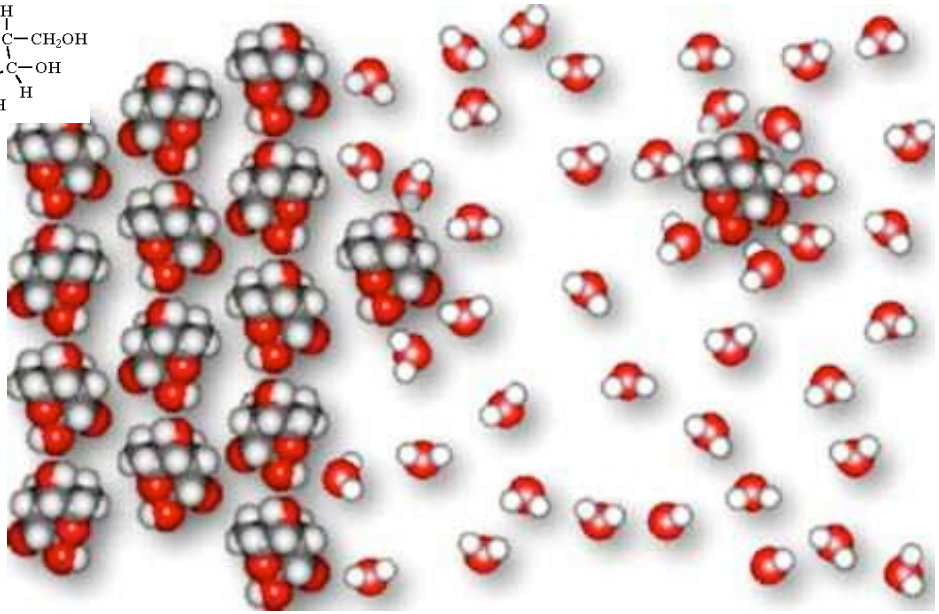


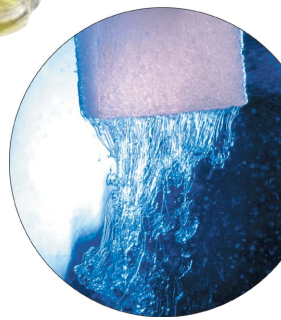




Molecular Solids Dissolve in Water

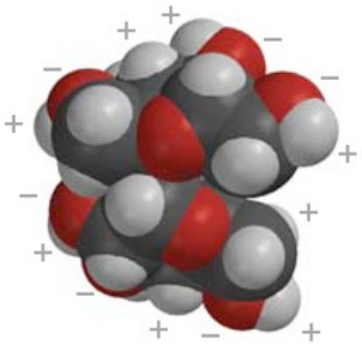




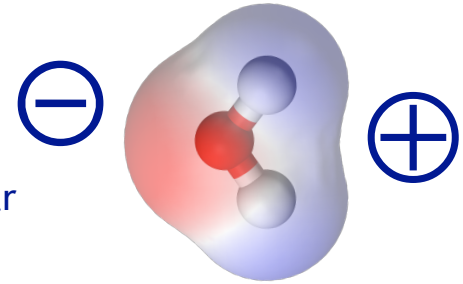


$$C_{12}H_{22}O_{11}\,(s) \xrightarrow{H_2O} C_{12}H_{22}O_{11}\,(aq)$$

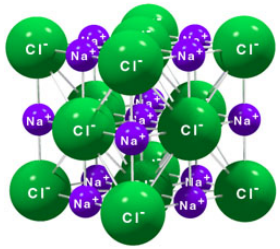
Sugar dissolving in water

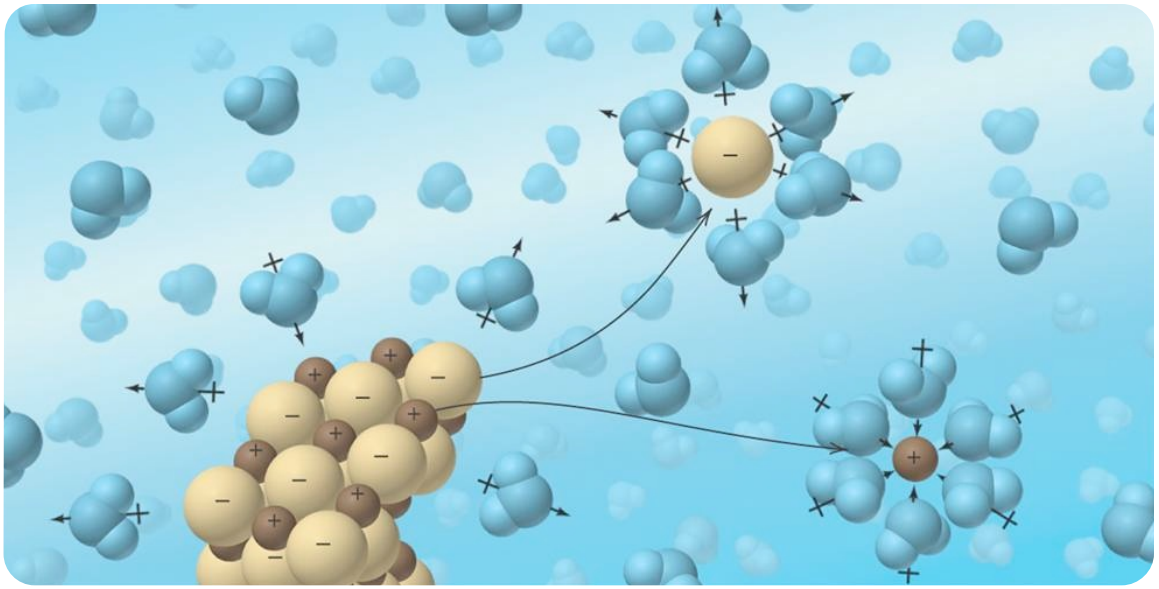


- Sugar dissolves in water.
- The molecules remain intact.
- Water molecules get in between sugar molecules.
- The result is a mixture of sugar and water.
- Mostly water.



Ionic Solids Dissolve in Water

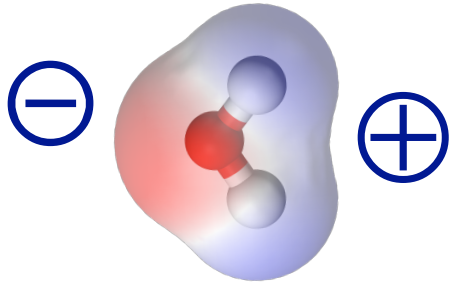




$$NaCl_{(s)} \xrightarrow{H_2O} Na^+_{(aq)} + Cl^-_{(aq)}$$

Dissociation of sodium chloride in water

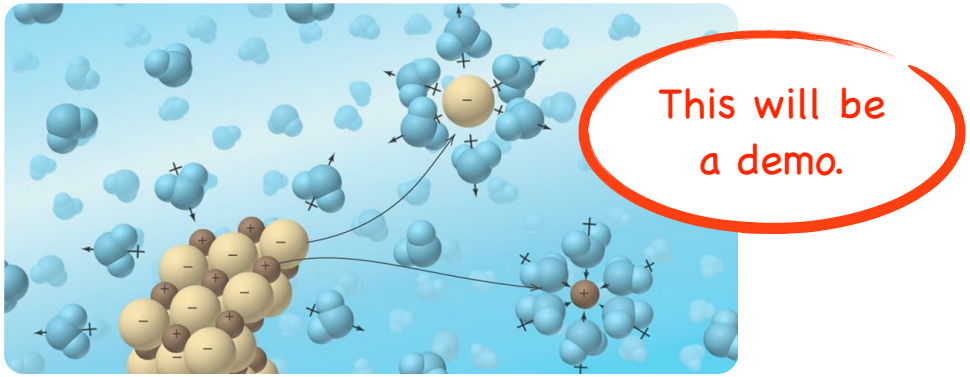
- Salt dissolves in water.
- The the ions separate.
- Water molecules get in between the ions.
- The result is a mixture of ions and water.
- Mostly water.
- Ions separating in solution is a process called dissociation.



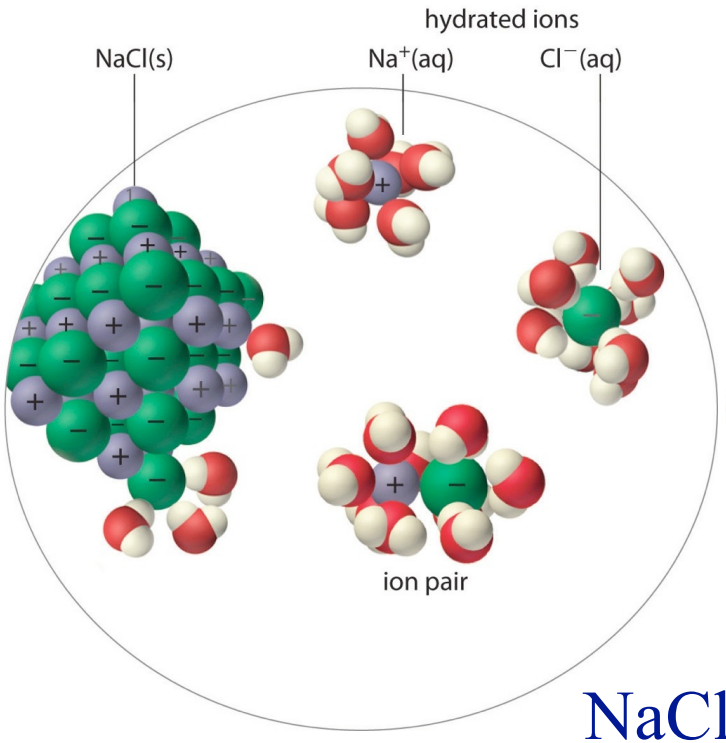
Exp 07: Electrolytes

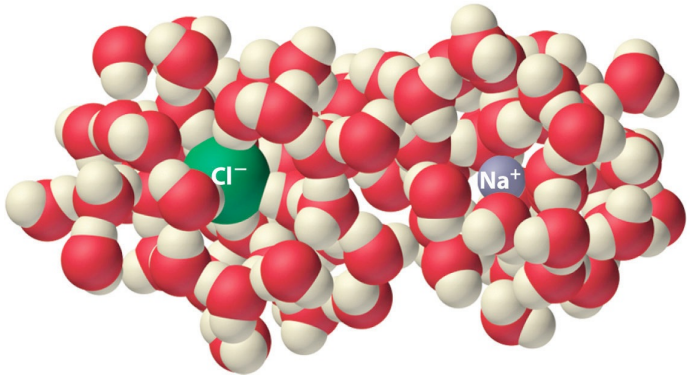
Part A: Solubility & Polarity

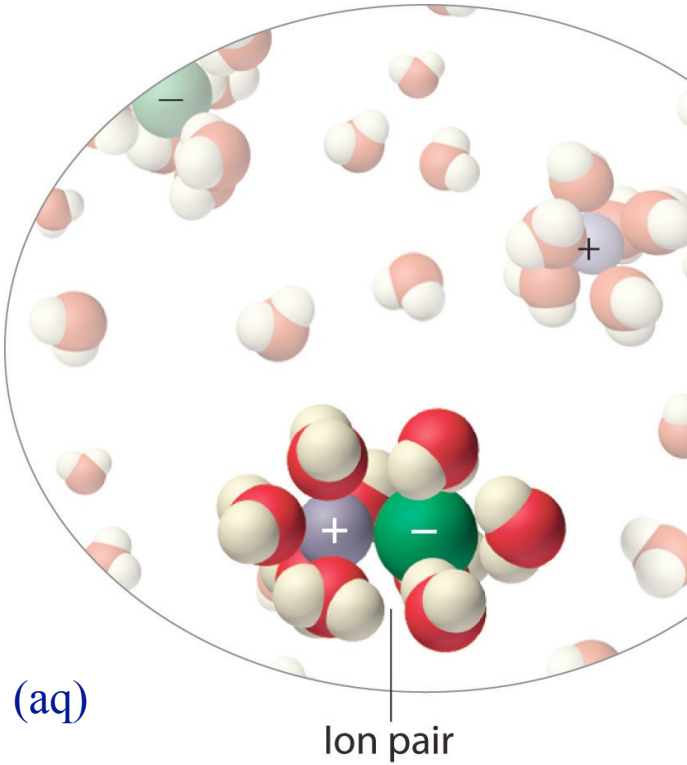
Why things are solid or dissolve?



Dissociation is often Reversible







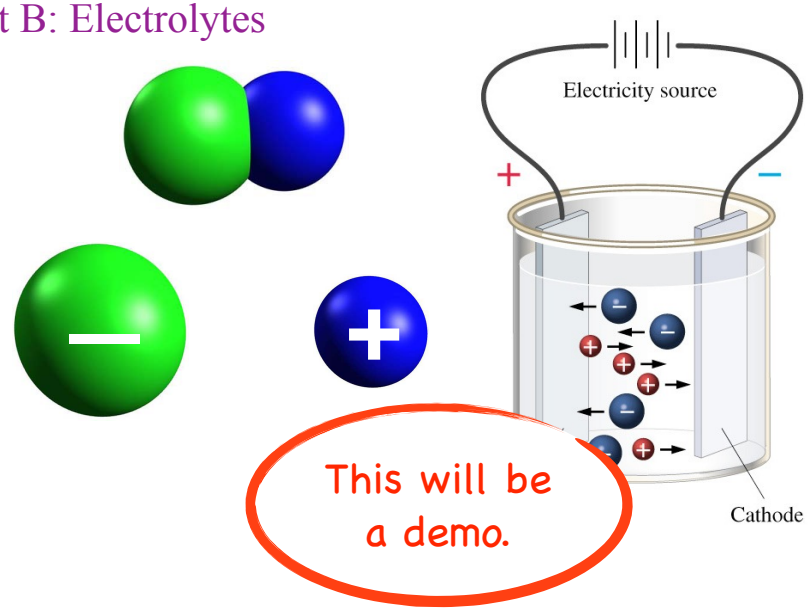
$$NaCl_{(aq)} \xrightleftharpoons{H_2O} Na^+_{(aq)} + Cl^-_{(aq)}$$

Dissociation of sodium chloride in water

- Dissolved ions in solution can find other dissolved ions.
- If the attraction between those ions is strong, they can re-associate.
- These dissolved ions form ion pairs.
- The ion pair is not a solid, it's still dissolved in solution.
- Ions that dissociate and re-associate in solution are a kind of reversible reaction.

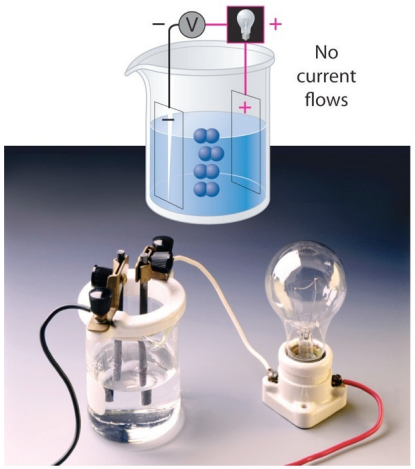
Exp 07: Electrolytes

Part B: Electrolytes

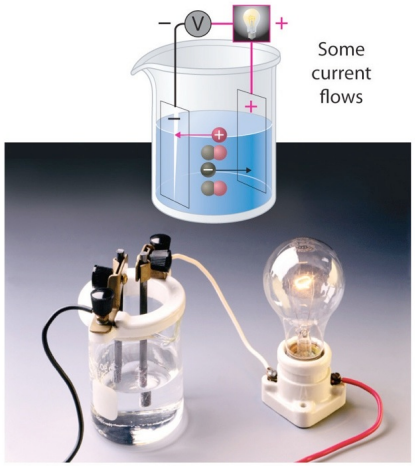


What is an electrolyte?

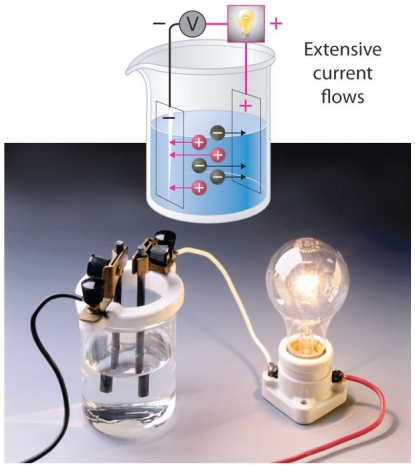
Electrolyte Strength



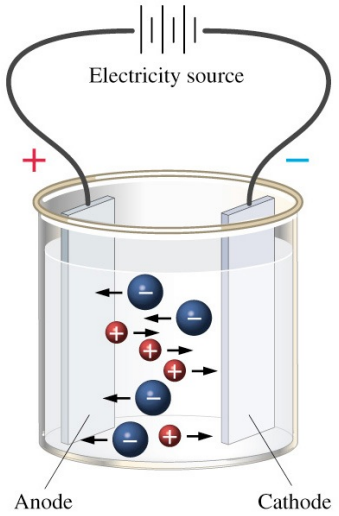
(a) Nonelectrolyte



(b) Weak electrolyte



(c) Strong electrolyte



Nonelectrolytes

- Molecular Substances
- Insoluble Ionic Salts

eg Sugar, AgCl, NO_2

Weak Electrolytes

- Weak Acids
- Weak Bases
- Partially soluble Ionic Salts

eg HOAc, HF (aq)

Strong Electrolytes

- Strong Acids
- Strong Bases
- Soluble Ionic Salts

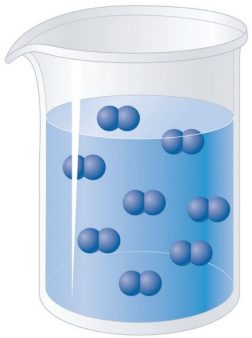
eg HCl (aq), NaCl, H_2SO_4

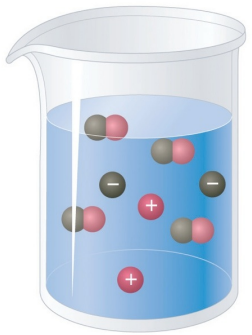
$CH_3COOH_{(aq)} \rightleftarrows CHCOO^-_{(aq)} + H^+_{(aq)}$

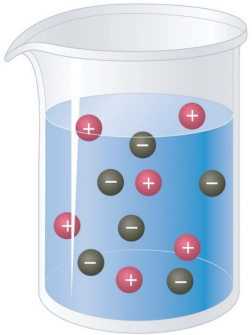
4 of 100 molecules dissociate

$HCl_{(aq)} \rightarrow H^+_{(aq)} + Cl^-_{(aq)}$

100 of 100 dissociate







Exp 07: Electrolytes

Part C: Imbalance

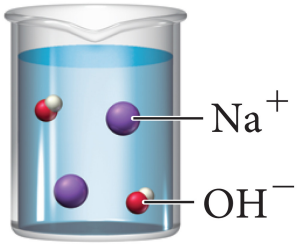
We will be skipping this part.

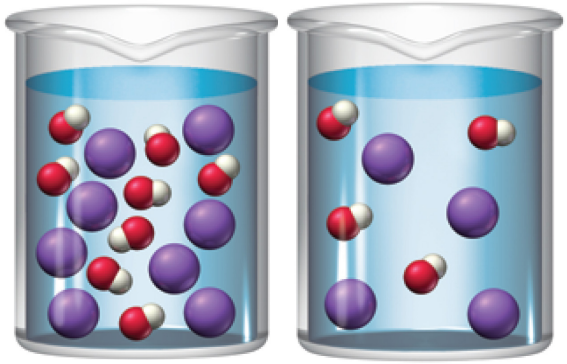
Exp 07: Electrolytes

Part D: Concentration

Your goal:

— Determine the concentration of a solution.



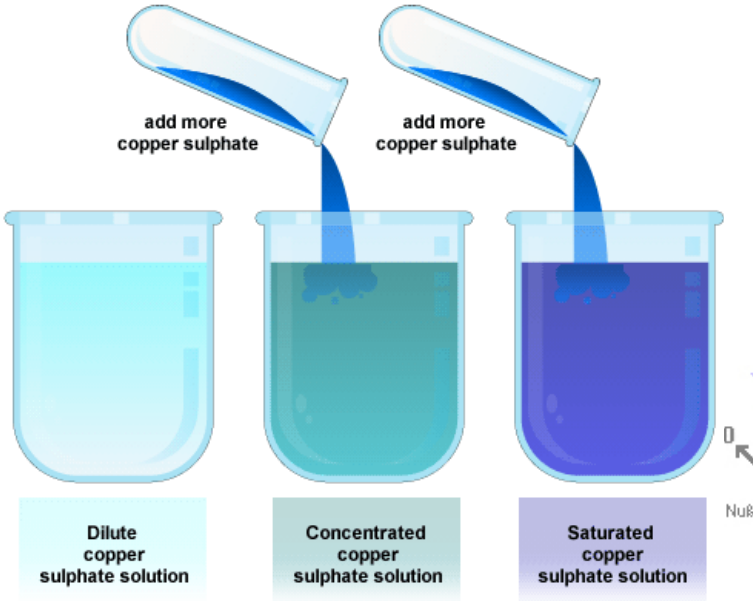


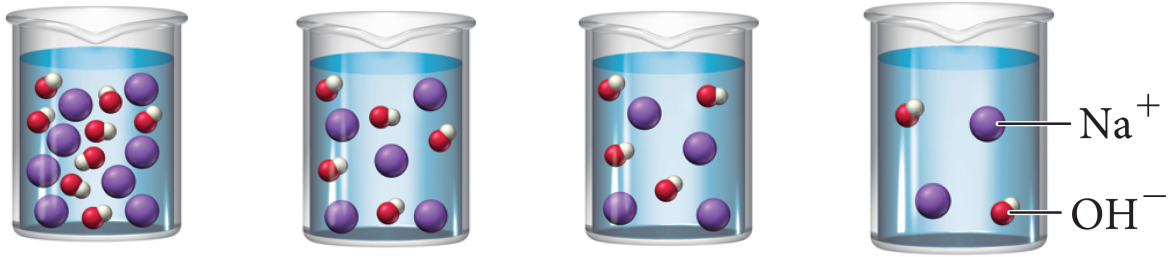
Solutions & Concentration

- Solutions are homogeneous mixtures.
- We know mixtures have tunable properties.
- The properties vary with the ratio of the pure substances that make up that mixture.

We describe that ratio as concentration.

- Concentration is the relationship between amount of a minor component of the mixture (a solute) to the major component of the mixture (the solvent).
- Concentration is how "crowded" the mixture is in a substance.
- Concentration is the amount of a solute in a given quantity of solvent.
- Solutions that contain greater amounts of solute are said to be more concentrated.
- Solutions that contain lesser amounts of solute are said to be more dilute.
- Solutions that contain the maximum amount of solute a solution can hold are said to be saturated.



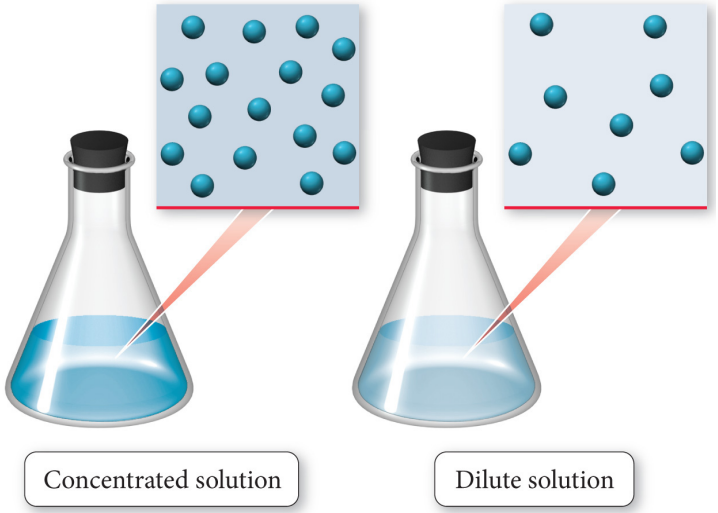


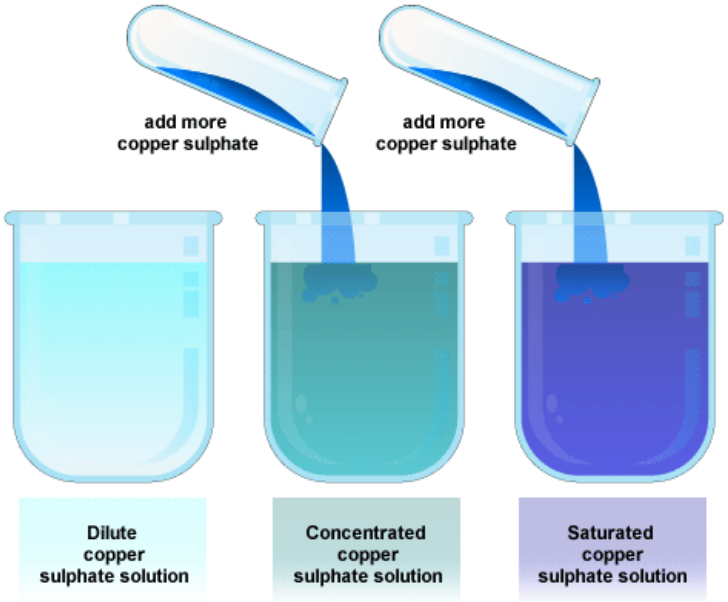
A solution is a homogenous mixture.

A solvent is the largest component of the mixture.

A solute is a smaller components of the mixture.

Concentration





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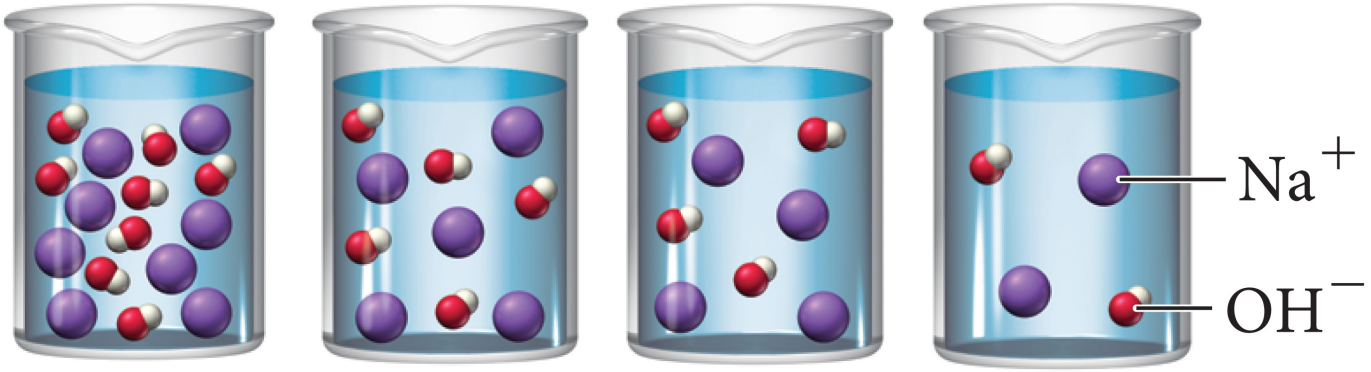
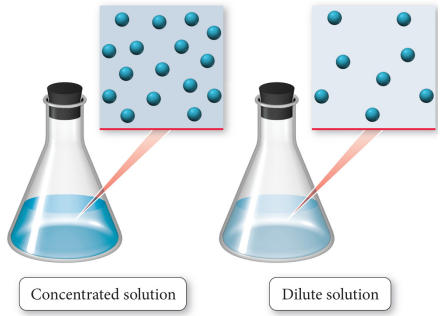


Measures of Concentration

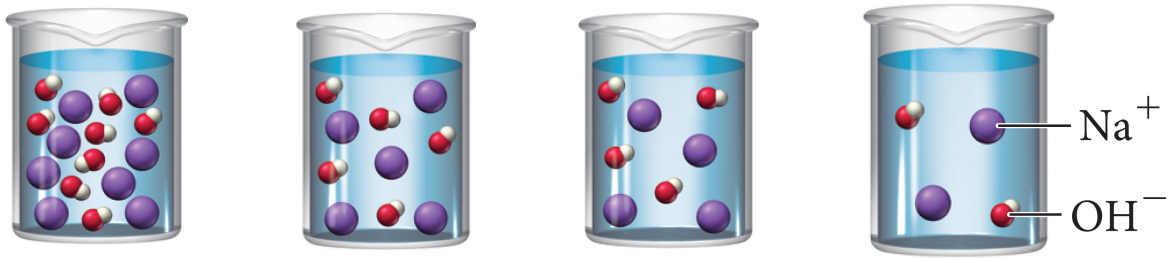
- There are a lot of ways we measure concentration.
- Three common ones are:
  - Mole Fraction (X)
    - Moles of solute per mole of solution.
    - We'll use this when we discuss gases, it's less useful for liquids.
  - Mass/Volume Percent (m)
    - Moles of solute, per g of solution.
    - a form of molality.
  - Molarity (M)
    - Moles of solute per liter of solution.
    - We'll use this **a lot** for liquids.

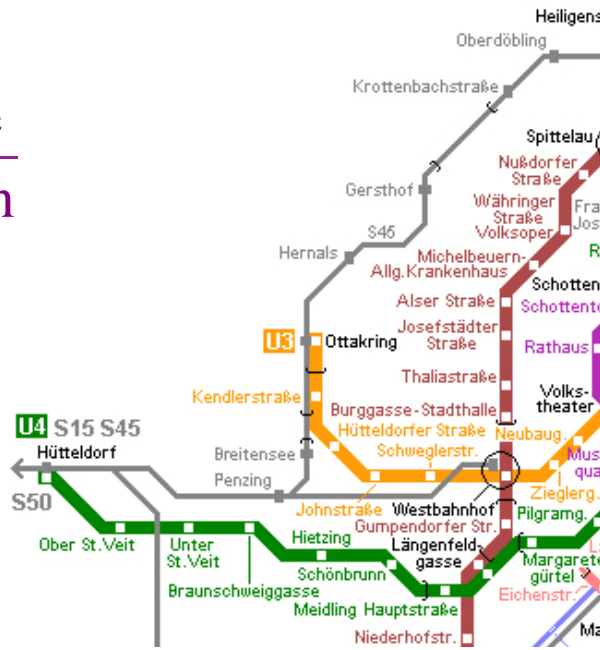
$$X = \frac{\text{moles of solute}}{\text{moles of solution}}$$



$$m = \frac{\text{moles of solute}}{\text{gram of solvent}} \times 100$$

$$M = \frac{\text{moles of solute}}{\text{liters of solution}}$$



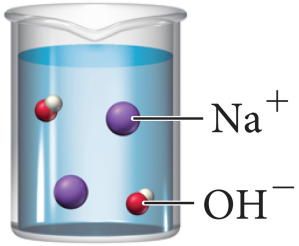


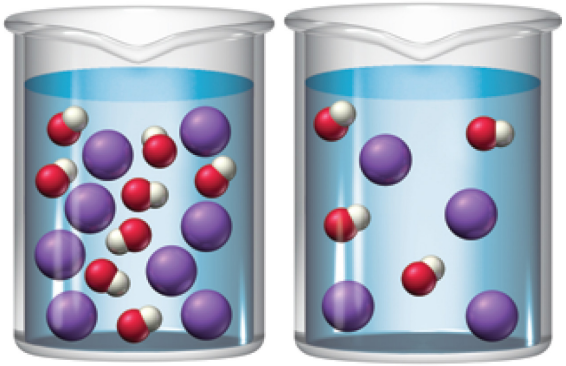
Exp 07: Electrolytes

Part D: Concentration

Your goal:

— Determine the concentration of a solution.





1. Pre-weigh your dish.
2. Transfer 10.00 mL of solution to the dish.
3. Record the volume of solution.
4. Record the weight of the dish + solution.
5. Heat it to remove the water.
6. Weigh the dish.
7. Record the weight of the dish + NaCl.

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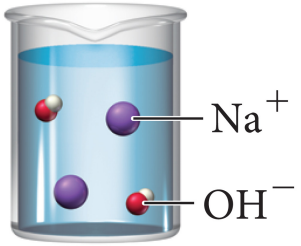

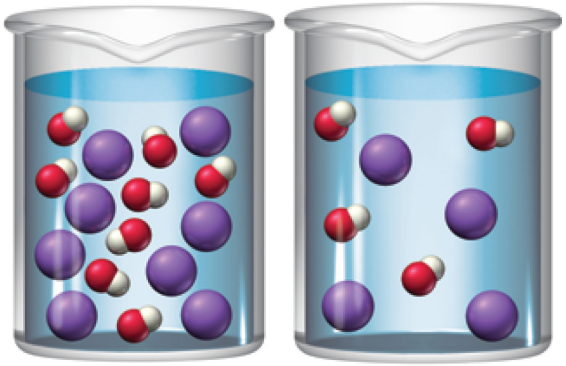

Calculations:

1. Calculate the moles of NaCl in your sample.
2. Calculate the volume of the solution in L.
3. Calculate the molarity of the solution.

$$M = \frac{\text{moles of solute}}{\text{liters of solution}}$$

1. Calculate the mass of the solution.
2. Calculate the mass/volume percent.

$$m = \frac{\text{moles of solute}}{\text{gram of solvent}} \times 100$$

Questions?