

# The Behavior of Solutions

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## Added Vocabulary from yesterday

- Two liquids that mix in any proportion are said to be *miscible*.  
Example: ethanol & water, hexane & carbon tetrachloride
- Two liquids that do not mix in are said to be *immiscible*.  
Example: water & carbon tetrachloride

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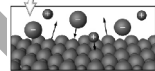
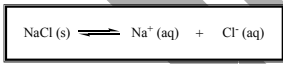
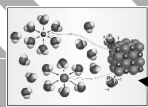
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## Saturated Solution

A stable solution containing the maximum amount of solute that can be dissolved in the solvent.



Supersaturated —force in more solute than when saturated

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## Solubility

**Solubility** - The concentration of solute in solution when the solution is saturated.  
(Expressed as g/100 mL H<sub>2</sub>O)

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## Colligative Properties

Properties of solutions which depend on the number of solute particles in the solution and not the nature of the solute.

• **Four Colligative Properties**

- 1) Vapor pressure lowering
- 2) Boiling point elevation
- 3) Freezing point depression
- 4) Osmosis

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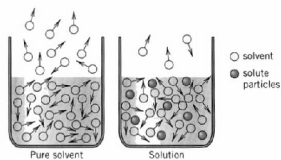
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## Vapor Pressure Lowering

- The vapor pressure of the solution is lowered because the solute particles at the liquid/vapor boundary block the solvent particles from jumping into the vapor state.



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## Why is Vapor Pressure decreased?

- The bonds between molecules keep molecules from escaping.
- In a solution, some of the solvent is busy keeping the solute dissolved.
- Lowers the vapor pressure

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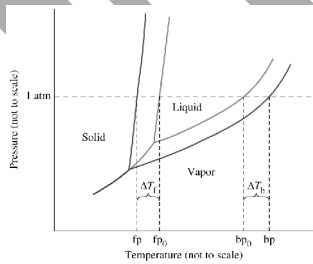
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## Boiling Point Elevation

**Solvents** can cause a change in boiling point ( $\Delta T_{bp}$ )



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## Why is the Boiling Point Elevated?

- The vapor pressure determines the boiling point.
- Lower vapor pressure = higher boiling point.
- The number of dissolved particles determines how much, as well as the solvent itself.
- Salt water boils above  $100^\circ\text{C}$

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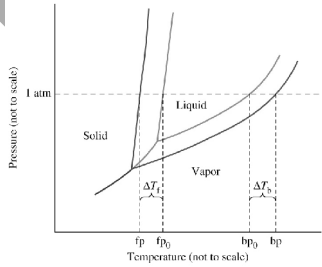
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## Freezing Point Depression

- Solvents can cause a change in freezing point ( $\Delta T_f$ )



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## Why is the Freezing Point Depressed?

- Solids form when molecules make an orderly pattern.
- The solute molecules break up the orderly pattern.
- Makes the freezing point lower.
- Salt water freezes below  $0^{\circ}\text{C}$
- How much depends on the number of solute particles dissolved.

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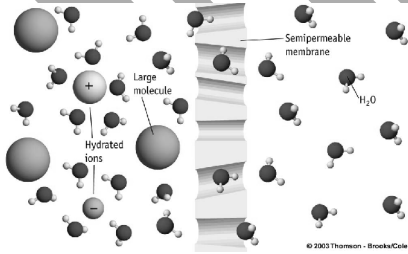
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## Osmosis and Osmotic Pressure

**Osmosis** - The movement of solvent molecules through a semipermeable membrane from a region of low solute concentration to a region of high solute concentration.



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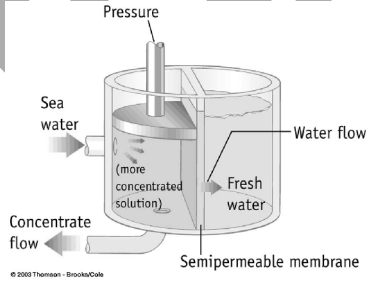
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## Reverse Osmosis is Used for Water Purification



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## II. Units of Concentration

- Naturally occurring solutions are often very dilute so environmental chemists, biologists, geologists, etc. often use **parts per million (ppm)**.

$$\text{Parts per million (ppm)} = \frac{1 \text{ mg}}{1 \text{ kg}} \text{ or } \frac{1 \text{ mg}}{1 \text{ L}}$$

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