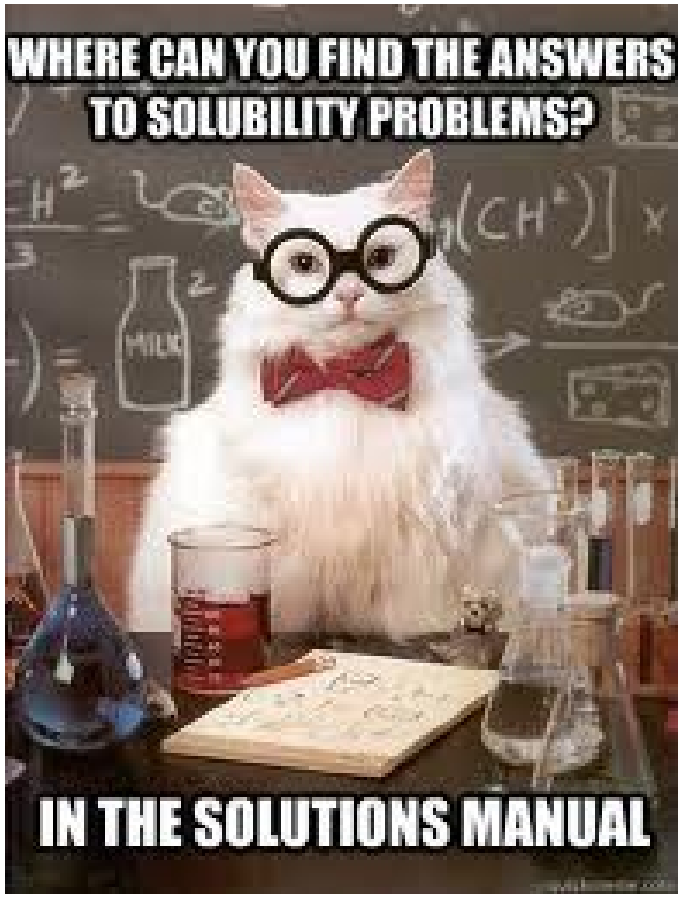
Solutions Introduction



Outcomes:

- Describe and give examples of various types of solutions. Include: all nine possible types
- Describe the structure of water in terms of electronegativity and the polarity of its chemical bonds.
- Explain the solution process of simple ionic and covalent compounds, using visual, particulate representations and chemical equations. Include: crystal structure, hydration, dissociation
- Explain heat of solution with reference to specific applications. *Examples: cold packs, hot packs*

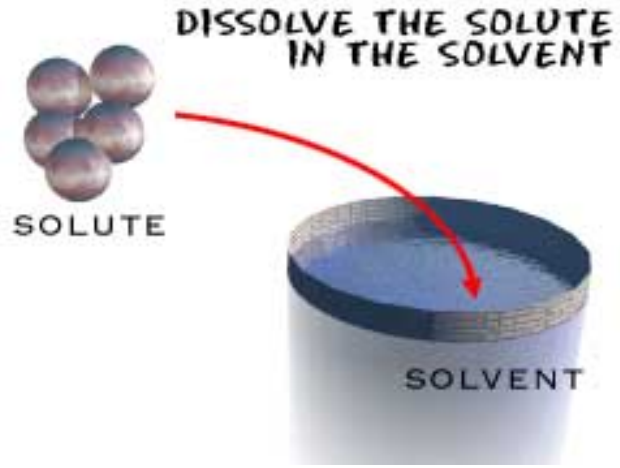
Solutions Intro Vocabulary:

1. Solute – The substance that **DISSOLVES** in a solution. (what is **BEING DISSOLVED**) Usually the **SMALLER PART** of a solution

2. Solvent – The substance that **DISSOLVES A SOLUTE** to form a solution. (What **DOES** the dissolving) Usually the **LARGER PART** of the solution

dissolver

3. Solution – A **UNIFORM** mixture that may contain solids, liquids, or gases. It is **HOMOGENEOU**s. It is made up of at least a **SOLUTE** and a **SOLVENT**



http://www.chem4kids.com/files/matter_solution.html

Solutions

Homogeneous Solutions:

- a mixture that has a **UNIFORM COMPOSITION** throughout and always has a **SINGLE PHASE**. A **SOLUTION** is homogeneous.

Examples:

Lemonade, sugar cookie, jello, milk

O.S. w/o pulp

Tap water

Hot dog

Kool-aid

pop

http://newsexaminer.net/crime/one-person-dead-after-argument-over-favorite-kool-aid-flavor/

Heterogeneous Solutions

- a **MIXTURE** that **DOES NOT** have a **UNIFORM** composition. Heterogeneous **MIXTURES** are **NOT SOLUTIONS**.

Examples:

C.Ch.P cookie

O.S. w Pulp

Bubble tea

Spaghetti + meatballs

Vomit

Salad

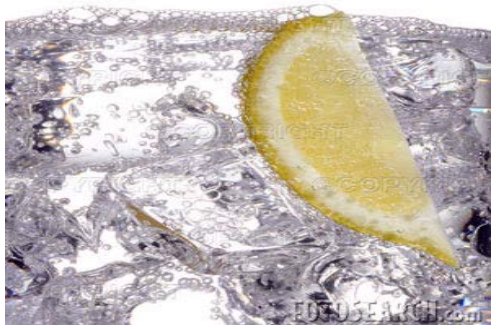
Raisin Bread

http://www.womansday.com/food-recipes/cooking-tips/tips/g1102/orange-juice/

Types of Gas Solutions

Solvent	Solute	Example
Nitrogen (gas)	Oxygen (gas)	 Air
Air (gas)	Water (liquid)	 Moist/Humid Air
Air (gas)	Carbon (solid)	 Smoke

Types of Liquid Solutions

Solvent	Solute	Example
Water (liquid)	Carbon Dioxide (gas)	 Carbonated water
Water (liquid)	Ethylene glycol (liquid)	 Antifreeze
Water (liquid)	Sodium chloride (solid)	 Ocean Water

Types of Solid Solutions

Solvent	Solute	Example
Carbon (solid)	Poisonous Gases (gas)	 Charcoal Filter
Silver (solid)	Mercury (liquid)	 Tooth Filling
Copper (solid)	Zinc (solid)	 Brass

Structure of Water:

Electronegativity:

- Indicates the relative ability of an element's atoms to **ATTRACT ELECTRONS** in a chemical bond.

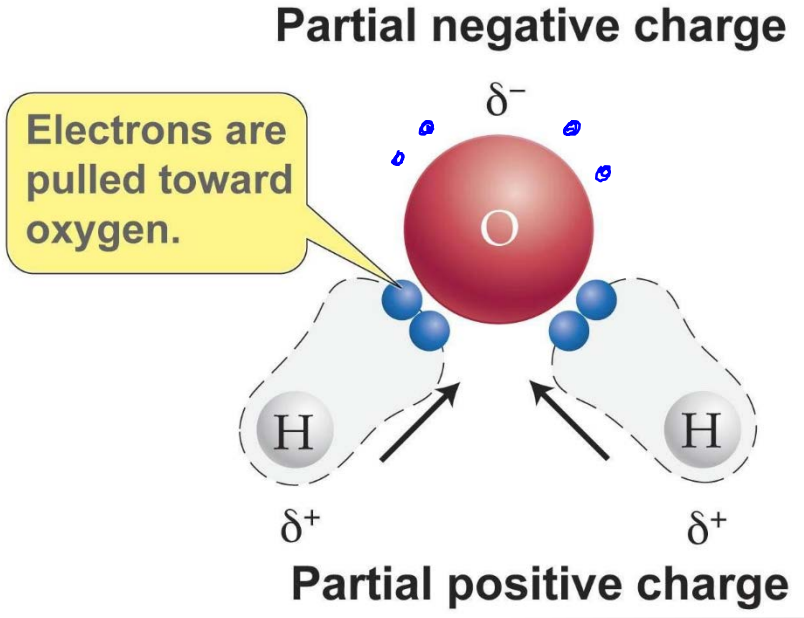
Polarity:

- The **POSITIVE** and **NEGATIVE CHARGES** in a molecule from **UNEQUAL SHARING** of electrons.

Draw a polar water molecule showing which ends are positive and negative.

The oxygen is more electronegative so the electrons in the chemical bond orient themselves more completely around the oxygen atom.

Note: "δ" Means "Partial"



https://socratic.org/questions/why-is-ammonia-hydrophilic

More Solutions Vocabulary:

Soluble:

- **ABILITY** of a substance to **DISSOLVE** in another substance
- Ex) **SALT** and **SUGAR** will dissolve in water.

Insoluble

- **INABILITY** of a substance to **DISSOLVE** in another substance.
- Ex) **DIAMONDS** (**CARBON**) are insoluble in water.

Miscible

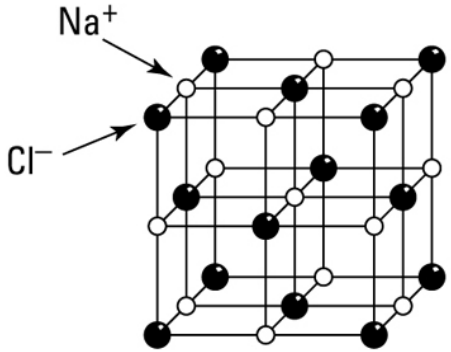
- Ability of a **LIQUID** to form a solution with another **LIQUID** in all proportions
- Ex) **WATER** and **VINEGAR** will mix

Immiscible

- Inability of a **LIQUID** to form a solution with another **LIQUID** in all proportions.
- Ex) **OIL** and **WATER** will not mix

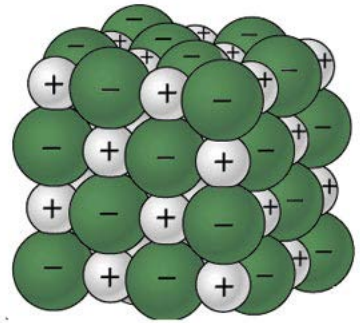
The Dissolving Process - Ionic

Here is what a crystal of NaCl looks like at the molecular level:



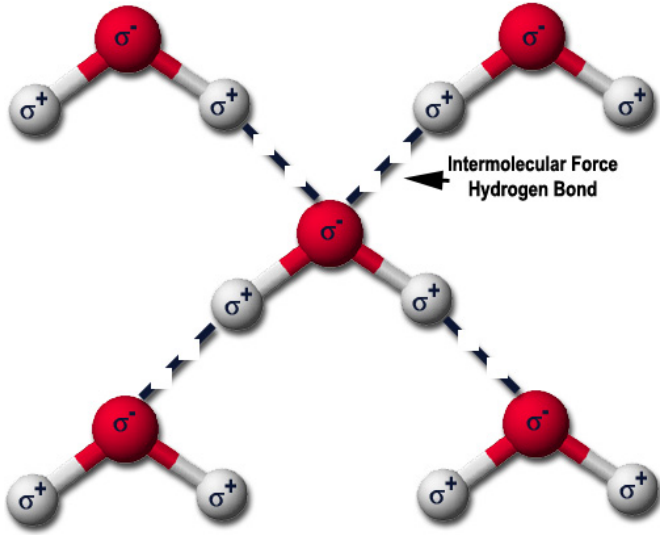
http://www.dummies.com/education/science/chemistry/ionic-bonds-why-and-how-ions-are-formed/

OR



http://www.middleschoolchemistry.com/multimedia/chapter5/lesson3

Here is what water looks like at the molecular level:



http://www.nemoquiz.com/genchem/petroleum/viscosity/

The Dissolving Process - Ionic

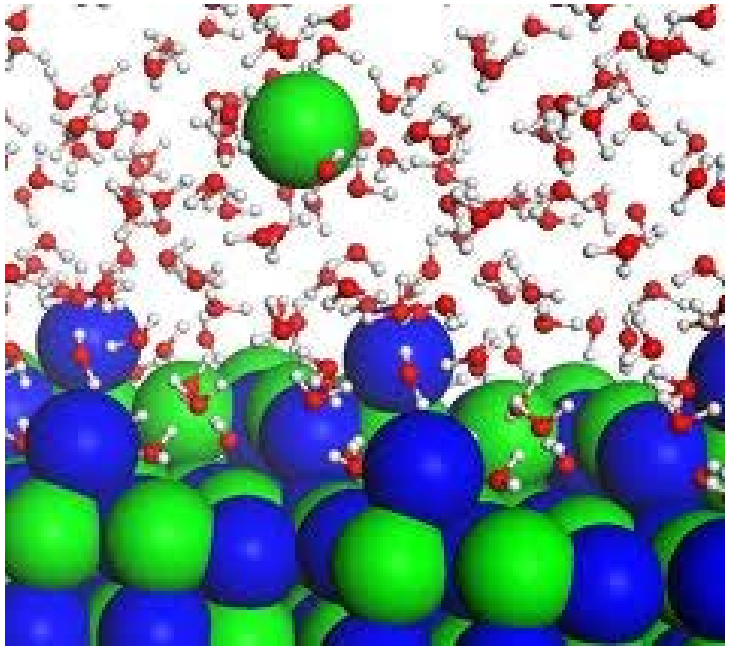
Questions:

1. Why do you think sodium chloride will dissolve in water?

   The polar water molecules are attracted to the Na^+ and Cl^- ions.

2. Where on the salt would the process of dissolving occur?

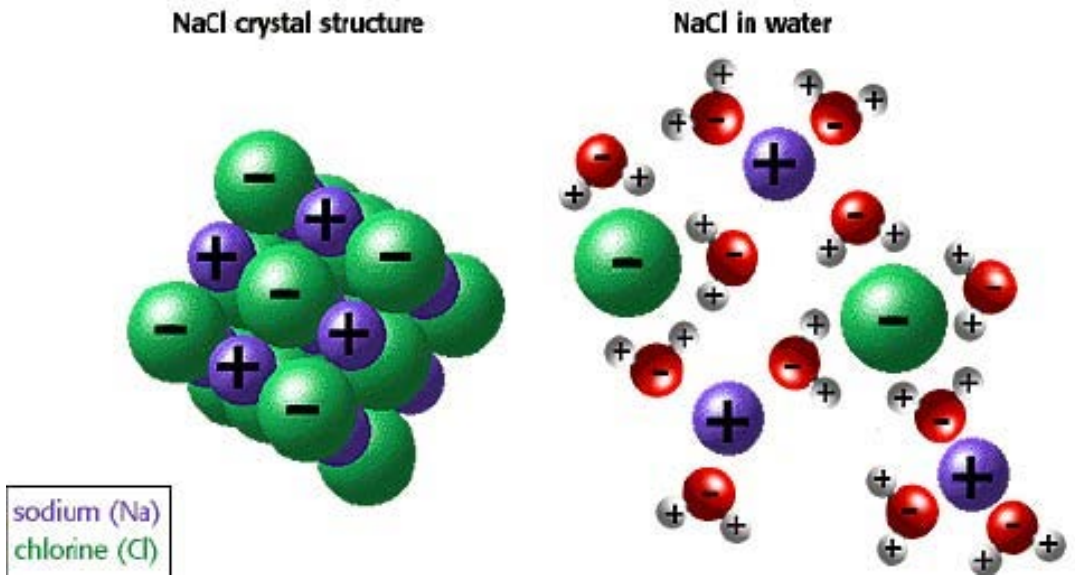
   At the surface of the solid.



https://jahschem.wikispaces.com/solubility

The Dissolving Process - Ionic

Here is the dissolving of NaCl in water.



http://butane.chem.uiuc.edu/pshapley/Enlist/Labs/LiquidSol/LiquidSol.html

The formation of a solution of NaCl in water involves:

1. the **BREAKING** of attractions between **SOLUTE** particles,
2. the **BREAKING** of attractions between **SOLVENT** particles,
3. The **FORMING** of attractions between **SOLUTE** and **SOLVENT** particles.

The Dissolving Process - Ionic

Dissolving IONIC Compounds:

→ Soluble Ionic compounds will dissolve and ***dissociate*** (break apart)

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

Let's see how it works!!

Here is another example

Dissociation:

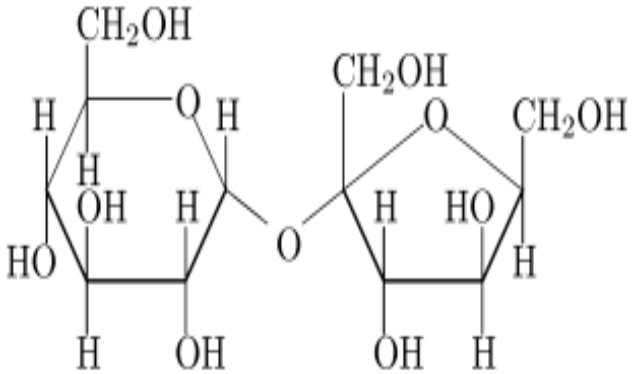
- The **BREAKING UP** of **IONIC** compounds when they **DISSOLVE**.
- The reaction above is called a **DISSOCIATION REACTION**

Example:

Write the balanced dissociation reaction for the dissolving of Aluminum Sulphate:

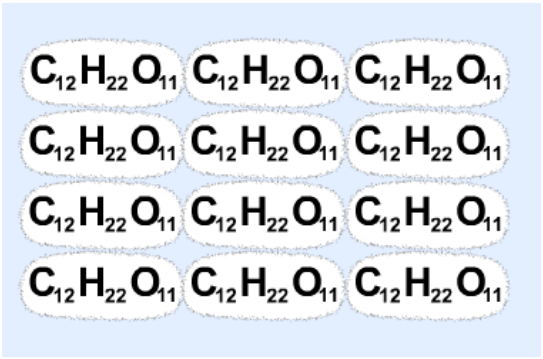
The Dissolving Process - Covalent

Here is a molecule of common table sugar at the molecular level:



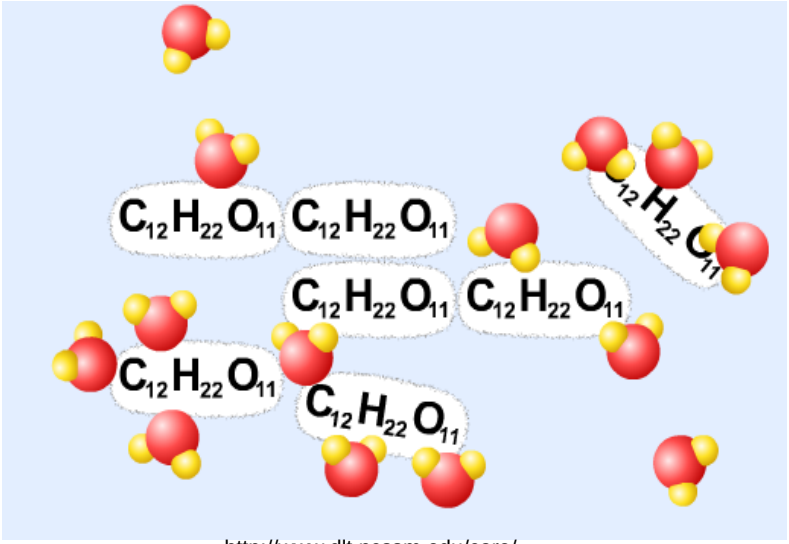
http://chemistry.about.com/od/workedchemistryproblems/a/molecularmass.htm

OR



http://www.dlt.ncssm.edu/core/

Here is what it looks like when sugar (a covalent molecule) dissolves:



http://www.dlt.ncssm.edu/core/

The Dissolving Process - Covalent

Dissolving COVALENT Compounds

→ Soluble covalent compounds will dissolve as a **WHOLE MOLECULE**

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

Let's see how it works!!

Solvation:

- When **COVALENT** molecules dissolve, they get **SURROUNDED** by the solvent molecules → called **SOLVATION**

Example:

Write the solvation reaction for the dissolving of octane (C_3H_8)

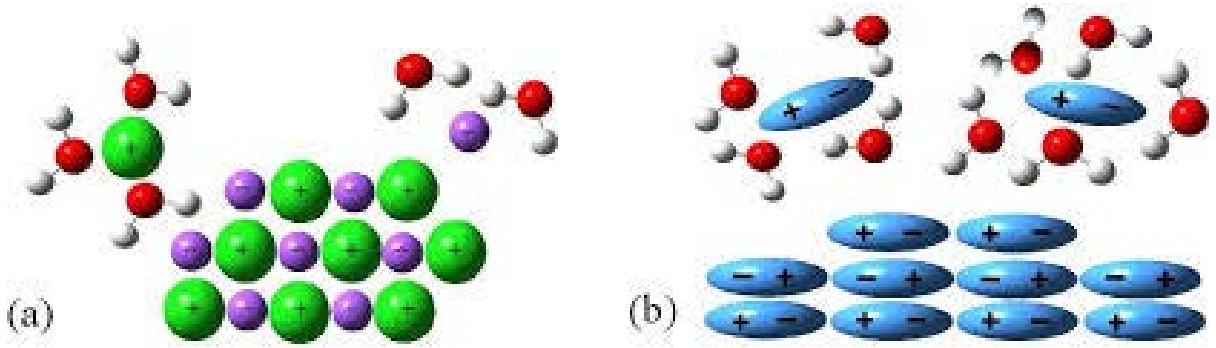
Note:

Anytime a substance is dissolved by water, the process can be called **HYDRATION**.

The Dissolving Process - Covalent

Questions:

1. How is the dissolving of covalent compounds different than dissolving ionic compounds?
    - ***Covalent compounds separate into single molecules***
    - ***Ionic compounds separate into ions***



Ionic **Covalent**

https://tnrtb.wordpress.com/2013/05/20/water-designed-for-life-part-1-of-7/

Lets put it all together!

2. Which of the two solutions would most likely conduct electricity? Why?
    - ***The ionic solution → it has charges that can move!***

The Dissolving Process

Unsaturated Solution

- Contains **LESS SOLUTE** for a given **TEMPERATURE** and **PRESSURE** than a saturated solution. It **CAN** hold **MORE SOLUTE**.

Saturated Solution

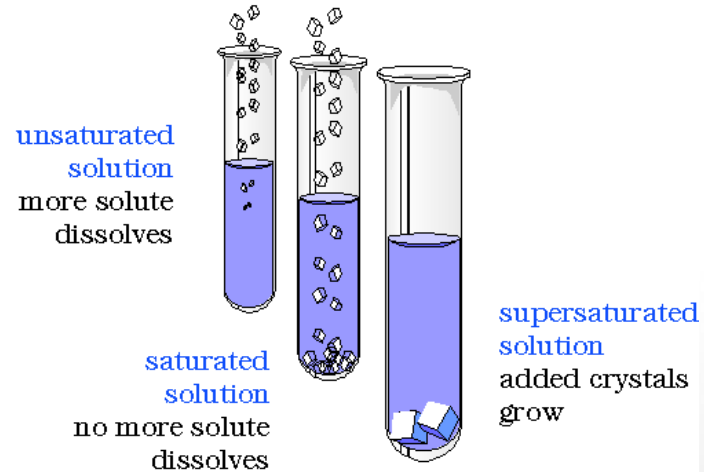
- Contains the **MAXIMUM AMOUNT** of dissolved **SOLUTE** for a given amount of solvent at a specific **TEMPERATURE** and **PRESSURE**.

Supersaturated Solution

- Contains **MORE** dissolved **SOLUTE** than a saturated solution at the same **TEMPERATURE**. This is an **UNSTABLE** condition that is achieved by **HEATING** and then **COOLING**.

Equilibrium of AgCl

Soluble Salts Applet



http://resource2.rockyview.ab.ca/science8/Sci8%20U1%20MixFlow/Sci8U1%20Lessons/Sci8U1L3.html

Heat of Solution:

- Anytime attractions are **BROKEN**, **ENERGY** is **NEEDED**.
- Anytime attractions are **FORMED**, **ENERGY** is **RELEASED**.

Remember that for a solute to dissolve…

1. **SOLUTE** particles must **SEPARATE**

   → attractions are **BROKEN** so energy is **NEEDED**.
   → temperature goes **DOWN** (feels **COLDER**)

2. **SOLVENT** particles must **SEPARATE**
   → attractions are **BROKEN** and energy is **NEEDED**.
   → Temperature goes **DOWN** (feels **COLDER**)

3. **SOLUTE** and **SOLVENT** particles form **NEW ATTRACTIONS**

   → Energy is **RELEASED**
   → Temperature **RISES** (feels **HOTTER**)

Heat of Solution:

In the overall process of **SOLUTION FORMATION** heat is either **ABSORBED** or **RELEASED**.

Whether heat is **ABSORBED** or **RELEASED** depends on the two opposing processes. The two opposing processes are the **BREAKING** of attractions and the **FORMING** of attractions.

Exothermic

- When a solute dissolves and the overall solution **INCREASES** in temperature. The solution is **WARM/HOT**.
- The **FORMING** of bonds gave off **MORE ENERGY** than the **BREAKING** of bonds **REQUIRED**.

Endothermic

- When a solute dissolves and the overall solution **DECREASES** in temperature. The solution is **COOL/COLD**.
- The breaking of bonds **REQUIRED** more energy than the **FORMING** of bonds **GAVE OFF**.

Heat of Solution:

Example:

1. If more energy is released when new attractions between the solute particles are formed than when they were broken apart would the solution feel hot or cold?

Heat of Solution

How does a cold pack work?

- Instant cold packs have two sealed bags, one inside the other. The outer bag is made of thick strong plastic and contains a white **POWDER**, usually **AMMONIUM NITRATE**.
- The inner bag is made of a thin weak plastic bag and contains **WATER**.
- When the bag is twisted or squeezed, the **WATER MIXES** with the **POWDER**.
- Since the **DISSOLVING** of **AMMONIUM NITRATE** in **WATER** is **ENDOTHERMIC**, the bag containing the solution gets **COLD**.