Name:________________________

It is all about the learning

Solution Basics

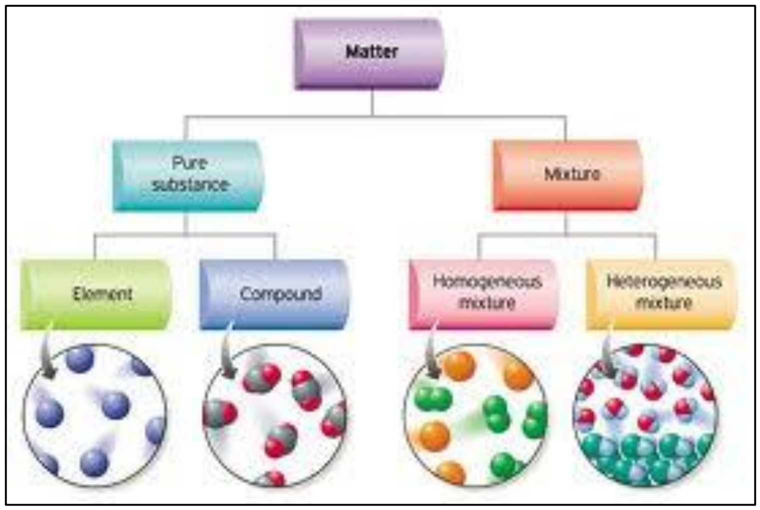
Unit 6 Notes

Homo/Hetero Activity:

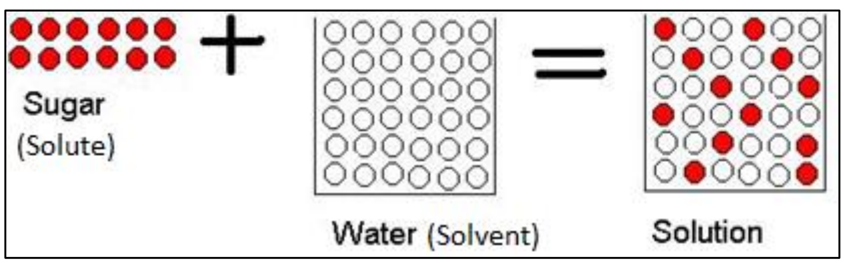
	Hypothesis:	Examples	Definition
Homogeneous			
Heterogeneous			

Reading:

Homogenous mixtures are also called solutions. Solutions have only one phase, as the solute and solvent are both thoroughly mixed together. Solutions are uniform throughout, unlike heterogeneous mixtures like sand or Italian dressing. Solvents are the chemicals in solutions that take up most of the volume, whereas solutes are the chemicals in solutions that take up the least volume. For example, in salt water there is much more water than there is salt. Water is the solvent and salt is the solute.



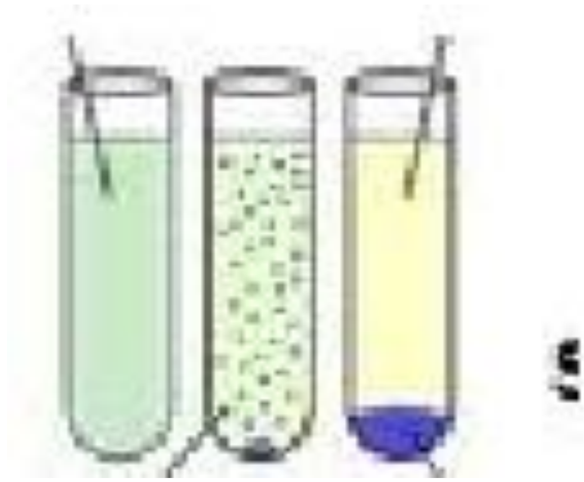
Solutions don't always have to be between a solid and a liquid though. There are solutions for any possible combination of solids, liquids, and gases. Steel is an example of a solid solution of iron and carbon. Air is an example of a gas solution of nitrogen, oxygen, water (if it is humid), and other gases.



Guided Practice:

1) Ethanol and water can be dissolved in each other forever. They are infinitely soluble in each other. If a solution starts with 10g of ethanol and 50g of water but then 90g of ethanol is added, how does the designation of solute and solvent change?

2) Which picture most likely shows a solution and why?

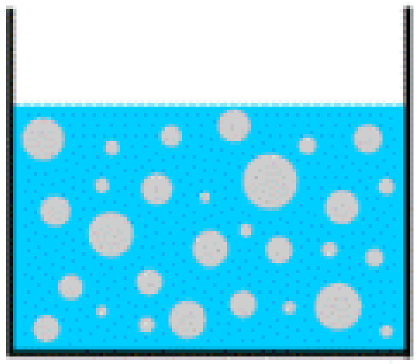


A B C

3) Brass is made from copper and zinc. There are many different types, but typically brass is ~60% copper and ~40% zinc. Identify and explain the solute, solvent, and solution.

Read the scenario and answer the remaining questions in complete sentences, using academic language.

Latex paint is an emulsion made from mostly water, some latex (plastic), some pigments, and dyes. Paint that is placed on the wall eventually dries. The water evaporates and leaves behind the latex, pigments, and dyes, which helps to decorate and protect the wall. The figure below shows a picture of an emulsion. Most of the volume is occupied by the water. The latex forms small spheres called micelles, which float around in the water.



Good Emulsion

A) Is paint a solution? Explain.

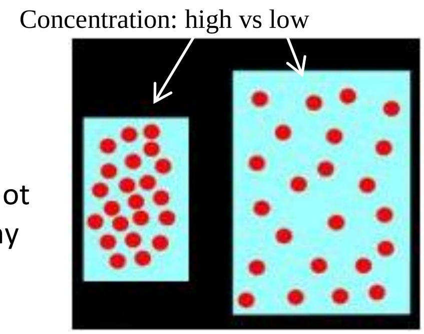
B) If we assume that paint is a solution (whether or not it actually is), what would the solute(s) and solvent be? Explain.

C) When the water evaporates, is the resulting mixture a solution? Explain.

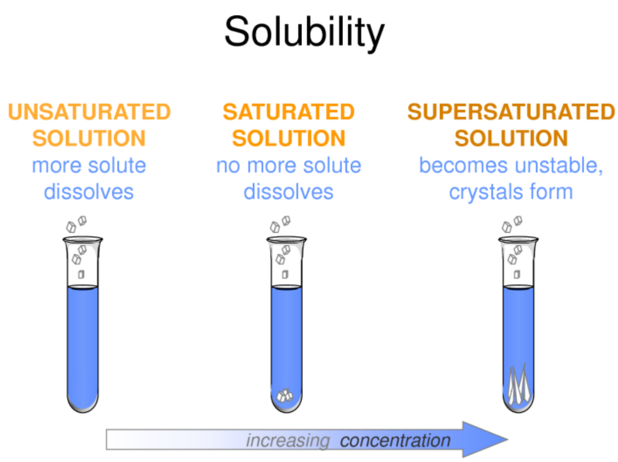
D) Why do you think that paint needs to be shaken before being used?

The Dissolving Process

Reading:

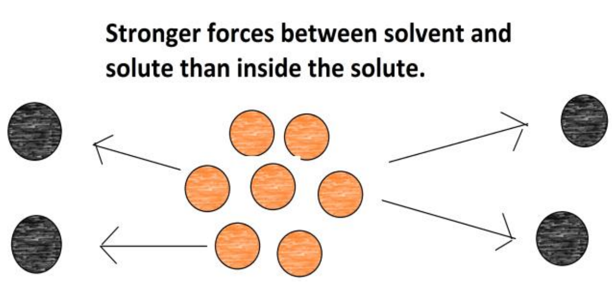
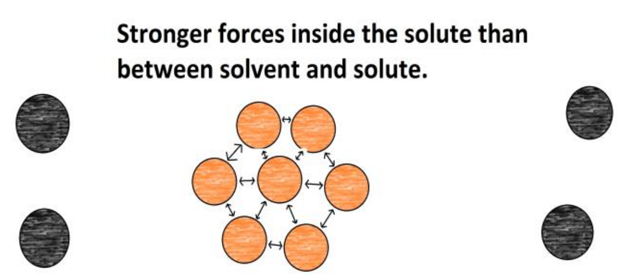


The concentration of a solution is a measure of how much solute is dissolved for a given volume of solution. The higher the concentration, the more potent a solution is. The amount of solution volume or solute itself is not important because concentration is the ratio of solute to volume. That is why pouring Gatorade into a glass doesn't change the drink's flavor; the ratio of sugar to water does not change.



Most solutions have a limit to how much solute can be dissolved. Solubility is the ability of the solute to dissolve in a solvent. A solute which dissolves is called soluble while an insoluble solute is one that does not dissolve. When a solution has reached its solubility limit, the solution is said to be saturated: no more solute can dissolve. If more solute can still dissolve, the solution is unsaturated. Sometimes a very unstable solution called a supersaturated solution can be produced. Even slight disturbances can cause the solute to fall out of the solution as a precipitate.

Whether a solute is soluble or insoluble can be explained by understanding how substances dissolve. Dissolving is a process driven by the random molecular motion of solvent molecules. The solvent molecules collide with the solute, and if the attractive forces between the two are strong enough, will start to dissolve the solute. In cases where the solute is insoluble, the attractive forces are not strong enough to break apart the solute. Some solvents, like water, are very good at dissolving solutes because they tend to form very strong attractions. Once attractive forces pull the solute apart, the random molecular motion of the solvent will ensure the solute is spread evenly throughout the whole solution.

<table>
<tr><th>Soluble</th><th>Insoluble</th></tr>
<tr><td>
</td><td>
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Guided Practice:

1) If 35g of salt can dissolve in 100g of water at room temperature, will a solution of 500g of water and 100g of salt be unsaturated, saturated, or supersaturated?

2) For salt to dissolve in water, what most occur on the molecular level?

3) If solute A is more attracted to itself than it is attracted to solvent B, will solute A dissolve? **Why or why not?**

4) We studied how random molecular motion was important because it caused gases to diffuse (standard 4.a-b). How is the dissolving process similar to the process of diffusion?

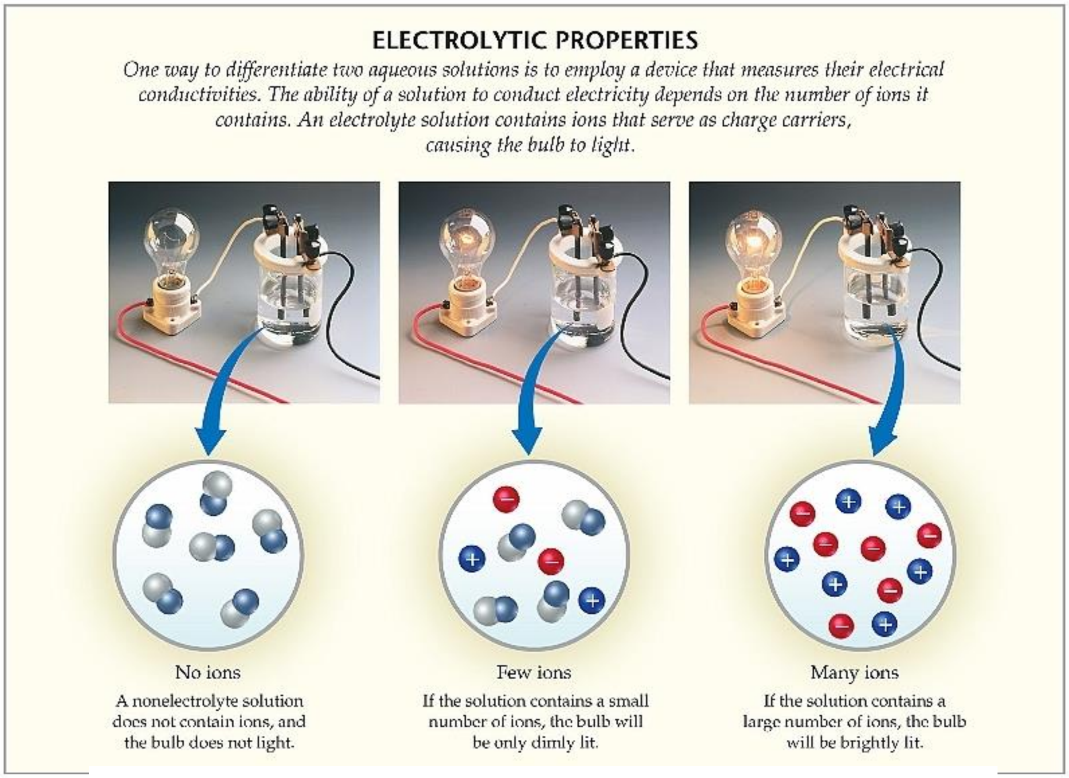
5) When a solvent and solute interact with each other very strongly….
   a. The solute will not dissolve in the solvent.
   b. The solute will react with the solvent.
   c. The solvent will dissolve the solute.
   d. The solute will form a new crystal lattice.

Electrolytes

Simulation:

1) What differences do you observe between the salt and sugar? How can this be used to explain the experiment?

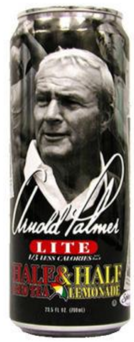
Reading:



Non-Electrolyte Weak Electrolyte Strong Electrolyte

Read the scenario and answer the remaining questions in complete sentences, using academic language.

Mr. Itow loves Arnold Palmers (almost as much as coffee). An Arnold Palmer is a drink named after the golfer, which is 50% lemonade and 50% ice tea. Ms. Chen makes Mr. Itow some Arnold Palmer from a powder mix. She places two cups of the powder into a gallon jug. She fills the jug half-way with water and shakes it. All of the powder completely dissolves. She then fills the jug the rest of the way with water.



A) Identify the solute, solvent, and solution in the scenario.

B) Diagram the process of dissolving on the molecular level. Label the solute and solvent particles.

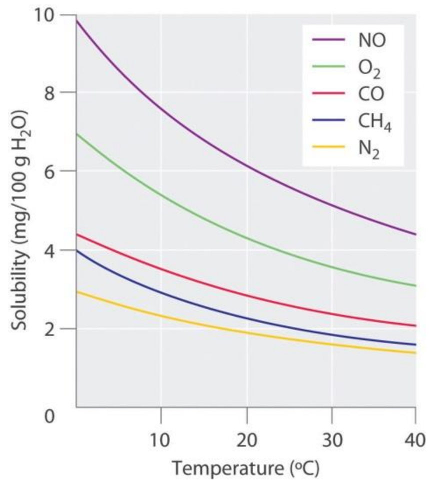
C) Is this mixture most likely unsaturated, saturated, or supersaturated? Explain.

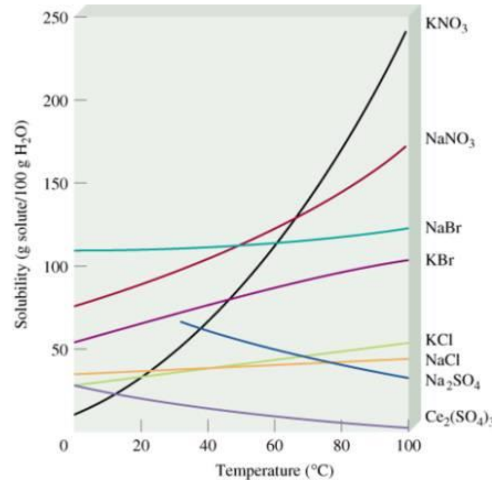
D) How could you test if the drink powder contains electrolytes?

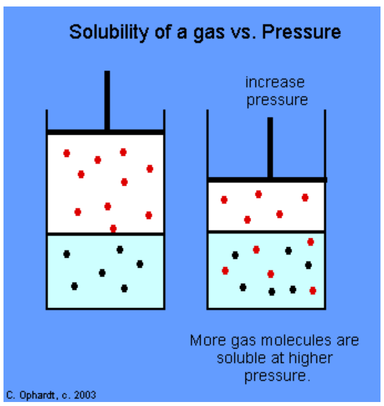
The Effect of Temperature and Pressure on Solubility

Reading:

Temperature affects the speed of particles. For solid solutes, an increase in temperature will help to break the solid apart and will generally help the solid to dissolve as shown in the figure to the far right. Gases, on the other hand, already move quickly. An increase in the temperature will increase the speed of the particles to the point where the gas particles escape the solution. This causes gases to be less soluble in high temperatures as shown in the figure to the immediate right.







Pressure does not affect solids but will affect gases. As the pressure of a gas above a solution increases, the solute particles are forced into the solution. Thus, at high pressures, gases are more soluble. This is why soda is always under pressure: the carbon dioxide gas requires a high pressure to stay dissolved in the soda.

Practice:

1) Using the graphs above, how much $NaNO_3$ will dissolve in 100g of H_2O at 60°C?

2) How much $NaNO_3$ will dissolve in 25g of water at 60°C?

3) If you want to dissolve a lot of oxygen in your fish tank, what could you do?

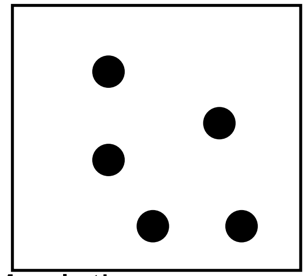
4) If you had a saturated solution of KBr at 100°C and cooled it down, what would happen inside the solution?

Molarity

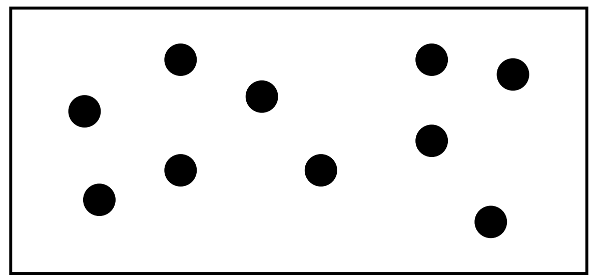
Reading:

The concentration of the solutions to the right and below are equal (5M). The volume of the bottom solution is twice as large, and so there is twice as much solute.

1L of 5M solution



2L of a 5M solution



Concentration is a measure of the amount of solute in a certain amount of solution. A solution with a high concentration will have a large amount of solute compared to the total amount of solution. This does not necessarily mean that there is a lot of solution. A high concentration just means that the ratio of solute to solution is high. In most cases, concentration is measured in units of molarity (M). Molarity can be calculated by dividing the number of moles of solute by the liters of solution as shown in the equation below.

$$Molarity = \frac{moles\ of\ solute}{Volume\ of\ solution\ (L)}$$

Examples:

1) What is the molarity of a solution where 6 moles of NaOH are dissolved in 600mL of water?

$$600mL\ x\ \frac{1L}{1000mL} = 0.600L$$

$$Molarity = \frac{6\ moles\ NaOH}{0.600L} = 10M\ NaOH$$

The solution is 10 molar in NaOH.

2) How many grams of O_2 are dissolved in 2.5L of a 0.02M solution of O_2?

$$\frac{0.02\ mol\ O_2}{L} x \frac{2.5L}{} = 0.05mol\ O_2$$

$$\frac{0.05\ mol\ O_2}{} x \frac{32g\ O_2}{1\ mol\ O_2} = 1.6g\ O_2$$

There would be 1.6g of oxygen in the solution.

3) How many liters of solvent are needed to make a 10 molar solution using 5.00 moles of HCl?

$$\frac{5\ mol\ HCl}{} x \frac{1\ L}{10\ mol\ HCl} = 0.5\ L\ HCl$$

0.5L of solvent would be needed to make a 10 molar solution of HCl.

Guided Practice:

1. What volume of a 0.40 molar $Cd(NO_3)_2$ solution is needed in order to have 1.5 moles of the solute?

(3.75L)

2. What is the molarity of a solution containing 0.80 mole of $MnSO_4$ in 1.2 L of solution?

(0.67M)

3. What is the molar concentration when 600 ml of a $CaCl_2$ solution contains 1.4 moles of the solute?

(2.33M)

4. How many moles of $CuSO_4$ are needed to make 50ml liters of a 7.00M solution?

(0.35mol)

5. How many liters of solution are needed to make a 3M sucrose solution with only 0.6 mol of sucrose?

(0.2 L)

6. What is the molarity of a solution in which 53 g of sodium carbonate (Na_2CO_3) are dissolved in 200 mL of solution?

(2.5M)

Read the scenario and answer the remaining questions in complete sentences, using academic language.

Fish need oxygen to live. They use gills to remove oxygen from the water around them. Many fish have trouble living in areas that are colder or warmer than what they are used to because the oxygen concentration changes. The data table below contains information about the solubility of various gases in water.

Table 1: Temperature and water solubility for various gases at 0, 20, and 50°C.

Temperature (°C)	Nitrogen (N_2)	Oxygen (O_2)	Carbon Dioxide (CO_2)
0	0.0030M	0.0070M	0.34M
20	0.0020M	0.0050M	0.16M
50	0.0012M	0.0031M	0.08M

A) Why are nitrogen, oxygen, and carbon dioxide considered solutes?

B) How many grams of oxygen will dissolve in 250mL of water at 20°C?

C) Why does the concentration of gas change with temperature?

D) What effect might global warming and the resulting rising ocean temperatures have on sea life, based on the information presented?

Read the scenario and answer the remaining questions in complete sentences, using academic language.

Intravenous therapy (IV therapy) is the infusion of liquid substances directly into a vein. Many times when patients are dehydrated, doctors will use an IV of saline solution (NaCl solution) to hydrate the person. They will use a needle to feed the saline solution directly into the person's blood stream. This is much faster, and also allows for any medication to be easily given to the patient. A typical IV bag will use a saline solution with a molarity of 0.15M.

A) If a saline bag has a volume of 2L, how many moles of NaCl must have been dissolved in the solution?

B) The manufacturer of the saline bags probably uses mass to measure out the NaCl. How many grams of NaCl are needed for a 2L bag?

C) If 500mL of pure water are added to the saline bag, what would the new molarity of NaCl be?

D) Increasing the temperature of a saline solution will increase the solubility of NaCL. Will increasing the temperature also increase the molarity of the solution? Explain.

Rates of Solution

Experiment:

Station A: Effect of temperature on a solid solute.	Station B: Effect of surface area on a solid solute.
Procedures:	
1. Fill 2 150mL beakers with ~100mL of water. 2. Place one beaker on a hotplate and heat the water. Get the water to about 60ºC before testing the rate of solution of the hot water. 3. Add 1 sugar cube to the beaker at room temperature and determine the time of dissolution by stirring at a constant rate until the cube has dissolved. Record the time it takes for the cube to dissolve. Record the temperature and time (with units) and repeat with the hot water. 4. Once finished with both trials, rinse out both beakers and turn the hotplate off.	1. Prepare 3 sugar cubes as so: a. Cube #1: leave alone b. Cube #2: crush into chunks. c. Cube #3: crush into a powder. 2. Rank the cubes' surface area from high to low. 3. Fill 3 beakers with ~200mL 4. Add cube #1 to the first beaker. Stir continuously at a constant rate and record the dissolving time, in seconds. Repeat for each cube.
Results:	

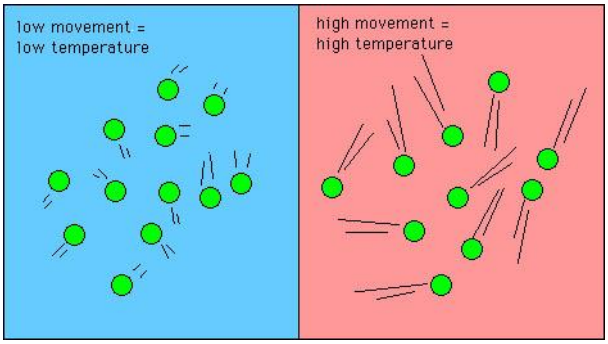
Temperature	Time to dissolve
Room temp:	
Hot water:	

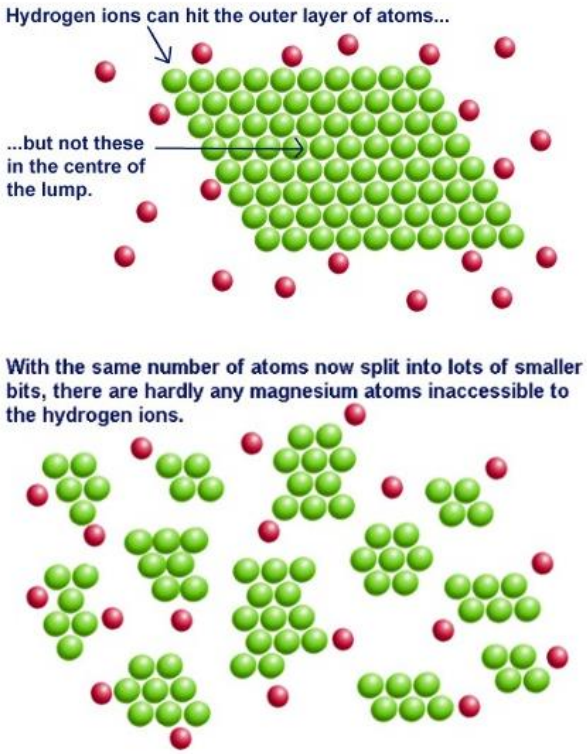
Cube	Surface area	Time to dissolve
Cube #1 : Whole		
Cube #2: Chunks		
Cube #3: Powder		

Conclusions:	
Did the hot or the room temperature water dissolve the sugar faster? Why?	Describe how changing the surface area affected the dissolving process. Why did this happen?

Reading:

The rate of solution is the speed at which a solute dissolves into a solvent. The three main factors that affect rate of solution are temperature, surface area, and agitation. Temperature is proportional to the speed of particles. When there is a high temperature, solute and solvent particles will interact more frequently and this will help to dissolve the solute.





Surface area affects the rate of solution through a similar mechanism. As the surface area of the solute increases, there is more solute exposed to the solvent, and the number of solvent/solute interactions will increase. With more interactions, the solute will dissolve faster. It is important to note that an increase in surface area occurs with a decrease in particle size. As particles get smaller, there is more exposed to the surface. The diagram to the left shows this process. In the first picture, a large piece of magnesium will not react very quickly with hydrogen ions, because the hydrogen can only interact with the outer atoms. In the second picture, there is the same amount of magnesium, but it is broken up so that hydrogen ions can interact with all of the solute.

The last major way that the rate of a reaction can be changed is through the level of agitation occurring in the solution. Agitation refers to shaking or mixing. When a solution is agitated (mixed), the solvent is forced into contact with the solute and this increased contact will increase the rate of solution.

Demonstration:

Determine a procedure to show how agitation affects the rate of solution using the following materials:

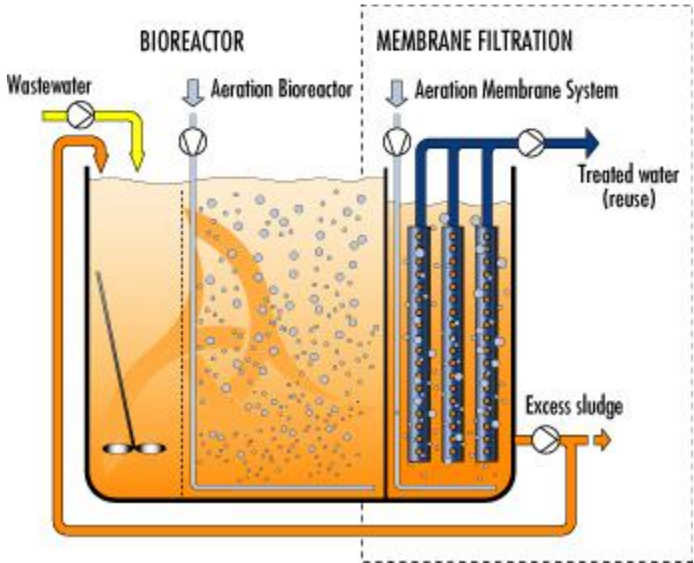
- Stirring rod
- Water
- 2 250mL beakers
- Food dye

Procedures:

Observations:

Read the scenario and answer the remaining questions in complete sentences, using academic language.

When wastewater leaves your house, it doesn't just go straight to the ocean or into the ground. First, the wastewater is treated to remove most of the dangerous material. Wastewater is treated by using bacteria to metabolize the waste in the water, and then using a filter to separate the solid material from the treated water. In order for bacteria to metabolize the waste in the water, the bacteria need a steady supply of oxygen. In water treatment plants, oxygen is bubbled into the bottom of the system. The oxygen rises and dissolves in the water so that the bacteria can keep on metabolizing the waste.



A) If you were engineering the aeration system (the system to deliver oxygen), would you make the oxygen bubbles small or large, assuming the same total amount of oxygen will be delivered either way? Explain.

B) You're thinking about running the treatment reactor at a high temperature. What are some advantages of this?

C) You're thinking of running the treatment reactor at a low temperature. What are some advantages of this?

Name:________________________ *It is all about the learning* Unit 6 Notes

Intro Acids/Bases

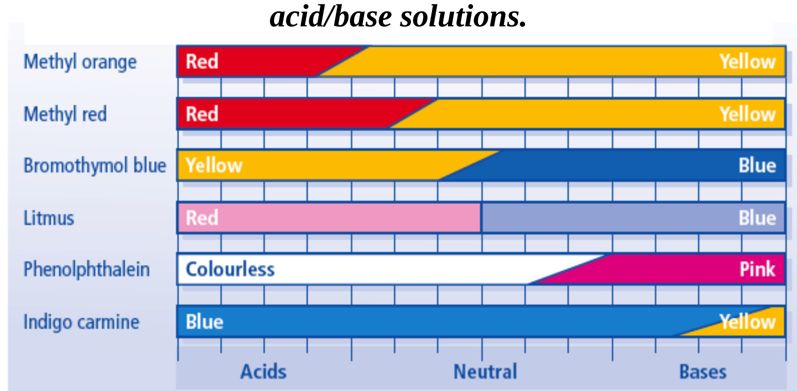
Reading:

Acids and bases are special categories of solutions. They are extremely useful to us in our everyday lives precisely because of their unique properties. The term acid comes from the Latin word acidus, which means sour. Many of the sour tastes in our food come from the acids found in those foods. For much of history, the term alkaline was used instead of base. Bases are found in many household cleaners, from soaps to drain openers to oven cleaners. Bases have a bitter taste, as you may have noticed if you have ever accidentally tasted soap. Bases usually feel slippery to the touch. The slipperiness of bases arises from the fact that they are reacting with the fats in your skin and turning them into soap.

In general, acids and bases are toxic, especially large quantities of concentrated solutions. It is important that acids and bases do not splash on your skin or in your eyes. Acids and bases are both corrosive and can cause a chemical burn. A chemical burn is one in which living tissue is damaged. Acids can also dissolve metal and produce hydrogen gas in the process.

Many acidic and basic solutions are colorless and odorless, which can make them difficult to detect by their appearance alone. Because these solutions can be toxic, it is useful to be able to monitor them. Luckily, there are molecular substances called indicators that change color when they come into contact with acids and bases. If you add a drop or two of an indicator to an unknown solution, you can tell if you have an acid or a base by the color that results.

Six common indicators and their responses to acid/base solutions.



Acids and bases have different properties because they react differently. Acids will tend to lose hydrogen ions (H^+) and bases will tend to gain hydrogen ions (H^+). If a chemical has a hydroxide ion (OH^-) in it, it can almost always absorb an H^+ and would be a base. When an acid and base react with each other they will neutralize each other and produce a solution that is not acidic or basic: neutral. The acid donates an H^+, but the OH^- from the base absorbs it to produce water. The other parts of the acid and base (the Na^+ and Cl^-) form a salt.

Acid gives H^+: $HCl(aq) + H_2O(l) \rightarrow H_3O^+(aq) + Cl^-(aq)$

Acid

Base takes H^+: $OH^-(aq) + NH_4^+(aq) \rightarrow H_2O(l) + NH_3(aq)$

Base

Acid Base Water Salt

$HCl(aq) + NaOH(aq) \rightarrow H_2O(l) + NaCl(aq)$

Practice:

1) Categorize the properties of acids and bases

Acids	**Bases**

2) Identify each solution as an acid, base, or neutral salt solution.

Solution properties	**Solution classification**
Sour	
Does not change the color of blue or red litmus	
Feels slippery	
HCl	
KOH	
LiOH	
A mixture of equal acid and base	
Bubbles when in contact with a metal	
Bitter	

3) In the reaction below, which chemical is acting like a base and which is acting like an acid? Explain.

$$HBr + KOH \rightarrow H_2O + KBr$$

4) In the reaction below, which chemical is acting like a base and which is acting like an acid? Explain.

$$NH_3 + H_2SO_4 \rightarrow NH_4^+ + HSO_4^-$$

5) If we flip around the reaction above, now what is the acid and what is the base? Any observations?

$$NH_4^+ + HSO_4^- \rightarrow NH_3 + H_2SO_4$$

Experiment:

For the Unit 5 lab, we will be performing an acid/base titration. In order to accomplish this, we need to make stock solution. A stock solution is simply a solution of a known molarity. Your goal is to make 100mL of a 1.00M NaOH solution. You have the following materials available.

Materials:

- Balance
- Weighing tray
- Anhydrous NaOH
- Scoop
- 100mL volumetric flask
- DI water

Procedures:

Strong and Weak Acids/Bases and the pH Scale

Experiment

Each solution has a concentration of 0.1M. How well does each concentration conduct electricity?

HCl	$HC_2H_3O_2$	NaOH	NH_3

These four solutions fit into how many categories if we ***<u>just look at conductivity</u>***?:_______
Give these categories descriptive names:

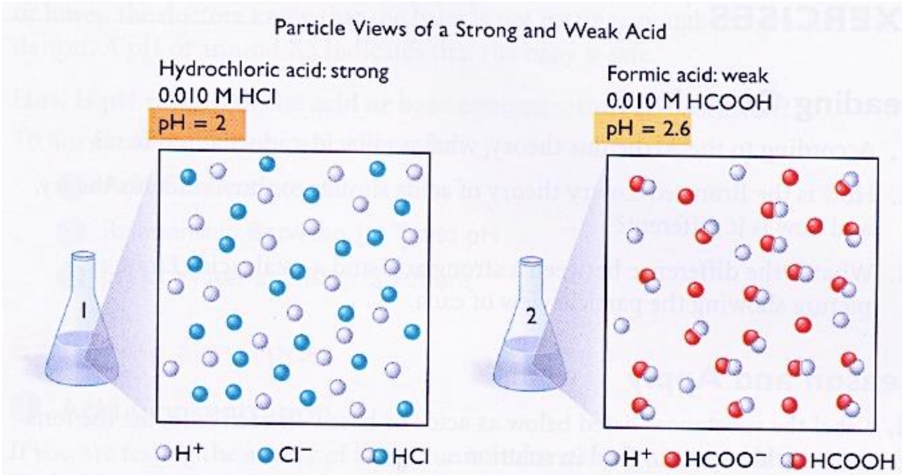
Let's pretend each of the four chemicals can be represented by two circles before they dissolve: 
Diagram how these chemicals will look in water when dissolved. Label your diagrams with your categories.

Diagrams:

Category 1: ______________________________	Category 2: ______________________________

Reading:

These two illustrations show particle views of 0.010M hydrochloric acid, HCl, solution and 0.010M formic acid, HCOOH, solution. The water molecules are not shown. Take a moment to examine them.



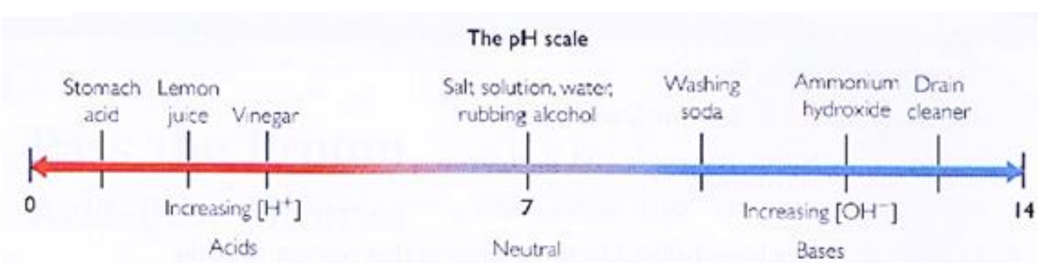
Notice that there are no molecules of HCl in the solution on the left. The HCl has dissociated completely into H^+ and Cl^- ions. However, the solution on the right contains formic acid molecules. Only some of the HCOOH molecules have dissociated into ions. This means that the concentration of H^+ ions is smaller in the formic acid solution than in the hydrochloric acid solution, even though the solutions have the same molarities.

Acids that dissociate completely in solution are called strong acids. Strong acids include hydrochloric acid, HCl, nitric acid, HNO_3, sulfuric acid, H_2SO_4, and hydrobromic acid, HBr. Strong acids are good conductors of electricity because they have so many ions in solution.

Acids that dissociate only partially in solution are called weak acids. These solutions are only moderate conductors of electricity. Some common weak acids are formic acid, HCOOH, acetic acid (vinegar), CH_3COOH, citric acid, $C_3H_5O(COOH)_3$, and phosphoric acid, H_3PO_4. Weak acids tend to be less corrosive because they do not dissociate completely into ions.

Bases can also be classified as strong or weak. A strong base dissociates completely into ions in solution and weak bases dissociate only partially. Some examples of strong bases include sodium hydroxide, NaOH, and barium hydroxide, $Ba(OH)_2$. Examples of weak bases include ammonia, NH_3, and aniline, $C_6H_5NH_2$.

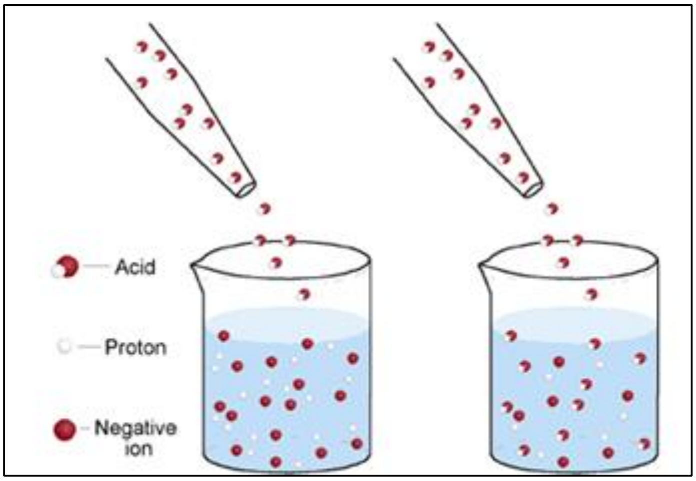
The pH scale is a number line that assigns number values from 0 to 14 to acids and bases. Substances with a pH below 7 at 25°C are acids. Substances with a pH above 7 at 25°C are bases. Substances with a pH at or near 7 at 25°C are considered neutral. Stomach acid is extremely acidic, with a pH around 1. Lemon juice is the next most acidic substance shown here, with a pH near 2.4. The most basic substance shown here is drain cleaner. The substances on either end of the pH scale are potentially more dangerous and more toxic than substances found in the middle of the scale.



Guided Practice:

1) NaOH is a strong base and NH_3 is a weak base. What is the difference?

2) Identify which is a weak acid and which is a strong acid in the diagram below. Explain.



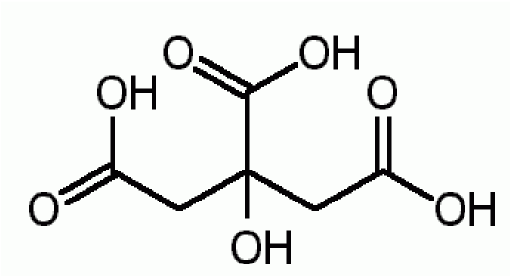
3) Identify each solution as a strong or weak acid or base. (or neutral)
   a. Gastric (stomach) juice : pH 1.5
   b. Sea water : pH 8.6
   c. Lye (NaOH) : pH 14
   d. Blood : pH 7.35
   e. Coffee : pH 6

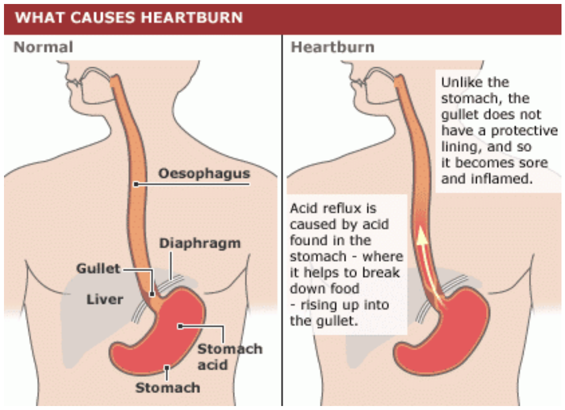
4) Is it possible to have a concentrated sample of weak acid? Explain.

Read the scenario and answer the remaining questions in complete sentences, using academic language.

Humans use acids and bases all the time. In fact, we even eat and drink them. Lemons contain citric acid, which is a weak acid. Some people, who produce too much gastric (stomach) acid, can get heartburn when the acid starts to burn their esophagus. Gastric acid is actually the strong acid HCl, hydrochloric acid. Heartburn symptoms are exaggerated when people eat acidy foods.

Citric





A) How is the citric acid found in lemons, a weak acid, similar and different from a strong acid like hydrochloric acid, found in the stomach?

B) Draw a diagram indicating how citric acid looks in solution on the molecular level. Use H^+ to represent hydrogen ions, A^- to represent acid anions, and HA to represent any undissociated acid.

C) What would a reasonable pH be for citric acid? How do you know?

D) If someone is suffering from heartburn, should they ingest more acid or more base? Why?

Title:	Solution basics
Standard:	*6.a Students know the definitions of solute, solvent, and solution.* *6.b Students know how to describe the dissolving process at the molecular level by using the concept of random molecular motion*

1. Identify the solute, solvent, and solution in each example.

   a. Instant coffee powder is added to water to make coffee.

   b. To make soda, sugar is dissolved into water along with other flavoring and carbon dioxide.

   c. 70g of ethanol are mixed with 30g of water to make a mixture.

   d. 15g of ethanol and 30g of water are dissolved in each other to make a homogenous mixture

   e. Seawater has salt dissolved in water to make the solution salty.

   f. Carbonated water has 1 mole of CO_2 mixed with 10 mol of water.

   g. Mr. Larkin makes some Tang (fake orange juice) by dissolving some powder in water.

   h. A fuel mixture contains 10g of oil and 100g of gasoline.

2. Diagram what a soluble and insoluble solid would look like on the molecular level if placed in water.

Soluble	Insoluble

3. Which forces must be stronger in order for a solid to be soluble in water: the forces of attraction inside the solid or the forces of attraction between water and the solid? **Explain:**

4. Why is random molecular motion important in the dissolving process?

Title:	Concentration (Molarity)
Standard:	*6.d Students know how to calculate the concentration of a solute in terms of grams per liter, molarity, parts per million, and percent composition.*

1) What is the concentration of a solution with 7 moles of HNO_3 dissolved in 0.2L of solution?

2) If you want to prepare 250ml of a 2M salt solution, how many moles would you need?

3) 22g of CO_2 dissolve into 4L of carbonated water. What is the concentration of CO_2?

4) How many liters of solution are needed to obtain 0.05 moles of NaOH from a 2M solution?

Title:	Rate of solution and solubility
Standard:	*6.c Students know temperature, pressure, and surface area affect the dissolving process.*

1) What is the difference between rate of solution and solubility?

2) Why do powders dissolve faster than chunks?

3) How does temperature affect rate of solution?

4) How does temperature affect the solubility of gases and solids in water?

5) What factors are important to consider when dissolving a lot of a solid solute in a solvent?

Title:	Acid/Base Basics
Standard:	*5.a-b Students know the observable properties of acids, bases, and salt solutions, including that acids donate hydrogen ions to solution and bases accept them from solution.*

1. A student tests four solutions. The table shows the results:

Solution	**Reaction with magnesium (Mg)**	**Color with litmus paper**	**Electrical conductivity**
A	Bubbles on surface of metal	Red	Bright conductor
B	No visible reaction	Pink	Weak conductor
C	No visible reaction	No change	None
D	No visible reaction	Blue	Bright Conductor

Classify each solution:

a.
b.
c.
d.

2. Of the solutions above, which would be the sourest?

3. A student records the following observations about an unknown solution:

- Conducts electricity
- pH = 2
- Phenolphthalein remains clear

The student should conclude that the unknown solution is most likely:

4. Label the Acid and the Base.

a. H_2SO_4 (aq) + H_2O (l) ⇆ HSO_4^- (aq) + H_3O^+ (aq)

b. H_2O (l) + H_2O (l) ⇆ H_3O^+ (aq) + OH^- (aq)

c. CH_3COO^- (aq) + H_2O (l) ⇆ CH_3COOH (aq) + OH^- (aq)

d. NH_3 (g) + H_2O (l) ⇆ NH_2^- (aq) + H_3O^+ (aq)

Title:	Strong/Weak Acids/Bases and the pH scale
Standard:	*5.c-d Students know strong acids and bases fully dissociate and weak acids and bases partially dissociate and that both can be characterized with the pH scale.*

1. A solution of nitric acid (HNO_3) conducts electricity. Which equation best demonstrates why this occurs? **Explain**
   a. HNO_3 (s) → HNO_3 (l)
   b. HNO_3 (s) → H^+(aq) + N^{-3}(aq) + $3O^{-2}$(aq)
   c. HNO_3 (s) → HNO_3 (aq)
   d. HNO_3 (s) → H^+(aq) + NO_3^-(aq)

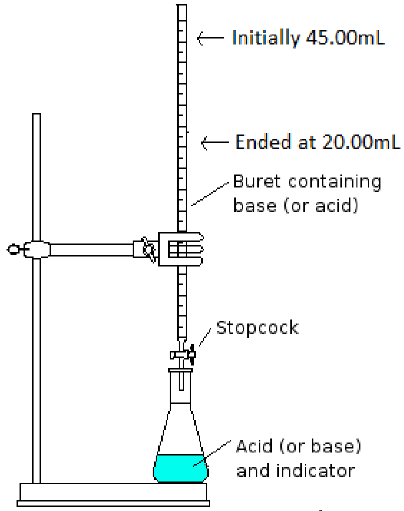
2. If Cl^- acts as a base, it will react to form:__________________

3. A conductivity tester is placed in a sodium hydroxide (NaOH) solution and shines with a bright light. The same conductivity tester is placed in an ammonia (NH_3) solution and shines with a dim light. Explain.

4. What are reasonable pH values for the solutions in problem 3?

Read the scenario and answer the remaining questions in complete sentences, using academic language.

Mr. Larkin was cleaning the lab stockroom the other day and found a vial of acid. It was labeled as hydrochloric acid, HCl, but the molarity was not indicated. Using a buret that initially had 45.00mL of 1M NaOH, Mr. Larkin added NaOH to 50mL of HCl until there was only 20.00mL of NaOH left. He stopped when the solution was completely neutral.



$$NaOH(aq) + HCl(aq) \rightarrow H_2O(l) + NaCl(aq)$$

A) [6.a] In the solution of NaOH, what is the solvent and what is the solute? Explain.

B) [6.b] Why is NaOH soluble in water?

C) [6.d] How many moles of NaOH were used?

D) [6.d] How many moles of HCl were in the 50mL?

E) [6.d] What is the molarity of the vial of acid?

F) [5.a-b] What makes HCl an acid? What is one other property of an acid?

G) [5.c-d] What would be a reasonable pH for the final solution after the experiment? Explain.

Read the scenario and answer the remaining questions in complete sentences, using academic language.

Mr. Larkin often gets heartburn after eating greasy, acidic foods like pepperoni pizza. The only problem with this is that pepperoni pizza is very tasty. Fortunately, Mr. Larkin has taken a couple chemistry classes, and knows that if he ingests a base, he can counteract the acids. Feeling very intelligent, Mr. Larkin goes to the store to buy some antacid. When he gets there, he is confronted with many different choices. However, the main two types of antacid are chewables, like Tums, and liquids, like Maalox.

A) [6.c] If his only concern is immediate relief from heartburn, should he buy the liquid antacid or the chewable antacid? Explain.

B) [5.c-d] Given that Maalox is a base, what would a reasonable pH be for the solution?

C) [6.c] When he cools the Maalox, some solid forms on the bottom of the cup. It isn't frozen. Explain.

D) [5.c-d] Given your answer from B, will the Maalox conduct electricity well, poorly, or not at all? Explain.

E) [6.b] If you put the tums in water, it will eventually dissolve. Describe what is occurring on the molecular level when the tums dissolves.