Name Filled In Notes Hour 2014/2015

Unit 1: Acids and Bases

OBJECTIVES

_____1. I can distinguish between acids and bases when given a chemical formula.

_____2. I can distinguish between inorganic acids and oxy-acids when given a formula.

_____3. I can define the terms acid and base and describe each substance's characteristics.

_____4. I can describe the way to use different acid/base indicators in lab.

_____5. I can explain the purpose of different indicator solutions/papers.

_____6. I can identify a substance as an acid or a base and determine its relative strength given a pH value.

_____7. I can explain how hydronium and hydroxide ion concentrations are related.

_____8. I can explain how to calculate pH and hydroxide ion concentration when given hydronium ion concentration and vice versa.

_____9. I can predict the products of an acid-base neutralization reaction and identify each reactant or product as an acid, base, water, or salt.

_____10. I can explain how acid rain is produced and why limestone rock can reduce the effect of acid rain on an ecosystem.

_____11. I can name and follow all lab safety rules as outlined in my lab safety contract.

VOCABULARY (I can define/describe the following terms in my own words)

- Acid
- Acid rain
- Base
- Conductivity
- Electrolytes
- Hydronium ion
- Hydroxide ion
- Indicators
- Litmus paper
- Neutralization
- pH
- pH paper
- Phenolphthalein
- Salt
- Solution
- Universal Indicator solution

Chemistry Laboratory Safety Agreement

_____I will wear my goggles when I am instructed to do so. At no point in time during the lab will my goggles leave my eyes.

_____I will wash my hands after any lab in which I touch chemicals or biological materials.

_____I will behave properly in the laboratory. I will not touch other students or engage in horseplay of any kind. I will stay focused on the task at hand for the duration of the laboratory activity.

_____I will be respectful of all lab equipment. I will use equipment only as I am instructed to. I will clean all lab equipment and leave my lab station in better condition than I found it.

_____I will bring ONLY my lab sheet and a writing utensil into the laboratory area. I will leave all other personal materials in the classroom area.

_____I will not eat or drink in the laboratory area. I especially will not eat or drink any of my lab materials.

_____In the event that a chemical should enter my eye (which it won't because I will be wearing my safety goggles at all times when working with potentially harmful chemicals) I will use the eyewash located at the end of the instructor lab table in the front of the classroom.

_____In the event that chemicals have spilled or glassware is broken I will immediately call for my instructor. I will not try to clean up the mess myself. My instructor will assess the situation and determine if it is safe for a student to clean up or not.

_____I WILL FOLLOW ALL LABORATORY PROCEDURES EXACTLY AS THEY ARE STATED ON MY LAB SHEET AND/OR BY MY INSTRUCTOR

_____I am fully aware that breaking any of these lab safety rules will result in immediate dismissal from the laboratory, a zero grade for the lab activity, and possibly a trip to the principle's office.

I _____agree to follow all chemistry laboratory safety rules stated above. I am aware of the consequences should I break this contract.

Signed _____ Dated _____

How can Comet PRIDE help you succeed in Conceptual Chemistry?

Be Positive

- Come to class with a positive attitude. Whether chemistry is your most favorite or least favorite course, there are interesting things to learn from any experience.

Be Responsible

- Attend class daily and arrive on time.
- Get a 3-ring binder or folder that is just for chemistry to organize your course materials. Place some sort of zippered pouch in your binder to keep all of your flashcards in for the trimester (this can be a Ziploc baggie).
- Bring a writing utensil and your binder/folder to class every day.
- COMPLETE ALL HOMEWORK ASSIGNMENTS!

Have Integrity

- High school is preparation for the professional world. Make sure your dress, speech, and attitude are preparing you to successfully navigate your future!

Be Determined

- ASK FOR HELP! Chemistry has challenging content. Rise to the challenge by getting any extra help you may need. Ask your teacher to work with you before or after school or utilize the Science Intervention Center (help room) in room 411 after school or during lunch.
- Complete your homework each night and spend time practicing the chemistry content. Find a study buddy (parent, sibling, classmate) to ask you questions about your notes.
- Take advantage of the TEST RETAKE POLICY. Every test of the trimester can be retaken and the retake score replaces the original score. What an opportunity!

Be Engaged

- Keep all electronic devices out of sight and out of reach during class. You won't be fully focused on science if you can feel your cell phone buzzing in your pocket!
- Sign up for remind101 to get daily texts about homework, upcoming tests, and retake deadlines. To sign up, text the message @chemcon to (248) 236-1135.
- Participate in class!

Date _____ Hour _____ Name _____

The Magic Pitcher Demonstration

DIRECTIONS: Observe the demonstration and respond to the following prompts

1. Record as many questions as you can think of in 60 seconds.

2. A testable question: _____

3. Record at least 3 possible answers to the testable question in #2.

4. A testable hypothesis: _____

5. If the hypothesis in #4 is supported by evidence, what data might we observe?

6. If the hypothesis in #4 is refuted by evidence, what data might we observe?

7. What other questions does this lead you to ask? (List any questions from #1 that still apply as well.)

Front-Load the Words

Word: **Acid**

(Definition)	(Key Characteristics)
(Examples)	(Pictures)

Word: **Base**

(Definition)	(Key Characteristics)
(Examples)	(Pictures)

Acids and Bases Introductory Reading

Why does lemonade taste sour? Why does soap feel slippery? What makes cakes rise? These things happen because two kinds of chemicals, called acids and bases, are at work.

1 Acids and bases are important to everyone's health. Acids are sour chemicals and some are found in everyone's kitchen. The word acid means sour; almost everything sour has acid in it. Vinegar and lemon juice contain acids, and so do grapefruit, green apples, and sour milk. Raspberries, grapes, and many other foods contain acids. Hydrochloric acid, dissolved in a large amount of water is found in everyone's stomach. It helps us digest our food. Acids flavor foods. They also help turn milk into cheese and cucumbers into pickles. Many vitamins are acids that help our bodies grow. Vitamin C is ascorbic acid. It helps our bodies fight infection and repair wounds. Without enough Vitamin C, people can get a disease called scurvy.

2 Bases are bitter chemicals often found in kitchens and laundries. Most bases should not be tasted because few of them are foods. Many are bitter poisons. Bases have a soapy, slippery feel on the skin. Egg whites and ammonia are bases, and so are milk of magnesia and many drugs and medicines. Drain openers and oven cleaners are very strong bases. They can damage our skin if we touch them. Hominy is a vegetable we can eat that is made from corn soaked in a strong base. Our blood is a weak base. When bases are cooked with fats or oils, they turn into soap.

3 Have you ever tried mixing baking soda and vinegar together? It really bubbles up and usually overflows from the container. This same reaction is what causes cakes to rise. If baking soda is used in the cake recipe, an acid such as buttermilk is also needed. The acid in the buttermilk reacts chemically with the baking soda and causes carbon dioxide bubbles to form, which then causes the cake to rise.

4 We measure the strength of acids and bases with the pH scale. Water is neither an acid nor a base; it is a neutral substance. It measures 7 on the pH scale. Acids have lower numbers than 7; the lower the number, the more acidic the substance is. Milk is a 6 on the pH scale, soda pop is a 4, vinegar is a 3, lemon juice a 2, and stomach acid is a 1. Bases have higher numbers than 7; the higher the number, the more basic the substance is. Egg whites are 8 on the pH scale, ammonia is a 10, drain opener is a 12, and oven cleaner is a 13. To test the pH of a substance, we use a pH test strip. This is a chemically treated strip of paper that will change color to show whether the substance being tested is an acid or a base. You may have seen someone testing swimming pool water with them. The strip will change color according to the pH of the substance you are testing. You simply compare the strip to a color chart to find out the pH of the substance you tested. It is fun to test common household substances to see if they are acids or bases. You might test things like vinegar, orange juice, coffee, and dish soap. Chemistry is fun!

Acid Base Reading ReQuest

After reading each paragraph, write an "I wonder" question sparked from information in the passage. Then think about what the teacher will ask you to remember from the passage and write a fill-in-the-blank quiz question using information from the passage.

1st Paragraph

I wonder....	
Quiz question	

2nd Paragraph

I wonder....	
Quiz question	

3rd Paragraph

I wonder....	
Quiz question	

4th Paragraph

I wonder....	
Quiz question	

Acid Base Notes: Video Notes

Acids & Bases – Watch the movie from the beginning until 3:13.

Write down all the properties of acids and bases that you see in the movie.

Acids
- React with metals
- Taste sour or tart
- Electrolytes
- Turns litmus paper Red
- Stings
- Feels like water

Bases
- Do not react with metals
- Taste bitter
- Electrolytes
- Turns litmus paper Blue
- Feels slippery

The pH Scale – Watch from 12:35 until The pH in the Chemistry of Nature

Acids on the pH scale are from 0 up to 7

Water on the pH scale is 7 (neutral)

Bases on the pH scale are from above 7 + up to 14

The pH in the Chemistry of Nature – Watch from 15:18 until the quiz.

Roses prefer a pH scale of 5.8 to 6.2. Is this an acidic or basic soil? acidic

Most rainwater is between 6 and 7. Acid rain is below 5.6.

What causes acid rain? Coal burning + auto emmissions

What does acid rain harm? Everything - living + nonliving things, metal, stone, fish, plants.

Human blood must have a pH range between 7.35 and 7.45. If it is outside this range, it could cause problems/death

Quiz – Answer the following questions:

1.

2.

9.

10.

Acid Base Notes: Identifying Acids and Bases

- What is an **ACID**? An acid donates hydrogen ions (H^+)
- What are the properties of an **ACID**?
  - Sour
  - Feels like water
  - reacts with metal
  - Stings
  - Electrolytes
  - Turns litmus paper red
  - How do you recognize an ACID by its **FORMULA**? Most ACIDS start with H
    - **Inorganic acids:** Start with H, end in one other element from the right side of the periodic table. No O's

      Ex. HCl, H_2S, HF, HI, H_3P
    - **Oxy-acids:** Start with H, end with multiple O's

      Ex. HNO_3, H_2SO_4, H_3PO_4
- What is a **BASE**? Bases accept hydrogen ions (H^+)
- What are the properties of a **BASE**?
  - Taste bitter
  - Don't react with metal
  - electrolytes
  - turns litmus paper Blue
  - feels slippery
  - How do you recognize a BASE by its **FORMULA**? MOST end in OH

    Ex. $NaOH$, $Ca(OH)_2$, $Mg(OH)_2$, $Al(OH)_3$, $LiOH$
- What are **indicators**? Identify acids + bases
  - **Litmus paper:** Quick, simple, tells acid or base, not strength.

    Blue = base, Red = acid

    Blue stays Blue AND Red stays Red = neutral
  - **Phenolphthalein:** Tells acid or base, not strength

    Clear = Acid or Neutral Pink/Magenta = Base
  - **Universal Indicator:** Many colors compared on color chart. Identifies acid or base + strength. - Each color represents a pH
  - **pH paper:** Same

Additionally...COMPLETE QUESTIONS #1 – 4 on Page 18 - Acid Base Comprehension Assessment

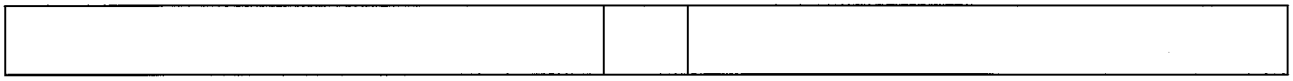
Indicator Flowers Demonstration

Purpose: Investigate the color changes of phenolphthalein and universal indicator by identifying unknown substances as acids or bases based on color change.

For each indicator bar, use colored pencils or markers to show the appropriate indicator response for each pH.

pH	Litmus	Universal Indicator	Phenolphthalein
0-2	Red	Red	colorless
3-4	Red	Orange	colorless
5-6	Red	Yellow	colorless
7	Red and Blue	Yellow-green	colorless
8	Blue	Yellow-green	colorless
9	Blue	Aqua blue	Pale pink
10-11	Blue	Violet-blue	fuchsia
12	Blue	Violet-blue	fuchsia
13-14	Blue	Purple	fuchsia

Litmus



Universal Indicator

Phenolphthalein

Data Table

Unknown Number	Color with Phenolphthalein	Color with Universal Indicator	pH Range	Acid or Base

Determining Properties of Acids and Bases Lab

Adapted from the Flinn Chemtopic Labs Volume 13

What are acids and bases? What properties can be used to distinguish acids and bases? Let's explore the properties of acids and bases and identify the characteristic features that will allow us to classify substances as acids and bases.

The word acid is derived from the Latin verb *acere* which means "to be sour". The origin of the word acid reveals a characteristic physical property of acids-they taste sour. Lemons, oranges and grapefruits are called citrus fruits because they contain citric acid an acidic compound that gives them their sour taste. Although taste is an interesting property of the foods we eat, it is NOT a property that we will use in the chemical laboratory to classify compounds as acids or bases. The following properties are typically used to classify compounds as acids or bases.

- Conductivity. Some acids and bases break into ions when dissolved in water. Solutions that contain large numbers of dissolved ions **conduct an electric current** and are called electrolytes. Other weaker acids and bases may ionize only partially when dissolved in water and may conduct electricity only weakly-they are called weak electrolytes.
  Substances that do not produce dissolved ions will not conduct electricity and are called nonelectrolytes. A way to test for conductivity is to see if a light bulb will light when put into the solution; bright light = strong electrolyte, dim light = weak electrolyte, no light = nonelectrolyte.

- Effect on Indicators: Indicators are organic dyes that change color in acidic or basic solutions. One of the oldest known acid-base indicators is litmus, a natural dye obtained from lichens. Its use was described as early as the sixteenth century. Litmus paper, prepared by soaking paper in a solution of the dye, is often used as a general test for acids and bases. Phenolphthalein is another indicator that shows a color change as solutions change from acidic to basic.
  Although these indicators are useful for broadly classifying substances as acids or bases, they are not able to distinguish among different levels of acidity or basicity. By using combinations of different indicators, however, it is possible to obtain a spectrum of color changes over a wide range of acidity levels. Universal indicator and pH paper are two products that use combinations of indicators to rank substances from most acidic to least acidic, or most basic to least basic.

- The pH scale. The pH scale is a numerical scale that is used to describe the relative acidity or basicity of a solution.

- Reaction with Metals. Acids react with certain metals. Reactive metals, such as magnesium and zinc, react with acids to produce hydrogen gas (which means that it will bubble!) and solutions of metal ions.
  The reaction of different acids is a well-known test used to rank metals from most active to least active. Reaction of a single active metal with a variety of different solutions is one of the best methods to identify acids and to compare their relative acidity.

Pre Lab Questions:

A conductivity meter will produce a bright light if the solution contains _____ electrolytes.

A conductivity meter will produce a dim light if the solution contains _____ electrolytes.

A conductivity meter will produce no light if the solution contains _____ electrolytes.

Indicators _____ _____ when put into acids or bases.

I know a substance reacts with metals because it will produce _____.

Purpose: The purpose of this experiment is to explore the properties of solutions and to classify them as acidic, basic or neutral. The results will be used to develop definitions of acids and bases and to analyze the pH scale for identifying acids and bases.

Materials:

Acetic acid	Universal indicator	Lemon juice	Dish soap
Ammonia	Wash bottle with distilled water	Distilled water	Windex
Hydrochloric acid	Conductivity tester	Stirring rod	Piece of paper
Magnesium pieces	Forceps	Pipets	Reaction plate
Phenolphthalein	Litmus paper	Sodium hydroxide	pH paper

Safety: All of the acids and bases used in this lab are corrosive to eyes, skin and other body tissues. They are toxic by ingestion. Avoid contact of all chemicals with eyes and skin. Notify your teacher and clean up all spills immediately with large amounts of water. Magnesium metal is a flammable solid and burns with an intense flame. Keep away from flames. Phenolphthalein is an alcohol-bases solution and is flammable. It is moderately toxic by ingestion. Keep away from flames and other ignition sources. Wear chemical splash goggles at all times in lab. Wash hands thoroughly with soap and water before leaving the laboratory.

Procedure:

Part I

1. Obtain a reaction plate. Notice that each well is labeled with a number that corresponds to the solution numbering.
2. Fill eight wells with the eight different solutions. The wells should be about 2/3 full.
3. Test each well using both red and blue litmus paper using the method that you were shown in class. Record the color of the paper in Data Table A.
4. Touch a piece of magnesium metal to each solution and move it around in the solution. Record if the reaction produces bubbles or not. Wipe the metal off between each solution.
5. Using the same solutions, add 1 drop of phenolphthalein solution to each well. Record the color of each solution in Data Table A.
6. Rinse the plate in the sink and clean with water.

Part II

7. Fill eight wells with the eight different solutions. The wells should be about 2/3 full.
8. Test each solution using a pH test strip and a glass stirring rod. Use the color chart on the pH paper container to assign a numerical pH value to each solution. Record the pH value for each solution in Data Table A.
9. Using the same solutions, add 1 drop of universal indicator to each well. Record the color of each solution in Data Table A.
10. Clean the plate and return all materials used. Wait for your teacher to continue.

Data Table A

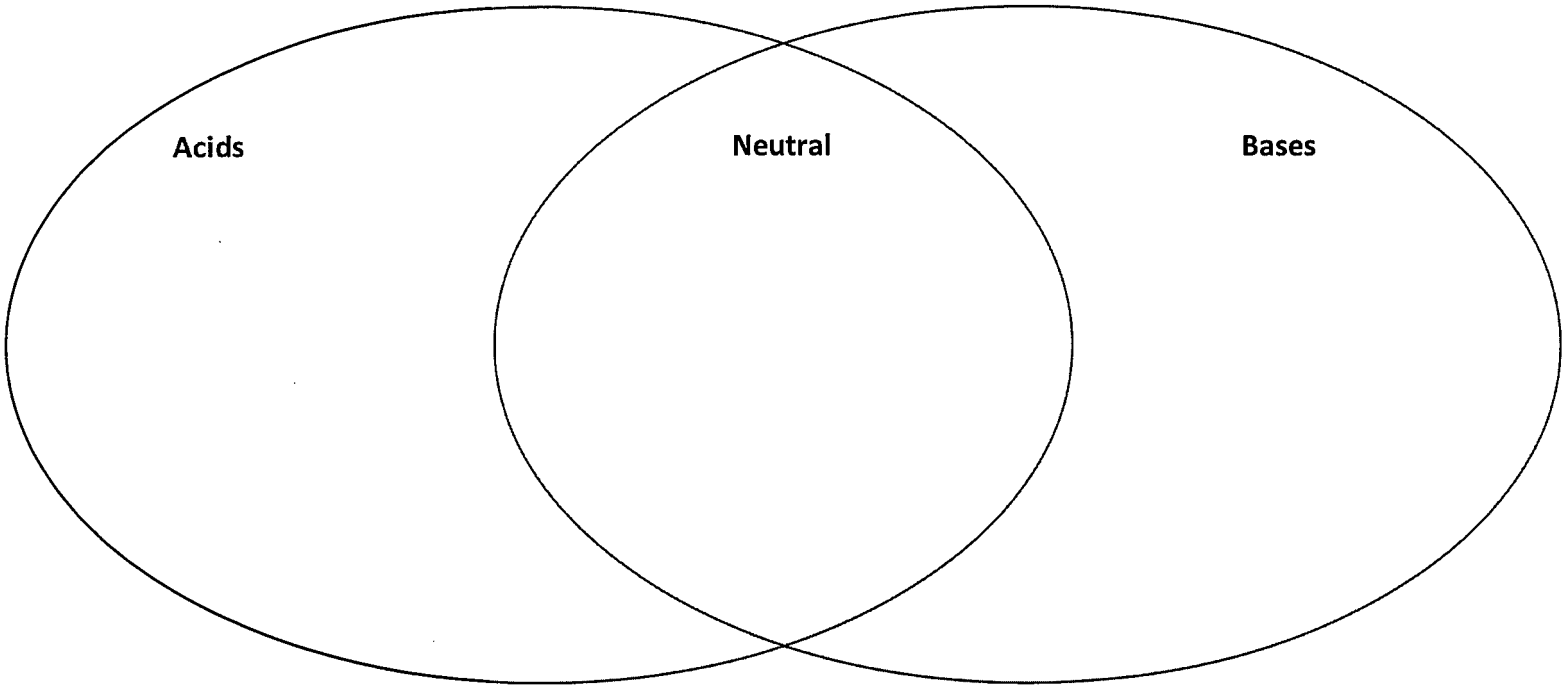
	Solutions							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Test Property	**Hydro-chloric Acid**	**Acetic Acid**	**Distilled Water**	**Ammonia**	**Sodium Hydroxide**	**Windex**	**Lemon Juice**	**Dish soap**
Conductivity – Demo								
Reaction w/ Mg								
Red Litmus Paper								
Blue Litmus Paper								
Phenolphthalein								
pH paper								
Universal indicator								

Chemistry Date _____ Hour _____ Name _____

Determining Properties of Acids and Bases Lab Handout

Characteristics of Acids and Bases

DIRECTIONS: In the Venn Diagram below, list the **SUBSTANCES** you determined to be acids, bases, or neutral.



DIRECTIONS: Complete the following table to summarize the **PROPERTIES** of acids and bases. Use words the words found in the following word bank (Note: words may be used more than once).

Red	Clear	Yes	less than 7
Fuschia	No	greater than 7	Blue

Property	Acids	Bases
Conductivity		
Litmus		
Phenolphthalein		
Reaction with Metals		
pH		

Acid Base Notes: The pH Scale

0 - 6.9 pH Acids	7 pH Neutral	7.1 - 14 pH Bases	
Strong acids (0-3)	Weak acids (4-6)	Weak bases (8-10)	Strong Bases (11-14)

STOP!! Comprehension Check Point:

pH	Acid, Base, or Neutral	If Acid or Base, Strong or Weak?	Red Litmus	Blue Litmus	Phenolphthalein
12					
3					
7					

Additionally...COMPLETE QUESTIONS #5 – 6 on Page 18 - Acid Base Comprehension Assessment

- Pre-Requisite Info:
  A. What is a solution? A solution is a mixture of substances dissolved in water.

  Example: Pop, orange juice, Kool-aid

  B. When comparing exponents, which is larger? Circle the correct answer, write the number out if you need help visualizing it.
     a. (10^10) or 10^1 10,000,000,000 or 10
     b. (10^1) or 10^-1 10 or 0.1
     c. (10^-1) or 10^-10 0.1 or 0.0000000001

- Since acids donate H^+, in solution, water will accept the hydrogen ions and $H_2O + H^+$ becomes H_3O^+. This is known as the **HYDRONIUM ION.**
  - The more hydronium ion present in solution, the more ACIDIC the solution is.

- Since bases ACCEPT H^+ ions, in solution, bases take H^+ away from water, leaving it with only 1 O and 1 H. $H_2O - H^+ =$ OH^- - this is called the **HYDROXIDE ION.** You'll notice that the END of bases' formulas also contain the HYDROXIDE ion.
  - The more hydroxide ion present in solution, the more BASIC the solution is.
- When concentrations of hydronium and hydroxide ions are equal, the solution is considered NEUTRAL.

- The concentrations are always expressed as 10^{-n} mole/L because we're referring to atoms and atoms are very SMALL.
    - The maximum concentration of an ion in solution would be 1×10^{-0} mol/L, because this would mean there was 100 % of that ion present, and nothing else (so it really wouldn't be a SOLUTION then)
    - The lowest concentration of an ion in solution (for our purposes) is 1×10^{-14} mol/L. This would be very very LITTLE of the ion is there.
- All this to say, the concentration of hydronium and hydroxide ion are related, when there is MORE of one, there is LESS of the other. The exponents of each concentration will always add up to -14.
    - Therefore, when you know the hydronium ion concentration, you can calculate the hydroxide ion concentration.
    - Ex. Hydroxide = 10^{-3} then Hydronium = 10^{-11} $-3 + -11 = -14$
- The Number on the pH scale is related to the concentration (or amount of) hydronium ions in solution.
    - The numeric component of the Exponent in the HYDRONIUM ION concentration IS the number for the pH of the substance.
    - This is why Acids have LOW pH numbers and Bases have HIGH pH numbers.

STOP!! Comprehension Check Point:

pH	$[H_3O^+]$	$[OH^-]$	Acid, Base, or Neutral?	
7	1×10^{-7}	1×10^{-7}	Neutral	$14 - 7 = 7$
0	1×10^{0}	1×10^{-14}	ACID	$14 - 14 = 0$
9	1×10^{-9}	1×10^{-5}	BASE	$14 - 9 = 5$

Additionally...COMPLETE QUESTIONS #7 – 10 on Page 18 - Acid Base Comprehension Assessment

Acid Base Notes: Neutralization Reactions

- When an acid and a base are added together, they will Cancel each other out. This is known as Neutralization.
- The products of a neutralization reaction are ALWAYS a Salt and Water.
  - Word Equation: Acid + Base → Salt + Water
  - Example: NaOH + HCl → NaCl + H_2O
  - What is a salt? A salt is neither acidic nor basic; it is also a neutral substance. Will not have H or OH in the beginning or end of formula.
  - When a strong acid is added to a weak base, the weak base cannot cancel out all of the strong acid, therefore some ACID will remain in solution.
  - The reverse is also true, when a weak acid is added to a strong base... the acid will not cancel out all of the base and there will be base left over in solution

STOP!! Comprehension Checkpoint:

Example Problem: $Ca(OH)_2$ + H_2SO_4 → _____ + _____

_____ _____ _____ _____

Additionally...COMPLETE QUESTION #11 on Page 18 - Acid Base Comprehension Assessment

Acid Base Notes Comprehension Assessment

1. Explain how you can tell the difference between an acid and a base by looking at a chemical formula.

2. How do inorganic acid chemical formulas differ from oxy-acid formulas?

3. What are litmus paper and phenolphthalein able to determine in the lab?

4. What can pH paper or universal indicator solution determine about an acid or a base that litmus paper or phenolphthalein cannot?

5. Where are acids located on the pH scale? Bases?

6. What does pH tell you about the strength of an acid or base?

7. What is the formula for the hydroxide ion? Hydronium ion?

8. If you know the hydronium ion concentration, what else can you determine?

9. How are hydronium and hydroxide ion concentrations related?

10. If the hydronium ion concentration is 1×10^{-3}, what is the pH? What is the hydroxide ion concentration?

11. List the two products of an acid-base neutralization reaction.

Acid Rain Lab

In this experiment you will observe the effects of limestone on the acidity of water. Some areas of the nation have a lot of limestone in lake bottoms and in soil. The reaction that occurs between acid rain and limestone is: $CaCO_3 + H_2SO_4 \rightarrow CaSO_4 + CO_2 + H_2O$. Limestone is primarily $CaCO_3$, which acts as a base. Sulfuric acid, H_2SO_4, is the main component of acid rain.

Materials:

Universal indicator	two cups
acid rain solution	limestone

Procedure:

1. Label one cup acid rain; the other cup acid rain plus limestone. Put your initials on both cups.
2. Line the bottom of the cup labeled acid rain plus limestone with a thin layer of limestone.
3. In the cup labeled acid rain, fill the cup with acid rain mixture. This mixture simulates acid rain.
4. Pour ½ of the acid rain cup into the cup with the limestone.
5. Check pH of each cup and record below.

Questions:

1. pH of acid rain cup _____ pH of acid rain + limestone cup_____

2. Why do you think the pH of the acid rain with limestone was different than the pH of just acid rain?

3. What kind of reaction occurred in the cup and what products (in general) remain in the cup?

4. How do you think having limestone in lakes and in soil might help with an acid rain problem?

5. Granite is also a common mineral in lake bottoms. Granite + $H_2SO_4 \rightarrow$ No reaction.

   a) What effect would granite have on acid rain?

   b) If a lake had a granite bottom and was experiencing an acid rain problem, what might be a solution for the problem?

   c) Would this solution last for an indefinite amount of time? Explain.

Acid Rain WebQuest

To START: Go to http://www.epa.gov/acidrain/index.html

1. To find out what is acid rain, start by answering the question: what are the precursors (chemical causes of) or chemical forerunners of acid rain? _____

2. How does acid rain occur and what chemicals are produced? _____

   _____

   _____

3. How is acid rain measured? _____

4. What is the normal pH of rain water? _____ What is the weak acid that is in normal rain water? _____

5. What is the pH of most acid rain falling in the US? _____

After question 5, follow these instructions: Note – clickable links are UNDERLINED

1. Follow the link for the National Atmospheric Deposition Program.
2. Click on the box that says National Trends Network
3. Select the blue Maps and Data Tab (it will be the 3rd tab along the top)
4. Click on the Annual Maps link (1st choice under green Maps and Data along left side)
5. Under Available Maps in middle of screen, select NTN Maps
6. Under Annual Maps, click on the li nk for "maps organized by year"
7. Choose the year 2006
8. Next to "Lab pH" click on the link called PDF

Answer the following questions:

6. What region of the US has the lowest pH value of acid rain? _____

7. What would be a good explanation for that region having the most acid rain? _____

   _____

8. What was the pH value of the rain in our town? _____

Hit the back button on your browser window, scroll down and click on 1994, again choose the PDF link next to "Lab pH"

9. Select at least three states to **record and comment** on the acid rain values. _____

   _____

   _____

   _____

10. How could you account for the change from 1994 to 2006?_____

_____

_____

Close the map of 1994 and open the Lab pH PDF file for 2010. Compare the maps for 2006 and 2010.

11. Does what you see seem congruent with the trend from 1994 to 2006? _____

Now, navigate back to the EPA website by using the back button or by retyping in the web address on the previous page.

12. What are the effects of acid rain? List at least five. _____

_____

_____

13. How does acid rain affect lakes and streams and aquatic animals? Read this whole page and then write at least five sentences in your own words! _____

_____

_____

_____

14. How does acid rain affect your car? _____

_____

15. How does acid rain affect your health?_____

_____

16. How can we reduce acid rain? _____

_____

17. How can you as an individual take steps to reduce the causes of acid rain? _____

_____

When you have completed the webquest, show your instructor and get his/her signature here: _____

Neutralization Lab

Background: Your stomach is an amazing organ! The stomach begins the digestive process by secreting a very strong/concentrated Hydrochloric Acid with a pH of about 2. The inside of your stomach is normally protected from the strong HCl by a coating of mucous, but sometimes your stomach produces too much acid (like when you eat too much spicy food, or you are very stressed) that can eat through the mucous coating and actually start to digest your stomach lining. This hurts and burns causing "heartburn", stomach aches, and in the worst causes a sore or ulcer to form. A quick relief for excess stomach acid is to take an antacid. Antacids are really just bases (pH>7) that will react with and neutralize the acid (pH<7) in your stomach to produce salt and water (pH=7). With the acid gone (or greatly reduced) the burning pain goes away and your stomach makes a new protective mucous lining!

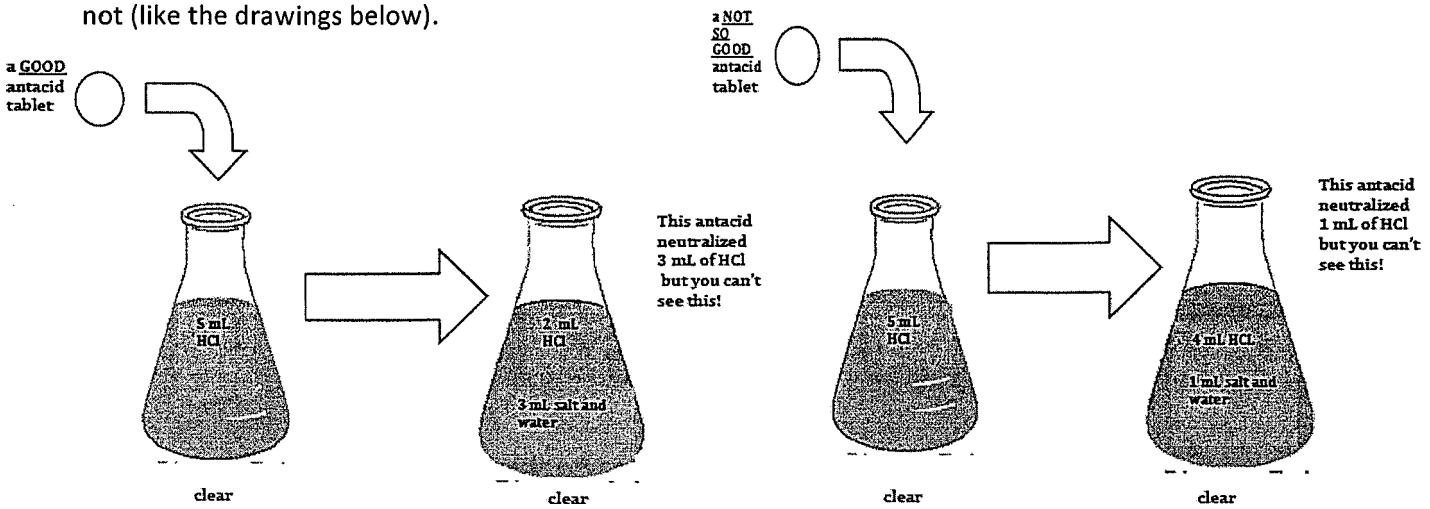
Part I – The Upset Stomach

1. You MUST keep your safety goggles on to protect you from the acids and bases used in this lab. If any acid or base gets on your skin RINSE IT OFF IMMEDIATELY!
2. Pick up a 50 mL beaker. This will represent your stomach! Use a graduated cylinder to carefully measure 5 mL of Hydrochloric Acid (HCl) and pour it into the beaker. Imagine this is your stomach after you have just eaten a large, spicy meal and your stomach is full of burning acid!
3. Choose an antacid you would like to test and record its name in Table 2.
4. Grind your antacid into a powder using a Mortar and Pestle (this will help the antacids tablet to dissolve in your stomach acid). Use a plastic spoon to scrape out the powdered antacid tablet, **clean and dry the mortar and pestle before moving on.**
5. Place your scrapings of the chosen antacid on a piece of weighing paper and take its mass using the electronic balance (don't forget to zero the balance before placing your tablet on the scrap paper). **Record the mass of the piece of tablet in Table 2.**
6. Pour all of the powdered tablet into your "upset stomach" beaker of acid. Gently swirl to help dissolve the antacid. This process may take a minute or two of stirring, try to get as much dissolved as possible. Some antacids will release a gas as they dissolve, wait till the bubbling has settled before beginning to stir.
7. You can't really see what happened in your "upset stomach" as you added the antacid but a Neutralization Reaction quickly took place. Antacids are really just bases – like $Mg(OH)_2$. When the antacid's base enters your stomach it reacts with the stomach's acid (HCl) to produce harmless salt and water. There is now less acid in your stomach!

   GOOD ANTACIDS CONTAIN MORE BASE AND WILL NEUTRALIZE MORE OF YOUR STOMACH'S ACID!
8. How did your antacid do? Remember you started with 5 mL of HCl in your "stomach". How much of this acid was neutralized by the antacid and how much remains in your "stomach"? Part II will help you answer these questions!

Part II – Titrating with a Pipet

1. Add THREE drops of Phenolphthalein Indicator Solution to your stomach beaker and observe. Are your stomach's liquids still acidic (pH<7) or did the antacid neutralize all the acid and turn your stomach's liquids slightly basic (pH>7)?
2. The clear color in your "stomach" beaker tells you the stomach liquid still has acid in it and the pH is less than 7. The antacid did NOT neutralize the entire 5 mL of HCl stomach acid. You still can't tell if your antacid worked great or not (like the drawings below).



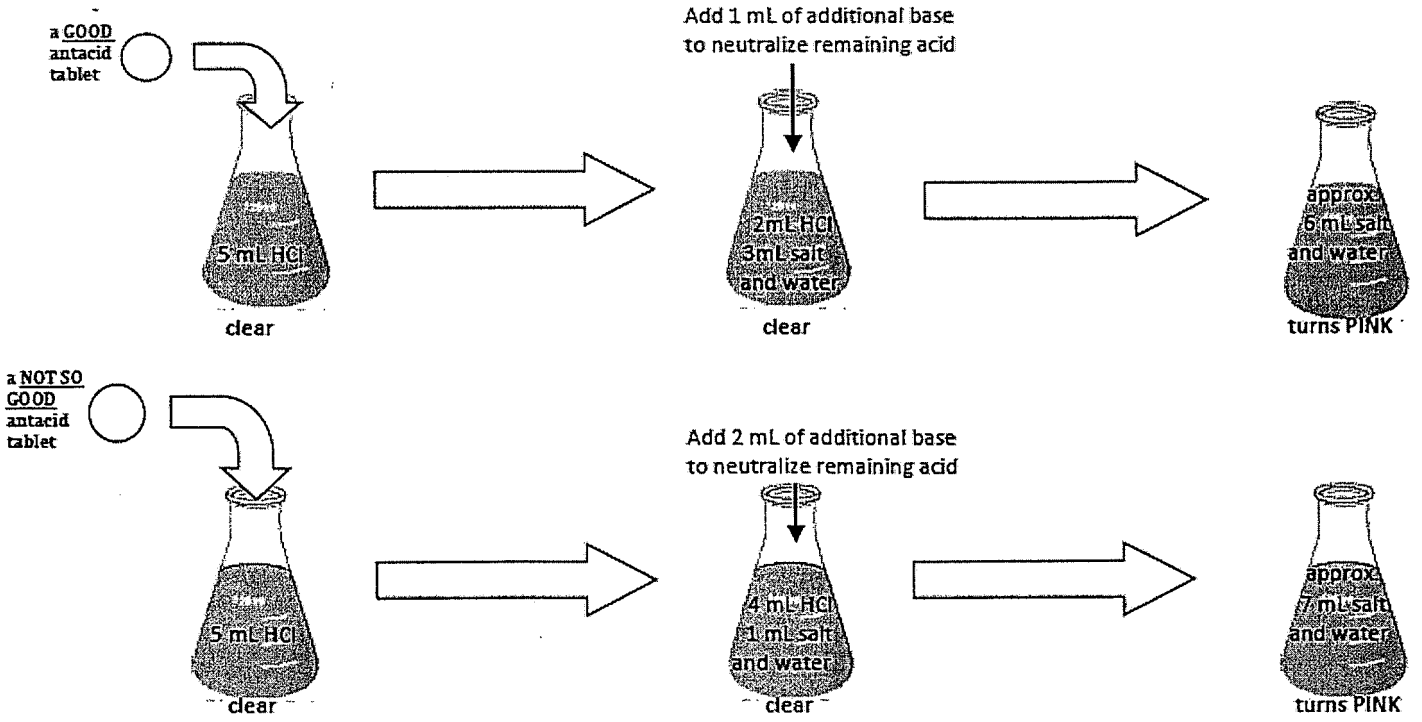
3. To find out exactly how well your antacid worked you are going to use a pipette to add Na(OH) base to your "stomach" beaker. A pipette is a small, plastic dropper that will allow you to add drops of Na(OH) one at a time. An average of 20 drops from a pipette is equal to 1 mL. The laboratory method you are going to use is called Titration. A titration is when you find the unknown concentration of one liquid (the amount of HCl left in the "stomach") by adding another liquid (Na(OH) base) to it until a color change occurs.
4. Obtain a pipette and fill with Na(OH) base. Practice dropping Na(OH) from the pipette into the beaker so you get the feel of how hard to press to get one full drop to come out at a time. Practice until you have control and are no longer getting streams of liquid to come out instead of drops.
5. Add drops ONE AT A TIME from your pipette to your "stomach" beaker, then gently swirl the beaker mixing with the glass stirring rod. The one drop of Na(OH) you just added will neutralize 2 drops of the HCl remaining in your "stomach" beaker because the base you are using is twice as concentrated as the acid in your "stomach". Your goal is to neutralize ALL the remaining acid so you will know how much was there. Remember, the phenolphthalein you added to the "stomach" beaker will turn pink the second all the acid is neutralized and the pH is greater than 7. Continue to slowly add drops of Na(OH) to the "stomach" beaker and **KEEP A CAREFUL COUNT OF YOUR DROPS!!!** When it turns pink and **stays a light pink color for at least 15 seconds** then all the acid is neutralized! If you add one drop after this point the liquid should turn bright pink and stay that way. If you get to this point, do not count the last drop you used to turn your beaker bright fuchsia.
6. Calculate the volume in milliliters of base you used (which will be the same as the volume of acid neutralized) by dividing the number of drops you added by 20. Example: 101 drops / 20 = 5.05 mL. Record your answer in Table 2.
7. Pour the neutralized "stomach" acid down the sink and rinse out the "stomach" beaker.

Part III – More Antacids!

1. Repeat the titration process using a SECOND antacid of your choice. Do Part I and Part II again completely for the new antacid. Record all your data in Table 2.
2. Repeat the titration process using a THIRD antacid of your choice. Do Part I and Part II again completely for the new antacid. Record all your data in Table 2.
3. Look at the data you recorded in Table 2. You should now have a rough idea about which of the antacids you tested neutralized the most stomach acid. After completing Part V you will know for sure which of the antacids is the best!
4. When you have completed all your tests you should clean up and return all your equipment.

Part IV – Calculating How Well Your Antacids Worked

1. Look at the pictures below to understand how titrating with Na(OH) helped you determine the amount of stomach acid each antacid neutralized.



2. You began each experiment with 5 mL of HCl in your "stomach". How many mL of this acid did each antacid tablet neutralize? Calculate by using this formula:

$$\text{mL of stomach acid neutralized by the antacid} = \text{5 mL of acid to begin with} - \frac{\text{total Na(OH) volume used during titration to neutralize remaining acid}}{2}$$

Record this calculation for each antacid in Table 2.

3. It really isn't fair to compare one antacid tablet to another because some tablet brands may work better simply because they are much larger than others. To make fair comparisons you should calculate how much strong acid can be neutralized by ONE GRAM of each antacid. Calculate by using this formula:

$$\text{mL of stomach acid neutralized by 1 gram of antacid} = \frac{\text{mL of stomach acid neutralized by the piece of tablet}}{\text{mass (grams) of the powdered antacid table}}$$

4. Do you pay for what you get? Do expensive antacid tablets neutralize more acid than cheaper brands? To answer these questions you must calculate how much strong acid can be neutralized by a single penny's worth of each antacid. Calculate by using this formula:

$$\text{mL of stomach acid neutralized by 1 penny's worth of antacid} = \frac{\left(\text{mL of stomach acid neutralized by one gram of antacid}\right)\left(\text{mass of a whole tablet}\right)}{\text{cost of one antacid tablet}}$$

	AlkaSeltzer	**Tums**	**Rolaids**
Mass of tablet	3.6 g	1.4 g	1.2 g
Cost/tablet	9.53 cents	1.96 cents	1.96 cents

Record your calculations in Table 2 on the Handout Sheet.

Chemistry
Neutralization LAB Date _____ Hour _____ Name _____

Table 2 – How much stomach acid will my antacid neutralize?

	Antacid 1	Antacid 2	Antacid 3	
brand of Antacid tested				
mass of the powdered Antacid tablet piece (grams)				
number of drops of Na(OH) used				
volume of Na(OH) used to neutralize remaining stomach acid (milliliters)				divide number of drops by 20
milliliters stomach acid neutralized by antacid tablet piece				use equation #2 in Part IV of lab
milliliters of stomach acid neutralized by ONE GRAM of antacid				use equation #3 in Part IV of lab
milliliters of stomach acid neutralized by ONE PENNY'S worth of antacid				use equation #4 in Part IV of lab

QUESTIONS –

1. Which antacid that you tested neutralized the greatest amount of acid per tablet piece? 1._____

2. You have 75 mL of HCl in your stomach. How many grams of your best antacid would you have to take before the entire 75 mL of acid was neutralized? 2._____

3. Which antacid that you tested neutralized the greatest amount of acid per gram? 3._____

4. Which antacid that you tested neutralized the greatest amount of acid per penny? 4._____

5. Based on the class data, and taking all calculations into consideration, which ONE antacid would you recommend that your family and friends purchase? 5._____

6. Based on the class data, and taking all calculations into considerations, which ONE antacid would you <u>least recommend</u> for your family and friends to purchase? 6._____

7. You are experiencing an upset stomach and take an antacid that contains $Mg(OH)_2$ to neutralize your excess stomach acid. A neutralization reaction occurs and your stomach feels much better! What chemical compounds are now present in your stomach? Please write the correct chemical formulas for the compounds now found in your stomach).

$$Mg(OH)_2 + HCl \longrightarrow \_\_\_\_\_ + \_\_\_\_\_$$

8. Write a pH number that would best fit the following situations as they occurred during the training lab.

   a. The "stomach" acid before adding anything to it. _____

   b. The "stomach" acid after adding the antacid tablet. _____

   c. The Na(OH) you used in your pipette. _____

   d. The "stomach" acid after adding an antacid tablet, phenolphthalein, and titrating with Na(OH) until the solution turned a pink color. _____

   e. The antacid tablet if you were to dissolve it in distilled water. _____

9. List three potential sources of error in this experiment.

Found in acidic solutions when water combines with a hydrogen ion to form H_3O^+	A quick, simple test to determine if a substance is an acid or a base by observing a color change from red to blue or blue to red	Solutions that have a large number of dissolved ions allowing them to conduct an electrical current	Substances that accept (take) hydrogen ions
Substances that change color when exposed to an acid or a base	Neither acidic nor basic, a neutral substance	A paper that, when dipped in an acid or base, will tell the strength of the acid or base by changing color which must be compared to a key	The ability to transmit an electrical current through a substance
A number that indicates the concentration of hydronium ions in a solution	Substances that donate hydrogen ions	Found in basic solutions, OH^-	A mixture of substances dissolved in water
A quick, simple test to determine if a substance is an acid or a base by observing adding this indicator to a solution an observing if the solution stays clear or turns fuchsia	Rain water with a pH below 5.6	An indicator solution that will tell the strength of an acid or base by comparing the color the solution turns to a color chart	When an acid is mixed with a base and cancel each other out