Lab: Cabbages in Chemistry

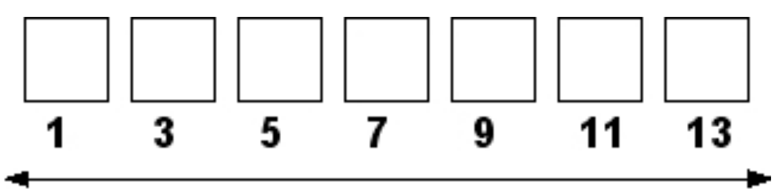
2pts ec printing

Telltale Colors

1. In the mixing tray, place 5 drops of cabbage juice in 9 compartments
2. Place 5 drops of chemical 1 in space 1. What color does it become? Record in the table below.
3. Complete for the remaining chemicals.
4. Think about "Alien Juice Bar" virtual lab. Decide whether each chemical is an acid, base, or neutral.

Product	Color Change	Acid, Base, or Neutral?
1. Vinegar		
2. Baking Soda		
3. Water		
4. Lemon juice		
5. Salt water		
6. Drain Cleaner		
7. Aspirin		
8. Alka Seltzer		
9. Alcohol		
10. Ammonia		
11. Cola		
12. Milk		

Color in the pH scale below, using the colors you obtained above. Then, label: strong acids, strong bases, weak acids, weak bases, neutral.



Presto Change-O

You know which colors turned pink, which turned blue/green, but can you make them all pink? Which chemical do you think is the strongest pink? ______________________________________

Which pink chemical will turn a blue/green space pink with the least amount of drops? ________________________________

Test your hypothesis by adding the chemical to each of the "blue/green" spaces. How many drops of pink did it take to turn each "blue/green" space pink? Record your answers & any additional observations: _______________________________________

____

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____

____

So, can you do the reverse??? Which chemical do you think is the strongest blue/green? ______________________________

Which blue/green chemical will turn a pink space blue/green with the least amount of drops? _____________________________

Test your hypothesis by adding the chemical to each of the pink spaces. How many drops of blue/green did it take to turn each pink space green? Record your answers & any additional observations:

____

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____

____

Which chemical worked the fastest (least amount of drops), to change a blue/green to pink? ________________

Which worked the fastest to change a pink to blue/green?

____

More or Less Acid

1. Put a drop of vinegar in compartment #1.
2. Put 5 drops of vinegar in compartment #2.
3. Add 4 drops of water to compartment #1.
4. Now add 5 drops of cabbage juice to each of the two compartments
5. Show what each compartment looks like by shading in the correct colors.

#1 1 drop vinegar + 4 drops water

#2 5 drops vinegar

Which compartment is the most concentrated? _________ Why?

Which compartment turned pink the fastest? __________ Why?

Now, put 5 drops of cabbage juice in 3 different compartments.

- Put 2 drops of aspirin solution in the 1st compartment.
- Put 2 drops of lemon juice in the 2nd compartment.
- Put 2 drops of vinegar in the 3rd compartment.

2 drops of aspirin solution	2 drops of lemon juice	2 drops of vinegar

Show what each compartment looks like by shading in the correct colors.

Which acid solution is the most concentrated? _________ Why?

Which acid solution is the least concentrated? _________ Why?

More or Less Base

1. Put a drop of drain cleaner in compartment #1.
2. Put 5 drops of drain cleaner in comp. #2.
3. Add 4 drops of water to compartment #1.
4. Now add 5 drops of cabbage juice to each of the two compartments
5. Show what each compartment looks like by shading in the correct colors.

#1 1 drop drain cleaner + 4 drops water

#2 5 drops drain cleaner

Which compartment is the most concentrated? _________ Why?

Which compartment turned blue the fastest? __________ Why?

Now, put 5 drops of cabbage juice in 3 different compartments.

- Put 2 drops of alka seltzer solution in the 1st compartment.
- Put 2 drops of baking soda solution in the 2nd compartment.
- Put 2 drops of drain cleaner in the 3rd compartment.

2 drops of alka seltzer	2 drops of baking soda solution	2 drops of drain cleaner

Show what each compartment looks like by shading in the correct colors.

Which basic solution is the most concentrated? _________ Why?

Which basic solution is the least concentrated? _________ Why?

Neutralize This!

From Base to Neutral

1. Put 5 drops of cabbage juice in 3 compartments
2. Put 10 drops of drain cleaner in those same compartments
3. Count how many drops of aspirin solution it takes to neutralize (change to purple) in compartment #1. ______
4. Count how many drops of lemon juice it takes to neutralize compartment #2. ______
5. Count how many drops of vinegar it takes to neutralize compartment #3. ______

1	2	3

6. Which acid solution is most concentrated? ___________
7. Which acid solution is least concentrated? _______
8. How do you know this?

____

____

____

From Acid → Neutral

1. Put 5 drops of cabbage juice in 3 compartments
2. Put 10 drops of vinegar in those same compartments
3. Count how many drops of baking soda solution it takes to neutralize compartment #1. ______
4. Count how many drops of alka seltzer it takes to neutralize compartment #2. ______
5. Count how many drops of drain cleaner it takes to neutralize compartment #3. ______

1	2	3

6. Which acid solution is most concentrated? ___________
7. Which acid solution is least concentrated? _______
8. How do you know this?

____

____

____

Household Mysteries **Mrs G will do in class**

Acid, Base or Neutral?

Test Liquid	Prediction	Result
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		

Acids

In everyday life we deal with many compounds that chemists classify as acids. For example, orange juice and grapefruit juice contain citric acid. These juices, and others, also contain ascorbic acid, a substance more commonly known as Vitamin C. Salads are often flavored with vinegar, which contains dilute acetic acid. Boric acid is a substance that is sometimes used to wash the eyes.

In any chemistry laboratory, we find acids such as hydrochloric acid, sulfuric acid, and nitric acid. These acids are called mineral acids because they can be prepared from naturally occurring compounds called minerals. Mineral acids are generally stronger than household acids, and should be handled with great care because they can burn skin and clothing.

Properties of Acids:

Acids taste sour. Citric acid is responsible for the sour taste of lemons, limes, grapefruits, and oranges. Acetic acid is responsible for the sour taste of vinegar.

Acids turn litmus (or indicator papers) red. Litmus is a vegetable dye that may be either red or blue, depending on the acidity. When a sample of an acid is placed on red litmus paper, the color of the litmus does not change. Red litmus has been previously treated with acid. Adding more acid does not change the red color. However, when the same acid is placed on blue litmus paper, the color turns from blue to red. (Blue litmus has been treated with a base).

Acids contain combined hydrogen. When a sample of zinc, a fairly reactive metal, is dropped into a test tube containing an acid such as hydrochloric acid, a reaction occurs. The bubbling in the tube indicates that a gas is released. When we test this gas by inserting a burning splint into the test tube, the gas burst into flame and produces a small popping sound. This is the characteristic test for hydrogen gas. In general, when certain acids react with metals, hydrogen gas is released. See following reactions: $Zn (s) + 2HCl (aq)$ à $H_2 (g) + ZnCl_2 (aq)$

$Zn (s) + H_2SO_4 (aq)$ à $H_2 (g) + ZnSO_4 (aq)$

Acids release hydrogen in water solutions. When an acid dissolves in water, the acid ionizes, releasing both hydrogen ions and ions of a nonmetal or nonmetallic polyatomic ion. Thus, when hydrochloric acid is dissolved in water, the acid ionizes, forming hydrogen ions and chloride ions, as shown in the following equation:

$HCl (aq)$ à $H^+ (aq) + Cl^{1-} (aq)$

Thus acids are defined as substances that release hydrogen ions in solution. It is these H+ (aq) that are responsible for the properties of acids.

Uses of Acids:

Sulfuric acid is the chemical most widely used in industry. Sulfuric acid is also used to make other acids such as hydrochloric and nitric acid. It is also used to remove the surface oxide layers on metals (pickling) before the metals are coated with materials that prevent rusting. For example, before iron is coated with chromium (in chromium plating), the iron is dipped into dilute sulfuric acid to remove the iron oxide normally present on the surface of the iron. Another important use of sulfuric acid is the storage cell. In a lead storage cell, dilute sulfuric acid serves as the electrolyte through which ions move between the lead plates, acting as the cathode, and the spongy lead dioxide, acting as the anode. Several such cells connected together make up the type of storage battery used in automobiles.

Nitric acid, another important industrial acid, is used in the manufacture of fertilizers, plastics, photographic film, and dyes. Nitric acid is also used in the preparation of such explosives as dynamite and TNT.

Hydrochloric acid, like sulfuric acid, is used to clean metals. Hydrochloric acid is also used to clean brick and tile; it is used in the manufacture of sugar and glue. Hydrochloric acid is produced in small quantities in the stomach where the acid aids digestion.

Bases: Ammonium hydroxide, or ammonia water, is very irritating to the nose and the eyes. This substance, called a hydroxide, or a base, is often used in the home for cleaning because bases generally dissolve grease. Milk of magnesia (magnesium hydroxide), which is used as an antacid, is a base; lye (sodium hydroxide), which is used in the manufacture of soap, is another familiar example of base.

Bases are ionic compounds containing metal ions and hydroxide ions. For example, sodium hydroxide contains sodium ions and hydroxide ions. When sodium metal is placed in water, sodium hydroxide is formed and hydrogen gas is released. Since the formula for water can be written as HOH instead of H2O, the reaction involves single replacement:

2 Na (s) + 2 HOH (l) à 2 NaOH (aq) + H2 (g)

Properties of Bases: (in water solutions)

1. **Bases taste bitter**. A bitter taste is characteristic of all bases. It is the presence of a base that give unflavored milk of magnesia its bitter taste.

2. **Bases feel slippery**. If you rub a drop or two of household ammonia between your fingers, you experience the slippery feeling of a base. Wet soap is also slippery because of the presence of a base.

3. **Bases turn red litmus blue.** A common indicator, used to detect the presence of a base, is phenolphthalein which, when mixed with a base, turns pink.

4. **Bases release hydroxide ions in water solutions**. When dissolved in water, bases ionize releasing metal ions (or metallic polyatomic ions) and hydroxide ions. For example: when sodium hydroxide is dissolved in water, it ionizes as:

NaOH (s) + H2O (l) à Na1+ (aq) + OH1- (aq)

Thus bases are defined as substances that release hydroxide ions in solution. It is these OH1- (aq) ions that are responsible for the properties of bases.

Uses of Bases: Ammonium hydroxide, frequently called ammonia, is used in the preparation of important related compounds such as nitric acid and ammonium chloride. Ammonia is also used as a cleaning agent.

Sodium hydroxide is used in the manufacture of soap, rayon, and paper. Strong solutions of this base are very caustic; that is, they are extremely harmful to the skin.

Calcium hydroxide, commonly known as slaked lime, is used in the preparation of plaster and mortar. Water solutions of calcium hydroxide, called limewater, can be used in the lab as a test for the presence of carbon dioxide.

Salts: 1) neutralization of acid and base--When an acid and base react, they counteract each other, that is, they neutralize each other. Such a reaction, known as a neutralization reaction, results in the formation of water and a salt.For example, when sodium hydroxide (NaOH) and hydrochloric acid (HCl) react, water and the salt sodium chloride are formed. **NaOH + HCl --> NaCl + H2O.** This occurs because the hydrochloric acid and the sodium hydroxide first ionize, and then react. The compounds ionize releasing hydrogen, chloride, sodium, and hydroxide ions. Since these are mobile in solution, hydrogen ions meet hydroxide ions and unite to form water. At the same time sodium ions and chloride ions remain as aqueous salt

Acid-Base Indicators: Many substances, including **litmus**, the one dye almost everyone associates with acids and bases, change color in response to acid or base. The pigment in **red cabbage juice** is another natural substance very commonly used to show color change. **Phenolphthalein** is one of the most common indicators used for beginning chemistry, because its color change is very obvious which makes it easy to use. There are many other indicators that change colors at different pH's, and so are useful for different purposes. **pH paper** commonly contains a mixture of different indicators that change colors at different pH's. The mixture is applied to paper, and then compared to a color chart to see what the pH of a solution is, approximately.

Acids & Bases

ACIDS

donate protons to water to form hydronium ions taste sour, turn cabbage juice red (bright pink), turn litmus paper red

BASES

donate hydroxyl groups accept protons, taste bitter, feel slimey, turn cabbage juice yellow, green or blue depending upon the solution concentration, turn litmus paper blue

Acids in some common substances

Substance	Acid Present
Aspirin	acetylsalicylic acid
citrus fruit juice	ascorbic acid
sour milk	lactic acid
soda water	carbonic acid
vinegar	acetic acid
apples	malic acid
spinach	oxalic acid

Bases in some common substances

Substance	base present
Deodorant, antacid	aluminum hydroxide
household cleaner	ammonium hydroxide
leather production/mortar	calcium hydroxide
laxative, antacid	magnesium hydroxide
drain cleaner, soap	sodium hydroxide

Approx. pH Values of some common substances

substance	pH	substance	pH	substance	pH
stomach contents	1.6	carrots		blood	7.35
vinegar		5.0		sea water	8.4
2.8		urine	6.0	milk of magnesia	10.5
apples	3.0	milk	6.5	household ammonia	11.1

Strength of Some Acids & Bases

	Strong	Weak
Acids	nitric acid HNO_3 hydrobromic acid, HBr	acetic acid, CH_3COOH citric acid carbonic acid, H_2CO_3 oxalic acid, $C_2H_2O_4$
Bases	sodium hydroxide, NaOH calcium hydroxide, $Ca(OH)_2$ potassium hydroxide, KOH	ammonia, NH_3 iron (III) hydroxide, Fe(OH) aluminum hydroxide, Al(OH)

pH scales