Activity 7 - Chemical Changes[1]

Goals

- Observe and record chemical changes.
- Design and carry out experiments to identify chemicals in consumer products.
- Use proper small-scale techniques to produce reproducible results.

Pre-lab Questions *(answer these on a separate sheet using complete sentences)*

1. What do you expect to see if a chemical reaction occurs?
2. Why do chemists record what they see in the laboratory?
3. What are possible sources of errors in the laboratory?
4. How can visible changes help us describe invisible atoms and molecules?
5. How do you clean up your reaction surface after you have recorded your data and answered your questions?
6. Why are sodas called "carbonated beverages"?

Introduction

In today's lab you will practice combining prepared solutions in a reproducible manner to observe whether a change occurs. Chemical changes involve a change to the starting materials (the reactants) and are visible when a color changes, a solid comes out of solution or a gas is formed. By recording what you see when two solutions are mixed you testify to what you saw. This information can be used to identify unknowns or to describe changes on a submicroscopic level.

Description of liquids

Recording meaningful observations requires a descriptive vocabulary. Solutions may be colored and clear or colorless and clear. Proper description of a liquid should include both the color and clarity. Water for instance is described as clear and colorless. It is clear because there are no particulates floating in the liquid and light is transmitted through it. Water is lacking in color so it is colorless. Milk on the other hand is opaque and white. One should try to be as accurate as possible in the description of colors. The description of "blue" is incomplete, since periwinkle blue is a different observation than navy blue.

Descriptions of precipitates

A precipitate is a solid material that results from the chemical reaction of two liquids or solutions. Precipitates are described on the basis of color, consistency and distribution. Precipitates vary greatly in appearance. Any cloudy solution indicates a precipitate was formed. White solids may be opalescent white, ecru chunks or grayish white suspensions. A suspension consists of solid particles dispersed throughout the mixture, which looks different than precipitates that settle to the bottom. Other examples of appropriate adjectives include: milky, cloudy, sticky, clumpy, grainy, free-flowing… the list goes on.

In today's lab you will practice combining prepared solutions in a reproducible manner to observe whether a change occurs. You will study some of the chemicals in common consumer products. Based on your observations, you will try to make conclusions about the content of these consumer products.

[1] Adapted from: Waterman, E. L. *Chemistry: Small-Scale Chemistry Laboratory Manual;* Addison-Wesley/Prentice-Hall, Inc.: Upper Saddle River, New Jersey, 2002; pp 17-24.

Safety

Act in accordance with the laboratory safety rules of Cabrillo College.
Wear safety glasses at all times.
Avoid contact* with all chemical reagents and dispose of reactions using appropriate waste container.

*Contact with silver nitrate ($AgNO_3$) will stain the skin.

Materials

Reagent Central chemicals include microburets filled with the following solutions:

Sodium hydrogen carbonate ($NaHCO_3$)
Sodium hydrogen sulfate ($NaHSO_4$)
Phenolphthalein (phen)
Starch
Ammonia (NH_3)
Sodium hypochlorite (NaOCl)
This will damage your clothing!
Lead (II) nitrate ($Pb(NO_3)_2$)
Copper (II) sulfate ($CuSO_4$)
FD&C No. 1 (blue dye)
Potassium iodide (KI)
Calcium chloride ($CaCl_2$)
Sodium carbonate (Na_2CO_3)
Silver nitrate ($AgNO_3$)
Sodium hydroxide (NaOH)

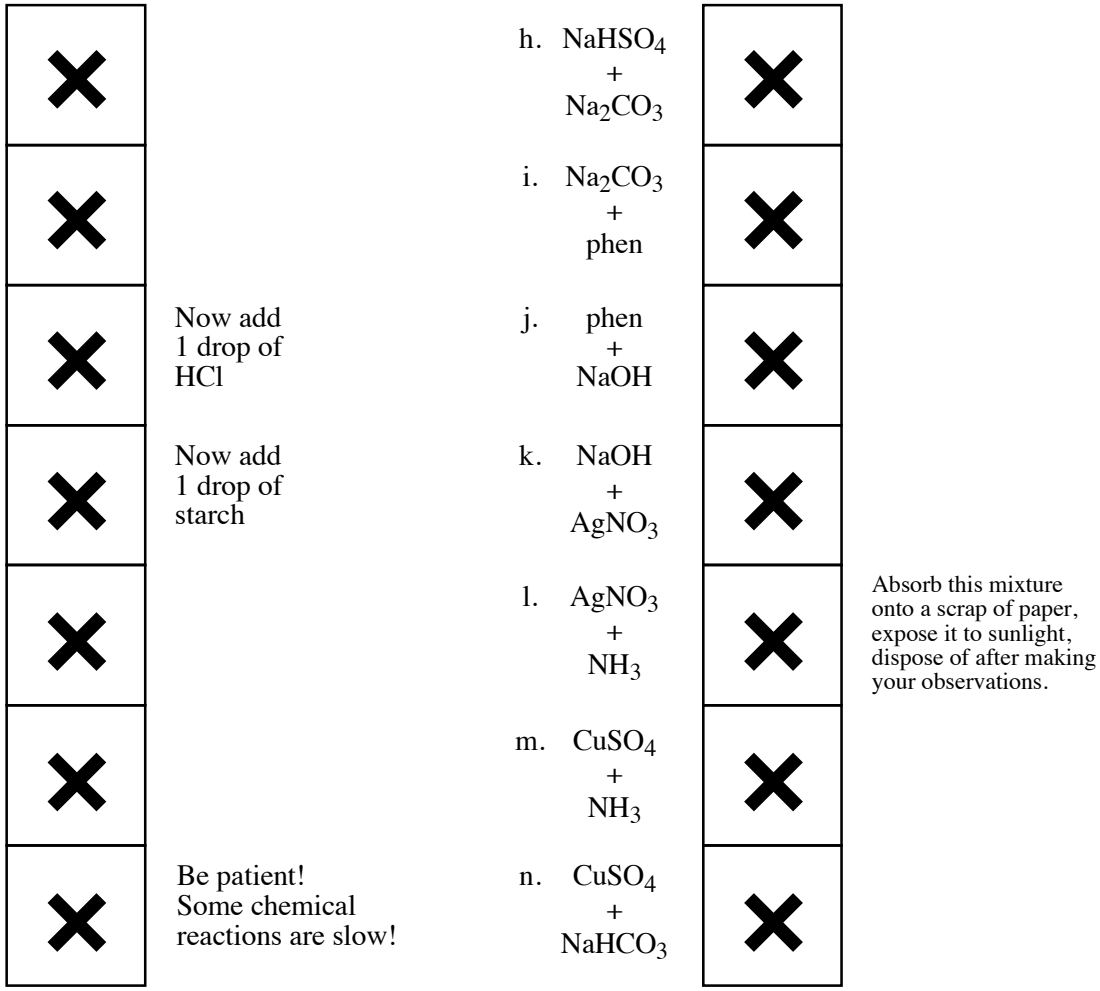
Hydrochloric acid (HCl) 

Equipment: Empty pipet for stirring Lab top reaction surface

Experimental Procedure

1. Use small-scale microburets to put 2 drops of each chemical on the X's in the indicated spaces below. For background contrast, view the drops on both black and white backgrounds provided by the X's. Stir each mixture by blowing air from an empty pipet (as previously described). Record what you see in your lab notebook or on your worksheet (according to your instructor's direction). Do not clean your surface yet.
2. Test several foods for the presence of starch. If you don't know how to do this, answer the questions on your worksheet. If you still don't know how to test for starch, ask your instructor.
3. Avoid contamination by cleaning up in a way that protects you and your environment. Carefully clean the small-scale reaction surface by absorbing the contents onto a small square of tissue paper or paper towel. Dispose of the paper in the appropriate waste container. Wipe the surface with a damp towel and then dry it. Wash your hands with soap and water before leaving the lab.

Reaction Template: Insert this page into the lab-top. Mix one drop of each solution, using a long stem pipet to blow air past the droplet to complete the mixing.



Activity 7 - Chemical Changes

Name_____

Section_____ **Date**_____

Experimental Data: Record all your observations**.**

	Initial Observations Reactants (before mixing)			Final Observations Product (after mixing)
	X	+	Y	Products
a.	$NaHCO_3$		HCl	
b.	HCl		blue dye	
c.	blue dye		NaOCl	
				after HCl
d.	NaOCl		KI	
				after starch
e.	KI		$Pb(NO_3)_2$	
f.	$Pb(NO_3)_2$		$CaCl_2$	
g.	$CaCl_2$		$NaHSO_4$	

Experimental Data Cont.: Record all your observations.

	Initial Observations Reactants (before mixing)			Final Observations Product (after mixing)
	X	+	Y	Products
h.	$NaHSO_4$		Na_2CO_3	
i.	Na_2CO_3		phen	
j.	phen		NaOH	
k.	NaOH		$AgNO_3$	
l.	$AgNO_3$		NH_3	 after sunlight
m.	NH_3		$CuSO_4$	
n.	$CuSO_4$		$NaHCO_3$	

Testing Foods for Starch

1. Describe **how** you tested the available samples for starch. (Include reagents used.)

2. Complete the following table:

Sample	Observation	Conclusion (+/- for starch)
	Before: After:	
	Before: After:	
	Before: After:	
	Before: After:	

Questions and Problems

1. Sodium hydrogen carbonate, $NaHCO_3$, is also known as sodium bicarbonate or more commonly as baking soda. When an acid such as hydrochloric acid, HCl, is added to sodium bicarbonate, bubbles of carbon dioxide form. Write the formula for carbon dioxide. What common consumer products contain this gas?

2. Which of the other combinations of chemicals form bubbles?

3. Given that bicarbonate ion (HCO^{3-}) and carbonate ion (CO_3^{2-}) have similar chemical reactivities, what type of gas was likely formed from the other chemical combinations identified in question 2? Re-read the content of question 1. What is likely to be the nature of the reactant that does not contain carbonate ion in question 2 above, in other words, what type of chemical is it?

4. The body uses hydrochloric acid, HCl, to help digest food. In what organ is HCl is found?

5. What color does blue food dye turn when HCl is added?

6. Sodium hypochlorite, NaOCl, is a common ingredient in household bleaches and cleansers. What happened to the color of blue dye when both HCl and NaOCl are added?

7. Potassium iodide, KI, is the source of iodine (I_2) in iodized salt. What color is the KI + NaOCl mixture?

8. What color does starch change to in the presence of KI and NaOCl? Evaluate whether or not the mixture of KI and NaOCl can be used to distinguish solutions containing either starch or simple sugars (mono or disaccharides).

9. A precipitate is a solid that separates upon mixing solutions. These reactions typically result from the cations and anions of the reactants switching partners. Write the two reactants and possible products that could be formed for the combination that produced a bright yellow precipitate.

10. Which other mixtures produced precipitates? Describe their colors and textures with words like milky cloudy or grainy.

11. Write an equation showing the reactants and likely products for the reaction that was very slow to form a precipitate.

12. Which solutions produced a distinctive brown precipitate? Describe that color.

13. Look at the scrap of paper you used to absorb the silver nitrate and ammonia mixture. What evidence do you see that indicates that silver compounds are light sensitive? In what way is this chemical property utilized to form a long-term record of our daily experiences?

14. What were three observations that indicated the formation of a new substance (chemical change)?

15. Describe any other unique or interesting observations here.

16. Which foods contained starch? Is this consistent with what you would have predicted from your personal knowledge of food science? Explain.