Experiment: Chemical Changes*

Introduction

We can characterize chemical substances by their properties. Some of these are chemical properties (i.e., how they react with other substances), and some of these are physical properties. Most chemical changes are accompanied by changes in physical properties. Since many physical properties can be observed by an experimenter's senses, changes in physical properties are very often used to detect and to provide evidence that chemical changes have taken place.

Simple examples of evidence of chemical change include: a temperature change away from room temperature, changes in phase (a gas, a liquid, or a solid), change in color, solubility or precipitation (forming a new solid), how clear a solution is, and anything new and different or unexpected.

Objectives

In this experiment you will

- ✓ Observe physical changes as evidence that chemical changes have taken place.
- ✓ Use vocabulary terms relating to physical and chemical changes.
- ✓ Reinforce the practices of chemical safety and waste disposal.

To perform this laboratory you do not need any prior chemical experience. You will need to be familiar with our laboratory's safety procedures and follow them carefully. You will also need to read labels with care and to follow instructions exactly.

During this experiment you will need to make observations. Some changes are obvious, some are subtle; some observations are relevant to what you are studying, and some are not. To make a good observation you need to make a comparison between an initial and a final condition in order to note a change, or better yet, make a comparison between two samples, one of which differs only by the variable you are interested in. The best observations are those that can readily be verified by another experimenter.

Read the section in your textbook that discusses physical and chemical changes. Read the sections in the laboratory manual that discuss safety and waste disposal practices. Then, using your book's index/glossary, a dictionary, or another reference, complete the Prelab assignment for this laboratory and be prepared to have it checked before beginning work.

Hazards

 The acids and bases used in this experiment can damage eyes and harm skin. Safety goggles must be worn by everyone if any chemical work, including cleanup, is in progress in the laboratory. Wash your hands before leaving lab. You will be rotating to different experimental stations: do not carry out any procedure until you have read through the entire procedure for that section!

* Adapted with permission from Cascadia Community College

Procedure

General Instructions:

- Work with your lab partner to perform the experiments at each of the six stations. Each station will require between two and ten minutes. You may complete the experiments in any order you wish.
- Make sure the station and test tubes are clean for the next group. Since the test tubes will be filled with mixtures containing water, it is not necessary to use dry test tubes.
- Fill in your observations on the first page of the report. As you proceed through the stations, read (but do not fill in) the questions on each reaction that are on the second page of the report; complete these questions after you have completed all of the experiments.

Reaction Stations:

1. Calcium chloride solution with sodium carbonate solution.

a. Place about 20 drops of 5% sodium carbonate (Na_2CO_3) solution in a test tube.

b. Add about 5 to 10 drops of 5% calcium chloride ($CaCl_2$) solution.

c. Record your observations.

d. Pour the solution into the waste container and rinse the test tube with water. You do not need to dry the test tube. Leave the station clean for the next group.

2. Formation of a potassium nitrate solution.

a. Put about a teaspoon of postassium nitrate (KNO_3, a solid) in a test tube.

b. Touch the bottom of the test tube to the inside of your arm to get a sense of its temperature.

c. Add deionized water to the test tube (about 1/3 full) and stir with a glass stirring rod.

d. Touch the bottom of the test tube to the inside of your arm again. If you don't feel a difference, add more potassium nitrate. Record your observations.

e. When finished, place the contents of the test tube in the waste container. Rinse the test tube with water. You do not need to dry the test tube. Leave the station clean for the next group.

3. Limestone with acidic water.

a. Place a limestone chip (use smooth white chips for best results) on a watch glass and add about 5 drops of deionized water. Did anything happen?

b. Add 5 drops of 3 M hydrochloric acid (HCl). Did anything happen? What is different?

c. When finished observing, rinse the limestone chips with water and dry for reuse by others. Rinse the watch glass with water into the waste container. You do not need to dry the watch glass. Leave the station clean for the next group.

4. Vegetable dye with acidic and basic water.

a. Obtain 3 test tubes and fill each one with half a pipet full (0.5-1 mL) of red cabbage juice.

b. To the first test tube, add an equal amount of deionized water. To the second test tube, add an equal amount of 0.1M HCl (hydrochloric acid). To the third test tube, add an equal amount of 0.1M $NaHCO_3$ (baking soda).

c. Note any color changes and record them on your data sheet.

d. Pour the liquids into a waste container. Thoroughly rinse the test tubes with water. Leave the station clean for the next group.

5. Bleaching of paper

a. Obtain 3 test tubes and label them 1, 2, 3. To the first one, add approximately 5 mL of deionized water. To the second one, add approx. 5 mL of chlorox bleach. To the third one, add approx. 5 mL of regular chlorine bleach.

b. Using scissors, cut three strips of brown/colored paper or bright colored cloth (enough to fit inside the test tube with some of it submerged in the liquid and some of the paper above the liquid). Place one strip into each test tube.

c. Let it sit for 1 min at room temperature. Record your observations.

d. Heat the above test tubes in the hot water bath for 5 minutes. Record observations.

e. Remove the paper from the test tubes. Place the used paper in the garbage. Discard your bleach solutions in the waste container. Rinse out the test tubes with plenty of water, and leave them for the next group (they do not need to be dry). Leave the station clean for the next group.

6. Aluminum with copper ions

a. Obtain a test tube and add about 2-3 mL of 5%(m/v) $CuCl_2 \bullet 2H_2O$ (copper (II) chloride dihydrate) solution.

b. Record your observations. (Include color, temperature, states of matter, etc.)

c. To this test tube, add an approx. 1 inch piece of aluminum wire. Touch the test tube to the inside of your arm. Wait for a minute and record your observations. (Include color, temperature, states of matter, etc.)

d. When finished, place the aluminum wire and copper chloride solution in a labeled waste container. Rinse the test tube with water (it does not need to be dry). Make sure the station is clean for the next group. Leave the station clean for the next group.

Report

Chemical Changes

Name _____Section_____

Lab Partner _____

Data

For each reaction, write down your observation(s) before and after the reaction that you believe provide evidence that a chemical change took place. Be clear and concise; use only enough detail to communicate your findings.

	Reactions	Observations	
		Before	After
1	calcium chloride + sodium carbonate		
2	formation of potassium nitrate solution		
3	limestone + acidic water		
4	vegetable dye + acid/base solutions		
5	bleaching paper		
6	Al wire + copper (II) chloride solution		

Post-Lab Questions

1. Reaction of calcium chloride solution with sodium carbonate solution: What term from the pre-laboratory assignment (besides "chemical change") describes this result? Explain.

2. Formation of a potassium nitrate solution: It could be correctly argued that this is a physical change or that this is a chemical change.
    a. What did you observe that gives evidence that it is a chemical change?
    b. For what practical purposes do you think that this reaction can be used?

3. Reaction of limestone with acidic water:
    a. Were the results for the deionized water similar or different than for the acid?
    b. What do you think acid rain would do to a limestone statue or gravestone?

4. Reaction of a vegetable dye with acidic and basic solutions: What was the purpose of adding deionized water to one of test tubes containing cabbage juice?

5. Bleaching of paper:
    a. What did you observe that indicates that this is a chemical change and not just a physical change?
    b. Did the reaction occur instantaneously? What do you think would happen if you waited longer?

6. Aluminum with copper ions:
    a. Based on your observation and chemicals used, what substance do you think deposited on the aluminum wire? What observations explain your choice?
    b. What practical application is there for what you observed?

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Name _____Section_____

1. Read through the experimental procedure. Most of the experiments require use of clean test tubes, but why is it not necessary to use dry test tubes?

2. What should you do with any waste materials from this laboratory? If you take excess chemicals that you don't use, what should you do with it?

3. Use your textbook's glossary and index to define the following terms:
    a. physical property
    b. chemical change
    c. reactants
    d. products
    e. precipitate
    f. solution

4. List three types of evidence that a chemical change has taken place. (Refer to Section 6.1 in your Timberlake textbook.)
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