Activity 2

More Chemical Changes

What Do You Think?

Mix 1 cup flour, 1/3 cup sugar, 1 teaspoon of baking powder with a cup of milk and 1 egg, well-beaten. Place the mixture in an oven for 30 minutes.

Add two drops of sodium carbonate (0.1 M Na₂CO₃) to two drops of sodium hydrogen sulfate (0.1 M NaHSO₄).

• Which of the instructions above will result in a chemical reaction? Why?

• Describe one similarity and one difference in the above instructions.

Record your ideas about these questions in your Active Chemistry log. Be prepared to discuss your responses with your small group and with the class.

Investigate

1. Eight solid materials listed on the next page have been dissolved in distilled water to make solutions. You will combine the solutions (one to one) with each other in an organized manner in order to observe their interactions.
Cool Chemistry Show

- barium nitrate \( \text{Ba(NO}_3\text{)}_2 \)
- sodium hydroxide (NaOH)
- sodium hydrogen carbonate (NaHCO₃)
- copper (II) sulfate (CuSO₄)
- potassium iodide (KI)
- silver nitrate (AgNO₃)
- iron (III) nitrate Fe(NO₃)₃
- hydrochloric acid (HCl)

After mixing two solutions, make notes on your chart of any changes you observe. Don’t overlook any color changes, the formation of a precipitate (sometimes observed as a cloudy solution), the formation of a gas (fizzing or bubbles), or a change in temperature.

Using another dropper, continue by adding three drops of the sodium hydrogen carbonate to the second well.

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Notes:
- a) Begin by making a chart to record your data. Your chart will require an entire page of your notebook. Allow plenty of room to record your observations. A sample chart has been provided. Notice that some of the blocks in this chart are shaded, indicating there is no need to mix those particular chemicals. Why do you suppose those particular blocks are shaded?

2. Now it is time to mix the solutions.

Begin with barium nitrate. Add three drops of the barium nitrate solution to each of seven wells of a well plate. Add three drops of sodium hydroxide solution to the first well.

a) After mixing the pairs of solutions, make note on your chart of any changes you observe.

Continue by putting three drops of sodium hydroxide into each of seven wells and adding the other solutions.
After completing your entire chart in this fashion and mixing all possible one-to-one combinations of solutions, clean up your workstation. Your teacher will provide disposal information. Wash your hands.

3. Use your chart to answer the following questions:
   a) Which combination of reactants seems to produce no reaction when mixed together?
   b) Which combination of reactants forms a gas? Can you guess which gas is formed? Try to deduce this from the reactants’ names and chemical formulas.
   c) Which combination of reactants produces a color change when mixed together?
   d) Which combination of reactants forms precipitates quickly? Slowly?
   e) Which combination of reactants forms a yellow precipitate? A muddy brown precipitate? A white precipitate? A blue precipitate?
   f) Which combination of reactants produces heat? How could you tell?
   g) What evidence indicates that a chemical change is occurring?

4. Place the following chemicals in a quart-size resealable plastic bag with a zipper seal:
   One teaspoon (scoop)(~28 g) of calcium chloride (CaCl₂)

   One teaspoon (scoop)(~28 g) baking soda (NaHCO₃)

   Seal the bag and mix the powders.
   a) Record your observations in your Active Chemistry log. Did a chemical reaction occur?
   b) Observe the reaction and, in your Active Chemistry log, describe what you see.
   c) Did a chemical reaction occur in the plastic bag? If so, identify all of the evidence of the chemical change.
   d) For this particular reaction, calcium chloride and sodium hydrogen carbonate combined to produce an aqueous solution of sodium chloride and calcium oxide in addition to the carbon dioxide and water.
What are the names of the reactants? What are the names of the products?

5. Your teacher will provide you with a small amount (~25 mL) of limewater, a solution of calcium hydroxide (Ca(OH)₂), in a beaker or flask.

Gently blow through a straw into the solution for a minute or so. One end of the straw should be submerged in the solution. You are actually bubbling carbon dioxide through the solution.

a) Did a chemical reaction occur? What is the evidence?

TESTS FOR CHEMICALS

Chemical Tests for Gases

In this activity you focused on chemical reactions, those processes that result in the formation of new products. You also tested for the presence of some of the new materials. You used chemical tests to identify the unknown substances. A chemical test is a form of a diagnostic test. To test for the presence of oxygen, you introduce a glowing splint into a test tube with a small amount of gas. If the splint bursts into a flame, you then know that the gas is oxygen. When you introduce a burning splint into a test tube and heard a loud pop, you assume the gas present to be hydrogen. In this activity you tested for the presence of carbon dioxide. Since carbon dioxide does not burn or support burning, by using a glowing or burning splint, you could not tell if a gas was carbon dioxide.
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(If the splint is extinguished you can say that the gas is neither oxygen nor hydrogen and therefore could be carbon dioxide.) The test for carbon dioxide uses limewater, a clear, colorless solution of calcium hydroxide in water. When you blew bubbles into the test tube you were actually blowing carbon dioxide from your lungs into the limewater. The carbon dioxide reacted with the calcium hydroxide forming a precipitate. The precipitate caused the limewater to turn cloudy in appearance.

Indicators for Acids and Bases

When acids and bases are involved in a chemical reaction the appearance of the products is often very similar to the appearance of the reactants. (You will learn more about acids and bases in a later activity.) Therefore, indicators are used to determine the presence of an acid or base. Substances that change color when they react with an acid or a base are called acid-base indicators. In this activity you used phenol red, an acid-base indicator that turns yellow in the presence of an acid. Chemists use a great variety of acid-base indicators. You may also have used litmus in previous science classes. It is a very common indicator used in school laboratories.

Checking Up

1. What is a chemical test?
2. Describe how you can use a burning or glowing splint to test for hydrogen or oxygen.
3. Why does a glowing splint test not work with carbon dioxide?
4. What test is used to identify the presence of carbon dioxide?
5. What is a precipitate?
6. What are acid-base indicators and how are they useful?

Chem Words

acid-base indicator: a dye that has a certain color in an acid solution and a different color in a base solution.

Reflecting on the Activity and the Challenge

In this activity you saw evidence of chemical changes taking place when you observed a color change, a change in temperature, a gas being emitted, a precipitate being formed, or light being produced. Which of these chemical reactions would be an exciting or informative addition to your class’s Cool Chemistry Show? Does your class want to be sure to include a variety of reactions that provide different types of evidence of a chemical reaction, or does your class just want to highlight a few of them? These are decisions your class will need to make as you build your Cool Chemistry Show.
Cool Chemistry Show

Chemistry to Go

1. In both Activity 1 and Activity 2 you gathered evidence for chemical changes. However, this evidence does not always indicate a chemical change. For instance, a change in color can be evidence of a chemical change. However, when you add water to a powdered drink mix, the color often changes, but a chemical change has not taken place.

In each of the following situations indicate whether the evidence suggests a chemical change or not:

a) An acid is dissolved in water and heat is released.

b) A burning match produces light.

c) A “seed” crystal is placed in a supersaturated solution and the extra solute particles “join” the crystal and come out of the solution.

d) A bottle of a carbonated beverage is opened and carbon dioxide is released.

e) The glowing filament of a light bulb produces light.

f) A small piece of metal is placed into an acid and hydrogen is released.

g) Solutions of sodium hydroxide and copper (II) sulfate are mixed and a blue precipitate appears.

2. Anhydrous copper (II) sulfate (CuSO₄) is a white solid. When it is dissolved in water, the solution becomes blue. Is this a chemical change? Explain how you would defend your answer.

3. If a glass of carbonated soda drink is allowed to sit out for a period of time, you find that the drink seems to be flat. Discuss this observation in terms of whether this is a physical or chemical change.

Preparing for the Chapter Challenge

Select one of the reactions you observed in this activity that you thought was pretty cool. Describe how you might incorporate it into a possible event in the Cool Chemistry Show you are designing. Would it meet the needs of the fourth-grade teacher, the fifth-grade teacher, or both? What additional information would you need to be able to explain the chemistry to the audience?