Chemistry Experiment

Chemical Changes Making Foam and Using Indicators

In this experiment, you will produce foam while using the ProScope Digital USB Microscope to take pictures of the chemical reaction and the physical changes prior to, during, and after the experimentation process.

Objectives

In this experiment, you will:

- Observe chemical and physical changes while producing a brilliant formation of foam
- Experience the use of an indicator in the reaction
- Record information based on your observations

Materials

- Power Macintosh G3 or better
- ProScope Digital USB Microscope and software
- Safety goggles
- Polyvinyl alcohol
- Sodium bicarbonate
- Aluminum sulfate and sodium tetraborate
- Food coloring (optional)
- Vinegar (optional)
- Craft stick
- Pipette
- Indicators such as bromocresol purple, phenol red, or bromthymol blue
- Small plastic cups with a large opening (such as those used on airplanes) or saucers
- Stopwatches (optional)

Procedure

1. Set up the ProScope USB microscope using the m0W lens. This should be focused over the plastic cup or saucer where the chemical reaction will be taking place.
2. After putting on your safety goggles, place two measures (each approximately one teaspoon) of the polyvinyl alcohol into the cup or saucer. Add another measure of sodium bicarbonate powder and stir it into the alcohol using the craft stick. Make the mixture as smooth as possible.

3. Add a measure of one of the indicators. Do not stir this too much so that a swirl effect is produced. Food coloring can also be used at this stage.
4. Put two measures of the aluminum sulfate–sodium tetraborate solution into another cup or saucer. The reaction may happen quickly, so set the timer on the ProScope USB microscope to take a picture immediately after adding the solution. Several trials may be necessary in order to get more than one good picture of the reaction as it occurs.
5. Pour all of the aluminum sulfate–sodium tetraborate solution into the cup or saucer with the alcohol mixture. Do this quickly, and observe any changes that occur. The ProScope USB microscope should be timed to take pictures before, during, and after this step of the experiment.
6. Observe all changes during the reaction and record these observations on paper or on another computer. Note whether the changes you observed were chemical or physical changes. Using the pictures taken by the ProScope USB microscope, compare and contrast the different stages of the reaction.

Data

Record all observations from the reaction in the experiment and from the pictures taken with the ProScope USB microscope. Describe and explain the differences between the chemical and physical changes that took place.

Processing the data

1. Which changes were chemical changes? Explain how you know this.
2. Which changes were physical changes? Explain how you know this.
3. What is an indicator? Which part of the reaction showed an indicator at work?
4. What safety precautions should you take to perform an experiment like this one? Why should safety precautions be used?

Extension

For further experimentation, use slightly varying amounts when preparing the solution of aluminum sulfate–sodium tetraborate. This will change the speed of the reaction and can be recorded with the ProScope USB microscope. You can also record the speed of the reaction with stopwatches.

Teacher information

- The chemicals in this experiment can be purchased from any science supply company such as NASCO or Science Kit and Boreal Laboratories. Check the labels and information accompanying the chemicals for storage, disposal, and first aid instructions.

- The aluminum sulfate–sodium tetraborate solution can be prepared using slightly varying amounts. The best reaction occurs with 14% aluminum sulfate and 2% sodium tetraborate. The speed of the reaction changes slightly depending on the solution of the aluminum sulfate–sodium tetraborate. This solution is a skin and eye irritant. It may also be harmful if swallowed. The polyvinyl alcohol should be 2% in solution. The sodium bicarbonate powder is baking soda.
- The aluminum sulfate reacts with the sodium bicarbonate to produce carbon dioxide gas. This gas release is what creates the foam and causes it to expand. The sodium tetraborate and the polyvinyl alcohol react to form a gooey mass. This is called a cross-linked polymer. This polymer helps hold the whole mass together.
- Bromocresol purple, bromthymol blue, and phenol red are acid base indicators. They change colors when added to an acid or a base. Bromocresol purple changes from purple to yellow when added to an acid. Phenol red changes from red to yellow in the presence of an acid, and bromthymol blue also changes to yellow in the presence of an acid. The indicators change back to their original colors when the acid is neutralized.
- When the aluminum sulfate reacts with the sodium bicarbonate, it initially forms a mild acid. This causes the goo to change to yellow. After awhile, the acid is neutralized and the original color comes back. The acid was removed as the gas escapes from the carbon dioxide bubbles in the foam. At this point, it should be safe for students to handle the foam. It is mostly water now, and you can squeeze the bubbles to feel the gooey polymer. The indicator may temporarily stain your fingers, but you can neutralize the color with a mild acid such as vinegar.
- For disposal, wash the liquid down the drain with plenty of water and throw the foam in the trash.

Sample results

The results should include the observation that the formation of the foam is a chemical reaction. The color change is a physical reaction. The color change is also a result of the acid base indicator. The reaction produces an acid as indicated by the color change, but this is neutralized as the color changes back to its original color. The mixing of the alcohol and the baking soda is a physical change creating a suspension. The pictures taken with the ProScope USB microscope should provide examples to support all observations and descriptions.

Answers to questions

1. The formation of the foam is a chemical change because the material at the end of the change is completely different than the original materials.
2. The color changes were physical changes. The suspension created by the alcohol and the baking soda was also a physical change. These changes affected the physical properties of the materials but did not change their chemical composition.
3. An indicator is a chemical that is designed to change colors in the presence of an acid or a base. These can be manufactured, such as litmus paper, bromocresol purple, bromthymol blue, and phenol red, or they can be natural, such as red cabbage juice. The color change in the reaction showed an indicator at work and the presence of an acid. It changed back to its original color when the acid was neutralized.

4. Safety goggles should always be worn when working with heat, glass, or chemicals. The work area should be cleaned with soap and water when the experiment is concluded. Student and teacher hands should also be washed after the experiment is concluded. If contact is made with any of the chemicals before the reaction, the area should be washed thoroughly with soap and water. If a rash develops, a doctor should be consulted immediately. The chemical labels should be consulted for further instructions on handling, use, and disposal.

Special thanks to the curriculum writer, Wayne Robinson, Ph.D., Coordinator of Science and Technology, Walker County School District, Georgia, and to Jane Yonts, Ph.D., Classroom Teacher, Fairyland Elementary School, Walker County School District, Georgia, who assisted in developing the curriculum.