Chemistry Is More Than Just Hot Air!

Contributed by the American Chemical Society
Student Affiliates Group at Northwestern State University

Main Science Idea for Kids

In this activity, students place a baking soda-filled balloon over the top of a bottle containing vinegar and red cabbage indicator solution. When they empty the baking soda into the vinegar and the substances react, students can visualize two important things about chemical reactions: (1) In a chemical reaction the substances you start with change to form new substances and (2) The amount of carbon dioxide gas made depends on the amount of baking soda and vinegar used.

Grade Level

We usually do this activity with 3rd and 4th graders and we bring at least 4 presenters.

How We Introduce this Activity

We show students a red cabbage slice and explain to them that red cabbage has a chemical in it that changes color when different substances are added to it. Then we flip the cabbage slice over and surprise them with its *blue* color. Before meeting with the students, we "painted" this side of the cabbage slice with a baking soda solution. We tell students what we did to this side of the cabbage and explain that if you know what to look for, the color changes can tell you about the types of chemicals that come in contact with it.

Materials

Red cabbage indicator solution

- Red cabbage
- Knife
- Cutting board
- Water (couple of cups)
- Electrical blender or food processor
- Strainer
- Two clear bowls
- Spoons
- Set of measuring cups
- Gallon sized jug with a secure lid

For each group of 2-3 kids

- 4 Coke bottles
- 4 Large colorful balloons
- Funnel to fill the bottles
- Powder funnel to fill balloons
- Plastic spoons
- Measuring cups or beaker
- Baking soda
- Vinegar
- Red cabbage indicator solution
- Waste container

Materials Preparation

Red cabbage to show students

1. Slice the cabbage on either side of the core so that there are two flat sides. (Save the piece containing the core for the demo and use the rest to make the indicator solution.)
2. Mix up a solution of half baking soda and half water. Then “paint” this solution on *one* side of the cabbage until it turns blue. Leave the other side its natural red color.

Red Cabbage Indicator

1. Shred the cabbage into small pieces and place them in a large soup pot or bowl.
2. Bring about 2 quarts of water to a boil.
3. Pour the hot water over the cabbage.
4. Wait until there is a significant amount of blue or purple color in the water.
5. Decant the liquid into a large container, place a cap on the container, and store in the fridge.

Bottles

1. Collect and clean empty Coke® or other single-serve drink bottles.

   Note: We decided that varying sizes of bottles are ok. The number of bottles needed depends on the number of kids in each group. We supplied about 4 bottles per group of 2-3 kids. We collected these bottles among our group, but if you need a large number of bottles, you could put bins out for collection.

Procedure

We usually have kids choose the amounts of vinegar and baking soda and, with a little assistance, pour them into the appropriate places. Making these kinds of decisions helps kids better understand the material being presented. We tell them to start with relatively small amounts of baking soda and vinegar and then use larger amounts in the following trials.

Prepare the bottles

1. Use a funnel as you pour red cabbage indicator to a depth of about 1 inch in each of 4 bottles. (Coke bottles have a nice little line at this height.)
2. Add some amount of vinegar to one of the bottles.

Fill a balloon

1. Hold a balloon on the end of a powder funnel and add 1 teaspoon or another amount of baking soda to the balloon. Carefully remove the balloon and set it aside.

Cause a chemical reaction

1. Carefully place the neck of the balloon holding the least amount of baking soda onto top lip of the bottle.
2. Once the balloon is securely in place, lift it so that the baking soda drops into the vinegar and indicator solution.
3. Observe the size of the balloon and the color change of the indicator solution.

Plan for the next reaction

1. What can you change to make the balloon bigger?
2. What can you change to make the indicator solution return to its original blue color?
3. Follow the same procedure as before but adjust the amount of baking soda and/or vinegar. How is the size of balloon and color of indicator affected?

The Chemistry Explanation

The size of the balloon and the color of the indicator solution provide information about the products produced during the chemical reaction. Both changes occur because new substances are created during the chemical reaction. The size of the balloon gives an estimate of the amount of gas produced in the reaction. If you want a bigger balloon you should use more baking soda and vinegar because then more carbon dioxide gas will be produced. This observation leads to an important rule in chemical reactions: The amount of reactants used affects the amount of products produced.

The indicator turns bright pink when vinegar is added. As the baking soda reacts with the vinegar, the color changes to purple. If the reaction is complete, meaning that all the baking soda and vinegar are used in the reaction, the color of the indicator will return to its original blue color, indicating that the solution is neutral. This observation alludes to another important point about chemical reactions: The substances you start with change to become different substances.

This activity immerses students in the process of scientific inquiry as they control variables and interpret their observations. Students explore: (a) ratio of baking soda to vinegar required to give a “complete” reaction (b) rates of reaction (c) size/shape of balloons and how this effects measuring the amount of gas evolved (d) use of controls e.g. what colors indicate acidic/basic solutions in the red cabbage solution (e) and what the resulting color of the solution implies about the product(s) produced.

Why We Like this Activity

This activity uses household chemicals and the students love watching the balloons grow. They quickly figure out how to make the balloons grow bigger!

About Us

The ACS SA Group at Northwestern State University assists students in the area of science, especially chemistry, to increase interest in the field. We provide hands on activities, along with hand outs including complete instructions, to better teach the presented material. We work with local elementary and high school students through school participation and through after school groups, such as the Boys and Girls Club. We also try to use household chemicals so the experiments can be repeated at home with the student’s family.

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