

Frozen Bubbles

By Alex Madonik

Introduction

Did you ever notice bubbles in your ice cubes? Scientists look at bubbles in ancient ice buried deep in Greenland or Antarctica to find out what gases were in the air long ago. In this experiment, you will explore gas that is trapped in ice, just like climate scientists do. You will freeze some carbon dioxide (CO_2) bubbles using sparkling water and can use a red cabbage indicator solution to see if sparkling water is **acidic** or **alkaline**.

Materials

- 3 small plastic bags with zipper closures
- $\frac{3}{4}$ cup (about 0.17 L) tap water
- $\frac{3}{4}$ cup (about 0.17 L) colorless plain sparkling water
- $\frac{1}{2}$ cup (about 0.12 L) red cabbage indicator solution
- Milk of Magnesia and eyedropper (optional)

Procedures

1. Follow the instructions on the next page to prepare your cabbage juice indicator. If you have some Milk of Magnesia, add a drop or two of it to the turn the indicator blue, which will make it easier to see the color changes with CO_2 .
2. Label your bags: #1) tap water, #2) 50% tap water / 50% sparkling water, #3) sparkling water.
3. Put a tablespoon of red cabbage indicator solution into each bag. Add the following to the bags:
 - Bag #1: $\frac{1}{2}$ cup tap water
 - Bag #2: $\frac{1}{4}$ cup tap water plus $\frac{1}{4}$ cup sparkling water
 - Bag #3: $\frac{1}{2}$ cup sparkling water
4. Close the bags, squeezing out as much air as possible. Record and zip tightly. Note the color of the liquid in each bag. Place the bags in the freezer overnight.
5. The next day, remove the bags from the freezer and make careful observations. What differences can you see in the bags?
6. Let the bags melt. Compare the bags to each other. What differences do you notice? What could have caused these differences?



Safety Suggestions

- ✓ **Disposal:** Liquids may be poured down the sink and flushed with water. Bags can be thrown away in trash.
- ✓ Safety goggles suggested.
- ✓ Do not eat or drink any of the materials used in this activity.
- ✓ Thoroughly wash hands after this activity.
- ✓ Adult assistance is required to prepare the cabbage indicator if using electric kitchen equipment.

How does it work? Where's the chemistry?

Carbon dioxide (CO_2) is formed by combining carbon and oxygen. Whenever we burn wood, charcoal, coal, or oil, one of the products of the reaction is CO_2 . It also happens when our bodies digest sugar to produce energy. We exhale CO_2 with every breath.

Many people like sparkling drinks. The bubbles come from dissolving CO_2 in water. This is why these beverages are said to be **carbonated**. When CO_2 dissolves in water, it forms **carbonic acid**. This weak acid causes the color of the cabbage indicator to change color to pink. Freezing the sparkling water trapped the CO_2 bubbles in ice. When the bags melted, the CO_2 escaped and the bags containing the sparkling water puffed up. The bag with all sparkling water had the most CO_2 , so it puffed up the most.

What did you see?

What color is the water in each of the bags? What causes the differences? After freezing, can you see bubbles in any of the bags?