

The Secret Science of Self-Inflating Balloons

Main idea

Chemistry investigates how substances interact and change.

Say to students

Look at this inflated balloon and this flat balloon. I want to inflate this flat balloon so that it looks just like this other one. But there is a problem, I can't find an opening where I can blow air into it.

As you feel the balloon, notice that there is something inside the balloon.

Each presenter will have

- Inflated balloon
- Flat balloon
- Goggles
- Sodium bicarbonate, baking soda
- Citric acid solution, 10%
- Small clear plastic cup
- Small scoop, $\frac{1}{8}$ teaspoon
- Pipet
- Photos of items containing citric acid
- Photos of showing uses of baking soda



Ask students

- **What is usually inside an inflated balloon?**
Air, breath, helium, some kind of gas
- What is inside the flat balloon?
- *Tell students because they do not yet know*

Say to students

There is a small liquid-filled pouch containing citric acid inside the balloon. The balloon also contains baking soda. These chemicals are kept separate inside the balloon.

Show the cards with photos of items that contain citric acid and baking soda.

Procedure for volunteer

Mix baking soda and citric acid solution

1. Place one small scoop of baking soda in the bottom of a small clear plastic cup.
2. Squeeze one pipet-full of citric acid on top of the baking soda.

Ask students

- What do you see that shows something more than ordinary mixing is going on in the cup?
The bubbling and foaming.

Say to students

- Bubbles are a sign that a gas is being made.
- These bubbles are filled with carbon dioxide gas. Carbon dioxide gas is made in the chemical reaction between baking soda and citric acid. Most balloons are filled with a gas.

Give each child one self-inflating balloon

1. Distribute one shiny self-inflating balloon to each person.
2. Direct each child to carefully feel the balloon to find out what might be inside.
3. Be sure to point out the pouch of citric acid and how hard it is to feel the baking soda. Citric acid and baking soda are the same chemicals used in the demonstration.

Ask students

- How can we start the chemical reaction?
Break the pouch
- What is going to inflate the balloon?
Carbon dioxide gas

Procedure for children

1. Break the inner pouch of citric acid.
 - a. Toddlers to 8 year olds should place the balloon on the floor, position a foot directly over the pouch, and step on it.
 - b. Children older than 8 or so, should place the balloon on the table and press the pouch with the heel of one hand pushed down by the other.
2. Pick up the balloon and shake it briefly.
3. Hold the balloon close to your ear.

Expected results

As the balloon inflates, it will make a fizzing sound and the liquid, which pools in the palm of your hand when you hold the balloon to your ear, feels colder.

Ask students

- Do you hear the chemical reaction?
Yes
- What is the name of the gas, which inflates this balloon?
Carbon dioxide gas
- How did it get in the balloon?
It was made during the chemical reaction





Explanation for younger children

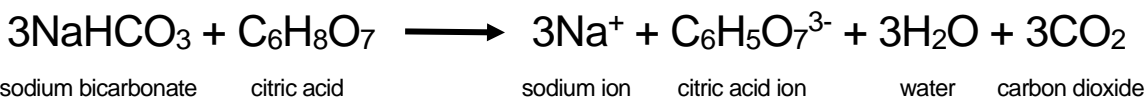
We started with a solid and a liquid. When we mixed them, they reacted to make something different—carbon dioxide gas.

Explanation for older children

We started with citric acid, baking soda, and ended with carbon dioxide gas and other substances. This is an example of a chemical reaction because the atoms you start with rearrange to form different groups. The different groups of atoms are different substances.

Explanation for the very curious

In the demonstration and activity, baking soda (also known to chemists as sodium bicarbonate) and citric acid react to produce carbon dioxide gas. Other chemicals are formed, too.



Everything on the left side of the reaction arrow is referred to as a “reactant”, while everything on the right side of the arrow is called a “product”. In a chemical reaction, the products are always chemically different than the reactants. All the same atoms are present (and in the same amounts!) on both sides of the equation. The difference is in the way the atoms in the products are rearranged and recombined. These new arrangements make different molecules and ions, which are unlike those in the reactants.

FAQs

Where can I buy a self-inflating balloon? Self-inflating balloons are sold at dollar stores, sometimes with seasonal themes. They can be purchased online from ACS at www.acs.store.

How much do the ACS balloons cost? The balloons cost \$24 for a pack of 25 balloons.

Do these self-inflating balloons contain latex? The balloons do not contain latex. They are made of aluminum deposited on a material similar to a plastic bag (polyethylene).

How long will my balloon remain inflated? Balloons remain fully inflated for several weeks.

What is inside the balloon? At first, the balloon contains 5 mL of citric acid solution in a small plastic pouch and 3 grams of sodium bicarbonate (baking soda). Once the pouch is broken, a chemical reaction between citric acid and baking soda takes place. Carbon dioxide gas inflates the balloon. Water and sodium citrate ions are also formed. These new substances, along with some unreacted citric acid or baking soda, remain sealed inside the balloon.

What should I do if the balloon leaks? Typically, balloons do not leak. However, if liquid leaks out, it may cause your skin to become red or feel itchy. Minimize this irritation by washing your hands and any other affected area as soon as possible. Use a paper towel to absorb any spilled liquid.

